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Oil Price Shocks and Economic Resilience: A Comparative Analysis of Norway and Portugal

André Moura Venâncio Baroeth

Master (MSc) in Economics

Supervisor:

Ph.D. Luís Filipe Farias de Sousa Martins, Associate Professor (with aggregation), ISCTE Business School, ISCTE-IUL

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BUSINESS
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Department of Economics

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Resumo

Neste estudo, explora-se a relação intrínseca entre a variação do preço do petróleo bruto e diversos indicadores macroeconómicos, como a taxa de crescimento do Produto Interno Bruto real (GDPGR), a taxa de inflação (IR), a taxa de crescimento das exportações (EXPGR), a taxa de desemprego (UR), a taxa de crescimento da produção total da indústria (PTI) e a taxa de crescimento da despesa de consumo final privado (CSPE). Utilizando dados de séries temporais (T1:1988–T4:2021) da Noruega e de Portugal, o estudo emprega ferramentas de modelação macroeconómica, incluindo causalidade de Granger, funções de resposta ao impulso e análise de decomposição de variância num modelo vetorial autorregressivo (VAR). Os resultados revelam uma influência positiva dos preços do petróleo na economia norueguesa, com um aumento significativo na taxa de exportação após um choque de um desvio padrão nos preços do petróleo. Portugal, por outro lado, demonstra vulnerabilidades, manifestadas por impactos negativos acentuados na economia global um ano após o choque. As recuperações subsequentes destacam a capacidade de Portugal de absorver e adaptar-se às flutuações nos preços do petróleo. Com base nas funções de resposta ao impulso e na análise de decomposição de variância, observa-se que os choques nos preços do petróleo têm um impacto estatisticamente significativo apenas na taxa de crescimento das exportações na Noruega. Este estudo fornece uma análise valiosa para os decisores políticos de ambos os países, delineado para o desenvolvimento de políticas fundamentadas para atenuar os efeitos das flutuações nos preços do petróleo e promover o desenvolvimento económico sustentável.

Palavras-Chave: Preço do Petróleo; Ciclo Económico; Modelo VAR; Portugal; Noruega.

Código JEL: C51 E52

Abstract

This research delves into the complex relationship between crude oil price volatility and key macroeconomic economic indicators, i.e., real GDP growth rate (GDPGR), inflation rate (IR), export growth rate (EXPGR), unemployment rate (UR), production of total industry growth rate (PTI) and private final consumption expenditure growth rate (CSPE). The study gathered time-series data (Q1:1988–Q4:2021) from Norway and Portugal, utilizing macroeconomic policy modeling tools such as Granger causality, impulse response functions and variance decomposition analysis within the framework of a vector autoregressive (VAR) model. Oil prices presented a positive influence over the Norwegian economy. The results gathered in our study show a significant increase in the exports rate after a one standard deviation shock in oil prices. The causal relationship observed highlights the significant role of favorable oil price changes in driving growth in the Norwegian export sector. Portugal demonstrates vulnerabilities in response to these shocks. The effects surface with pronounced negative impacts on the overall economy only 1 year after the shock. Subsequent recoveries underscore Portugal's capacity to absorb and adapt to oil prices fluctuations. Based on the impulse response functions and variance decomposition analysis I found that oil price shocks only had a statistically significant impact over the export growth rate in Norway. From a practical standpoint, the study offers valuable insights for policymakers in both nations, assisting in the development of well-informed policies to mitigate the effects of oil price fluctuations and promote sustainable economic development.

Keywords: Oil Prices; Business Cycle; VAR Model; Portugal; Norway.

JEL Code: C51 E52

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Acronym Glossary

ADF: Augmented Dickey-Fuller

AIC: Akaike Information Criteria

BDFM: Bayesian Dynamic Factor Model

CSPE: Private Final Consumption Expenditure Growth Rate

DF: Dickey-Fuller

DSGE: Dynamic Stochastic General Equilibrium

EXPGR: Export Growth Rate

FPE: Final Predictor Error

FRED: Federal Reserve Economic Data

GDP: Gross Domestic Product

GRACH: Generalised Regression-based Autoregressive Conditional Heteroscedasticity

HQIC: Hannan-Quinn Information Criterion

INFR: Inflation Rate

IRF: Impulse Response Functions

JB: Jarque-Bera

LR: Likelihood-ratio

LM: Lagrange Multiplier

OLS: Ordinary Least Squares

OPGR: Oil Prices

OPEC: Organization of the Petroleum Exporting Countries

PP: Phillips-Perron

PTI: Production of Total Industry Growth Rate

RF: Random Forest

SC: Schwarz Information Criterion

UR: Unemployment Rate

VAR: Vector Autoregression

VD: Variance Decomposition

WB: World Bank

1. Introduction

Oil prices have long been widely recognised as a key determinant of economic growth in many countries worldwide. The fluctuations in oil prices have far-reaching implications on the global economy, particularly on the business cycle of nations. Understanding the relationship between oil prices and the business cycle is essential for policymakers, investors, and other stakeholders to formulate effective policies and implement strategies to ensure economic stability.

Over the past few decades, the global economy has witnessed significant spikes and declines on oil price movements that have impacted various economies. For instance, the oil price shocks of the 1970s led to a significant recession in many developed countries, while the sharp decline in oil prices in the mid-1980s caused a decline in the economic activity of oil-exporting countries. More recently, the sharp decline in oil prices between 2014 and 2015 led to a significant economic slowdown in many oil-exporting countries, such as Russia and Venezuela, causing a ripple effect on the global economy.

Given the critical importance of oil prices in the world economy, understanding their relationship with the macroeconomic variables that define the business cycle is essential for policymakers and investors to anticipate and prepare for potential economic shocks. Therefore, this thesis aims to examine the extent to which oil prices can help to understand and influence the dynamics in the business cycles of two countries: Portugal and Norway. These two economies were chosen due to their distinctive economic dependence on oil. While Portugal is known for not being a major oil-producing country, relying heavily on crude oil imports to meet its energy needs, Norway on the other hand, is one the largest oil exporters in the world. According to the World Bank (WB), crude oil exports individually, in 2020, made up around 24% of Norway's total exports of goods and the oil and gas sector accounted for around 14.4% of Norway's GDP in 2020.

The thesis will focus on a quantitative analysis of the relationship between oil prices and the variables that characterise the business cycles of these two economies, using several statistical methods and techniques. Specifically, the thesis will investigate the following research questions:

- What is the relationship between oil prices and the business cycle of Portugal and Norway?

- Do oil-importing and oil-exporting economies exhibit different behaviours in the relationship between oil prices and the business cycle, namely in the response to oil shocks?

To answer these research questions, the thesis will review the existing literature on the relationship between oil prices and the business cycle, analyse the data from Portugal and Norway over the period between Q1:1988 and Q4:2021, and use VAR models to estimate the impact of changes in oil prices on economic growth and macroeconomic variables.

The thesis will be structured as follows: Chapter 2 will provide a framework for the study by reviewing the existing literature on the business cycle, oil prices, and their interrelationship. Chapter 3 will describe the methodology and data used in the study. In Chapter 4, we will showcase and examine the outcomes derived from scrutinizing the residuals of the VAR model. This includes the results of Granger causality tests, variance decompositions, and impulse response functions. Chapter 5 will discuss the main findings and draw conclusions from the study, provide policy recommendations and suggest areas for future research.

In conclusion, this thesis seeks to contribute to the existing literature on the relationship between oil prices and the business cycle by providing a comprehensive and rigorous analysis of the issue. The findings of the study are expected to be useful to policymakers, investors, and other stakeholders in formulating effective policies and strategies to ensure stable economic growth.

2. Literature Review

2.1. The Relationship between Oil Prices and the Business Cycle

The business cycle corresponds to “the fluctuations in economic activity that an economy experiences over time" as stated by Estrella, A., & Mishkin, F. S. (1998) typically characterised by periods of economic expansion, contraction, and recovery. Accurate forecasting of the business cycle is critical for businesses, since it helps planning and make investment decisions based on a realistic outlook of the economic conditions and for policymakers as it helps in formulating fiscal and macroeconomic policies that can stabilise the economy during economic downturns, promote growth during economic expansion, and maintain price stability (Lai & Ng, 2020). One factor that has been studied extensively for its ability to predict the business cycle is oil prices. This literature review examines various studies that have explored the relationship between oil prices and the business cycle, and how have they been affecting the economic behaviour of Portugal and Norway throughout the years.

Oil prices have been found to be closely related to the business cycle, with changes in oil prices often preceding changes in economic activity. Several studies have established that oil prices have a significant impact on the overall macroeconomy, as oil is a critical input in many industries, affecting consumer spending, business investment, and government policies.

One of the earliest studies to investigate this relationship was Hamilton (1983). The study used data on US oil prices and industrial production between 1948 and 1981 to show that oil price increases were associated with decreases in industrial production, while oil price decreases were associated with increases in industrial production. The study concluded that oil prices were a leading indicator of economic activity, and that oil price increases specifically were a significant predictor of recessions in the U.S.

Other studies have confirmed these findings, including Barsky and Kilian (2004) and Blanchard and Gali (2007). However, there is some disagreement on the magnitude and timing of the impact of oil price shocks on the business cycle, some studies found that the effect is relatively short-lived (e.g., Bernanke et al., 1997) while others suggest that the impact can persist for longer periods of time (e.g., Kilian and Park, 2009).

To support the goals of this thesis, it is crucial to obtain a clear overview of diverse perspectives regarding the effects of oil price fluctuations. This pertains to different categories including oil producers and non-oil producers, as well as oil importers and non-oil importers. According to the research conducted by Mohaddes & Pesaran (2016), lower oil prices yield positive repercussions for economies reliant on oil imports. The authors underscore that reduced oil prices exert a notable positive influence on these nations. As oil prices decrease, it translates into an advantageous income effect for both consumers and businesses. This leads to an augmentation in purchasing power, fostering escalated demand for oil-related products and services. Consequently, oil consumption surges in oil-importing countries, potentially serving as a catalyst for economic growth. The United States standing as a prominent exemplar in this context, where decreased oil prices correspond to heightened demand and increased economic activity.

The effects of diminished oil prices on economies heavily dependent on oil exports present a dual facet. On one hand, these nations confront a reduction in revenue as a consequence of the plummeting oil prices. This phenomenon directly impacts the income generated from oil exports, thereby potentially creating fiscal obstacles and constraints on domestic expenditures. However, the authors posit that the overall impact on oil-exporting economies, including examples like Saudi Arabia and Iraq, might still lean toward a positive outcome. This assertion stems from the pronounced surge in global demand triggered by lower oil prices. While oil-exporting nations deal with the adverse impact of reduced revenue, the amplified demand emanating from oil-importing nations tends to offset these challenges to a certain extent. In essence, the global surge in demand serves to temper the economic hurdles confronted by oil-exporting economies in the light of decreasing revenues.

Iwayemi and Fowowe (2010) employed an unrestrained VAR model at levels to scrutinise the impact of oil price shocks on the macroeconomy in Nigeria. The study utilised quarterly data spanning from 1985 to 2007, encompassing variables such as real GDP, government expenditure, net exports, inflation, and real effective exchange rate to represent the macroeconomic landscape. Granger-causality tests, impulse response functions, and variance decomposition analysis were employed as analytical tools to address the research inquiry. However, delving deeper into the results of the analysis is challenging due to the absence of robustness tests for their model. The outcomes of the analysis suggested that oil price shocks did not significantly influence the macroeconomic variables; nevertheless, the authors refrained from discussing the statistical significance of these results.

Cologni and Manera's (2008) research has revealed the complex connections within the G-7 economies, showing how changes in oil prices create ripples throughout the economy. They emphasise that these shifts not only influence short-term indicators, such as inflation and interest rates, but also fundamentally reshape the core balance that defines economic stability. The findings suggest that the impact of an oil price shock is not uniform across all G-7 countries. Instead, the response varies based on each country's monetary policy stance. In some countries, such as the United States, a substantial portion of the significant and negative effects of the oil price shock can be attributed to the way monetary policy is adjusted in response to the shock. This means that the U.S. tightening monetary policy reaction plays a significant role in shaping the overall impact of the shock on the economy. In contrast, for countries like Canada, France, and Italy, the impact of the oil price shock is offset to some extent by an easing of monetary conditions. This could mean that these countries' central banks took measures to lower interest rates or implement other expansionary policies in response to the shock. These policies might have helped mitigate some of the negative effects of the shock on their economies.

Furthermore, Korhonen and Ledyaeva (2009) dissected the effects of fluctuating oil prices on both oil-consuming and oil-producing nations. Their findings reveal distinct impacts: oil-producing countries like Russia and Canada experience gains from favorable oil price changes, whereas oil-consuming nations such as Switzerland, Japan, Germany, and the UK suffer financial losses.

2.2. Impact of oil prices in Portugal and Norway

The fluctuation of oil prices wields a major impact on the global economy. However, it is notably the countries that exhibit pronounced dependence on either oil exports or imports, alongside those marked by significant energy intensity, that manifest heightened susceptibility to these fluctuations. Portugal and Norway are two countries with different relationships regarding oil, and their experiences provide an interesting case study of the impact of oil price fluctuations on different types of economies.

In the context of Portugal, several studies have examined the relationship between oil prices and its economy. Dias (2013) utilised a structural VAR model, examining quarterly data spanning from Q1:1995 to Q4:2012. The variables under consideration included oil prices, consumer price index, gross domestic product deflator, wage index for the private sector, gross domestic product, and private sector employment. In the context of the country's ongoing economic adjustment and global uncertainties, the study estimated the long-term effects of a 13% increase in oil prices.. Projections indicate a depressive impact on GDP, with a 0.7 percentage point decrease after five years, and a substantial portion of this adjustment occurring in the second-year post-shock. The study also observes similar, albeit slightly smaller, depressive effects on private sector employment, and a temporary increase in inflation for the first two years, diminishing thereafter. This research is particularly pertinent given Portugal's current economic challenges, providing valuable quantitative insights into the consequences of oil price fluctuations.

The second part of the study focuses on impulse response functions, revealing the effects of an oil price shock equivalent to one standard deviation of innovations. The response patterns align with conventional expectations, showcasing a gradual increase in consumer prices over two years, peaking after eight quarters, and negative impacts on GDP and private sector employment.

Examining the impact of oil price shocks on the overall economic activity, industrial production, and price levels in Portugal, Robalo and Salvado (2008) employed a multivariate VAR methodology. The study focused on two distinct time intervals, 1968-1985 and 1986-2005, to assess the stability and magnitude of these relationships. Key variables included average oil prices, real gross domestic product, industrial production index, total employment, unemployment rate, and the consumer price index. The findings highlighted a significant influence of oil price fluctuations on inflation levels throughout the entire studied period and on the unemployment rate from 1968 to 1985. The use of impulse response functions proved valuable in analyzing the adjustment and initial impact of oil price variations. The study indicated persistent effects of oil prices on unemployment and inflation rates, with less persistent effects on total employment and GDP. The authors observed ambiguity in the reaction of industrial production. Overall, the research supported the prevailing notion in the literature that the responsiveness of economic factors to oil shocks weakened after 1985, accompanied by a more rapid adjustment. Furthermore, their study provided evidence indicating a shift in the relationship between various economic variables in Portugal and oil price shocks, particularly from the 1980s onward. Notably, the significance of the effects, their magnitudes, and the speed of adjustments were significantly diminished during the second time interval of the analysis (1986-2005).

The study conducted by Esteves and Neves (2004) is noteworthy, as it provides a forecast for the effects caused by an oil price shock on GDP and inflation. The research compares the outcomes for the Portuguese economy with those for OECD countries. The effects are estimated using the annual Macroeconometric Model of the Bank of Portugal. Despite the limitations of this type of model in capturing structural shocks and the response from monetary policy, the obtained results align reasonably well with existing literature.

A 100% variation in oil prices leads to an increase of approximately 3 percentage points in inflation over a 4-year period. The impact on GDP is more substantial and persists for a longer duration: a variation of 4 percentage points by the end of an 8-year period.

In contrast, Norway is one of the largest oil-producing countries in the world, and the impact of oil price variations on the Norwegian economy has been the subject of much research. Bjørnland and Thorsrud (2014) find that oil price fluctuations produce a meaningful consequence over the Norwegian economy, particularly through their effects on investment, consumption, and the exchange rate. The research developed accounted for data ranging from Q1:1996 to Q4:2012 using a Bayesian Dynamic Factor Model (BDFM) to address this relationship. They also find that the impact of oil price fluctuations in Norway has become more pronounced in recent years, as the country became more reliant on oil exports.

Norway was also included in an extensive study conducted by Jiménez-Rodríguez and Sánchez (2004), which encompassed both oil-importing and oil-exporting countries. The study utilised a VAR model as its foundation, incorporating various oil price shock variables. The primary objective of the analysis was to examine the impact of oil price shocks on GDP, real effective exchange rate, real wage, inflation, and short- and long-term interest rates.

Notably, Norway exhibited distinct results compared to the United Kingdom among the oil-exporting countries. A positive oil price shock had a favorable effect on Norway's GDP, whereas the U.K. did not experience similar benefits. While Norway also demonstrated a real effective exchange rate appreciation, it was notably milder than that observed in the U.K., resulting in a modest yet positive impact of oil shocks in Norway.

The differing responses in Norway and the U.K. were attributed, in part, to adjustments in real wages and interest rates. In Norway, real wages increased following an oil price hike, whereas the opposite occurred in the U.K. The analytical tools employed included Granger-causality tests, impulse response functions, and variance decomposition.

Bergholt et al. (2017) thoroughly investigate the impact of oil shocks on Norway's economic dynamics using a Dynamic Stochastic General Equilibrium (DSGE) model. The study employs a set of variables, namely Sectoral value added, core private consumption, investments, wages, consumer prices, and interest rates from Q1:1995 to Q4:2015 to elucidate the intricate mechanisms involved. Key findings highlight the substantial impact of oil shocks, particularly fluctuations in oil prices, on mainland Norway's business cycle. The transmission mechanism elucidates how international oil supply shocks, typically inducing a global economic downturn, surprisingly lead to positive spillover effects in Norway. This phenomenon is attributed to the interconnectedness of the Norwegian economy with the oil industry, where higher oil prices trigger increased demand for productive inputs, culminating in a domestic economic boom.

2.3. Exploring the Connections Between Oil Prices and Economic Fluctuations: Methodological Approaches

There are several methodologies used to address economic fluctuations based on oil prices. One common approach is to use econometric models that estimate this relationship.

One such econometric model is the VAR model, which has been used extensively in the literature to forecast business cycles using oil prices. As previously mentioned, the VAR model estimates the relationship between multiple variables, such as oil prices and economic activity, and can be used to simulate the impact of changes in one variable over the others. For example, Lescaroux and Mignon (2009) employed a VAR model to assess the interplay between fluctuations in oil prices and multiple economic variables. Their study aimed to trace the impact of oil prices across OPEC Members (pre-Ecuador's accession), as well as major economies categorised as oil-importing and oil-exporting. In addition to the VAR model Conraria & Soares (2011) also used wavelet analysis to identify cyclical patterns in oil prices and economic activity. These techniques can be used to identify cyclical patterns at different time frequencies, providing insights into the underlying drivers of the business cycle. For example, the authors used wavelet analysis to identify cyclical patterns in oil prices and economic activity in the U.S. showing that oil price increases negatively affect industrial production in alignment with the cyclic shifts of the economy. Lower frequencies until the mid-1960s suggest demand-driven changes. Oil price increases consistently lead to inflation increases, but tight monetary policy in the 1980s reduces the impact. Volatility of inflation and output decreased in the 1950s-1960s, except for the 1970s oil crises.

Additionally, machine learning approaches have been employed to anticipate shifts in the business cycle through the utilization of diverse sets of variables. These types of techniques typically use large datasets to identify patterns and relationships between variables. For example, in the research conducted by Nyman and Ormerod (2016), their emphasis lies in short-term predictions of real GDP growth for the United States and the United Kingdom. They adopt a statistical approach involving Ordinary Least Squares (OLS) regression alongside the application of the Random Forest (RF) machine learning technique. Their work displays that the latter method ensures greater forecasting accuracy, particularly during the significant economic downturn of 2008/09.

In conclusion, the literature suggests that oil prices are a significant predictor of the business cycle, and that estimating the business cycle using oil prices can provide valuable insights for businesses and policymakers. The econometric models such as the VAR model, statistical techniques such as wavelet analysis and spectral analysis, and machine learning have all been used to assess this interdependence. Hybrid models that combine multiple methodologies have also been proposed to improve the accuracy of business cycle analysis. However, the unpredictability and volatility of oil prices driven by various factors, such as changes in global demand and supply, geopolitical tensions, and production cuts, make it challenging to predict their impact on the business cycle (Hamilton, 1983; Hamilton, 2009). Moreover, the relationship between oil prices and economic activity is complex and nonlinear, making it challenging to build accurate estimation models (Barsky & Kilian, 2004). Addressing these challenges is fundamental for the worldwide economies in constructing accurate and robust analytical models using oil prices.

3. Data and Methodology

This thesis aims to analyse the relationship between oil prices and the macroeconomic variables that define the business cycles of Portugal and Norway and to check whether this variable acts as a relevant predictor of economic fluctuations.

This chapter is divided into two parts: a first section, in which the data is presented and described, and a second section covering the methods used to evaluate and compare the implications of oil price variations over both economies.

3.1. Data Description

To capture the short- and medium-term effects of oil price fluctuations over the economies of Portugal and Norway, for this study we retrieved quarterly data from different macroeconomic variables. The endogenous variables of the VAR model present in this study are the following: real GDP growth rate (GDPGR), unemployment rate (UR), production of total industry growth rate (PTI), private final consumption expenditure growth rate (CSPE), exports rate (EXPGR), inflation rate (INFR) and crude oil prices growth rate (OPGR). Due to data availability restrictions on crude oil prices the analysis starts in Q1:1988 and goes until Q4:2021 for all the chosen variables except the UR for Norway. This variable will also be included in the model, but the first observation happens only in Q1:1990, since data prior to this period was also not available by the time of the analysis. The same happens with GDPGR, CSPE and EXPGR in Portugal. The Portuguese data for these variables starts only in Q2:1995.

A dummy variable, labeled "dummy," was also included in the context of Portugal to capture the exceptional economic conditions during the 2009 global financial crisis and the Covid-19 pandemic. It takes the value of 1 for the quarters of Q1:2009, Q1:2020, Q2:2020, Q3:2020, Q1:2021 and Q2:2021 and 0 for all other periods. Failure to include this exogenous variable could lead to misleading conclusions, as these two events had a significant and distinct impact on economic behaviour during this timeframe for the Portuguese economy. These impacts have varied significantly between Portugal and Norway. Norway's economy did not experience substantial disruptions during these periods comparable to those in Portugal, the inclusion of a dummy variable was not necessary for this country to achieve reliable conclusions.

All data for the endogenous variables was obtained through the Federal Reserve Economic Data (FRED) website at the Federal Reserve of St. Louis. Table A1 in the appendix displays the data for both countries.

Real GDP growth rate is widely recognised as one of the best indicators to measure economic activity and is often used as a proxy for the business cycle Stock and Watson (1998). The data gathered for this variable is seasonally adjusted, so it does not exhibit seasonal patterns that can distort the true underlying trend in the data.

The production of total industry growth rate is also another commonly used measure of economic activity that provides insights into the overall health and growth of the economy. Our choice is also informed by theoretical models and empirical studies on the relationship between PTI and oil prices. For instance, Scholtens and Yurtsever (2012) and Wang and Zhang (2014) used oil prices to estimate the impact on industrial output using different estimation methods[1] suggesting that the causal relationship between the two holds across different analytical approaches and regions. The data is seasonally adjusted.

The unemployment rate was included as a measure of the labour market's "health". Changes in the unemployment rate can help to identify turning points in the business cycle, which can be useful for predicting future economic trends. According to literature, oil price increases lead to a greater unemployment rate. Studies conducted by Kilian and Park (2009) and Hooker (1996), among others, have consistently found evidence supporting this relationship, thus having a significant impact on unemployment rates. The data for this variable was seasonally adjusted.

As a measure of price stability, we included the inflation rate in our model, to track changes in the cost of living for both economies. The literature defends that oil price variations tend to have a significant impact over INFR. Chen and Rogoff (2002) concluded that this impact could be seen over the short and longer run, while Oloko et al. (2021) found that oil price increases lead to lasting effects on inflation, particularly in oil-importing economies, whereas

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[1] While Scholtens and Yurtsever (2012) used VAR and multivariate regression techniques, Wang and Zhang (2014) opted for autoregressive conditional jump intensity and generalised conditional heteroscedasticity (GRACH) models.

in oil-exporting countries the effects have a shorter time frame. For this variable the data used was not seasonally adjusted.

Private final consumption expenditure growth rate was included in the model as a measure of household spending, which is a significant component, alongside real GDP growth rate, of economic activity. CSPE tracks consumer behaviour when facing crude oil price variations, acting as proxy of consumer spending. According to Hamilton (2012) and Mehra & Petersen (2005) oil price increases have a significant and negative impact on consumer spending. The data gathered for this variable was seasonally adjusted.

The export growth rate was included as a measure of the country's external trade and economic activity. According to the studies conducted by Shamsuddin & Zakaria (2017) and Bayraç & Çemrek (2021) they found that oil prices have a significant effect over this variable for different economies. Shamsuddin and Zakaria (2017) specifically determined that a negative shock in 2014 had adverse consequences on Malaysia's export performance. Bayraç & Çemrek (2021) also found these causal relationships in OPEC economies. Furthermore, Cashin et al. (2014) concluded that oil prices have a stronger effect over the exports of developing economies compared to developed ones. Highlighting the relevance of considering an economy’s level of development when analyzing the relationship between oil prices and exports. The data was seasonally adjusted.

With respect to oil price fluctuations, we measure them using Brent Europe crude oil spot prices. Brent is a type of crude oil produced in the North Sea region which serves as a benchmark for pricing several other crude streams. Portugal and Norway are both reliant on Brent crude oil consumption for different reasons: Portugal is a net importer and Norway is a net producer and net exporter of this commodity. The data for this variable was not seasonally adjusted.

3.2. Research Methodology

3.2.1. VAR Model

The VAR model is a straightforward type of multivariate model that has gained widespread use when analyzing economic systems, largely due to the influential research conducted by Sims (1980). This model is especially useful for making predictions and estimates and it provides a convenient framework for connecting leading indicators with coincident variables, as well as for constructing composite indexes using regression analysis.

This statistical framework characterises the progression of a multivariate linear time series featuring K endogenous variables $Y_t = (y_{1t}, \ldots, y_k, \ldots, y_{Kt})$ for $k = 1, \ldots, K$. In this thesis, K=7 with the 7 endogenous variables being defined later on. To trace the evolution of these endogenous variables in the system, its considered a linear relationship with their own historical values and a linear dependence on the lagged values (up to lag p) of all K variables, along with an error term v.

The general reduced form of a K dimensional VAR(p) model with p lags and J exogenous x variables:

$$Y_t = C + \varphi_1 Y_{t-1} + \ldots + \varphi_p Y_{t-p} + \gamma_1 x_{t-1} + \cdots + \gamma_q x_{t-q} + v_t \qquad (1)$$

The generic reduced form of a K-dimensional VAR(p) model with exogenous variables, incorporating p lags, expressed in matrix notation:

$$\begin{pmatrix} y_{1t} \\ \cdots \\ y_{Kt} \end{pmatrix} = \begin{pmatrix} c_1 \\ \cdots \\ c_K \end{pmatrix} + \begin{pmatrix} \varphi_{11}^{(1)} & \cdots & \varphi_{1K}^{(1)} \\ \cdots & \cdots & \cdots \\ \varphi_{K1}^{(1)} & \cdots & \varphi_{KK}^{(1)} \end{pmatrix} \begin{pmatrix} y_{1t-1} \\ \cdots \\ y_{Kt-1} \end{pmatrix} + \cdots + \begin{pmatrix} \varphi_{11}^{(p)} & \cdots & \varphi_{1K}^{(p)} \\ \cdots & \cdots & \cdots \\ \varphi_{K1}^{(p)} & \cdots & \varphi_{KK}^{(p)} \end{pmatrix} \begin{pmatrix} y_{1t-p} \\ \cdots \\ y_{Kt-p} \end{pmatrix} +$$

$$\begin{pmatrix} \gamma_{11}^{(1)} & \cdots & \gamma_{1J}^{(1)} \\ \cdots & \cdots & \cdots \\ \gamma_{J1}^{(1)} & \cdots & \gamma_{KJ}^{(1)} \end{pmatrix} \begin{pmatrix} x_{1t} \\ \cdots \\ x_{Jt} \end{pmatrix} + \begin{pmatrix} \gamma_{11}^{(q)} & \cdots & \gamma_{1J}^{(q)} \\ \cdots & \cdots & \cdots \\ \gamma_{K1}^{(q)} & \cdots & \gamma_{KJ}^{(q)} \end{pmatrix} \begin{pmatrix} x_{1t-q} \\ \cdots \\ x_{Jt-q} \end{pmatrix} + \begin{pmatrix} v_{1t} \\ \cdots \\ v_{Kt} \end{pmatrix} \qquad (2)$$

Y_t denotes a vector of endogenous variables of length K, each φ_i represents matrix coefficient with size $K \times K$ for i = 1, …, p, and C is a $K \times 1$ vector of intercepts. X denotes a vector of exogenous variables of length J×1, while each γ_i is a matrix coefficient of size $J \times J$ for $i = 0 \ldots q$. Here, X is simply the dummy variables described earlier. The error vector v has an expected value of zero, follows white noise processes, and exhibits no autocorrelation. The variance-covariance matrix (Ω) is positive semidefinite: $v_t \sim WN_k$ such that $E(v_t) = 0_{K\times 1}$, $E(v_t v'_t) = \Omega_{K\times K}$, $E(v_t v'_t) = 0_{K\times k}$, t≠s.

To estimate the model parameters, Ordinary Least Squares (OLS) is employed. OLS minimises the sum of squared differences between the observed values of Y_t and the values predicted by the VAR model. This optimization process determines the values of $\varphi_1, \dots, \varphi_p, \gamma_1, \dots, \gamma_p$ that best explain the observed dynamics in the data.

Following estimation, it is imperative to conduct diagnostic checks, such as selecting the appropriate order *p*, examining residuals for no autocorrelation, and ensuring normality, to validate the model's assumptions and refine its reliability for policy analysis. This analysis was formulated and discussed in Chapter 4.

In our VAR modeling approach, the Cholesky Decomposition method suggested by Doan (1992) plays a central role, serving as a key mathematical procedure to transform the system of equations into uncorrelated shocks. This strategic choice is motivated by the decomposition's prowess in disentangling contemporaneous relationships among variables, offering a clearer interpretation of the timing and causal impacts of shocks on each variable.

The significance of Cholesky Decomposition unfolds in two main aspects. Firstly, it enables the extraction of uncorrelated shocks, facilitating a focused examination of individual variables' responses to exogenous shocks. Secondly, it aids in the temporal disentanglement of relationships, a critical aspect for precisely understanding the temporal dynamics of the variables.

The implementation process involves matrix factorization, where the covariance matrix is decomposed into a lower triangular matrix (*L*) and its transpose (*L^T*), denoted as *Σ* = *LL^T*. The sequence of variables in the VAR model determines the order in the lower triangular matrix.

3.2.2. Granger Causality

The Granger causality test allows us to determine whether the behaviour of one time series helps predict and explain the behaviour of another, or vice versa. If time series *X* causes time series *Y*, then the past values of *X*, denoted as *Xt-j* contribute to determining *Yt* independently of the contribution of the past values of *Y*, referred to as *Yt* (Granger, 1969).

In the context of VAR models, Granger causality is crucial for several reasons. VAR models capture the interdependencies among multiple time series variables, and the Granger causality test helps identify the directional causality among them. By determining the causal relationships, VAR models provide insights into the dynamic interactions and responses of different economic variables to shocks or changes in one another.

Understanding Granger causality in our VAR framework allows for the construction of more accurate and meaningful impulse response functions. The identification of Granger causality within a VAR model enhances the model's ability to capture the temporal ordering of shocks and their effects on the variables involved.

In this analysis, we employ the VAR Granger Causality model, or the Block Exogeneity F-test tailored for VAR(p) models. The F-test assesses whether an endogenous variable elucidates the behaviour of the dependent variable of interest. The null hypothesis posits that the lagged coefficients of the causality variable are collectively zero, implying that they do not Granger-cause the dependent variable.

To gauge the significance of this causal relationship, we employ the F-test. The F-statistic is computed by assessing the joint hypothesis that the lagged coefficients are collectively equal to zero. The formula for the F-statistic is given by:

$$F = \frac{(RSS_0 - RSS)/p}{RSS/(T-pk)} \tag{3}$$

Where RSS is the residual sum of squares under the null hypothesis, RSS_0 is the residual sum of squares under the alternative hypothesis, p is the number of restrictions (lags), T is the total number of observations, and k is the number of estimated parameters. The resulting F-statistic is then compared to critical values from the F-distribution to ascertain the statistical significance of the test.

In essence, the Granger causality test, when integrated into VAR models, contributes to a deeper understanding of the complex relationships within a system of time series variables. It aids in formulating more accurate economic models by capturing not only the contemporaneous relationships but also the causal links over time, thereby improving the model's capacity for forecasting and policy analysis.

3.2.3. Variance Decomposition

Variance decomposition in the context of VAR models is a technique used to understand the contribution of each variable in the system to the overall variability observed in the endogenous variables. In a VAR model, variables are interrelated, and shocks to one variable can propagate through the system, affecting others. Variance decomposition helps quantify the proportion of the forecast error variance in each variable that can be attributed to its own innovations (own shocks) and the innovations of other variables.

The process involves estimating the variance-covariance matrix of the forecast errors for each variable in the VAR model. This matrix captures the uncertainty or variability in the predictions of each variable. The diagonal elements represent the proportion of the forecast error variance that is due to the variable's own innovations, while off-diagonal elements capture the contributions of other variables' innovations.

By decomposing the variance, analysts can identify the relative importance of each variable in explaining the fluctuations observed in the system. This information is crucial for understanding the dynamic interactions and dependencies among variables. High contributions from a specific variable suggest that it plays a significant role in explaining the variability of other variables in the system.

3.2.4. Impulse Response Functions

Impulse Response Functions are pivotal tools offering an intricate understanding of how variables interact dynamically in response to sudden shocks in the realm of VAR models. The VAR model, then, explores how this shock reverberates throughout the system over subsequent periods.

IRFs manifest as graphical representations or functions, portraying the deviations of each variable from its anticipated trajectory following the shock. These functions are instrumental in uncovering not just the direct responses but, more significantly, the intricate interplay between variables. Their interpretation involves discerning the magnitude and direction of the response, understanding the duration of the effects, and distinguishing between immediate and delayed reactions.

One of the compelling aspects of IRFs lies in their ability to capture the dynamic interactions between variables. They don't just stop at illustrating initial responses; they shed light on how these responses influence the ongoing dynamics of the entire system. Policymakers find IRFs invaluable for their ability to forecast and comprehend the potential impacts of shocks, aiding in the formulation of strategies to manage and stabilise the economy effectively.

In essence, IRFs in VAR models serve as windows into the complex relationships within multivariate time series systems, unraveling the nuances of how variables respond to unexpected disturbances and providing crucial insights for both researchers and policymakers.

All of the econometric calculations were carried out using Stata, version 17, apart from the Variance Decompositions and Impulse Response Functions that were computed using EViews, version 12.

4. Empirical Analysis

4.1. Sample Analysis

For the purpose of our study, in order to comprehensively depict the impact of oil price movements on both economies, it is imperative to conduct a thorough examination of the selected sample.

The descriptive statistics of the variables for each of the countries, presented in Table A2, in the appendix, allows one to gain insights into the central tendency, spread, and range of the variables over the specific period examined for Norway and Portugal, respectively.

In Norway, the data suggests a relatively stable and positively growing economy. The country exhibits a moderate average real GDP growth rate, indicating consistent economic performance. The unemployment rate is relatively low, reflecting stability in the labour market. Private final consumption expenditure, export growth, and production growth exhibit moderate levels with discernible variability.

On the other hand, Portugal faces economic challenges, with a higher unemployment rate and a lower average real GDP growth rate compared to Norway. Private final consumption expenditure and export growth in Portugal also display moderate levels with variability. The inflation rate in Portugal is relatively low, signifying stable price levels.

In summary, Norway seems to enjoy a more stable economic environment with stronger growth indicators across several variables compared to Portugal. While Portugal faces challenges, it maintains stability in inflation and demonstrates moderate economic activity. It is important to note that these conclusions provide a snapshot based on the observed descriptive statistics and that a comprehensive understanding of each country's economic situation would require further analysis and consideration of additional factors.

The evolution of the macroeconomic variables of Norway can be verified in figures A1, A2, A3, A4, A5 and A6, while the Portuguese indicators are presented in figures A7, A8, A9, A10, A11 and A12 in the appendix. Each figure demonstrates the unique characteristics of each country, as both economies experienced distinct shocks in recent years. However, it is crucial to highlight the impact of the pandemic on both economies, particularly in terms of real GDP, private consumer expenditure, and exports. For Portugal it is also worth mentioning the impact that the global financial crisis of 2008, absorbed much better by Norway, and the sovereign debt crisis had over the economy.

Figure A13 illustrates the evolution of brent crude oil price variation over the period of analysis. Oil price growth rate presents the highest standard deviation from all the variables, reflecting the inherent uncertainty and dynamic nature of the global oil market.

Table 1 - Correlation Matrices (Source: Author's own elaboration)

Panel A - Correlation Matrix of Norway

	GDPGR	UR	PTI	CSPE	EXPGR	INFR	OPGR
GDPGR	1.0000						
UR	0.1472	1.0000					
PTI	0.5523	0.2049	1.0000				
CSPE	0.5073	0.0353	0.0340	1.0000			
EXPGR	0.1993	-0.0115	0.0696	0.1326	1.0000		
INFR	0.0878	0.0695	0.0959	0.1208	0.1251	1.0000	
OPGR	0.1049	-0.0134	-0.0285	0.2720	0.3183	0.1697	1.0000

Panel B - Correlation Matrix of Portugal

	GDPGR	UR	PTI	CSPE	EXPGR	INFR	OPGR
GDPGR	1.0000						
UR	-0.1009	1.0000					
PTI	0.8390	-0.0184	1.0000				
CSPE	0.9490	-0.1607	0.7705	1.0000			
EXPGR	0.8559	-0.0001	0.8240	0.7621	1.0000		
INFR	-0.0623	-0.1782	-0.0955	-0.0173	-0.0186	1.0000	
OPGR	0.3855	-0.0913	0.3551	0.3878	0.4916	0.2277	1.0000

Table 1 presents the computed Pearson correlation coefficients for Norway and Portugal, which evaluate the linear relationship between the variables. These coefficients quantify the strength and direction of the linear association between each pair of variables. Observing the relationship between oil prices and all the other variables, Portugal presents a stronger correlation overall. This could arguably be attributed to factors such as the composition of its industries and sectors, the extent of its reliance on oil imports, the proportion of oil-related exports in its economy, or even the influence of oil price changes on Portugal's consumption patterns and energy usage, as compared to Norway.

It is crucial to emphasise that correlation analysis does not establish causality. To explore causality further, Granger-Causality tests will be applied on Chapter 4.5. By doing so, we aim to deepen our understanding of the causal relationships between oil price movements and the selected variables in both economies.

4.2. Stationarity Tests

Stationarity proves to be an essential assumption underlying the VAR framework, impacting the validity of statistical inference, causal interpretations, and the stability of our model.

In order to check for stationarity in our data a few tests will be performed: the Augmented Dickey-Fuller (ADF, Dickey and Fuller, 1981) and the Phillips-Perron (PP, Phillips and Perron, 1988) unit root tests.

The ADF test is an extension of the original Dickey-Fuller (DF, Dickey and Fuller, 1979) test. The primary distinction between these tests lies in the regression equation used to assess stationarity:

Dickey-Fuller Test Regression Equation:

$$\Delta y_t = \beta_0 + \beta_1 t + \beta_2 y_{t-1} + \varepsilon_t \tag{4}$$

Augmented Dickey-Fuller Test Regression Equation:

$$\Delta y_t = \beta_0 + \beta_1 t + \beta_2 y_{t-1} + \beta_3 \Delta y_{t-1} + \beta_4 \Delta y_{t-2} + \cdots + \beta_p \Delta y_{t-p} + \varepsilon_t \tag{5}$$

The key addition in the ADF test is the inclusion of lagged differences (Δy_{t-1}, Δy_{t-2}, ..., Δy_{t-p}) of the time series data in the regression equation. These lagged differences effectively capture the autocorrelation present in the time series, thus accounting for the potential dependence between observations.

When $p > 0$, the ADF test becomes more efficient in detecting the presence of a unit root and autocorrelation in the data. Including additional lagged differences allows the ADF test to capture more complex patterns in the data and provides better diagnostic capabilities for time series with stronger autocorrelation.

The test introduces two hypotheses. The initial Null Hypothesis (*H0*) posits that our time series data contains a unit root, indicating its non-stationary nature. In simpler terms, this implies the presence of a certain level of trend or randomness, making the data unpredictable and variable over time. On the other hand, the Alternative Hypothesis (*H1*) suggests otherwise. It contends that our time series data lacks a unit root, signifying its stationarity. Stationarity, in this context, denotes that the statistical properties of the data remain consistent over time, devoid of any underlying trend or systematic change. If *H0* is not rejected, it indicates the existence of non-stationarity or a unit root, contingent on whether the test statistic surpasses critical values corresponding to the chosen confidence level (1%, 5%, and 10%).

Despite employing the same estimation scheme as the DF and ADF tests, the Phillips-Perron test offers several advantages. The PP test utilises a non-parametric approach, thereby ignoring the parameterization of serial correlation. Unlike other tests, there is no need to pre-specify the lag length before conducting the test, and it also corrects for heteroskedasticity in the error terms. The null and alternative hypotheses of this test are the same to the ones presented in the Augmented Dickey-Fuller test.

Table 2 presents the results of stationarity tests conducted on a panel for the Norwegian and Portuguese economic variables. Consistently obtaining remarkably low p-values from both the ADF and PP tests, whether at the original levels or when examining 1st differences, strongly suggests that the presence of a unit root is improbable in the examined economic variables from Norway and Portugal. This accumulation of evidence leans towards the likelihood that these variables are stationary, laying a robust foundation for further steps in modeling and comprehensive econometric analysis.

Table 2 - Stationarity Tests (Source: Author's own elaboration)

Panel A - Stationarity Tests for Norway							
	GDPGR	**UR**	**PTI**	**CSPE**	**EXPGR**	**IR**	**OPGR**
ADF Test							
Level	-14.730	-1.445	-15.273	-13.255	-8.439	-12.017	-10.391
	(<0,01)	0.56	(<0,01)	(<0,01)	(<0,01)	(<0,01)	(<0,01)
1st Diference	-22.732	-9.921	-25.171	-19.514	-15.712	-19.467	-16.884
	(<0,01)	(<0,01)	(<0,01)	(<0,01)	(<0,01)	(<0,01)	(<0,01)
PP test							
Level	-14.880	-1.774	-15.204	-13.475	-8.722	-12.055	-10.336
	(<0,01)	0.39	(<0,01)	(<0,01)	(<0,01)	(<0,01)	(<0,01)
1st Diference	-38.855	-10.125	-45.693	-29.031	-18.434	-28.580	-22.599
	(<0,01)	(<0,01)	(<0,01)	(<0,01)	(<0,01)	(<0,01)	(<0,01)

Panel B - Stationarity Tests for Portugal							
	GDPGR	**UR**	**PTI**	**CSPE**	**EXPGR**	**IR**	**OPGR**
ADF Test							
Level	-12.735	-0.636	-16.101	-13.141	-12.044	-8.108	-10.391
	(<0,01)	0.86	(<0,01)	(<0,01)	(<0,01)	(<0,01)	(<0,01)
1st Diference	-18.188	-6.432	-23.694	-19.337	-18.618	-27.602	-16.884
	(<0,01)	(<0,01)	(<0,01)	(<0,01)	(<0,01)	(<0,01)	(<0,01)
PP test							
Level	-12.937	-1.168	-16.702	-13.016	-12.289	-8.682	-10.336
	(<0,01)	0.68	(<0,01)	(<0,01)	(<0,01)	(<0,01)	(<0,01)
1st Diference	-29.699	-6.597	-44.700	-31.364	-29.061	-44.091	-22.599
	(<0,01)	(<0,01)	(<0,01)	(<0,01)	(<0,01)	(<0,01)	(<0,01)

The confirmation of stationarity not only strengthens the reliability of statistical conclusions but also reinforces the suitability of using time-series models on this dataset. It's worth noting, though, that while there isn't substantial evidence to reject the null hypothesis concerning a unit root at the initial level of the unemployment rate for both economies, compelling evidence does emerge when we shift our focus to the 1st differences. This observation indicates that the fluctuations or changes observed in the unemployment rate over time are likely stationary.

4.3. Optimal number of lags selection

The selection of the optimal number of lags is fundamental for the VAR model as it captures dynamic relationships, improves forecasting accuracy, and avoids both overfitting and underfitting. To determine the optimal lag, we employ various criteria, including the Likelihood-ratio test statistic (LR), Final prediction error (FPE), Akaike information criterion (AIC), Schwarz information criterion (SC), and Hannan-Quinn information criterion (HQ).

Table 3 - Selection of the Optimal Number of Lags (Source: Author's own elaboration)

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
Panel A: Lag-order selection criteria for Norway								
0	-1987,37				89890,1	31,2715	31,3982	31,5834
1	-1697,21	580,33	49	0,000	2079,27	27,5033	28,0736*	28,907*
2	-1648,8	96,813	49	0,000	2114,59	27,5126	28,5265	30,0001
3	-1577,34	142,93	49	0,000	1516,28	27,1615	28,6191	30,7489
4	-1521,82	111,03*	49	0,000	1417,61*	27,0597*	28,9609	31,7388
Panel B: Lag-order selection criteria for Portugal								
Lag	**LL**	**LR**	**df**	**p**	**FPE**	**AIC**	**HQIC**	**SBIC**
0	-1597,52				91718,1	31,2916	31,4366	31,6497
1	-1311,2	572,64	49	0,000	917,29	26,6834	27,3362	28,295*
2	-1216,97	188,46	49	0,000	386,751	25,8052	26,9656	28,6701
3	-1135,16	163,62	49	0,000	211,983	25,1681	26,8361*	29,2864
4	-1074,16	121,99*	49	0,000	179,757*	24,9352*	27,1109	30,307

Table 3 represents the optimal number of lags selection criteria for Norway and Portugal, respectively. In summary, both models ultimately selected lag 4 as the optimal lag order, indicating that it provides the best balance between model fit and complexity based on the chosen criteria. The differences between the models primarily stem from variations in the dataset and the specific values of the selection criteria.

4.4. Diagnostic Tests

To ensure the appropriate use of the VAR model, certain considerations beyond stationarity are essential. While stationarity is a foundational requirement, additional factors such as the absence of autocorrelation, the absence of heteroscedasticity, and the normality of residuals are crucial for valid statistical inferences and diagnostic assessments. In this section, we undertake an analysis to evaluate these conditions and ascertain the reliability of the VAR model.

4.4.1. Normality of the residuals

VAR models assume that the residuals (or errors) of each equation of the model follow a normal distribution. By testing the normality of residuals, we are assessing whether the data aligns with this assumption.

The assessment of residual normality was conducted using the Jarque-Bera (JB) test. This test was firstly introduced by Jarque & Bera (1987) and examines two key characteristics of the data: skewness and kurtosis, as they are indicative of departures from the normal distribution.

The Jarque-Bera test statistic is defined by the following equation:

$$JB = \frac{n}{6}\left(S^2 + \frac{1}{4}(K - 3)^2\right) \tag{6}$$

Where:

- n is the sample size.
- S is the sample skewness.
- K is the sample kurtosis.

The test is structured around the following hypotheses: The Null Hypothesis (H_0) asserts that, according to the JB test, the data adheres to a normal distribution. Conversely, the Alternative Hypothesis (H_1) posits that, as per the JB test, the data deviates from a normal distribution. This implies the presence of noteworthy departures from normality in terms of skewness and/or kurtosis. In essence, H_0 assumes normal distribution, while H_1 contends that the data exhibits significant deviations from the expected normal distribution pattern.

If the p-value associated with this statistic is less than the chosen significance level, then the null hypothesis (H_0) is rejected. This means that there is sufficient evidence to conclude that the data does not follow a normal distribution.

Table 4 - Normality Tests (Source: Author's own elaboration)

Panel A: Jarque-Bera test for Norway								
	GDPGR	**UR**	**PTI**	**CSPE**	**EXPGR**	**INFR**	**OPGR**	**Joint**
JB test	44,846	0,037	0,069	30,874	608,932	38,618	29,392	752,769
Probability	0,00000	0,98162	0,96607	0,00000	0,00000	0,00000	0,00000	0,00000
Panel B: Jarque-Bera test for Portugal								
	GDPGR	**UR**	**PTI**	**CSPE**	**EXPGR**	**INFR**	**OPGR**	**Joint**
JB test	3,488	4,369	0,195	1,347	7,604	3,33	1,868	22,201
Probability	0,17484	0,11252	0,90717	0,50992	0,02233	0,18915	0,39296	0,07458

Table 4 shows the results of the Jarque-Bera test conducted for Norway and Portugal. The results for Norway present non-normality of the residuals of each equation of the estimated model, except for UR and PTI. While it's important to acknowledge departures from normality for the context of VAR models, their practical significance diminishes in large datasets, such as the one we are currently handling.

In the context of Portugal, the analysis of p-values suggests that, at a 5% significance level, only the residuals of the variable EXPGR exhibits a noteworthy departure from a normal distribution. However, at the more stringent 1% significance level, we do not find sufficient evidence to reject the null hypothesis for this variable. In contrast, the residuals of the remaining variables do not present substantial indications of non-normality when subjected to the Jarque-Bera test at the conventional 5% significance level.

4.4.2. Residual autocorrelation test

In VAR models, the assumption of non-autocorrelation in the residuals is fundamental. It indicates that the errors (residuals) do not display any structured or systematic pattern of correlation when observed at different time lags. When the residuals are correlated, the estimated coefficients of the VAR model may not be optimal, and their standard errors may be incorrect. This can affect the accuracy of inference and statistical tests based on the model.

To determine whether there is serial correlation in the residuals of our time series data, we employ the Breusch-Godfrey test, developed by Breusch & Pagan (1979).

The Breusch-Godfrey test statistic is defined by the following equation:

$$LM = n.R^2_{\hat{u}} \dot{\sim} \chi^2_q \ . \tag{7}$$

Where:

- LM represents the Lagrange multiplier test statistic.
- n corresponds to the sample size.
- $R^2_{\hat{u}}$ denotes the R-squared value obtained from the regression of squared residuals in the Breusch-Pagan test.
- χ^2_q represents the chi-squared distribution with “q” degrees of freedom.

The test is guided by the following hypotheses: The Null Hypothesis (H_0) for the Breusch-Godfrey test posits that there is no serial correlation present in the residuals of the regression model. In contrast, the Alternative Hypothesis (H_1) asserts that there is indeed serial correlation in the residuals. In simpler terms, H_0 assumes an absence of systematic patterns or relationships among the residuals, while H_1 suggests the presence of such correlation. The Breusch-Godfrey test is employed to assess whether there are significant serial dependencies in the residuals of a regression model.

Table 5 - Residual Autocorrelation Tests (Source: Author's own elaboration)

Panel A: Breusch-Godfrey Test in Norway		
Lags	**LM-Stat**	**Prob.**
4	55,18656	0,2523
Panel B: Breusch-Godfrey Test in Portugal		
Lags	**LM-Stat**	**Prob.**
4	50,29522	0,4219

Table 5 shows the results of the conducted autocorrelations tests. The output suggests that for our model, there is no strong evidence of serial correlation in the residuals when considering 4 lagged values for both Norway and Portugal. This conclusion is drawn since the p-values for both countries exceed the 5% significance threshold, leading us to retain the null hypothesis.

4.4.3. Heteroskedasticity Test

Heteroskedasticity will be analysed whitin our model to assess whether the assumption of constant error variance, a critical assumption underlying VAR models, is met, or violated. Detecting and addressing heteroskedasticity, if present, is essential for ensuring the reliability of parameter estimates, the validity of hypothesis tests, and the overall robustness of our model's results. By investigating the presence of heteroskedasticity and taking appropriate corrective measures, we aim to enhance the accuracy and credibility of our statistical analysis.

To ensure the absence of heteroskedasticity in our model's residuals the White test proposed by White (1980) will be applied to our dataset. This test involves extending our original model to account for various potential forms of heteroskedasticity. It includes squared independent variables and interaction terms, which allows us to capture changes in error variance that might be related to our predictors.

The test statistic used in the White test is calculated based on the goodness of fit, specifically the R-squared, of this extended model. The test statistic is then compared to critical values from the chi-squared distribution to determine whether heteroskedasticity is present.

The test is guided by the following hypotheses: The Null Hypothesis (H_0) posits that the residuals do not exhibit heteroskedasticity, indicating that variations in the data are consistent across all data points. In other words, it assumes that the variability is constant throughout the dataset. On the other hand, the Alternative Hypothesis (H_1) contends that heteroscedasticity is present. This implies that the residuals do not adhere to an equal variance distribution, suggesting that the variability may vary across different segments of the data. In summary, H_0 assumes constant variance, while H_1 suggests the presence of unequal variance or heteroskedasticity in the residuals.

Table 6 - Heteroskedasticity Test (Source: Author's own elaboration)

Panel A - White test for Norway			
Lags	**Chi-sq**	**df**	**Prob.**
4	1571,344	1568	0,4715
Panel B - White test for Portugal			
Lags	**Chi-sq**	**df**	**Prob.**
4	1560,549	1568	0,5483

In Table 6, the p-values corresponding to the White test statistics for both Norway and Portugal exceed the 0.05 threshold (e.g., 0.4715 for Norway and 0.5483 for Portugal). These results indicate that there is insufficient evidence to reject the null hypothesis, suggesting that the assumption of homoskedasticity (constant variance of residuals) holds for both datasets.

4.5. Causality Tests

Given that our analysis primarily concentrates on examining how fluctuations in oil prices impact the business cycle, we will exclusively derive causality conclusions concerning the causality of this variable over the others. Table 7 summarises the Granger causality test results for OPGR in both economies. For a comprehensive view of all Granger causality relationships, please refer to Table A3 in the appendix.

Table 7 - Granger Causality Test Results for Brent Crude Oil Price Growth Rate (Source: Author's own elaboration)

Panel A: Granger causality test results for Norway

	Chi-sq	df	Prob.
CSPE	9.538849	4	0.0490
EXPGR	28.24721	4	0.0000
GDPGR	7.373575	4	0.1174
INFR	8.033767	4	0.0903
PTI	3.499842	4	0.4779
UR	4.918344	4	0.2958

Panel B: Granger causality test results for Portugal

	Chi-sq	df	Prob.
CSPE	6.168396	4	0.1869
EXPGR	8.096791	4	0.0881
GDPGR	6.075992	4	0.1935
INFR	6.301624	4	0.1777
PTI	9.083880	4	0.0590
UR	1.538304	4	0.8198

In the context of Norway, the analysis revealed Granger causality relationships between oil prices growth and three variables: CSPE (significant at a 5% level of confidence), EXPGR (highly significant at a 1% level of confidence), and inflation rate (somewhat significant at a 10% level of confidence).

Oil prices fluctuations present a noticeable causality on private consumer spending. This relationship could be due to various factors, such as changes in disposable income, consumer confidence, or inflationary pressures resulting from oil price movements.

The strong significance at the 1% level for EXPGR suggests that changes in oil prices significantly influence the growth of exports in Norway. This finding is particularly important for a major oil-exporting nation like Norway. When oil prices rise or fall, it can affect the competitiveness of Norwegian exports, especially those related to the oil and gas sector.

Although the relationship between oil prices and inflation rate is somewhat significant, it indicates that there may be an indirect impact of oil price changes on inflation in Norway. Oil price fluctuations can affect production costs, which may then translate into changes in consumer prices. Even though the level of significance is lower, this relationship should not be dismissed.

Notably, the lack of a direct causal relationship between oil prices and real GDP is acknowledged. While direct causation is not evident, the findings imply potential indirect effects that merit additional investigation. This differs with the conclusions drawn by Jiménez-Rodríguez and Sánchez (2004) for a different time frame. In their study, Jiménez-Rodríguez and Sánchez (2004) identified that an oil price shock could Granger-cause GDP at a 10% significance level.

For Portugal, the analysis has unveiled Granger causality relationships between the growth of oil prices and two variables: EXPGR (significant at a 10% level of confidence) and PTI (also significant at a 10% level of confidence). It is important to refer that with this method we do not obtain significant causality over inflation. Robalo and Salvado (2008) support this association, as their research reveals that the conducted causality tests yielded no significant evidence of a causal relationship between oil price shocks over inflation, real GDP, unemployment rate, and industrial production given the period between 1985-2005. In simpler terms, this aligns with previous research findings, indicating that oil price shocks have not exerted a substantial impact on macroeconomic variables since 1985, as demonstrated in earlier studies by Hooker (1996) and Hamilton (1996). This is also applicable for the Norwegian context.

These findings suggest that changes in oil prices may impact Portugal's export performance and overall industrial production. The influence on exports implies that global oil price fluctuations can affect the competitiveness and demand for Portuguese exports. The connection to industrial production suggests that oil price movements might affect the entire industrial sector, potentially through factors like energy costs, input prices, or demand from industries linked to oil and gas.

4.6. VAR analysis

The VAR coefficients[2] do not offer a straightforward interpretation concerning the immediate impact of one variable on another. This complexity arises from the fact that the influence of one variable on another is not solely determined by the coefficient that directly precedes it. To gain a deeper understanding of how variables interact and influence each other over time within the VAR model, we will focus on Impulse Response Functions (IRF) and Variance Decomposition (VD) analysis. These analytical tools enable a more comprehensive and nuanced interpretation of the intricate relationships within the system.

Table A8 in the appendix shows the results of the estimated values of our dummy variables in our VAR model. GDPGR exhibited distinctive patterns across these critical periods. The dummy variables for the first quarter of 2009 (dummy1) and the first quarter of 2020 (dummy2) revealed substantial and significant negative impacts, indicating the severe economic downturns associated with the global financial crisis and the initial stages of the pandemic. Surprisingly, the dummy for the second quarter of 2020 (dummy3) showed a significant positive impact, suggesting a rapid recovery or rebound during this period. However, the dummies for subsequent quarters in 2020 and 2021 demonstrated varied impacts, with some periods showing no statistically significant effects and others indicating continued challenges.

The unemployment rate, on the other hand, did not exhibit consistent and statistically significant relationships with the dummy variables. This implies that, while overall economic conditions were influenced by the crises, the immediate impact on unemployment might not have been as pronounced or directly correlated.

PTI and CSPE both experienced significant negative impacts during the identified crisis periods, with notable rebounds in the second quarter of 2020. These trends underscore the resilience of the Portuguese economy in the face of adversity, with the manufacturing sector and consumer spending demonstrating the ability to recover swiftly.

Export growth rate reflected a similar pattern, with significant negative impacts during crises followed by a positive rebound in the second quarter of 2020. This highlights the interconnectedness of the Portuguese economy with global markets and the subsequent recovery as international trade conditions improved.

[2] The estimated coefficients of our VAR model are presented in Table A4 in the appendix.

In terms of inflation rate and oil prices growth rate, the dummy variables did not consistently exhibit statistically significant effects, indicating that these economic indicators might have responded to a broader set of factors beyond the immediate crises.

4.6.1. Variance Decomposition analysis

In the following section, we present the results of the Variance Decomposition analysis for Norway and Portugal. Tables A6 and A7 in the appendix provide a comprehensive breakdown of the variance decomposition outcomes for the variables within the respective models.

Our primary focus in this thesis is to draw conclusions regarding the impact of oil prices on macroeconomic indicators. We initiate our analysis with the growth rate of private final consumption expenditure in Norway. Initially, the influence of Brent Crude oil price shocks is minimal, registering at 0% in the initial period. However, over time, these shocks progressively gain significance, indicating a growing impact on CSPE.

The cumulative effect of oil price shocks becomes evident as the percentages accumulate, reaching a total of 3.50% by the tenth period. This suggests a subtle responsiveness in consumption patterns to fluctuations in Brent Crude oil prices, indicating that consumers and economic agents in Norway may adapt their behaviours in response to changes in oil prices.

Moving on to the growth rate of exports in Norway, the Variance Decomposition analysis initially marks the impact at 0%, signifying an absence of influence. However, the influence of oil price shocks becomes significant over the observed periods, with a substantial contribution of 13.30% in the second period. Although the percentages fluctuate in subsequent periods, they consistently suggest a meaningful impact.

For the growth rate of real GDP in Norway, there is no discernible impact of oil price shocks in the first period, indicated by a percentage of 0%. Yet, as time progresses, the influence becomes apparent, with a noteworthy contribution of 1.67% in the second period. This influence fluctuates over subsequent periods, ranging from 1.60% to 2.32%, indicating a discernible but not overwhelming impact on the variability of real GDP growth.

The Variance Decomposition analysis for the inflation rate in Norway indicates no impact of oil price shocks in the first period, registering at 0%. However, as time progresses, the influence becomes more pronounced, with a noticeable increase in the percentage contribution in the second period (0.21%). This impact further escalates in subsequent periods, peaking at 4.85% in the seventh period, suggesting a moderate influence of oil price shocks on the variability of the inflation rate in Norway.

Analyzing the growth rate of industrial production in response to Brent Crude oil price growth rate in Norway, there is a marginal impact of oil price shocks in the first quarter (0.09%). As we progress through subsequent periods, the influence of these shocks becomes more pronounced, with a gradual increase in the percentage contribution, reaching 2.82% in the third quarter.

Finally, the Variance Decomposition analysis for the unemployment rate in Norway, considering Brent Crude oil price growth rate, reveals interesting patterns. In the initial period, the contribution of oil price shocks to the variability of the unemployment rate is measured at 0.11%, indicating a modest impact. As we progress through subsequent periods, the influence of oil price shocks remains low, reaching its peak at 0.89% in the tenth period.

Shifting the focus to Portugal, the Variance Decomposition analysis for private final consumption expenditure initially registers a negligible impact at 0% in the first period. However, the influence of Brent Crude oil price growth rate shocks gradually intensifies, becoming moderate and ranging from 2.43% to 3.06% in periods 5 to 10. This indicates a heightened sensitivity of CSPE to fluctuations in Brent Crude oil prices, with sustained influence during periods 6 to 8 (percentages around 2.55% to 2.84%).

For Portugal's export growth rate, the initial impact of Brent Crude oil price growth rate shocks is negligible at 0%. However, as time progresses, the impact becomes noteworthy, with an increased contribution of 3.33% in the second period. This influence persists, ranging from 3.31% to 6.43% in subsequent periods, emphasizing an increased impact.

Examining the Variance Decomposition for the real GDP growth rate in Portugal, in relation to Brent Crude oil price growth rate, reveals insightful trends. Initially, there is no impact of oil price shocks, marked at 0%. However, as time advances, the influence becomes apparent, with a noteworthy 0.34% contribution in the second period, gradually increasing in subsequent periods. The percentages fluctuate from 0.39% to 2.87%, signifying a noticeable yet not overpowering effect of oil price shocks on the variability of Portugal's GDPGR.

In the initial period, the inflation rate in Portugal shows no discernible impact of oil price innovation, registering at 0%. However, as time progresses, the influence of these shocks becomes more apparent, with a notable increase in the percentage contribution in the second period (0.11%). The impact peaks at 7.56% in the eighth period, highlighting the impact of oil price shocks on the variability of the inflation rate in Portugal. It's important to note that while this response is relatively modest, it represents the variable most explained by oil prices.

The Variance Decomposition analysis for Portugal's total industry production (PTI) in relation to Brent Crude oil price growth rate spans across ten periods. In the initial period, the contribution of oil price shocks to the variability of total industry production is measured at 0.088%. As we progress through subsequent periods, the influence of these shocks becomes more pronounced, with a gradual increase in the percentage contribution. By the tenth period, oil price shocks contribute 3.87% to the overall variability of total industry production, suggesting a growing impact over the observed periods.

Finally, the Variance Decomposition analysis for the unemployment rate in Portugal, considering the Brent crude oil price growth rate, unfolds over ten periods showing a negligible impact. In the initial period, oil price shocks contribute 2.36% to the variability of the unemployment rate. As we progress through subsequent periods, the influence of these shocks exhibits variability, reaching its peak at 1.81% in the tenth period.

In conclusion, although both Norway and Portugal reveal a growing sensitivity to oil price shocks, Norway distinctly shows heightened responsiveness in its export behaviour. On the contrary, Portugal demonstrates sustained impacts across various macroeconomic indicators, yet none of them significant. These findings underscore the importance of considering country-specific dynamics when assessing the economic consequences of oil price movements.

4.6.2. Impulse Response Function analysis

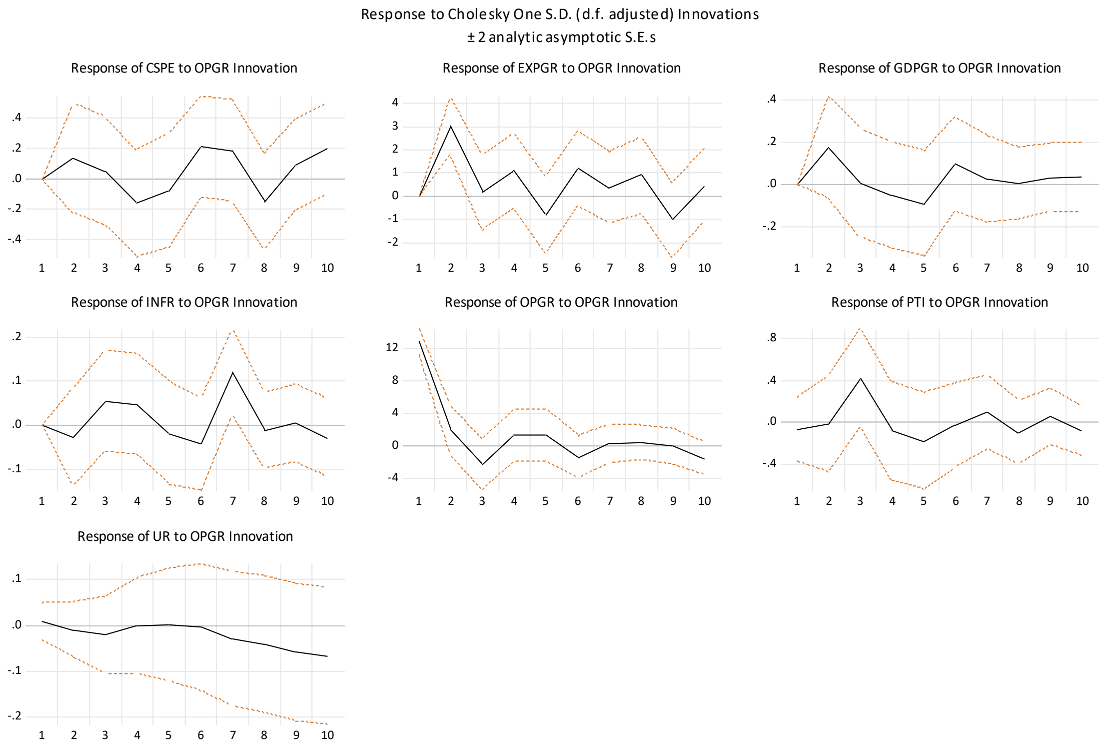
The sequencing of variables within the VAR system holds significance when examining impulse response functions. Employing the Cholesky decomposition method, as recommended, becomes instrumental in identifying innovations in each macroeconomic variable and understanding their dynamic responses over time. It's crucial to recognise that the impulse response functions are contingent on a predetermined order of variables in the Cholesky decomposition. This methodical approach allows for a structured analysis of how innovations in one variable propagate through the system, shedding light on the temporal dynamics of the entire macroeconomic framework.

Commencing with oil prices as the initial variable recognises its exogenous nature, representing shocks that can reverberate throughout the economic system. Following oil prices is the production of total industry, acknowledging the probable influence of oil price changes on industrial output. Real GDP growth rate ensues, tethered to production levels and illustrating the consequential impact on overall economic output. Subsequently, the export rate is introduced, capturing the potential influence of GDP growth and production on export levels. The inflation rate follows, responding to changes in production and economic activity. The unemployment rate reflects the overall economic activity and is succeeded by private final consumption expenditure, positioned last due to its dependence on multiple factors, including GDP growth, inflation, and employment.

This sequencing is methodically constructed to encapsulate the expected relationships and dependencies among the variables, recognising the lagged responses inherent in economic dynamics. Nonetheless, the chosen order remains amenable to scrutiny for robustness which will be further discussed.

Figures A14 and A15 contain all the impulse response functions computed in the appendix for the variables in our model for Norway and Portugal, respectively. Once more, our primary focus remains on examining the relationship between movements in oil prices and their broader impact on the economy.

Figure 1 - Impulse Response Functions with an Innovation in OPGR for Norway



In Figure 1, the impulse response functions illustrate the anticipated responses of various economic variables in Norway following a 1 percent standard deviation shock in the oil price growth rate. These IRFs are computed to project the expected changes in the variables over the following ten periods (two years and a half), providing insights into the dynamic and delayed impacts of OPGR fluctuations on the Norwegian economy.

CSPE reveals a positive response in Period 2 (0.139140%), indicating an increase in the consumption expenditure of final goods after the shock. However, Period 3 witnesses a positive yet smaller response (0.050715%), and Period 4 experiences a negative response (-0.156501%), signifying a contraction.

In Period 5, there is a slight negative response (-0.073778%), and the trend changes in Period 6 with a slight positive response (0.213225%). Period 7 continues the positive trend (0.184031%), but Period 8 sees a negative impact (-0.145937%). The ninth period witnesses a positive response (0.092520%), and the tenth period concludes with a positive impact (0.201095%).

Overall, while CSPE appears to be slightly influenced by oil price changes by analyzing the estimated IRFs, the adaptability and resistance of final private consumption expenditure in Norway is not evident, not showcasing resilience in the face of economic shocks. This is because for all the horizons from 1 to 10 quarters, the confidence sets (in orange) always include the value of a zero IRF. So, we cannot rule out the possibility that there is no response in CSPE after a shock of the oil prices.

The analysis of export growth rate in Norway, responding to OPGR changes over ten periods, reveals varying dynamics. In Periods 2 and 4, there are substantial positive responses (3.043631% and 1.117734%, respectively), indicating a significant increase in export growth associated with a positive oil price shock. In terms of statistical significance, by looking at the confidence intervals, horizon 2 (two quarters after the shock) is the only period for which we do not rule out the case of a nonzero response to the shock. It is significant, positive, and very large (three times larger the response to the shock). This underscores a strong positive correlation between oil price movements and export performance, highlighting the influential role of favorable oil price changes in driving growth in the export sector.

However, challenges emerge in Period 5, marked by a noteworthy negative response (-0.778145%), signifying a substantial decline in export growth. Despite this setback, Period 6 stands out with a substantial positive response (1.187884%), showcasing the short-lived negative impact on EXPGR. Period 9 is noteworthy for yet another substantial negative response (-0.999486%), underscoring a phase of stabilization and recovery towards its equilibrium.

In summary, these findings underscore the impactful connection between oil prices and export growth in Norway, in particular the significant, positive, and strong response two quarters after the shock.

The analysis of real GDP growth rate in Norway in response to changes in OPGR over the selected periods yields diverse patterns. Period 2 exhibits a positive response (0.174020%), indicating a modest increase in real GDP growth associated with a positive oil price innovation. However, in Period 3, the response is marginal (0.005160%), suggesting a minor impact on real GDP growth.

Contrastingly, Period 4 experiences a negative response (-0.050631%), signaling a slight contraction in GDPGR. The subsequent periods (5 to 10) reveal a mix of positive and negative responses, indicating fluctuations in the relationship between oil prices and GDPGR. Period 6 shows a positive response (0.095009%), while Period 7 exhibits a smaller positive response (0.024258%). The responses in the later periods (8 to 10) remain relatively small, suggesting a limited impact on real GDP growth. This result is in line with the findings of Bjørnland and Thorsrud (2014)

In conclusion, the responses in the specified periods underline the variable nature of the relationship between oil prices and GDPGR in Norway, presenting periods of both modest expansion and minor contraction. We cannot rule out the possibility that there is no response in GDPGR after a shock of the oil prices by looking at the confidence intervals of this variable response.

The analysis of the inflation rate response to OPGR in Norway suggests that the impact on inflation is not consistently significant. While certain periods exhibit positive responses, indicating an inflationary impact associated with favorable oil price movements, the magnitudes are relatively small. Additionally, there are periods of negative responses, signifying deflationary impacts, but again with limited impact.

For instance, Periods 3, 4 and 7 show positive responses, indicating inflationary effects. However, the substantial increase in Period 7 is notable (0.121462%), being the only horizon for which there is statistical significance of the response according to the confidence sets, suggesting a slighter rise in the inflation rate during that specific period. Nevertheless, the overall pattern reveals mixed responses with small magnitudes in the later periods (8 to 10), indicating a relatively stable but slightly fluctuating inflation rate in response to oil price changes.

In essence, while there are discernible responses, the overall impact of oil price fluctuations on inflation in Norway appears to be modest, thus not consistently substantial over the analysed periods. This implies that other factors or economic conditions may play a more prominent role in shaping inflation dynamics in the Norwegian economy.

The response of PTI in Norway to OPGR unfolds in a dynamic and varied manner over the ten periods. In the early periods, particularly in Periods 1 and 2, the industrial sector experiences modest declines as indicated by negative responses, suggesting a minor adverse impact following an oil price shock. However, in Period 3, there is a positive response (0.422265%), signifying an increase in industrial production associated with favorable oil price movements in the very short term. This period stands out as a phase of expansion, highlighting a potential positive correlation between crude oil price changes and the growth of the industrial sector.

Despite this positive phase, challenges resurface in subsequent periods, notably in Periods 4 and 5, where negative responses (-0.084321% and -0.179109%) imply a decrease in industrial production, respectively. These periods highlight a recovery of the industrial sector to an equilibrium.

The following periods (6 to 10) continue to demonstrate a mix of positive and negative responses, showcasing the dynamic and varied nature of the relationship between oil prices and industrial production in Norway. Despite the apparent impact of oil prices on PTI, an examination of the confidence intervals reveals that we cannot conclusively dismiss the possibility of no effect on this variable.

The response of the unemployment rate in Norway to fluctuations in the oil price growth rate unfolds in a nuanced pattern over the ten periods under examination. In the initial period, there is a small positive response (0.007613%), indicating a marginal uptick in the unemployment rate. This suggests that the labour market experienced a mild adverse effect following an oil price shock, aligning with the typical challenges faced by economies in adjusting to sudden changes in oil prices.

The subsequent periods (2 to 3) reveal negative responses, signaling a decline in the unemployment rate. However, the magnitudes of these responses are relatively small, suggesting only incremental improvements in the labour market. Period 7 stands out with a more substantial negative response (-0.028912%), indicating a decrease in the unemployment rate. This period suggests a potential positive impact of oil price changes, contributing to an improvement in labour market conditions.

In the later periods (8 to 10), the trend of negative responses continues, suggesting a prolonged positive influence of oil price changes on reducing unemployment over the medium term. Given the amplitude of the results over the 10 quarters, the effect of an oil price shock seems to be insignificant over the Norwegian unemployment rate.

In essence, Norway's economic landscape, as depicted by impulse response functions to oil price growth rate innovations, reflects a nuanced and resilient response across key variables. EXPGR is the macroeconomic variable whose response to the shock is statistically significant (after two quarters) and demonstrates a strong positive correlation with favorable oil price changes, showcasing sensitivity and adaptive recovery from setbacks.

In examining various economic variables, the majority exhibit positive responses to the shock, underscoring the resilience and adaptability of Norway's economic framework. This aligns seamlessly with the findings of Jiménez-Rodríguez and Sanchez (2006), Bergholt et al. (2017), and Bjørnland and Thorsrud (2014), indicating a consensus among researchers over this pattern. It's important to note that this positive trend holds true for most variables, with the notable exception being the unemployment rate. This nuance suggests that the labour market dynamics also experience the same immediate benefits.

Figure 2 - Impulse Response Functions with an Innovation in OPGR for Portugal

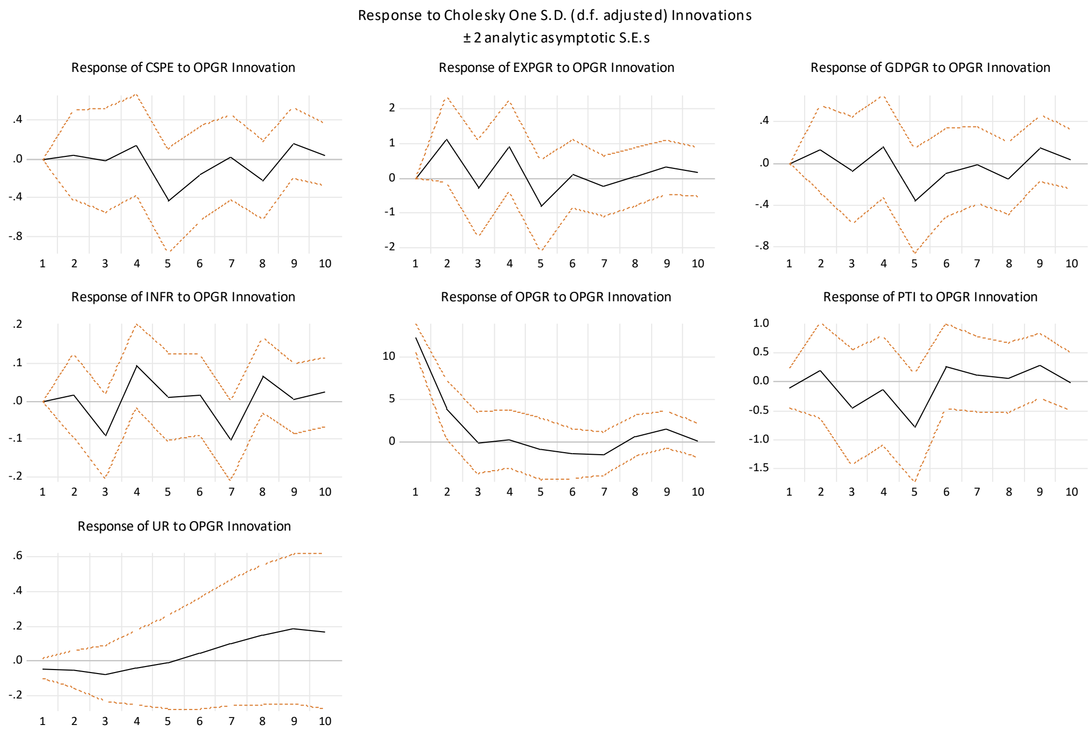


Figure 2 illustrates the impulse response functions in Portugal resulting from an innovation in oil prices growth rate for all variables in our model, depicting the trends over the ten periods ahead.

The analysis of the response of CSPE in Portugal to an oil price growth rate innovation reveals several noteworthy conclusions. The initial period demonstrates a relatively stable CSPE, suggesting a limited immediate effect in response to changes in oil prices. However, as we progress, distinct patterns emerge. Period 2 sees a positive response, indicating a modest increase in private consumption expenditure of final goods, while Period 3 witnesses a negative response, signifying a slight contraction.

The most significant impact occurs in Period 5, where CSPE experiences a more pronounced decrease (-0.428417%), indicating a negative response to oil price growth. This suggests that shocks in oil prices might have an adverse effect on private consumption expenditure in Portugal. Moreover, the seventh and eighth periods show further negative impacts, emphasizing the persistence of these effects.

Notably, the ninth and tenth periods show positive responses, hinting at a possible recovery or stabilization of this variable. The overall pattern, marked by periods of expansion and contraction in response to oil price changes, maintains the assumption of a null effect, as indicated by the visualization of confidence intervals, despite the observed fluctuations.

The analysis of the response of EXPGR in Portugal to an oil price growth rate innovation yields several key findings. In the initial period, there is no immediate response, suggesting a stable starting point. However, Period 2 experiences a noteworthy positive response (1.130742%), indicating a surge in export growth. This value without taking into consideration the confidence intervals suggests that positive shocks in oil prices contribute significantly to the expansion of export activities.

In Period 3, there is a negative response (-0.282476%), signaling a slight contraction in export growth. This contraction is followed by positive responses in subsequent periods: Period 4 (0.915222%), Period 6 (0.119333%), Period 8 (0.038017%), and Period 9 (0.314774%). Notably, Period 5 witnesses a more pronounced negative impact (-0.816315%), implying a noteworthy decline in export growth.

Period 7 also experiences a negative response (-0.232314%), contributing to the challenges faced by EXPGR. However, the tenth period concludes with a positive impact (0.168753%), hinting at a potential recovery or stabilization of this variable.

In summary, the results emphasise the responsiveness of export growth in Portugal to oil price fluctuations, indicating a potential positive effect of oil price growth rate on EXPGR in the short term, with a return to equilibrium after period 5. However, this assumption is subject to the observation of confidence intervals, which consistently encompass the value of a zero impulse response function. Therefore, we cannot dismiss the possibility of no response in EXPGR after an oil price shock.

The analysis of real GDP growth rate in Portugal in response to a shock in OPGR yields several conclusions. Firstly, the absence of an immediate response in Period 1 suggests a relatively stable starting point. The subsequent periods, especially Period 5, reveal a moderate negative impact (-0.35042%), indicating a decrease in real GDP growth. This contraction is followed by mixed responses in the later periods, with Period 10 concluding with a positive impact, suggesting a potential recovery or stabilization.

The general trend emphasises the susceptibility of real GDP growth to oil price fluctuations, featuring both contraction and expansion periods. The negative effects witnessed in specific periods underscore the difficulties encountered by the Portuguese economy in the face of unfavorable oil price shocks. Nevertheless, the positive influence observed in later periods suggests a potential resilience or adaptive reaction, highlighting the economy's ability to bounce back and stabilise following external shocks. Once more, we cannot exclude the possibility of a null impact given the confidence levels presented in the IRF.

The analysis of how the inflation rate in Portugal responds to innovations in oil price growth rate uncovers distinctive patterns over the ten periods. In Period 1, there is no immediate response, suggesting a stable starting point. Period 2 shows a positive response (0.016289%), indicating a slight increase in inflation. However, Period 3 experiences a negative response (-0.090188%), signaling a minor contraction in the inflation rate. The subsequent periods demonstrate mixed responses, with positive impacts in Periods 4, 5, 6, 8, and 9, and a slight negative response in Period 7. The tenth period concludes with a positive impact (0.023491%).

In summary, the findings lack statistical significance for these two variables, preventing a conclusive statement on the impact of an oil price innovation over the inflation rate in Portugal.

The examination of the influence of OPGR on PTI in Portugal across ten periods yields noteworthy findings. Initially, in Period 1, there is a negative impact (-0.101567%), indicating a brief decline in industrial production following an increase in oil prices. The positive response in Period 2 (0.187433%) suggests a swift recovery or potential growth in the subsequent period. However, Period 3 reveals a negative impact (-0.457188%), highlighting the potential industrial sector's sensitivity to oil price shocks.

The sustained negative responses in the fourth and fifth periods emphasise the prolonged challenges faced by the industrial sector. Period 5 shows a more pronounced negative impact (-0.775676%), implying a decline in production. The positive responses in the sixth, seventh, and eighth periods suggest a gradual recovery and stabilization, indicating the industrial sector's adaptation to earlier shocks.

The positive response in the ninth period signifies further growth in industrial production, showcasing resilience and potential expansion. The slightly negative impact in the tenth period suggests a minor setback, but overall, the industrial sector appears to have adapted and stabilised after the initial shocks.

In summary, the impact of the oil price growth rate on PTI in Portugal unfolds with initial contractions, followed by a period of recovery and stabilization. The industrial sector demonstrates both sensitivity to external shocks and resilience in the face of economic challenges. However, it's essential to note that statistical significance cannot be firmly established based on the provided confidence intervals.

The assessment of the impact of oil price growth rate on the unemployment rate in Portugal over ten periods reveal insightful conclusions. In the initial period, there is a slight negative response (-0.046634%), indicating a minor decrease in the unemployment rate following an oil price shock. Subsequent periods (2 to 4) show a continued negative impact, suggesting a prolonged adverse effect on unemployment. This sustained negative trend suggests that oil price shocks are associated with an increase in unemployment, reflecting potential challenges in the labour market in the very short term (up until year 1).

Notably, starting from the fifth period, the responses become less negative and eventually turn positive in the later periods. The positive responses in the latter part of the analysis (Periods 6 to 10) suggest a recovery or improvement in labour market conditions. The most significant positive impact (0.183758%) is observed in the ninth period, indicating a slight decrease in the unemployment rate. These results are not statistically significant; therefore, we fail to verify that oil price shocks have a direct effect on the Portuguese unemployment rate.

In conclusion, the analysis of Portugal's response to innovations in OPGR across various economic variables reveals nuanced and dynamic patterns. The results suggest that the Portuguese economy exhibits a moderate degree of sensitivity to fluctuations in oil prices.

The findings from impulse response functions in Portugal, exhibit both connections and disparities when compared with the results presented in the literature on the impact of oil price fluctuations. In terms of GDP impact, both the literature and the computed IRFs indicate periods of contraction and expansion, highlighting the economy's sensitivity to oil price changes.

However, nuances in the response patterns introduce complexities that may not align precisely with the literature's more generalised observations. The inflation rate's lack of statistical significance in our study and mixed effects after the shock in the impulse response functions contrasts with Dias's (2013) note on a temporary significant increase in inflation after oil price shocks, emphasizing the need for careful interpretation due to potential null effects observed in the computed IRF.

Regarding employment, both studies indicate a potential positive effect in the initial four quarters. However, beyond this period, they also reveal a deterioration in the labour market, characterised by a subsequent rise in the unemployment rate attributed to fluctuations in oil prices.

Dias (2013) observes an immediate negative effect on real GDP after the shock. Even though we observe a negative response in the fifth quarter, a positive response in this variable is noticeable during the first year.

In general, the shock appears to elicit a slight positive response in the Portuguese economy during the initial quarters. However, subsequent trends in real GDP, unemployment, industrial production, exports, and private consumer spending point towards an economic downturn after year 2.

It's important to note that the provided confidence intervals consistently encompass the value of a zero impulse response function for all the variables examined, preventing firm conclusions due to the possibility of a null effect. Therefore, while the analysis reveals intriguing insights into the dynamic relationship between oil prices and various economic indicators in Portugal, cautious interpretation is warranted due to the limitations posed by statistical significance.

4.6.3. Robustness Assessment

We conducted a comprehensive assessment to ensure the reliability of our VAR model results. This involved systematic adjustments to the number of lags and the ordering of variables. Re-estimating the VAR models with three and five lags yielded consistent and nearly identical results in terms of impulse response functions, instilling confidence in the stability of our findings. Furthermore, exploring diverse variable orderings, extending beyond the initially chosen Cholesky ordering, underscored the resilience of our results to variations in lag length and variable sequence. This robustness assessment enhanced the credibility and reliability of our VAR model results, providing a solid foundation for the conclusions drawn from the impulse response functions.

5. Concluding remarks

In conclusion, this study has unveiled significant insights into the intricate relationship between oil prices and the economies of Norway and Portugal. The examination of key economic indicators reveals that both nations exhibit a degree of sensitivity to oil price shocks, but with distinct patterns emerging over time.

The findings highlight Norway's resilience, particularly in export behaviour. The strong positive relationship between oil prices and export growth underscores the influential role of favorable oil price changes in driving growth in the Norwegian export sector. Even though we observe lack of statistical significance over the IRFs on the other indicators, a positive response from the overall economy is found. Our results follow the ones gathered by Solheim, H. (2008) and Bjørnland, H. (2000). However, this relationship may not be quite as clear-cut as many believe. Vatsa & Basnet (2020) contradicts the commonly held view that the performance of oil-exporting economies is positively associated with energy prices. Concluding that a positive oil price shock leads to a decrease in real GDP in Norway.

On the other hand, the Portuguese economy seems to be negatively influenced by an increase in oil prices. The negative impact on private consumption expenditure and industrial production happens right after this event underscoring possible vulnerabilities to changes in the oil market. However, some variables are only affected 1 year after the shock suggesting a delayed response. None of the oil shocks generated statistically significant effects over the Portuguese indicators as observed in the impulse response functions. For an oil-consuming economy like Portugal, the results go similarly with the ones provided by the literature. One study that provided a comprehensive framework was Korhonen and Ledyaeva (2009) for Switzerland, Japan, Germany, and the UK. In the Portuguese context Robalo and Salvado (2008) and Dias (2013) also observed a negative response in Portugal to oil price changes using VAR models for different timeframes.

Nevertheless, what is equally striking is the subsequent resilience and adaptability demonstrated by the Portuguese economy. Despite facing challenges, there are instances of recovery and stabilization in the affected economic variables. This resilience speaks to the nation's ability to absorb shocks and implement measures that mitigate the impact of external factors over time.

In summary, our analysis highlights a distinct disparity in how oil price fluctuations impact the economic trajectories of Portugal and Norway. The adverse effects of increasing oil prices on Portugal's economy stem significantly from its role as an oil importer. In contrast, Norway, being an oil-exporting nation, experiences positive outcomes, underscoring the divergent economic consequences associated with changes in oil prices. Furthermore, our research observes that the Norwegian economy is more responsive to oil price changes than Portugal's. This heightened sensitivity in Norway is rooted in its substantial reliance on oil as a primary economic driver. The country's significant share of oil exports and the resultant revenue significantly shape its economic landscape. Norway's government heavily relies on taxes and royalties from the oil sector, rendering it susceptible to global oil price fluctuations. This dependence extends to trade balances, investment patterns, and employment dynamics, where the fortunes of the oil sector directly align with oil price movements. In contrast, Portugal, functioning as an oil importer, navigates a different economic landscape, absorbing the negative consequences of rising oil prices in a context less intricately connected to oil-related activities. These nuanced economic positions underscore the varied impacts of oil price fluctuations on nations dependent on oil production versus those reliant on oil imports.

Acknowledging the limitations of this study is essential to ensure a proper interpretation of the findings. The first set of constraints involves data limitations. Economic data, especially in a dynamic and globally interconnected context, can be subject to gaps, delays, or inaccuracies. Such limitations could influence the accuracy and reliability of the results, emphasizing the need for caution when drawing conclusions. Future research endeavors could address this limitation by exploring alternative data sources or employing advanced methodologies for data validation and cleaning.

The complexity of economic systems adds another layer of limitation. Economic phenomena are influenced by a myriad of interconnected factors, and isolating the impact of a single variable, such as oil prices, is a challenging task. The study acknowledges this complexity but delves into the relationships within the VAR model to the extent possible. Future research could employ more sophisticated modeling techniques or incorporate additional variables to provide a more comprehensive understanding of the intricate interactions within economic systems.

These acknowledged limitations also serve as opportunities for future research avenues. Delving deeper into specific sectors' responses to oil price shocks can provide a more granular understanding of the economic dynamics at play. For instance, examining how the manufacturing or service sectors respond to oil price fluctuations could offer insights into the sectoral nuances of these economies. Additionally, conducting a comparative analysis of diverse oil-dependent economies could reveal patterns and variations in the impact of oil prices on economic indicators, considering factors such as institutional frameworks, policy responses, and market structures.

For policymakers, the implications of these findings are noteworthy. The study underscores the importance of considering oil price dynamics in crafting economic policies. Policymakers are urged to incorporate these insights into decision-making processes, especially in navigating the challenges posed by oil price fluctuations on key economic indicators.

In terms of theoretical relevance, this study contributes to the advancement of economic theories by providing nuanced insights into how oil prices influence economic variables. Practically, the study offers guidance for decision-makers in both nations, facilitating informed policies to mitigate the impact of oil price changes and promote sustainable economic development.

Considering the research process, the application of an interdisciplinary approach in this study played a pivotal role in developing a holistic understanding of the complex relationships being examined. In the context of our interconnected global economy, gaining profound insights into the connections between oil prices and economic indicators is of great importance. This understanding is critical for making informed decisions and fostering sustainable economic development amid the complexity of interconnected factors.

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Appendix

Table A1 - Macroeconomic Indicators

Panel A: Portuguese Data							Panel B: Norwegian Data						
Period	**GDPGR**	**UR**	**PTI**	**CSPE**	**EXPGR**	**INFR**	**GDPGR**	**UR**	**PTI**	**CSPE**	**EXPGR**	**INFR**	**OPGR**
1988q1		7,0	1,1			3,7	-0,1		0,4	0,8	6,1	2,5	-12,4
1988q2		6,9	1,3			1,7	-1,5		-1,1	0,2	-0,5	1,7	3,0
1988q3		6,3	-0,3			2,5	0,8		0,9	-0,6	2,7	0,9	-11,2
1988q4		6,4	2,0			3,4	0,1		4,0	0,0	4,5	0,8	-5,3
1989q1		6,2	1,5			4,3	-0,6	4,9	2,9	2,0	9,8	1,3	29,7
1989q2		6,1	3,0			2,4	1,2	5,3	3,0	3,0	8,7	1,7	7,0
1989q3		6,0	1,4			2,6	1,0	5,5	1,7	-0,4	1,0	0,7	-7,8
1989q4		5,8	2,0			2,2	0,7	5,9	-0,8	1,7	-1,1	0,6	10,1
1990q1		5,9	1,6			5,2	-0,4	5,9	-0,6	0,7	3,5	1,3	3,6
1990q2		5,5	3,7			3,1	1,1	5,7	2,0	2,6	0,2	1,1	-19,2
1990q3		5,8	3,0			2,4	-1,0	5,7	-0,8	1,4	5,5	0,7	63,4
1990q4		5,4	0,0			2,9	2,7	5,8	3,7	0,4	15,0	1,3	24,8
1991q1		5,0	-1,5			4,3	0,8	5,8	0,7	3,1	-10,6	0,7	-36,2
1991q2		4,9	-1,8			2,4	0,5	5,8	-0,1	0,0	7,1	1,0	-9,4
1991q3		5,2	1,5			1,6	-0,2	6,0	-3,1	1,7	-3,3	0,4	5,3
1991q4		5,0	-1,2			1,4	0,7	6,5	2,5	0,4	-1,3	0,4	3,8
1992q1		4,8	1,0			3,4	2,1	6,4	3,2	3,2	-0,7	0,5	-13,0
1992q2		4,9	-0,5			3,3	0,5	6,5	2,4	-0,6	-1,0	1,1	11,5
1992q3		5,0	-5,7			1,3	1,3	6,6	1,5	0,0	-0,2	0,3	0,4
1992q4		5,2	1,0			0,9	-0,7	6,7	-1,4	2,8	0,2	0,4	-4,3
1993q1		5,7	-0,7			2,5	-0,6	6,7	-0,7	-0,2	1,2	0,8	-5,1
1993q2		6,2	-1,9			1,5	1,7	6,7	2,3	1,4	7,4	0,9	0,1
1993q3		6,5	-0,3			1,3	2,0	6,7	3,8	2,5	-1,7	0,0	-9,7
1993q4		6,8	-0,4			1,4	3,6	6,4	2,7	2,5	-0,8	0,2	-8,0
1994q1		7,3	0,4			2,1	-1,1	6,0	1,4	-0,6	-1,1	0,1	-8,0
1994q2		7,6	0,0			1,1	2,3	6,1	0,9	0,4	3,6	0,7	15,3
1994q3		7,7	1,0			0,5	-1,4	5,9	-2,0	2,2	1,1	0,6	4,3
1994q4		7,8	-0,5			0,7	4,0	6,0	5,3	0,6	10,1	0,4	-1,3
1995q1		8,0	0,4			2,2	-0,7	5,9	-0,4	1,7	-1,3	1,0	2,0
1995q2	1,2	7,9	2,5	2,6	-0,2	0,8	0,9	5,5	1,7	2,1	-2,1	0,7	7,0
1995q3	0,4	7,8	2,5	-0,8	3,5	0,2	2,4	5,3	2,3	1,5	2,1	0,2	-10,3
1995q4	0,7	8,0	4,1	1,1	4,8	0,6	1,2	5,1	1,8	1,1	0,6	0,2	4,3
1996q1	0,8	8,0	-0,9	3,0	-0,1	0,9	1,5	4,9	2,8	3,5	12,1	-0,2	9,7
1996q2	1,2	8,2	2,3	1,2	-0,4	1,5	-0,1	4,8	-1,3	0,3	0,9	0,8	5,1
1996q3	1,4	7,9	0,0	2,7	0,3	0,4	3,4	4,7	2,2	2,5	4,2	0,6	7,0
1996q4	0,3	7,8	-2,3	0,4	0,6	0,2	-1,6	4,6	-2,2	1,8	5,4	0,6	13,0
1997q1	1,6	7,8	2,5	2,5	3,7	0,9	2,7	4,2	3,2	0,2	0,0	1,0	-10,0
1997q2	0,9	7,4	1,2	0,5	5,2	0,6	2,4	4,1	0,8	2,4	3,5	0,4	-15,0
1997q3	1,3	7,6	-0,6	2,7	3,0	0,4	-0,1	3,8	0,3	0,6	2,9	0,2	2,6
1997q4	0,7	7,2	2,5	1,0	3,6	0,4	1,4	3,5	2,0	2,2	-3,0	0,6	1,4
1998q1	1,4	6,8	2,7	2,0	1,5	0,5	1,0	3,3	-2,1	-0,3	0,4	0,9	-24,8
1998q2	1,5	6,1	1,6	2,3	3,6	1,3	1,1	3,3	0,7	3,3	-5,6	0,5	-5,6
1998q3	1,1	5,9	-0,5	1,5	1,0	0,5	-1,8	3,0	-2,9	0,9	-4,4	0,2	-6,4
1998q4	0,8	5,8	0,2	2,1	-3,5	0,7	0,5	2,8	0,3	0,3	-2,1	0,6	-10,0
1999q1	1,3	5,8	1,9	2,9	1,7	0,2	0,9	2,8	-0,2	2,2	2,1	0,9	1,4
1999q2	0,5	6,0	1,1	0,7	1,2	1,1	0,0	2,9	-0,8	-0,5	10,8	0,7	36,1
1999q3	1,0	5,7	-0,7	2,1	3,8	0,0	2,1	3,1	2,8	3,1	11,5	-0,2	33,4
1999q4	0,6	5,4	1,5	1,5	3,2	0,7	1,7	3,4	0,8	2,8	9,8	1,2	16,2
2000q1	2,2	5,4	-2,2	3,6	4,5	0,1	1,5	3,4	1,5	2,2	12,3	1,1	12,4
2000q2	-0,5	5,3	-0,4	0,0	1,3	1,7	-1,5	3,1	-1,0	1,2	4,1	0,8	0,2
2000q3	1,5	5,4	3,6	2,3	4,9	0,8	1,0	3,2	1,5	0,7	8,3	0,3	13,5

2000q4	0,7	5,0	0,8	1,0	4,3	1,0	0,0	3,3	-0,8	0,1	6,3	0,9	-2,4
2001q1	-0,3	5,2	0,3	1,8	-2,9	1,1	1,2	3,3	-0,5	2,4	-2,7	1,5	-13,7
2001q2	1,0	5,5	0,4	0,6	1,3	1,6	-0,2	3,3	-1,8	1,6	-1,6	1,2	5,7
2001q3	0,1	5,4	-0,6	0,3	-2,9	0,4	1,2	3,5	1,8	-0,4	-2,6	-1,0	-7,3
2001q4	1,4	5,4	2,0	1,5	2,0	0,8	0,9	3,6	2,3	0,8	-7,1	0,4	-23,3
2002q1	0,2	5,6	-2,4	2,1	0,8	0,5	-0,9	3,7	-2,6	2,0	-4,5	0,5	8,9
2002q2	-0,5	6,1	2,2	0,6	2,7	1,6	2,1	3,7	4,1	0,5	5,2	0,6	18,9
2002q3	-0,5	6,7	-1,6	1,4	0,0	0,6	-1,5	3,6	-4,9	1,3	-5,1	-0,1	7,1
2002q4	-0,7	7,4	-0,4	0,1	1,5	1,2	1,1	3,8	-0,2	2,8	-0,2	1,2	-0,6
2003q1	0,1	7,6	-0,1	1,1	3,1	0,5	0,0	4,0	0,6	1,8	3,2	2,9	17,8
2003q2	-0,9	7,9	0,0	0,3	0,7	1,2	-0,5	4,2	-2,6	-0,5	-3,1	-1,7	-16,9
2003q3	0,9	7,8	1,1	1,7	-4,0	0,0	1,4	4,4	1,3	2,1	1,5	-0,4	8,6
2003q4	0,4	7,9	0,2	0,5	0,9	0,9	0,0	4,3	1,9	2,4	6,8	0,5	3,4
2004q1	0,9	7,6	-1,7	2,1	2,5	0,1	3,5	4,2	-1,2	2,5	4,5	0,2	8,8
2004q2	0,6	8,1	0,7	0,9	7,2	1,5	0,2	4,2	1,6	0,7	1,3	0,6	10,7
2004q3	0,0	8,4	-3,9	1,0	-4,8	-0,1	-1,2	4,4	-7,0	1,0	4,6	0,0	16,9
2004q4	-0,3	8,6	0,8	1,1	4,9	0,9	1,0	4,4	4,0	1,3	2,5	0,5	6,3
2005q1	0,8	8,8	-0,2	2,3	-5,0	-0,1	1,6	4,5	-2,1	0,7	3,5	-0,1	8,8
2005q2	0,4	9,1	-1,0	1,6	3,7	1,2	0,5	4,6	4,0	3,1	6,5	1,1	7,8
2005q3	-0,5	9,5	-3,4	-0,1	1,7	0,6	0,8	4,6	-1,2	2,2	5,9	0,2	19,3
2005q4	0,1	9,4	2,0	1,7	2,6	0,9	0,2	4,4	-0,5	-1,0	4,1	0,6	-7,7
2006q1	0,8	9,1	-2,0	2,1	5,9	0,4	0,7	4,2	-0,9	2,9	6,3	0,3	8,7
2006q2	1,0	9,1	0,7	0,8	4,8	1,7	0,1	3,9	-0,4	2,3	-1,4	1,2	12,5
2006q3	-0,1	9,4	2,7	1,0	7,2	-0,1	1,0	3,5	-1,3	1,2	2,2	0,0	0,4
2006q4	0,7	9,7	1,4	1,0	-1,2	0,5	1,8	2,8	-1,4	1,6	-0,2	0,8	-14,6
2007q1	1,1	9,7	-2,1	1,8	3,2	0,3	0,0	2,9	0,0	2,1	-2,2	-1,1	-2,9
2007q2	0,4	9,8	-1,9	2,2	0,7	1,8	0,0	2,7	0,2	1,0	1,3	0,6	18,6
2007q3	0,2	9,6	-3,4	0,7	0,6	-0,4	1,3	2,7	1,8	1,4	1,9	-0,1	9,0
2007q4	1,1	9,3	3,2	2,6	2,0	1,0	1,1	2,5	-1,7	2,3	8,3	2,1	18,1
2008q1	0,0	9,0	-0,9	1,3	4,4	0,6	-1,0	2,7	-0,4	2,1	7,1	1,0	9,7
2008q2	-0,5	9,1	-2,7	0,5	-2,1	1,8	0,0	2,8	2,4	0,4	8,6	0,3	25,1
2008q3	-0,1	9,3	-3,6	0,1	-0,5	-0,3	-0,2	3,0	-2,7	0,0	-1,5	1,3	-5,4
2008q4	-1,3	9,5	-4,1	-1,5	-8,8	-0,6	0,3	3,1	1,9	0,2	-6,3	0,9	-52,0
2009q1	-2,5	10,3	-6,7	-3,1	-11,4	-0,9	-1,5	3,3	-1,2	-0,6	-18,7	-0,1	-19,1
2009q2	0,1	11,0	0,1	-1,0	1,1	0,7	-0,9	3,6	-4,5	2,3	-0,5	0,9	32,2
2009q3	0,9	11,7	2,9	0,4	6,4	-0,7	0,1	3,4	1,1	1,5	4,7	0,0	15,7
2009q4	0,0	11,9	0,7	1,7	0,9	0,3	0,1	3,5	-0,8	1,5	1,1	0,6	9,4
2010q1	0,8	12,1	-1,0	2,0	2,8	0,1	2,3	4,1	-1,0	3,2	2,6	1,4	2,5
2010q2	0,6	12,7	-0,2	0,8	3,6	1,3	-1,1	4,1	-2,5	-1,6	0,3	0,6	2,7
2010q3	0,1	12,9	-0,4	0,1	3,8	0,3	-2,5	3,8	-6,4	1,8	-0,6	-0,7	-2,1
2010q4	-0,2	12,7	1,0	1,1	2,9	0,7	2,8	3,8	6,6	2,2	8,1	1,0	12,6
2011q1	-0,7	12,9	0,9	-1,3	2,8	1,4	0,0	3,5	-3,7	-0,3	2,7	0,5	21,9
2011q2	-0,4	13,0	-1,8	-1,3	4,6	1,4	-0,4	3,6	-4,7	1,8	2,1	0,6	11,0
2011q3	-0,8	13,4	-1,2	-0,9	0,6	-0,3	1,6	3,5	4,8	-0,1	3,0	-0,7	-3,2
2011q4	-1,5	14,6	-3,2	-1,4	1,6	1,4	0,1	3,6	-0,3	1,4	0,0	0,3	-3,4
2012q1	-0,5	15,5	-1,4	0,0	2,6	0,9	2,3	3,5	3,6	1,4	7,0	0,5	8,5
2012q2	-1,3	16,2	-2,1	-1,9	-0,7	0,8	0,2	3,4	0,6	0,8	-1,2	0,2	-9,2
2012q3	-1,1	16,8	2,9	-0,1	0,5	-0,2	-1,5	3,3	-4,4	1,6	-4,7	-0,7	1,7
2012q4	-1,6	17,9	-3,5	-1,3	-0,5	0,5	0,8	3,7	0,4	1,1	-1,4	1,2	0,5
2013q1	0,4	18,2	2,1	-0,3	3,9	-0,9	0,1	4,0	-5,4	1,6	-0,7	0,6	2,1
2013q2	0,8	17,6	-0,3	1,2	2,2	1,2	0,7	3,9	4,0	0,8	4,0	0,9	-8,8
2013q3	-0,1	16,8	-0,6	0,8	1,8	-0,4	1,0	4,0	-0,1	1,2	3,8	0,3	7,5
2013q4	1,1	16,0	2,7	1,2	0,0	0,1	-0,2	3,9	-2,3	0,8	-0,3	0,5	-0,9
2014q1	-0,6	15,5	0,6	-0,1	-1,6	-0,9	1,0	3,8	4,0	1,5	2,0	0,4	-1,0
2014q2	0,3	15,0	-1,2	0,4	4,0	1,0	0,7	3,4	-1,5	1,1	-3,9	0,7	1,4
2014q3	0,1	14,1	-0,2	1,3	-0,3	-0,6	0,4	4,0	1,8	0,6	0,2	0,6	-7,1
2014q4	0,8	14,0	0,6	0,5	1,8	0,5	1,2	3,9	2,3	1,4	1,4	0,4	-25,0
2015q1	0,6	13,9	-0,7	0,1	1,9	-0,9	-0,2	4,6	-1,2	2,0	-4,7	0,3	-29,4

2015q2	0,3	12,8	3,0	1,8	1,3	1,8	0,5	4,5	-1,5	0,4	0,5	0,9	14,2
2015q3	0,1	12,7	0,9	0,7	-0,2	-0,6	1,2	4,8	3,1	1,3	4,8	0,4	-18,2
2015q4	0,5	12,6	0,4	0,1	-0,5	0,3	-0,9	4,8	-2,5	1,7	-7,8	0,9	-13,7
2016q1	0,5	12,4	-0,3	1,3	-1,5	-0,9	0,5	5,2	0,3	0,9	-8,1	1,0	-22,3
2016q2	0,3	11,6	1,1	0,6	2,0	1,7	0,0	4,8	-0,5	0,4	3,8	1,2	34,6
2016q3	1,2	11,2	0,5	1,0	4,3	-0,4	-0,3	5,0	-4,1	0,8	1,2	0,9	0,5
2016q4	0,9	10,7	0,2	1,6	2,7	0,4	1,3	4,6	4,9	1,5	2,9	0,4	7,1
2017q1	1,2	10,1	1,9	0,8	5,6	-0,3	1,1	4,5	1,2	1,3	4,3	0,0	9,3
2017q2	0,5	9,5	0,1	0,3	-1,1	1,8	1,0	4,5	0,4	1,3	1,0	0,8	-7,5
2017q3	0,7	8,9	4,4	1,1	2,3	-0,7	0,7	4,3	0,2	0,5	-0,5	0,3	5,1
2017q4	0,8	8,3	-3,8	0,9	3,3	0,7	-0,6	4,1	-2,8	1,7	2,7	0,3	17,8
2018q1	0,7	7,8	1,8	1,3	2,0	-1,0	0,5	4,1	3,2	0,1	4,3	0,7	8,9
2018q2	0,8	7,2	-1,2	1,1	1,6	2,0	0,3	4,0	-0,7	1,8	4,2	1,2	11,5
2018q3	0,5	6,9	1,7	0,7	0,0	-0,3	0,6	4,2	1,4	0,7	6,2	1,1	0,7
2018q4	0,6	6,8	-3,4	1,5	-0,5	0,2	0,0	3,8	-1,2	1,3	-4,5	0,4	-8,4
2019q1	0,9	6,7	-0,7	1,3	3,8	-1,1	-0,4	4,0	-4,7	0,7	0,6	0,3	-8,2
2019q2	0,6	6,7	0,8	0,6	0,0	1,7	0,9	3,5	-0,5	0,2	-7,3	0,6	9,4
2019q3	0,5	6,6	-0,7	0,7	0,0	-1,0	0,6	4,0	-1,5	1,4	-1,5	0,4	-10,3
2019q4	0,8	6,8	1,0	1,0	3,1	0,6	0,8	4,1	5,0	0,4	6,7	0,3	2,1
2020q1	-4,4	6,6	-2,0	-2,7	-7,9	-0,9	-1,2	3,8	1,1	-2,9	-2,9	-0,1	-20,5
2020q2	-15,1	6,6	-22,9	-15,3	-37,3	1,1	-5,5	4,6	0,1	-10,9	-20,5	0,6	-40,9
2020q3	14,6	8,1	30,2	15,4	36,2	-0,7	4,2	5,5	1,0	10,6	-20,1	0,8	44,5
2020q4	0,4	7,2	-0,5	-0,3	5,3	0,4	1,3	5,1	-1,9	0,7	53,3	0,1	3,3
2021q1	-2,6	6,8	-1,0	-3,9	3,6	-0,3	-0,2	5,0	3,3	-3,4	9,9	1,5	37,7
2021q2	4,4	6,9	-3,2	7,9	-0,3	1,4	1,2	5,0	0,4	3,6	9,7	0,5	13,0
2021q3	2,8	6,4	-0,3	2,1	12,8	0,0	3,1	4,3	2,9	8,6	0,5	1,4	6,6
2021q4	1,9	6,2	2,9	1,9	10,6	1,3	0,5	3,6	-2,8	4,3	65,9	1,2	8,3

Table A2: Descriptive Statistics (Source: Author's own elaboration)

Variable (Norway)	Obs	Mean	Std. dev.	Min	Max
GDPGR	136	.5507882	1.333651	-5.45278	4.20681
UR	132	4.316162	1.063979	2.533333	6.733333
PTI	136	.2591285	2.532479	-6.98423	6.62146
CSPE	136	1.249311	1.89539	-10.86117	10.60916
EXPGR	136	2.253653	9.016569	-20.53968	65.94274
INFR	136	.5976572	.6114856	-1.67142	2.85115
OPGR	136	2.383188	15.868	-52.01776	63.41888

Variable (Portugal)	Obs	Mean	Std. dev.	Min	Max
GDPGR	107	.3614575	2.295199	-15.11934	14.58799
UR	136	8.672794	3.279818	4.8	18.2
PTI	136	.1251049	3.82275	-22.91213	30.23236
CSPE	107	.896951	2.550228	-15.33616	15.40181
EXPGR	107	1.588026	6.059705	-37.33145	36.22496
INFR	136	.8765932	1.163025	-1.07012	5.1784
OPGR	136	2.383188	15.868	-52.01776	63.41888

Figure A1 - Evolution of the Norwegian Real GDP Growth Rate (Source: Author's own elaboration)

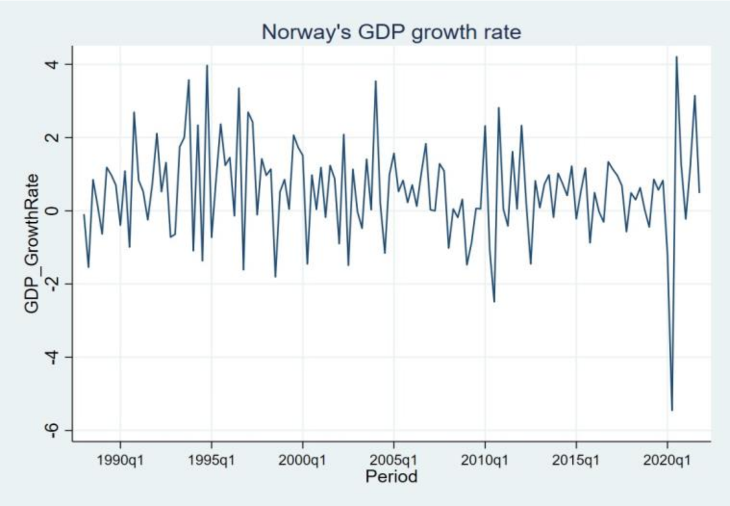

Figure A2 - Evolution of the Norwegian Unemployment Rate (Source: Author's own elaboration)

Figure A3 - Evolution of the Norwegian Total Industrial Production Growth Rate (Source: Author's own elaboration)

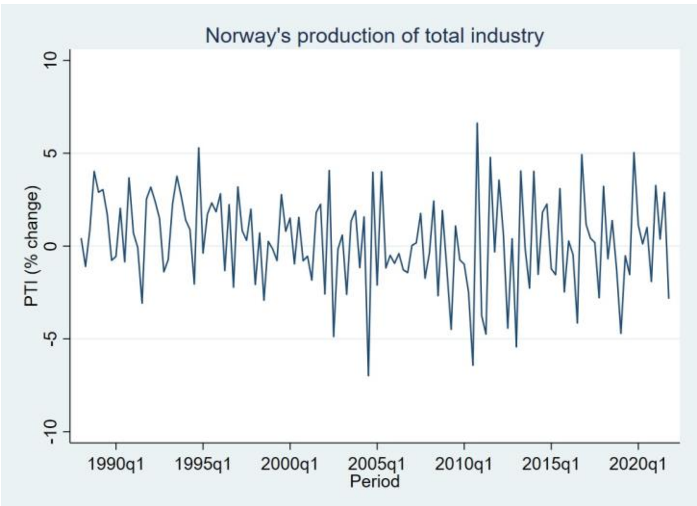

Figure A4 - Evolution of the Norwegian Private Final Consumption Expenditure Growth Rate (Source: Author's own elaboration)

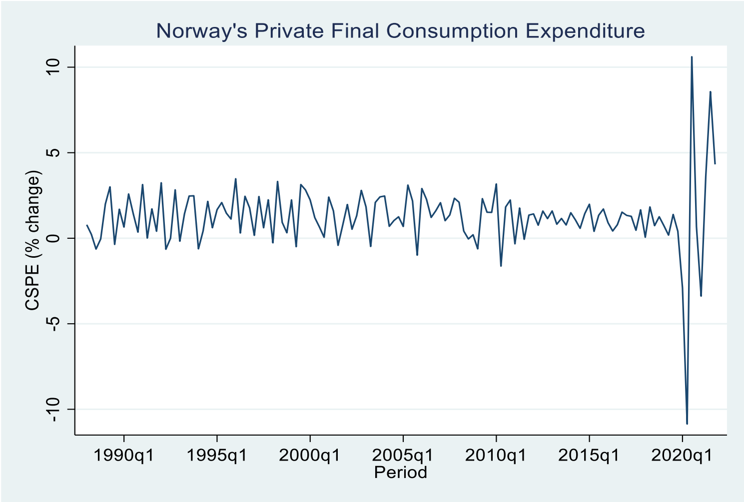

Figure A5 - Evolution of the Norwegian Export Growth Rate (Source: Author's own elaboration)

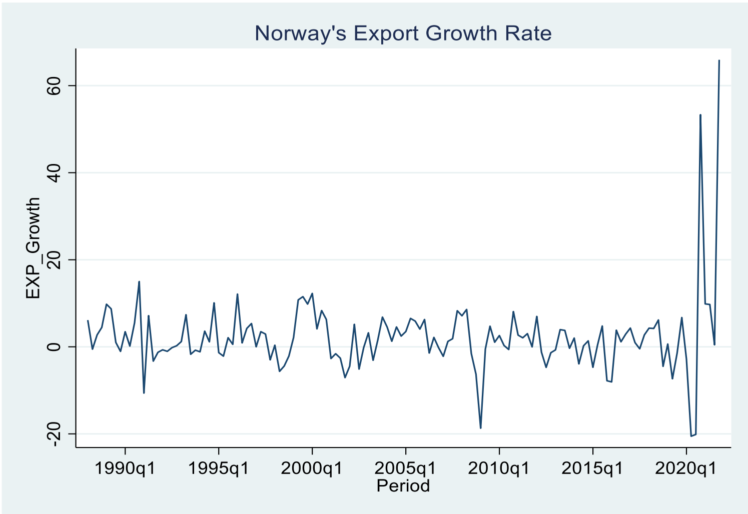

Figure A6 - Evolution of the Norwegian Inflation Rate (Source: Author's own elaboration)

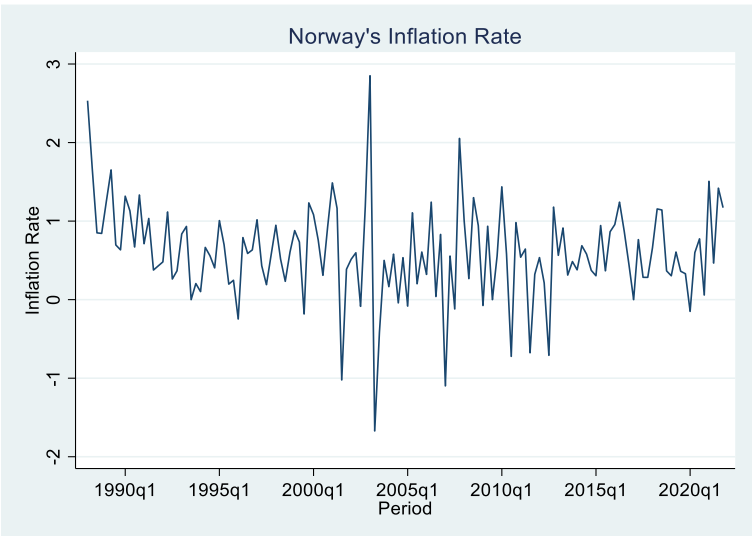

Figure A7 - Evolution of the Portuguese Real GDP Growth Rate (Source: Author's own elaboration)

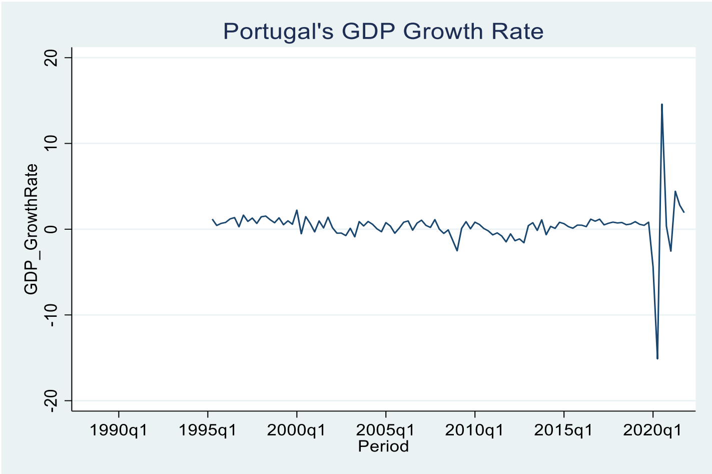

Figure A8 - Evolution of the Portuguese Unemployment Rate (Source: Author's own elaboration)

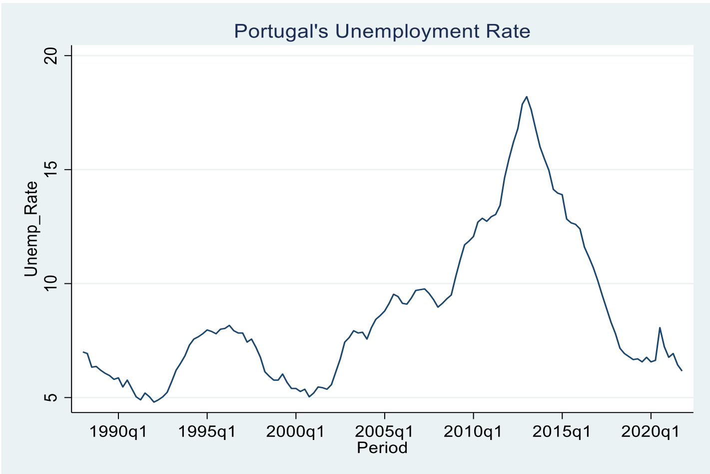

Figure A9 - Evolution of the Portuguese Total Industrial Production Growth Rate (Source: Author's own elaboration)

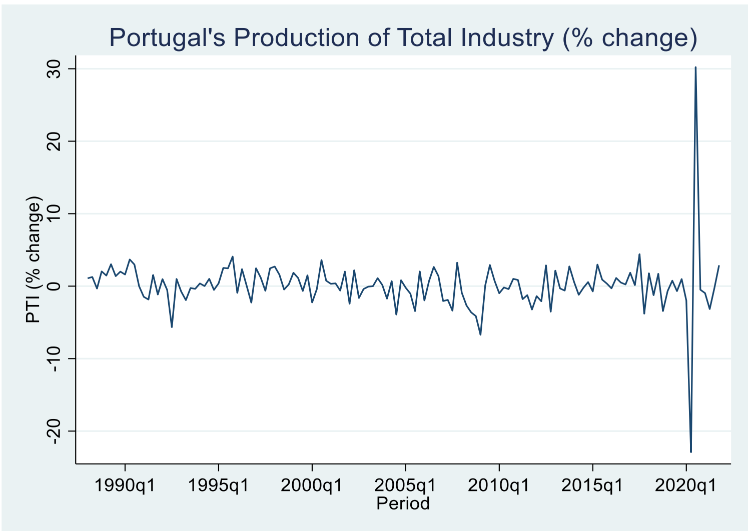

Figure A10 - Evolution of the Portuguese Private Final Consumption Expenditure Growth Rate (Source: Author's own elaboration)

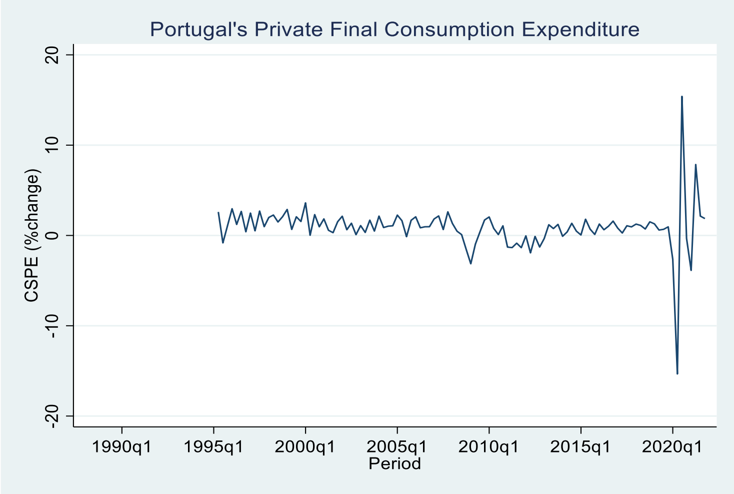

Figure A11 - Evolution of the Portuguese Export Growth Rate (Source: Author's own elaboration)

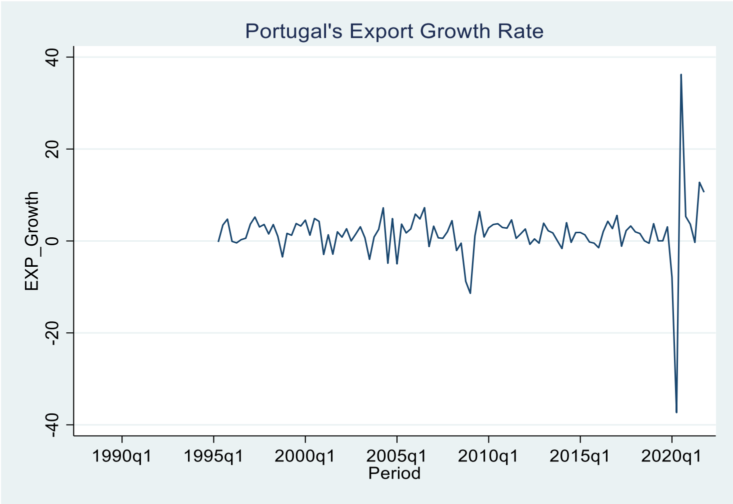

Figure A12 - Evolution of the Portuguese Inflation Rate (Source: Author's own elaboration)

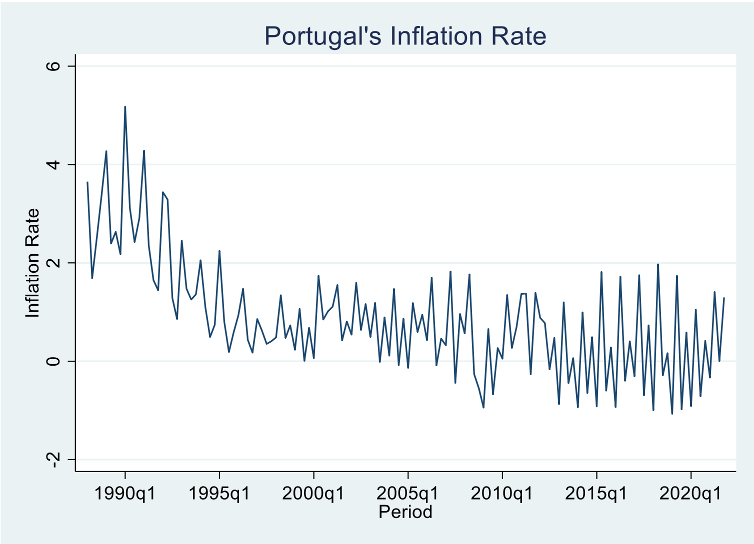

Figure A13 - Evolution of the Price of Brent Crude Oil Growth Rate (Source: Author's own elaboration)

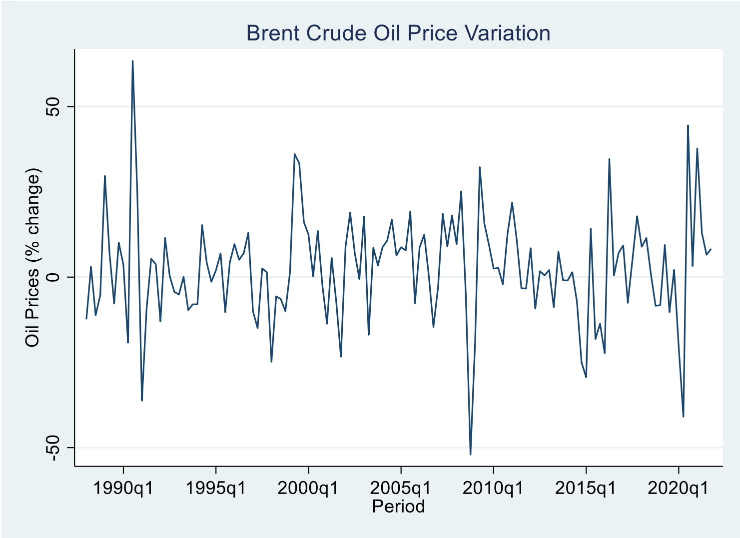

Table A3: Causality Tests (Source: Author's own elaboration)

Panel A: Granger causality of Norway

Dependent Variable: CSPE

Excluded	Chi-sq	df	Prob.
EXPGR	17.61778	4	0.0015
GDPGR	4.876055	4	0.3003
INFR	2.666572	4	0.6151
OPGR	9.538849	4	0.0490
PTI	3.082395	4	0.5441
UR	5.966392	4	0.2017
All	33.23859	24	0.0991

Dependent Variable: EXPGR

Excluded	Chi-sq	df	Prob.
CSPE	47.07376	4	0.0000
GDPGR	2.525425	4	0.6401
INFR	2.233083	4	0.6930
OPGR	28.24721	4	0.0000
PTI	4.933515	4	0.2942
UR	3.249490	4	0.5170
All	160.0664	24	0.0000

Dependent Variable: GDPGR

Excluded	Chi-sq	df	Prob.
CSPE	3.056384	4	0.5484
EXPGR	7.348451	4	0.1186
INFR	4.965362	4	0.2909
OPGR	7.373575	4	0.1174
PTI	2.857630	4	0.5819
UR	20.51914	4	0.0004
All	51.33063	24	0.0010

Dependent Variable: INFR

Excluded	Chi-sq	df	Prob.
CSPE	4.678871	4	0.3219
EXPGR	7.142712	4	0.1285
GDPGR	9.942221	4	0.0414
OPGR	8.033767	4	0.0903
PTI	10.14595	4	0.0380
UR	3.416656	4	0.4907
All	40.97047	24	0.0168

Panel B: Granger causality of Portugal

Dependent Variable: CSPE

Excluded	Chi-sq	df	Prob.
EXPGR	1.585609	4	0.8114
GDPGR	12.22539	4	0.0158
INFR	10.54519	4	0.0322
OPGR	6.168396	4	0.1869
PTI	12.52339	4	0.0139
UR	21.72227	4	0.0002
All	65.64309	24	0.0000

Dependent Variable: EXPGR

Excluded	Chi-sq	df	Prob.
CSPE	3.396949	4	0.4937
GDPGR	10.76784	4	0.0293
INFR	6.104073	4	0.1915
OPGR	8.096791	4	0.0881
PTI	8.584838	4	0.0724
UR	11.93987	4	0.0178
All	45.05503	24	0.0057

Dependent Variable: GDPGR

Excluded	Chi-sq	df	Prob.
CSPE	6.723622	4	0.1512
EXPGR	2.702040	4	0.6089
INFR	9.605282	4	0.0476
OPGR	6.075992	4	0.1935
PTI	12.97987	4	0.0114
UR	21.41857	4	0.0003
All	66.67392	24	0.0000

Dependent Variable: INFR

Excluded	Chi-sq	df	Prob.
CSPE	2.732712	4	0.6035
EXPGR	9.483952	4	0.0501
GDPGR	9.314801	4	0.0537
OPGR	6.301624	4	0.1777
PTI	2.993839	4	0.5589
UR	8.283274	4	0.0817
All	40.08849	24	0.0209

Dependent Variable: OPGR			
Excluded	**Chi-sq**	**df**	**Prob.**
CSPE	2.652265	4	0.6176
EXPGR	2.433260	4	0.6566
GDPGR	6.252079	4	0.1811
INFR	6.0255964	4	0.1972
PTI	4.919455	4	0.2957
UR	10.82013	4	0.0287
All	34.35453	24	0.0786

Dependent Variable: OPGR			
Excluded	**Chi-sq**	**df**	**Prob.**
CSPE	1.377236	4	0.8481
EXPGR	2.387418	4	0.6649
GDPGR	3.061144	4	0.5476
INFR	4.830031	4	0.3052
PTI	3.026542	4	0.5534
UR	9.234913	4	0.0555
All	33.38274	24	0.0963

Dependent Variable: PTI			
Excluded	**Chi-sq**	**df**	**Prob.**
CSPE	6.900171	4	0.1413
EXPGR	5.611976	4	0.2301
GDPGR	7.352966	4	0.1184
INFR	3.609822	4	0.4614
OPGR	3.499842	4	0.4779
UR	13.28910	4	0.0099
All	45.58879	24	0.0050

Dependent Variable: PTI			
Excluded	**Chi-sq**	**df**	**Prob.**
CSPE	3.918099	4	0.4172
EXPGR	5.329968	4	0.2551
GDPGR	14.19054	4	0.0067
INFR	5.811460	4	0.2137
OPGR	9.083880	4	0.0590
UR	19.19935	4	0.0007
All	54.12892	24	0.0004

Dependent Variable: UR			
Excluded	**Chi-sq**	**df**	**Prob.**
CSPE	13.00617	4	0.0112
EXPGR	7.441820	4	0.1143
GDPGR	4.424549	4	0.3516
INFR	4.083039	4	0.3949
OPGR	4.918344	4	0.2958
PTI	8.051445	4	0.0897
All	61.96271	24	0.0000

Dependent Variable: UR			
Excluded	**Chi-sq**	**df**	**Prob.**
CSPE	11.64327	4	0.0202
EXPGR	0.589936	4	0.9642
GDPGR	8.142309	4	0.0865
INFR	8.873163	4	0.0643
OPGR	1.538304	4	0.8198
PTI	3.825720	4	0.4301
All	74.05177	24	0.0000

Table A4: VAR Estimation Results (Source: Author's own elaboration)

Panel A: VAR estimators of Norway

	Coefficient	Std. err.	z	P>z	[95% conf. Interval]	
GDPGR						
GDPGR						
L1.	-.5240455	.1442505	-3.63	0.000	.8067713	-.2413198
L2.	-.2338156	.1572075	-1.49	0.137	.5419365	.0743054
L3.	-.1629769	.1578809	-1.03	0.302	.4724178	.146464
L4.	-.0683285	.1411317	-0.48	0.628	.3449416	.2082847
UR						
L1.	.356656	.4464698	0.80	0.424	.5184088	1.231721
L2.	-.9936085	.604838	-1.64	0.100	2.179069	.1918522
L3.	.4046856	.6137328	0.66	0.510	.7982086	1.60758
L4.	.7478689	.4650759	1.61	0.108	.1636631	1.659401
PTI						
L1.	-.0028703	.0586517	-0.05	0.961	.1178255	.1120849
L2.	-.032759	.0615229	-0.53	0.594	.1533417	.0878238
L3.	-.0425693	.0631036	-0.67	0.500	.1662501	.0811116
L4.	-.1075585	.057957	-1.86	0.063	.2211522	.0060351
CSPE						
L1.	.1032256	.0865213	1.19	0.233	-.066353	.2728042
L2.	.0477421	.1036366	0.46	0.645	-.155382	.2508661
L3.	-.088316	.1089691	-0.81	0.418	.3018916	.1252596
L4.	-.0234993	.1007304	-0.23	0.816	.2209274	.1739287
EXPGR						
L1.	-.0010817	.0241115	-0.04	0.964	.0483394	.0461761
L2.	.0397468	.0242858	1.64	0.102	.0078525	.0873462
L3.	.0610321	.0245439	2.49	0.013	.0129268	.1091373
L4.	.0201979	.0184432	1.10	0.273	.0159501	.056346
INFR						
L1.	-.273662	.1885063	-1.45	0.147	.6431275	.0958035
L2.	-.2818988	.1944	-1.45	0.147	.6629158	.0991182
L3.	-.2452299	.1818824	-1.35	0.178	.6017127	.111253
L4.	.1597539	.1833573	0.87	0.384	.1996199	.5191276
OPGR						
L1.	.013398	.0083359	1.61	0.108	.0029401	.029736
L2.	.0046507	.008998	0.52	0.605	.0129849	.0222864
L3.	-.0094394	.0088724	-1.06	0.287	.0268289	.0079501
L4.	-.0186158	.0087792	-2.12	0.034	.0358227	-.0014088
_cons	-.9249191	.5089868	-1.82	0.069	1.922515	.0726766
UR						
GDPGR						
L1.	-.0375641	.0279625	-1.34	0.179	.0923697	.0172415
L2.	-.072379	.0304742	-2.38	0.018	.1321074	-.0126506
L3.	-.0362557	.0306048	-1.18	0.236	.0962399	.0237285
L4.	-.0204321	.027358	-0.75	0.455	.0740528	.0331885
UR						
L1.	.9474019	.0865469	10.95	0.000	.7777731	1.117031
L2.	.2171134	.1172461	1.85	0.064	.0126848	.4469115
L3.	-.178912	.1189703	-1.50	0.133	.4120895	.0542655
L4.	-.0248678	.0901536	-0.28	0.783	.2015656	.15183
PTI						
L1.	.0100958	.0113695	0.89	0.375	-.012188	.0323795
L2.	.0326824	.011926	2.74	0.006	.0093078	.056057
L3.	.0061146	.0122325	0.50	0.617	.0178605	.0300898
L4.	.0185913	.0112348	1.65	0.098	.0034285	.0406111
CSPE						
L1.	-.041462	.0167719	-2.47	0.013	.0743343	-.0085896
L2.	.0124909	.0200897	0.62	0.534	.0268841	.0518659
L3.	.0366541	.0211234	1.74	0.083	.0047469	.0780551
L4.	.0243634	.0195263	1.25	0.212	.0139074	.0626343
EXPGR						
L1.	-.0037869	.004674	-0.81	0.418	.0129477	.0053739
L2.	-.0038934	.0047077	-0.83	0.408	.0131204	.0053336
L3.	-.0136953	.0047578	-2.88	0.004	.0230204	-.0043703
L4.	-.0041846	.0035752	-1.17	0.242	.0111918	.0028226
INFR						
L1.	.0066974	.0365414	0.18	0.855	.0649224	.0783172
L2.	-.048453	.0376839	-1.29	0.199	-.122312	.0254061
L3.	.0145413	.0352574	0.41	0.680	.0545619	.0836445
L4.	-.0677792	.0355433	-1.91	0.057	.1374427	.0018844
OPGR						
L1.	-.0012856	.0016159	-0.80	0.426	.0044526	.0018815

L2.	.0012486	.0017442	0.72	0.474	-.00217	.0046673
L3.	.0028964	.0017199	1.68	0.092	.0004745	.0062673
L4.	.0027152	.0017018	1.60	0.111	.0006203	.0060507
_cons	.2763621	.0986656	2.80	0.005	.0829811	.4697432
PTI						
GDPGR						
L1.	-.1337492	.2644871	-0.51	0.613	.6521343	.384636
L2.	.2513451	.288244	0.87	0.383	.3136028	.8162931
L3.	.7707383	.2894788	2.66	0.008	.2033702	1.338106
L4.	.4104196	.2587688	1.59	0.113	.0967579	.9175971
UR						
L1.	.8370689	.8186143	1.02	0.307	.7673856	2.441523
L2.	-.7028558	1.108987	-0.63	0.526	2.876429	1.470718
L3.	.145758	1.125295	0.13	0.897	-2.05978	2.351296
L4.	.5570745	.852729	0.65	0.514	1.114244	2.228392
PTI						
L1.	-.4213727	.1075394	-3.92	0.000	-.632146	-.2105993
L2.	-.0739276	.1128039	-0.66	0.512	.2950192	.1471641
L3.	-.2785261	.1157022	-2.41	0.016	.5052983	-.0517539
L4.	-.4702439	.1062657	-4.43	0.000	.6785208	-.261967
CSPE						
L1.	-.0455962	.1586391	-0.29	0.774	.3565231	.2653307
L2.	-.4530923	.1900205	-2.38	0.017	.8255256	-.0806589
L3.	-.424842	.1997978	-2.13	0.033	.8164386	-.0332455
L4.	-.0856438	.1846919	-0.46	0.643	.4476334	.2763457
EXPGR						
L1.	.1151614	.0442091	2.60	0.009	.028513	.2018097
L2.	.0155334	.0445287	0.35	0.727	.0717413	.1028081
L3.	-.0127142	.045002	-0.28	0.778	.1009165	.075488
L4.	.0017269	.0338161	0.05	0.959	.0645515	.0680054
INFR						
L1.	-.2872877	.3456313	-0.83	0.406	.9647125	.3901371
L2.	.2491776	.3564375	0.70	0.485	.4494271	.9477824
L3.	.3250352	.3334861	0.97	0.330	.3285856	.9786561
L4.	.5531483	.3361905	1.65	0.100	-.105773	1.21207
OPGR						
L1.	-.0035836	.0152841	-0.23	0.815	.0335398	.0263726
L2.	.0081976	.016498	0.50	0.619	.0241378	.0405331
L3.	.0030042	.0162677	0.18	0.853	.0288799	.0348884
L4.	-.0288152	.016097	-1.79	0.073	.0603646	.0027342
_cons	-3.282947	.9332407	-3.52	0.000	5.112066	-1.453829
CSPE						
GDPGR						
L1.	-.1313126	.2124109	-0.62	0.536	.5476303	.2850051
L2.	-.0447114	.2314902	-0.19	0.847	.4984239	.4090011
L3.	-.3078901	.2324819	-1.32	0.185	.7635462	.147766
L4.	-.4901706	.2078185	-2.36	0.018	.8974873	-.0828538
UR						
L1.	.729336	.6574332	1.11	0.267	.5592094	2.017881
L2.	-1.508785	.8906325	-1.69	0.090	3.254393	.2368226
L3.	-.0394196	.9037302	-0.04	0.965	1.810698	1.731859
L4.	1.126408	.6848308	1.64	0.100	-.215836	2.468651
PTI						
L1.	-.0097416	.0863654	-0.11	0.910	.1790147	.1595315
L2.	-.1092272	.0905934	-1.21	0.228	-.286787	.0683326
L3.	-.022871	.092921	-0.25	0.806	.2049928	.1592508
L4.	.1175655	.0853425	1.38	0.168	.0497027	.2848337
CSPE						
L1.	-.2684329	.1274038	-2.11	0.035	.5181398	-.018726
L2.	-.1882247	.1526064	-1.23	0.217	.4873277	.1108784
L3.	.0744311	.1604586	0.46	0.643	-.240062	.3889242
L4.	.0432675	.148327	0.29	0.771	.2474481	.3339831
EXPGR						
L1.	-.004574	.0355046	-0.13	0.897	.0741617	.0650137
L2.	.0356436	.0357612	1.00	0.319	.0344472	.1057343
L3.	.1544585	.0361413	4.27	0.000	.0836229	.2252942
L4.	.0673186	.0271579	2.48	0.013	.0140901	.1205471
INFR						
L1.	.035715	.2775782	0.13	0.898	.5083282	.5797582
L2.	-.4862368	.2862567	-1.70	0.089	-1.04729	.0748161
L3.	-.2029473	.2678244	-0.76	0.449	.7278734	.3219788
L4.	-.19818	.2699963	-0.73	0.463	.7273629	.331003
OPGR						
L1.	.0104099	.0122747	0.85	0.396	.0136481	.0344679
L2.	.0090793	.0132496	0.69	0.493	.0168894	.0350481

L3.	-.0176484	.0130647	-1.35	0.177	.0432547	.0079579
L4.	-.0364957	.0129275	-2.82	0.005	.0618332	-.0111582
_cons	1.053253	.7494902	1.41	0.160	.4157211	2.522227
EXPGR						
GDPGR						
L1.	-.1686519	.7239454	-0.23	0.816	1.587559	1.250255
L2.	-.0064379	.7889721	-0.01	0.993	1.552795	1.539919
L3.	-.3700281	.7923519	-0.47	0.641	1.923009	1.182953
L4.	.8570294	.7082934	1.21	0.226	.5312002	2.245259
UR						
L1.	.3346215	2.240684	0.15	0.881	4.057038	4.726282
L2.	-1.638066	3.035481	-0.54	0.589	-7.5875	4.311368
L3.	4.213542	3.080121	1.37	0.171	1.823385	10.25047
L4.	-2.159855	2.334062	-0.93	0.355	6.734532	2.414821
PTI						
L1.	-.224373	.2943533	-0.76	0.446	.8012948	.3525489
L2.	-.1771656	.3087632	-0.57	0.566	.7823305	.4279992
L3.	.2847609	.3166963	0.90	0.369	.3359523	.9054742
L4.	-.5038777	.2908669	-1.73	0.083	1.073966	.0662109
CSPE						
L1.	2.058204	.4342217	4.74	0.000	1.207145	2.909263
L2.	-.7479476	.5201179	-1.44	0.150	-1.76736	.2714647
L3.	-1.715014	.54688	-3.14	0.002	2.786879	-.6431485
L4.	-1.522847	.5055327	-3.01	0.003	2.513672	-.5320207
EXPGR						
L1.	-.1307683	.1210078	-1.08	0.280	.3679393	.1064027
L2.	.1316672	.1218825	1.08	0.280	.1072182	.3705526
L3.	.090377	.1231779	0.73	0.463	.1510473	.3318013
L4.	.331441	.0925604	3.58	0.000	.1500259	.512856
INFR						
L1.	-1.396495	.9460505	-1.48	0.140	-3.25072	.4577296
L2.	.0887499	.9756291	0.09	0.928	1.823448	2.000948
L3.	-.2794856	.9128073	-0.31	0.759	2.068555	1.509584
L4.	-.7088926	.9202096	-0.77	0.441	-2.51247	1.094685
OPGR						
L1.	.2369644	.0418351	5.66	0.000	.1549692	.3189596
L2.	-.0171762	.0451578	-0.38	0.704	.1056838	.0713314
L3.	.1123766	.0445275	2.52	0.012	.0251044	.1996489
L4.	-.0601763	.04406	-1.37	0.172	.1465324	.0261798
_cons	.9832973	2.554436	0.38	0.700	4.023305	5.989899
INFR						
GDPGR						
L1.	-.158296	.0654852	-2.42	0.016	.2866447	-.0299474
L2.	-.2463783	.0713673	-3.45	0.001	.3862556	-.106501
L3.	-.1137182	.071673	-1.59	0.113	.2541947	.0267583
L4.	-.06823	.0640694	-1.06	0.287	.1938038	.0573437
UR						
L1.	.1921306	.2026833	0.95	0.343	.2051214	.5893827
L2.	-.3748057	.2745775	-1.37	0.172	.9129678	.1633564
L3.	.444996	.2786155	1.60	0.110	.1010803	.9910724
L4.	-.2376517	.2111299	-1.13	0.260	.6514587	.1761553
PTI						
L1.	.0050555	.026626	0.19	0.849	.0471305	.0572416
L2.	.0900832	.0279295	3.23	0.001	.0353424	.144824
L3.	.0359324	.0286471	1.25	0.210	.0202148	.0920797
L4.	.0361574	.0263107	1.37	0.169	.0154106	.0877253
CSPE						
L1.	.0876075	.039278	2.23	0.026	.0106241	.1645908
L2.	.0844421	.0470478	1.79	0.073	.0077699	.176654
L3.	.0421098	.0494686	0.85	0.395	.0548468	.1390665
L4.	.0127663	.0457285	0.28	0.780	.0768598	.1023925
EXPGR						
L1.	.0238109	.0109459	2.18	0.030	.0023573	.0452644
L2.	.0014094	.011025	0.13	0.898	.0201993	.023018
L3.	.0243089	.0111422	2.18	0.029	.0024706	.0461471
L4.	.0063746	.0083726	0.76	0.446	.0100355	.0227846
INFR						
L1.	-.1604374	.085576	-1.87	0.061	.3281632	.0072884
L2.	-.1984248	.0882515	-2.25	0.025	.3713946	-.025455
L3.	-.0762838	.0825689	-0.92	0.356	.2381159	.0855483
L4.	.1515492	.0832385	1.82	0.069	.0115952	.3146936

OPGR						
L1.	-.0022029	.0037842	-0.58	0.560	.0096199	.005214
L2.	.0006794	.0040848	0.17	0.868	.0073266	.0086855
L3.	.0049022	.0040278	1.22	0.224	.0029921	.0127965
L4.	-.0099979	.0039855	-2.51	0.012	.0178093	-.0021864
_cons	.5501927	.2310641	2.38	0.017	.0973154	1.00307
OPGR						
GDPGR						
L1.	-3.054247	1.847457	-1.65	0.098	6.675196	.5667022
L2.	.3355538	2.013401	0.17	0.868	3.610639	4.281746
L3.	-2.535815	2.022026	-1.25	0.210	6.498912	1.427282
L4.	.7299703	1.807514	0.40	0.686	2.812692	4.272633
UR						
L1.	1.852841	5.718066	0.32	0.746	9.354362	13.06004
L2.	-17.26697	7.746332	-2.23	0.026	-32.4495	-2.084434
L3.	26.92713	7.86025	3.43	0.001	11.52132	42.33294
L4.	-10.54922	5.956359	-1.77	0.077	22.22347	1.125024
PTI						
L1.	.2583709	.7511686	0.34	0.731	1.213893	1.730634
L2.	-1.144679	.7879418	-1.45	0.146	2.689017	.3996584
L3.	.6930526	.8081863	0.86	0.391	.8909634	2.277069
L4.	-.3141404	.7422716	-0.42	0.672	1.768966	1.140685
CSPE						
L1.	.8538758	1.108103	0.77	0.441	1.317966	3.025717
L2.	-.7036025	1.327304	-0.53	0.596	-3.30507	1.897865
L3.	-1.516961	1.395599	-1.09	0.277	4.252284	1.218363
L4.	-1.27651	1.290083	-0.99	0.322	3.805026	1.252007
EXPGR						
L1.	.3849824	.3088033	1.25	0.213	-.220261	.9902258
L2.	-.0745832	.3110355	-0.24	0.810	.6842016	.5350352
L3.	.1274525	.3143413	0.41	0.685	.4886451	.7435501
L4.	-.1637531	.2362076	-0.69	0.488	.6267114	.2992052
INFR						
L1.	-3.936876	2.414253	-1.63	0.103	8.668726	.7949737
L2.	-1.456963	2.489736	-0.59	0.558	6.336756	3.42283
L3.	-5.065315	2.329419	-2.17	0.030	9.630892	-.4997374
L4.	-3.957519	2.348309	-1.69	0.092	8.560121	.6450822
OPGR						
L1.	.1604087	.1067601	1.50	0.133	.0488372	.3696547
L2.	-.2563249	.1152394	-2.22	0.026	-.48219	-.0304599
L3.	.1735478	.1136309	1.53	0.127	.0491647	.3962604
L4.	.0554514	.1124381	0.49	0.622	.1649232	.275826
_cons	11.24047	6.518738	1.72	0.085	1.536022	24.01696

Log likelihood = -1580.585 AIC = 27.86852
FPE = 3163.356 HQIC = 29.7063
Det(Sigma_ml) = 125.3998 SBIC = 32.39166

Equation	Parms	RMSE	R-sq	chi2	P>chi2
GDPGR	29	1.20036	0.3878	81.07907	0.0000
UR	29	.232686	0.9625	3288.378	0.0000
PTI	29	2.20089	0.4229	93.79037	0.0000
CSPE	29	1.76754	0.3447	67.33555	0.0000
EXPGR	29	6.0242	0.6684	258.0087	0.0000
INFR	29	.544925	0.3271	62.21014	0.0002
OPGR	29	15.3733	0.2823	50.35221	0.0059

Panel B: VAR estimators of Portugal

Coefficient		Std. err.	z	P>z	[95% conf.	interval]
GDPGR						
GDPGR						
L1.	.2155941	.1453145	1.48	0.138	.0692171	.5004053
L2.	-.0048701	.1306205	-0.04	0.970	.2608815	.2511414
L3.	.137681	.138832	0.99	0.321	.1344248	.4097868
L4.	-.0452224	.1339256	-0.34	0.736	.3077118	.2172669
UR						
L1.	-.2187262	.2148538	-1.02	0.309	.6398319	.2023796
L2.	.0148335	.344928	0.04	0.966	-.661213	.6908799
L3.	.6306042	.3410333	1.85	0.064	.0378087	1.299017
L4.	-.5273803	.1951995	-2.70	0.007	.9099643	-.1447964
PTI						
L1.	.0164618	.0344652	0.48	0.633	.0510887	.0840124
L2.	-.0088412	.0307932	-0.29	0.774	.0691947	.0515124
L3.	.0920902	.0307494	2.99	0.003	.0318224	.152358
L4.	.01276	.0317396	0.40	0.688	.0494485	.0749684
CSPE						
L1.	-.1177588	.0867432	-1.36	0.175	.2877723	.0522547
L2.	.1036434	.0800328	1.30	0.195	.0532181	.2605048
L3.	-.1149283	.0783312	-1.47	0.142	.2684547	.0385982
L4.	.1252021	.0883595	1.42	0.156	.0479793	.2983835
EXPGR						
L1.	-.0141775	.0260506	-0.54	0.586	.0652358	.0368808
L2.	-.005102	.0249143	-0.20	0.838	.0539331	.0437292
L3.	-.001311	.0280182	-0.05	0.963	.0562256	.0536037
L4.	.0419375	**.0252153**	**1.66**	**0.096**	**.0074836**	**.0913586**
INFR						
L1.	-.2338969	.1113573	-2.10	0.036	.4521533	-.0156405
L2.	-.3636357	.1045581	-3.48	0.001	.5685658	-.1587055
L3.	-.297761	.099967	-2.98	0.003	.4936927	-.1018293
L4.	-.2029577	.1022032	-1.99	0.047	.4032723	-.002643
OPGR						
L1.	-.0052886	.0050662	-1.04	0.297	-.015218	.0046409
L2.	.000567	.0050005	0.11	0.910	.0092338	.0103678
L3.	.0046735	.0046745	1.00	0.317	.0044883	.0138352
L4.	-.0134613	.0051167	-2.63	0.009	-.02349	-.0034327
_cons	1.817672	.4183604	4.34	0.000	.9977009	2.637643
UR						
GDPGR						
L1.	-.2541387	.0717924	-3.54	0.000	.3948491	-.1134283
L2.	.0088629	.0645328	0.14	0.891	-.117619	.1353449
L3.	.1221201	.0685897	1.78	0.075	.0123133	.2565534
L4.	.101378	.0661657	1.53	0.125	.0283043	.2310604
UR						
L1.	1.327102	.1061481	12.50	0.000	1.119056	1.535149
L2.	-.3232208	.170411	-1.90	0.058	.6572203	.0107786
L3.	-.043891	.1684868	-0.26	0.794	.3741191	.2863371
L4.	.0158124	.0964379	0.16	0.870	.1732025	.2048272
PTI						
L1.	-.0114787	.0170275	-0.67	0.500	.0448519	.0218946
L2.	-.0082612	.0152133	-0.54	0.587	.0380788	.0215563
L3.	-.0248436	.0151917	-1.64	0.102	.0546188	.0049316
L4.	-.016739	.0156809	-1.07	0.286	-.047473	.013995
CSPE						
L1.	.096792	.0428553	2.26	0.024	.0127971	.1807869
L2.	-.037525	.0395401	-0.95	0.343	.1150221	.0399721
L3.	-.1441176	.0386994	-3.72	0.000	-.219967	-.0682681
L4.	-.0775585	.0436538	-1.78	0.076	.1631184	.0080014
EXPGR						
L1.	.0056767	.0128703	0.44	0.659	.0195486	.0309019
L2.	-.0109743	.0123089	-0.89	0.373	.0350992	.0131506
L3.	-.0073321	.0138423	-0.53	0.596	.0344626	.0197984
L4.	-.0066897	.0124576	-0.54	0.591	.0311061	.0177267
INFR						
L1.	.0944111	.0550159	1.72	0.086	.0134181	.2022402
L2.	.1701923	.0516567	3.29	0.001	.068947	.2714377
L3.	.0869583	.0493885	1.76	0.078	.0098414	.183758
L4.	.0191111	.0504933	0.38	0.705	-.079854	.1180762
OPGR						
L1.	.0003847	.0025029	0.15	0.878	.0045209	.0052903
L2.	-.0021642	.0024705	-0.88	0.381	.0070062	.0026779
L3.	.0035795	.0023094	1.55	0.121	.0009468	.0081059

L4.	.0010773	.0025279	0.43	0.670	.0038774	.0060319
_cons	.2085084	.2066901	1.01	0.313	.1965968	.6136136
PTI						
GDPGR						
L1.	.4231484	.4591948	0.92	0.357	.4768568	1.323154
L2.	-.4419963	.4127615	-1.07	0.284	1.250994	.3670014
L3.	.0077737	.4387101	0.02	0.986	.8520822	.8676296
L4.	.0589269	.4232058	0.14	0.889	.7705412	.888395
UR						
L1.	-1.312705	.6789394	-1.93	0.053	2.643401	.0179923
L2.	1.947697	1.089975	1.79	0.074	.1886136	4.084008
L3.	-.6074695	1.077667	-0.56	0.573	2.719658	1.504719
L4.	-.1764823	.6168316	-0.29	0.775	-1.38545	1.032485
PTI						
L1.	-.2946672	.1089103	-2.71	0.007	.5081274	-.0812069
L2.	-.1502026	.0973067	-1.54	0.123	.3409202	.0405151
L3.	-.1112179	.0971684	-1.14	0.252	.3016645	.0792287
L4.	-.0765031	.1002973	-0.76	0.446	.2730823	.120076
CSPE						
L1.	-.1016139	.274109	-0.37	0.711	.6388577	.4356299
L2.	.2472348	.2529042	0.98	0.328	.2484484	.7429179
L3.	.0624751	.2475272	0.25	0.801	.4226693	.5476196
L4.	-.1675748	.2792165	-0.60	0.548	-.714829	.3796795
EXPGR						
L1.	.1345498	.0823201	1.63	0.102	.0267947	.2958943
L2.	.203731	.0787294	2.59	0.010	.0494243	.3580377
L3.	.0373487	.0885377	0.42	0.673	-.136182	.2108795
L4.	.0992078	.0796805	1.25	0.213	.0569632	.2553787
INFR						
L1.	-.4600174	.3518899	-1.31	0.191	1.149709	.2296741
L2.	-.5378022	.3304043	-1.63	0.104	1.185383	.1097783
L3.	-.0003182	.3158963	-0.00	0.999	.6194636	.6188271
L4.	-.0388354	.3229628	-0.12	0.904	.6718309	.5941601
OPGR						
L1.	-.015527	.0160091	-0.97	0.332	.0469042	.0158502
L2.	-.0184599	.0158016	-1.17	0.243	.0494304	.0125107
L3.	-.0462991	.0147713	-3.13	0.002	.0752503	-.0173479
L4.	-.0297705	.0161689	-1.84	0.066	-.061461	.00192
_cons	1.491077	1.322021	1.13	0.259	1.100037	4.082191
CSPE						
GDPGR						
L1.	.3120368	.1966494	1.59	0.113	-.073389	.6974625
L2.	.0165779	.1767644	0.09	0.925	-.329874	.3630298
L3.	.2060395	.1878769	1.10	0.273	.1621924	.5742713
L4.	-.0301705	.1812372	-0.17	0.868	.3853888	.3250478
UR						
L1.	-.3596878	.2907547	-1.24	0.216	.9295565	.2101809
L2.	.7236	.4667798	1.55	0.121	.1912716	1.638472
L3.	.1594802	.4615092	0.35	0.730	.7450612	1.064022
L4.	-.6397607	.2641571	-2.42	0.015	1.157499	-.1220223
PTI						
L1.	.0394523	.0466406	0.85	0.398	.0519617	.1308663
L2.	.0056337	.0416714	0.14	0.892	.0760408	.0873082
L3.	.112373	.0416122	2.70	0.007	.0308146	.1939314
L4.	-.0240379	.0429522	-0.56	0.576	.1082226	.0601468
CSPE						
L1.	-.1194926	.1173867	-1.02	0.309	.3495663	.1105812
L2.	.1899754	.1083058	1.75	0.079	.0223001	.4022509
L3.	-.0198854	.1060031	-0.19	0.851	.2276477	.1878769
L4.	.1618172	.119574	1.35	0.176	.0725435	.396178
EXPGR						
L1.	.000615	.0352535	0.02	0.986	.0684805	.0697105
L2.	.0108828	.0337157	0.32	0.747	.0551988	.0769644
L3.	-.0560724	.0379161	-1.48	0.139	.1303866	.0182419
L4.	.0306783	.0341231	0.90	0.369	.0362016	.0975583
INFR						
L1.	-.2768862	.1506963	-1.84	0.066	.5722455	.018473
L2.	-.394155	.1414951	-2.79	0.005	.6714802	-.1168297
L3.	-.12674	.1352821	-0.94	0.349	.3918879	.138408
L4.	-.245154	.1383083	-1.77	0.076	.5162332	.0259253
OPGR						
L1.	-.0144673	.0068559	-2.11	0.035	.0279045	-.00103
L2.	.0095789	.006767	1.42	0.157	.0036842	.022842
L3.	-.0005292	.0063258	-0.08	0.933	.0129275	.0118691

L4.	-.0131879	.0069243	-1.90	0.057	.0267593	.0003835
_cons	2.302939	.5661534	4.07	0.000	1.193298	3.412579
EXPGR						
GDPGR						
L1.	1.523777	.7075143	2.15	0.031	.1370748	2.91048
L2.	1.010683	.6359713	1.59	0.112	.2357979	2.257164
L3.	.17291	.6759521	0.26	0.798	1.151932	1.497752
L4.	.6329365	.6520635	0.97	0.332	.6450844	1.910958
UR						
L1.	.9758731	1.046091	0.93	0.351	1.074427	3.026173
L2.	-.97271	1.679402	-0.58	0.562	4.264278	2.318858
L3.	1.492001	1.660439	0.90	0.369	-1.7624	4.746402
L4.	-1.37323	.9503966	-1.44	0.148	3.235973	.489513
PTI						
L1.	-.1786445	.1678059	-1.06	0.287	-.507538	.150249
L2.	-.2249466	.1499274	-1.50	0.134	-.518799	.0689057
L3.	-.0773278	.1497143	-0.52	0.606	.3707625	.2161069
L4.	-.2233985	.1545353	-1.45	0.148	.5262821	.079485
CSPE						
L1.	-.263892	.4223394	-0.62	0.532	1.091662	.563878
L2.	-.3504748	.3896677	-0.90	0.368	1.114209	.4132598
L3.	-.0259317	.381383	-0.07	0.946	.7734286	.7215651
L4.	.107011	.4302089	0.25	0.804	.7361829	.9502049
EXPGR						
L1.	-.0881388	.1268366	-0.69	0.487	.3367339	.1604563
L2.	.0979366	.121304	0.81	0.419	.1398148	.335688
L3.	-.0754522	.1364164	-0.55	0.580	.3428234	.191919
L4.	.1321755	.1227695	1.08	0.282	.1084483	.3727993
INFR						
L1.	-.1234798	.542182	-0.23	0.820	1.186137	.9391774
L2.	-.7667445	.5090776	-1.51	0.132	1.764518	.2310292
L3.	-.4895669	.4867241	-1.01	0.314	1.443529	.4643948
L4.	.2545455	.497612	0.51	0.609	-.720756	1.229847
OPGR						
L1.	.0429344	.0246663	1.74	0.082	.0054107	.0912795
L2.	-.0158142	.0243467	-0.65	0.516	.0635328	.0319044
L3.	.0513766	.0227592	2.26	0.024	.0067694	.0959839
L4.	-.035199	.0249126	-1.41	0.158	.0840268	.0136288
_cons	.1637223	2.036933	0.08	0.936	3.828593	4.156038
INFR						
GDPGR						
L1.	-.0665124	.113922	-0.58	0.559	.2897954	.1567705
L2.	.0280384	.1024023	0.27	0.784	.1726664	.2287433
L3.	-.0379179	.1088399	-0.35	0.728	.2512402	.1754044
L4.	.2296494	.1049934	2.19	0.029	.023866	.4354327
UR						
L1.	-.0645769	.1684386	-0.38	0.701	.3947105	.2655566
L2.	.2533389	.2704126	0.94	0.349	.2766601	.7833379
L3.	.0212531	.2673593	0.08	0.937	.5027615	.5452676
L4.	-.2263665	.1530302	-1.48	0.139	.5263002	.0735671
PTI						
L1.	.0030695	.0270196	0.11	0.910	-.049888	.056027
L2.	.0032827	.0241409	0.14	0.892	.0440325	.050598
L3.	.0298674	.0241066	1.24	0.215	.0173806	.0771155
L4.	-.0147149	.0248828	-0.59	0.554	.0634844	.0340545
CSPE						
L1.	.0816068	.0680039	1.20	0.230	.0516785	.214892
L2.	.0242368	.0627432	0.39	0.699	.0987376	.1472112
L3.	.0247121	.0614092	0.40	0.687	.0956477	.145072
L4.	-.0688914	.069271	-0.99	0.320	.2046601	.0668773
EXPGR						
L1.	.0425432	.0204229	2.08	0.037	.0025151	.0825713
L2.	.0421108	.019532	2.16	0.031	.0038287	.0803929
L3.	.0042413	.0219654	0.19	0.847	-.03881	.0472927
L4.	-.0250454	.019768	-1.27	0.205	.0637899	.0136992
INFR						
L1.	-.1720491	.0873006	-1.97	0.049	.3431552	-.000943
L2.	.0278433	.0819702	0.34	0.734	.1328155	.188502
L3.	-.1349242	.0783709	-1.72	0.085	.2885284	.01868
L4.	.6507909	.0801241	8.12	0.000	.4937506	.8078312
OPGR						
L1.	-.0001771	.0039717	-0.04	0.964	.0079615	.0076073
L2.	-.0082546	.0039202	-2.11	0.035	.0159381	-.0005711
L3.	.006132	.0036646	1.67	0.094	.0010505	.0133145

L4.	.0005166	.0040114	0.13	0.898	.0073456	.0083787
_cons	.2653764	.3279813	0.81	0.418	.3774551	.9082078
OPGR						
GDPGR						
L1.	1.654734	3.280364	0.50	0.614	4.774661	8.084129
L2.	8.189561	2.948657	2.78	0.005	2.410299	13.96882
L3.	1.363486	3.134027	0.44	0.664	4.779094	7.506065
L4.	2.507657	3.023268	0.83	0.407	-3.41784	8.433154
UR						
L1.	11.3661	4.850161	2.34	0.019	1.859956	20.87224
L2.	-18.79047	7.786485	-2.41	0.016	-34.0517	-3.529241
L3.	20.46995	7.698565	2.66	0.008	5.381042	35.55886
L4.	-12.45395	4.406479	-2.83	0.005	21.09049	-3.81741
PTI						
L1.	-.3408831	.7780258	-0.44	0.661	1.865786	1.184019
L2.	.2492786	.6951329	0.36	0.720	1.113157	1.611714
L3.	-.3931384	.694145	-0.57	0.571	1.753638	.9673608
L4.	-1.166469	.7164971	-1.63	0.104	2.570777	.2378397
CSPE						
L1.	1.11806	1.958161	0.57	0.568	2.719865	4.955986
L2.	-2.472689	1.80668	-1.37	0.171	6.013716	1.068339
L3.	-.0536205	1.768268	-0.03	0.976	3.519362	3.412121
L4.	1.539723	1.994647	0.77	0.440	2.369714	5.44916
EXPGR						
L1.	-.2919087	.588073	-0.50	0.620	1.444511	.8606931
L2.	-1.339361	.5624214	-2.38	0.017	2.441686	-.2370349
L3.	-.0125362	.6324895	-0.02	0.984	1.252193	1.227121
L4.	-.2237627	.5692162	-0.39	0.694	1.339406	.8918806
INFR						
L1.	.015665	2.513807	0.01	0.995	4.911305	4.942636
L2.	-3.711365	2.360319	-1.57	0.116	8.337505	.9147761
L3.	-2.040029	2.256678	-0.90	0.366	6.463037	2.382978
L4.	4.858421	2.307159	2.11	0.035	.3364721	9.380371
OPGR						
L1.	.2835112	.1143645	2.48	0.013	.0593608	.5076616
L2.	-.0745429	.1128824	-0.66	0.509	.2957883	.1467026
L3.	.1316968	.1055222	1.25	0.212	.0751229	.3385166
L4.	-.0849951	.1155064	-0.74	0.462	.3113834	.1413933
_cons	-5.35418	9.444165	-0.57	0.571	-23.8644	13.15604

Log likelihood = -961.6624	AIC = 23.43034
FPE = 43.04035	HQIC = 25.96872
Det(Sigma_ml) = .303588	SBIC = 29.69741

Equation	Parms	RMSE	R-sq	chi2	P>chi2
GDPGR	35	.601483	0.9559	2230.793	0.0000
UR	35	.297162	0.9949	20026.96	0.0000
PTI	35	1.90069	0.8669	670.963	0.0000
CSPE	35	.813968	0.9337	1449.772	0.0000
EXPGR	35	2.92853	0.8494	580.9706	0.0000
INFR	35	.471544	0.7684	341.7498	0.0000
OPGR	35	13.578	0.4995	102.783	0.0000

Table A5: Dummy VAR estimator results (Source: Author's own elaboration)

	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
GDPGR						
dummy1	-28.61447	12.5845	-2.27	0.023	-53.27964	-3.949304
dummy2	-29.76883	16.25631	-1.83	0.067	-61.63062	2.092962
dummy3	91.48811	33.73502	2.71	0.007	25.36867	157.6075
dummy4	50.39372	42.56867	1.18	0.236	-33.03933	133.8268
dummy5	2.526382	37.79603	0.07	0.947	-71.55247	76.60523
dummy6	-11.31614	13.77845	-0.82	0.411	-38.32139	15.68912
UR						
dummy1	-.1923366	.2754179	-0.70	0.485	-.7321458	.3474725
dummy2	-.5732813	.3557773	-1.61	0.107	-1.270592	.1240294
dummy3	-1.123332	.7383074	-1.52	0.128	-2.570388	.3237235
dummy4	.1528808	.9316359	0.16	0.870	-1.673092	1.978854
dummy5	1.108472	.8271844	1.34	0.180	-.5127797	2.729723
dummy6	.5557367	.301548	1.84	0.065	-.0352864	1.14676
PTI						
dummy1	-3.072033	1.761615	-1.74	0.081	-6.524734	.3806678
dummy2	-22.60997	2.275606	-9.94	0.000	-27.07008	-18.14986
dummy3	31.76594	4.722326	6.73	0.000	22.51035	41.02153
dummy4	-6.229727	5.958884	-1.05	0.296	-17.90893	5.449471
dummy5	-1.984537	5.290796	-0.38	0.708	-12.35431	8.385234
dummy6	-7.2881	1.928746	-3.78	0.000	-11.06837	-3.507827
CSPE						
dummy1	-5.137101	.7544085	-6.81	0.000	-6.615714	-3.658487
dummy2	-16.02393	.9745243	-16.44	0.000	-17.93396	-14.11389
dummy3	17.37309	2.022328	8.59	0.000	13.4094	21.33678
dummy4	-7.277494	2.551882	-2.85	0.004	-12.27909	-2.275897
dummy5	4.869908	2.265775	2.15	0.032	.4290708	9.310745
dummy6	-4.630319	.8259824	-5.61	0.000	-6.249215	-3.011423
EXPGR						
dummy1	-11.95822	2.714246	-4.41	0.000	-17.27804	-6.638396
dummy2	-32.78467	3.506189	-9.35	0.000	-39.65667	-25.91266
dummy3	50.90043	7.276026	7.00	0.000	36.63968	65.16118
dummy4	.4852802	9.18128	0.05	0.958	-17.5097	18.48026
dummy5	7.284167	8.15191	0.89	0.372	-8.693282	23.26162
dummy6	-13.22147	2.971758	-4.45	0.000	-19.04601	-7.39693
INFR						
dummy1	-.3499075	.4370403	-0.80	0.423	-1.206491	.5066757
dummy2	-.4620863	.5645567	-0.82	0.413	-1.568597	.6444245
dummy3	2.195331	1.171565	1.87	0.061	-.1008945	4.491557
dummy4	-.7137749	1.478344	-0.48	0.629	-3.611276	2.183726
dummy5	.0376167	1.312598	0.03	0.977	-2.535027	2.610261
dummy6	-.8500823	.4785041	-1.78	0.076	-1.787933	.0877686
OPGR						
dummy1	-28.61447	12.5845	-2.27	0.023	-53.27964	-3.949304
dummy2	-29.76883	16.25631	-1.83	0.067	-61.63062	2.092962
dummy3	91.48811	33.73502	2.71	0.007	25.36867	157.6075
dummy4	50.39372	42.56867	1.18	0.236	-33.03933	133.8268
dummy5	2.526382	37.79603	0.07	0.947	-71.55247	76.60523
dummy6	-11.31614	13.77845	-0.82	0.411	-38.32139	15.68912

Table A6: Variance Decomposition for the Norwegian Indicators (Source: Author's own elaboration)

Variance Decomposition of CSPE:

Period	S.E.	CSPE	EXPGR	GDPGR	INFR	OPGR	PTI	UR
1	1.767545	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	1.861795	97.73561	0.000197	0.835546	0.075254	0.558525	0.000321	0.794545
3	1.929342	91.66197	1.111408	1.181429	2.267785	0.589199	0.932418	2.255796
4	2.105222	83.44423	8.762359	1.257735	2.022129	1.047498	0.862085	2.603965
5	2.126860	82.64393	8.658495	1.409619	1.981196	1.146624	0.910673	3.249461
6	2.196251	81.50933	8.194914	2.318002	1.902457	2.017881	0.978194	3.079221
7	2.248220	78.94850	10.24910	2.275620	2.022794	2.595714	0.962845	2.945427
8	2.292598	77.83646	11.03214	2.296133	2.001118	2.901400	1.000366	2.932382
9	2.316102	76.28170	12.13941	2.339693	1.968602	3.002384	1.094319	3.173883
10	2.398887	75.89157	12.02736	2.251449	1.915244	3.501458	1.100655	3.312260

Variance Decomposition of EXPGR:

Period	S.E.	CSPE	EXPGR	GDPGR	INFR	OPGR	PTI	UR
1	6.024200	13.61615	86.38385	0.000000	0.000000	0.000000	0.000000	0.000000
2	8.345893	39.33921	45.03600	1.892436	0.217937	13.29959	0.206497	0.008323
3	8.827457	43.97161	41.36219	2.340051	0.211886	11.92122	0.185374	0.007672
4	9.159832	43.85107	39.29949	2.215389	0.877214	12.56079	0.593200	0.602849
5	9.623524	39.85580	43.09066	2.027676	1.752346	12.03332	0.623494	0.616698
6	9.974519	38.93261	43.25182	2.142078	1.651901	12.61963	0.724135	0.677826
7	10.63736	44.51298	38.21257	2.330415	1.582096	11.22220	0.639495	1.500247
8	10.78080	44.48521	37.59647	2.284971	1.635271	11.65360	0.731713	1.612768
9	10.86487	43.98794	37.33083	2.269217	1.766922	12.32022	0.736200	1.588680
10	11.26649	41.61326	40.64444	2.113153	1.729978	11.64120	0.689332	1.568636

Variance Decomposition of GDPGR:

Period	S.E.	CSPE	EXPGR	GDPGR	INFR	OPGR	PTI	UR
1	1.200358	26.11373	0.751927	73.13434	0.000000	0.000000	0.000000	0.000000
2	1.345288	21.08256	0.608651	75.48935	0.780932	1.673270	0.001332	0.363911
3	1.378029	20.09269	2.829538	71.97631	1.194929	1.596108	0.227994	2.082432
4	1.397022	19.55023	3.932357	70.05499	1.702013	1.684353	1.018885	2.057174
5	1.432884	18.86499	4.822506	66.68332	2.893778	2.018977	2.356791	2.359642
6	1.476833	19.96234	4.539756	63.43453	2.962024	2.314472	4.120620	2.666254
7	1.491806	20.12654	4.941953	62.60811	3.181411	2.294687	4.038471	2.808829
8	1.499646	20.53956	5.099364	62.04003	3.164772	2.271906	4.079727	2.804646
9	1.519806	20.13240	6.176341	60.49759	3.300166	2.258858	4.237948	3.396695
10	1.547367	21.70002	6.632189	58.36168	3.197383	2.229021	4.410773	3.468936

Variance Decomposition of INFR:

Period	S.E.	CSPE	EXPGR	GDPGR	INFR	OPGR	PTI	UR
1	0.544925	0.460468	0.136386	1.813937	97.58921	0.000000	0.000000	0.000000
2	0.585630	2.528317	3.315202	6.715169	86.61367	0.212584	0.057775	0.557280
3	0.614764	2.728400	3.045019	6.995171	80.08147	0.991770	5.059468	1.098700
4	0.653528	2.456444	11.50734	6.194272	70.87802	1.411477	4.514458	3.037996
5	0.662816	2.394739	11.24952	6.124579	71.29699	1.449105	4.449907	3.035160
6	0.672054	2.905344	12.07518	6.068705	69.82764	1.808098	4.346291	2.968743
7	0.687719	2.780374	12.25269	6.200701	66.75225	4.845989	4.252456	2.915532
8	0.701580	4.349463	13.43973	6.320222	64.19214	4.682126	4.147821	2.868498
9	0.708647	4.624475	14.47049	6.195705	63.06365	4.592660	4.107591	2.945428
10	0.712383	5.219342	14.32663	6.171600	62.40573	4.705073	4.064625	3.107004

Variance Decomposition of OPGR:

Period	S.E.	CSPE	EXPGR	GDPGR	INFR	OPGR	PTI	UR
1	15.37333	18.00299	7.309665	4.666467	1.000857	69.02002	0.000000	0.000000
2	16.16273	16.97066	8.982034	7.665467	2.173482	64.04511	0.095210	0.068041
3	17.09835	15.66547	8.853042	6.912275	2.530299	58.82157	2.570377	4.646970
4	17.79886	18.78595	8.173136	6.458434	2.913949	54.90709	2.791374	5.970068
5	18.05225	19.06374	8.108144	6.623556	3.471712	53.94997	2.977148	5.805736
6	18.22532	19.08238	7.957614	7.171066	3.552568	53.47101	3.044319	5.721048
7	18.57227	18.47744	10.41540	6.970374	4.050039	51.51709	3.043048	5.526605
8	18.79563	19.30095	11.08200	6.832002	3.979568	50.36464	2.971391	5.469446
9	18.86350	19.17309	11.42605	6.786767	4.018094	50.00292	2.950980	5.642097
10	18.99851	19.53699	11.26518	6.701083	3.970327	49.99217	2.958850	5.575390

Variance Decomposition of PTI:

Period	S.E.	CSPE	EXPGR	GDPGR	INFR	OPGR	PTI	UR
1	2.200889	0.036967	1.695634	36.24010	0.039152	0.087389	61.90076	0.000000
2	2.461630	0.082614	5.225139	35.85022	0.452973	0.072225	57.71814	0.598692
3	2.544371	0.291402	5.103748	35.66832	1.133639	2.821897	54.31301	0.667985
4	2.601431	1.107859	4.957160	34.23440	1.094252	2.804526	54.90527	0.896539
5	2.706093	1.030898	7.208393	33.96296	1.392360	3.029858	52.54048	0.835051
6	2.815778	2.424617	6.784221	32.36865	1.994370	2.808450	52.32461	1.295083
7	2.847409	2.515030	7.393957	32.24856	1.950747	2.854318	51.29478	1.742605
8	2.882884	2.968790	7.214970	32.00111	2.249336	2.907655	50.75650	1.901643
9	2.901892	2.930315	8.009672	31.61768	2.237914	2.907044	50.27441	2.022962
10	2.912289	3.082216	8.000121	31.48150	2.225195	2.969157	50.09843	2.143375

Variance Decomposition of UR:

Period	S.E.	CSPE	EXPGR	GDPGR	INFR	OPGR	PTI	UR
1	0.232686	1.106443	0.071162	0.751511	0.918180	0.107058	1.417343	95.62830
2	0.350584	15.64659	0.934030	0.335339	0.842062	0.126304	2.179981	79.93569
3	0.468158	19.75570	1.496950	0.188185	0.501797	0.265089	5.557008	72.23527
4	0.578220	19.16923	5.358293	0.145211	1.010495	0.174202	6.725942	67.41663
5	0.707188	20.67755	9.439401	0.291869	0.981627	0.117178	8.351633	60.14074
6	0.815068	21.61669	13.67745	0.475085	1.106566	0.090410	8.352423	54.68138
7	0.901382	20.84964	17.01351	0.539930	1.158581	0.176806	8.530167	51.73137
8	0.984358	19.05945	21.79231	0.599108	1.276169	0.322047	8.623353	48.32756
9	1.059520	18.04843	25.51284	0.610768	1.388310	0.586303	8.326851	45.52650
10	1.118070	16.99453	28.31082	0.607481	1.520853	0.887146	8.310507	43.36866

Cholesky One S.D. (d.f. adjusted)
Cholesky ordering: CSPE EXPGR GDPGR INFR OPGR PTI UR

Table A7: Variance Decomposition for the Portuguese Indicators (Source: Author's own elaboration)

Variance Decomposition of CSPE:

Period	S.E.	CSPE	EXPGR	GDPGR	INFR	OPGR	PTI	UR
1	1.977759	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	2.365431	93.28572	0.233108	0.687363	1.090691	0.034795	2.724211	1.944112
3	2.504921	84.67553	0.579552	2.382991	1.282322	0.034853	8.548568	2.496184
4	2.606262	81.62744	2.630263	2.305334	1.323342	0.338256	8.863576	2.911784
5	2.914550	74.89035	4.471529	2.748011	4.606646	2.431162	8.046075	2.806229
6	2.998819	73.64818	4.426941	2.620086	4.974220	2.550835	8.718393	3.061350
7	3.080577	72.52901	4.512373	2.589605	5.527067	2.421681	9.504753	2.915510
8	3.130040	72.14782	5.029287	2.514836	5.356560	2.841004	9.229190	2.881304
9	3.161282	70.98277	4.968505	3.266603	5.638395	3.062371	9.064493	3.016860
10	3.183517	70.98634	4.979467	3.242267	5.562692	3.037569	8.972863	3.218806

Variance Decomposition of EXPGR:

Period	S.E.	CSPE	EXPGR	GDPGR	INFR	OPGR	PTI	UR
1	5.392717	64.11708	35.88292	0.000000	0.000000	0.000000	0.000000	0.000000
2	6.194657	64.39219	27.29486	0.077813	0.143615	3.331907	4.339278	0.420333
3	6.404065	60.49601	25.55986	1.086043	0.451820	3.312126	8.250216	0.843931
4	6.526347	58.70237	24.94905	1.256852	0.708914	5.155755	8.286657	0.940401
5	6.672394	56.72210	24.05998	1.648001	1.984430	6.429284	8.116346	1.039854
6	6.784010	55.43282	24.13607	1.646026	3.550269	6.250407	7.915581	1.068828
7	6.929088	55.72095	23.13958	1.661078	3.854557	6.103819	8.490348	1.029668
8	7.053856	56.70857	22.43702	1.774987	3.913778	5.892706	8.266882	1.006059
9	7.106429	55.89003	22.25673	2.361139	4.315707	6.002037	8.148183	1.026171
10	7.154807	55.38441	22.27845	2.404385	4.754517	5.976775	8.038396	1.163066

Variance Decomposition of GDPGR:

Period	S.E.	CSPE	EXPGR	GDPGR	INFR	OPGR	PTI	UR
1	1.824434	87.67215	3.571889	8.755956	0.000000	0.000000	0.000000	0.000000
2	2.232454	84.92641	3.225106	6.530226	0.676604	0.340696	3.088496	1.212461
3	2.373411	75.86465	3.455588	7.486962	0.898820	0.394495	9.294129	2.605358
4	2.445159	72.48184	6.035675	7.080861	1.205910	0.804334	9.813212	2.578166
5	2.620384	68.13578	6.796210	7.426621	3.636511	2.577178	8.961062	2.466636
6	2.679850	67.40635	6.814672	7.109797	4.267418	2.602197	8.939381	2.860184
7	2.756828	66.92390	6.605060	6.761228	4.952716	2.463481	9.590852	2.702761
8	2.810710	67.41517	6.714146	6.539979	4.768590	2.648188	9.308755	2.605174
9	2.835877	66.31469	6.650944	7.270809	5.148942	2.867467	9.145264	2.601881
10	2.855870	66.22885	6.784550	7.231950	5.102500	2.842943	9.031291	2.777917

Variance Decomposition of INFR:

Period	S.E.	CSPE	EXPGR	GDPGR	INFR	OPGR	PTI	UR
1	0.474308	3.759213	6.695637	6.888016	82.65713	0.000000	0.000000	0.000000
2	0.500463	4.332804	8.536561	8.303742	77.32479	0.105935	0.001993	1.394171
3	0.533221	8.753156	11.45853	7.317916	68.16315	2.954108	0.074123	1.279016
4	0.552571	8.642399	11.23810	7.059263	65.65484	5.647864	0.361588	1.395948
5	0.620712	7.243185	9.225926	6.305209	70.99325	4.508193	0.514627	1.209612
6	0.635748	7.154181	8.823208	6.286590	71.01051	4.359502	0.632692	1.733322
7	0.644848	6.954336	8.726717	6.166144	69.04855	6.713367	0.676771	1.714114
8	0.655035	6.861525	8.548588	6.072919	68.45005	7.559964	0.828921	1.678033
9	0.687232	6.239619	7.784896	5.563167	70.54379	6.873598	1.469446	1.525489
10	0.702634	6.021958	7.481852	5.325870	69.96497	6.687325	1.820001	2.698021

Variance Decomposition of OPGR:

Period	S.E.	CSPE	EXPGR	GDPGR	INFR	OPGR	PTI	UR
1	15.08585	21.76221	5.687564	2.776199	3.853419	65.92061	0.000000	0.000000
2	16.01289	21.15147	5.127907	2.896276	3.488533	64.47440	1.486900	1.374517
3	16.81699	20.29329	7.199298	3.941981	3.809377	58.46672	4.320385	1.968942
4	17.45181	24.19837	6.778662	3.759534	4.315200	54.31832	4.011946	2.617969
5	17.89514	23.18131	8.494615	4.633265	4.582490	51.94070	3.989490	3.178127
6	18.07120	22.97483	8.465841	4.588464	5.280597	51.54556	3.990946	3.153767
7	18.29132	23.33539	8.276532	4.546261	5.492703	50.94407	4.261464	3.143574
8	18.69322	25.64538	8.105637	4.664753	5.479320	48.89398	4.155721	3.055216
9	18.80873	25.39429	8.108998	4.728632	5.560203	48.87964	4.300564	3.027679
10	18.88951	25.19155	8.121184	4.770067	5.602216	48.46429	4.493034	3.357667

Variance Decomposition of PTI:

Period	S.E.	CSPE	EXPGR	GDPGR	INFR	OPGR	PTI	UR
1	3.417651	63.57115	6.712222	1.698123	0.635833	0.088319	27.29435	0.000000
2	4.369250	66.42151	4.205073	1.139783	1.600682	0.238063	23.06204	3.332843
3	4.591096	60.95044	3.810938	3.647583	1.612936	1.207260	25.53275	3.238094
4	4.623738	60.46512	4.285118	3.597908	1.787779	1.290523	25.28824	3.285318
5	4.763819	57.92365	4.248888	3.473537	3.341360	3.866987	24.03119	3.114389
6	4.900504	58.01142	4.068288	3.343980	4.931105	3.940210	22.70966	2.995341
7	5.001296	57.79718	4.091961	3.351814	5.318310	3.844753	22.71083	2.885151
8	5.092917	58.46043	4.096022	3.272895	5.244797	3.722743	22.35004	2.853080
9	5.143161	57.33637	4.234019	3.571968	6.148135	3.936644	21.97416	2.798707
10	5.185655	57.11855	4.565838	3.781597	6.200757	3.872651	21.61832	2.842289

Variance Decomposition of UR:

Period	S.E.	CSPE	EXPGR	GDPGR	INFR	OPGR	PTI	UR
1	0.303419	0.804027	1.686668	0.334244	0.089659	2.362229	2.838879	91.88429
2	0.566322	10.75105	0.496575	1.491578	1.033589	1.498955	4.817217	79.91104
3	0.805163	10.51358	0.250855	2.440011	3.991164	1.655926	4.324384	76.82408
4	1.053103	9.976199	0.918783	1.634108	7.529072	1.119201	5.826612	72.99603
5	1.317858	9.745927	1.072069	1.064620	10.69711	0.719876	7.949294	68.75110
6	1.567842	8.143445	1.312702	0.790419	14.59392	0.579343	8.760879	65.81930
7	1.812037	7.383684	1.797973	0.682782	17.47835	0.753859	9.140224	62.76313
8	2.041215	6.277084	2.330024	0.581882	20.60995	1.130514	8.742065	60.32848
9	2.260287	5.573567	2.929573	0.490405	23.08063	1.582932	8.330034	58.01286
10	2.462416	5.235566	3.387186	0.416148	25.11031	1.811725	7.945215	56.09385

Cholesky One S.D. (d.f. adjusted)
Cholesky ordering: CSPE EXPGR GDPGR INFR OPGR PTI UR

Figure A14 – Impulse Response Functions for Norway (Source: Author's own elaboration)

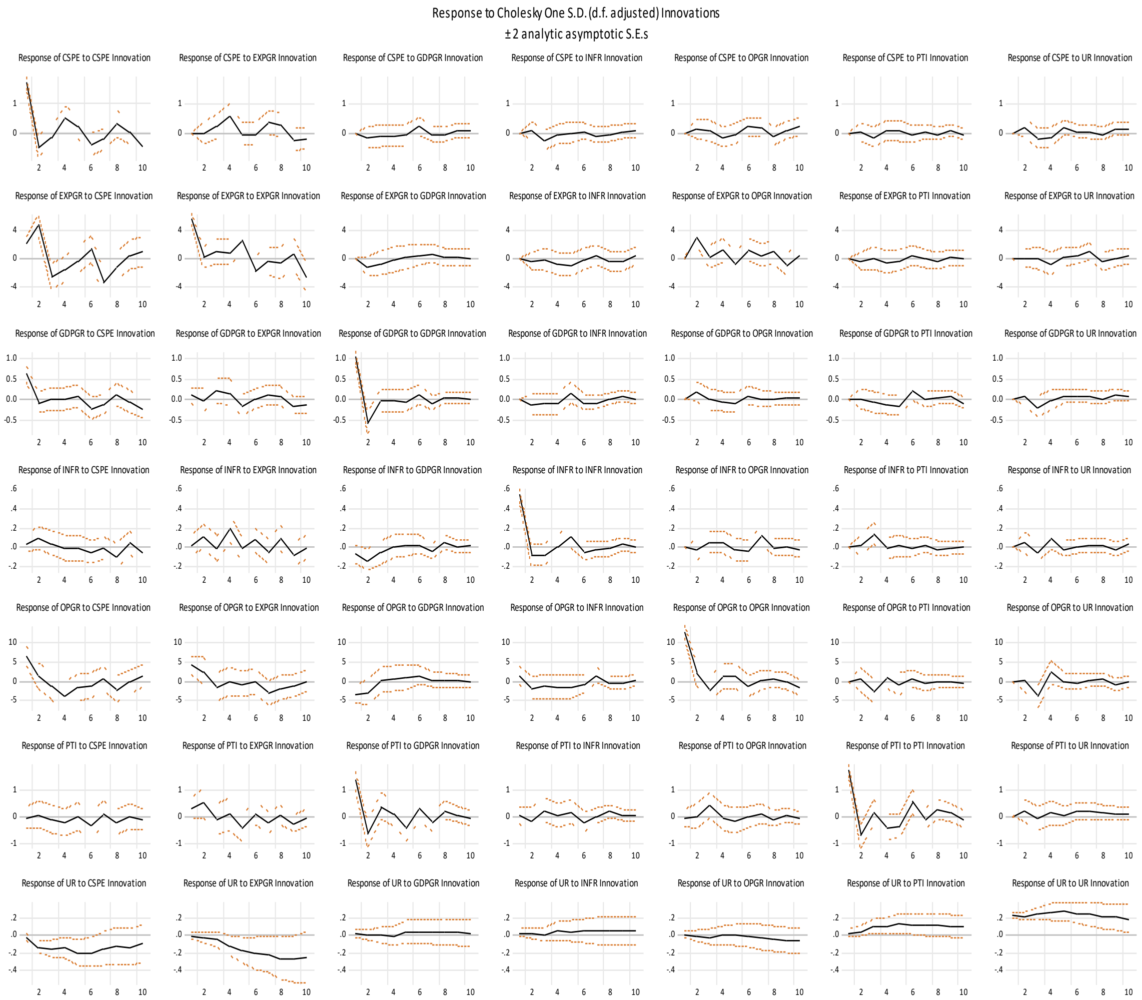

Figure A15 - Impulse Response Functions for Portugal (Source: Author's own elaboration)