How do oil and gas prices affect Greece's domestic inflation?

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Abstract:

This dissertation examines the relationship between oil and gas price changes and the Greek domestic inflation along with the existence or absence of any asymmetries of such relationship during periods of increasing and decreasing oil and gas prices. This paper focuses on a 10 year period, from 2012 until 2022, covering some challenging events for the global economy, such as the COVID-19 pandemic and the invasion of Russia in Ukraine. For the purposes of the main topic of this paper, we first use the ADF and KPSS tests to point out any non-stationarity issues between our variables. Then we estimate our model with the use of an ARMA model specification. The results reveal that increasing oil and gas prices have a positive impact on the Greek CPI with a lag and PPI contemporaneously. We then implement a non-linear specification model that includes a set of dummy variables, capturing the upward and downward fluctuations of the global oil and gas prices. The results point out the existence of a positive asymmetry between oil price changes and the Greek domestic inflation. In greater detail, there is a positive relationship between oil price changes and the Greek domestic inflation, which is larger during periods of decreasing oil prices. Another asymmetric relationship is identified among gas prices and the Greek PPI and CPI. Periods when gas prices increase result in a small increase of Greek national inflation, while there is no effect among the variables during periods of decreasing gas prices. As a final proposition, this paper suggests a number of policies that the Greek government could use to protect the country's households and businesses against future global oil price increases.

Keywords: oil prices, gas prices, inflation, asymmetries, Greece, government policies

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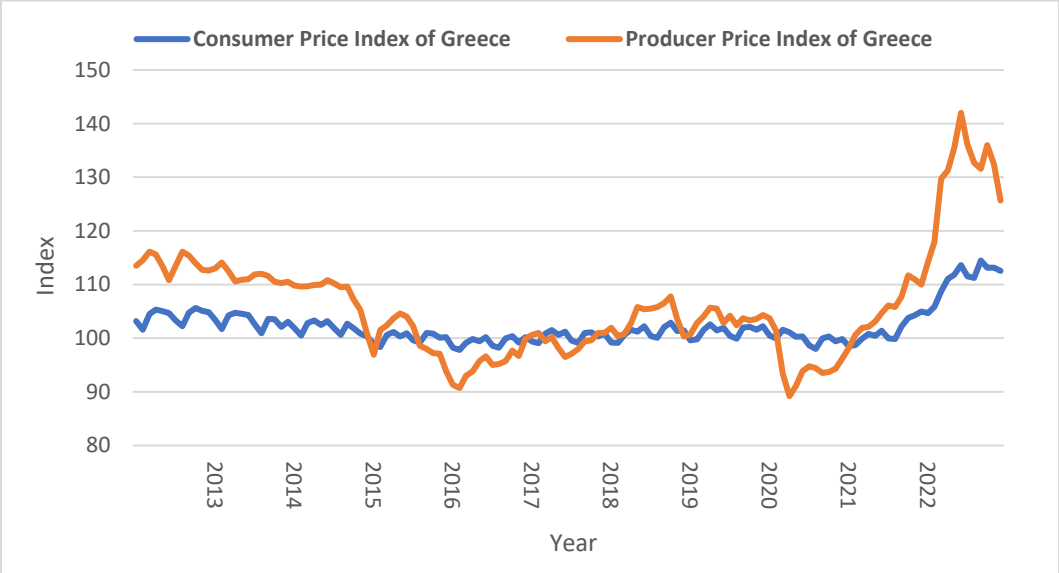
Contents

1. Introduction

The significance underlining the relationship between oil price volatility and domestic inflation has been one of the most popular aspects within the economic world over the last few years, mainly due to the excessive global oil price swings during a period highlighted by severe challenges for many nations around the globe. Considering the attention surrounding the topic in question and its relevance for analysts, researchers and policymakers, such an approach on the Greek economy remains topical. Most of the literature is mainly concerned about oil-exporting nations and advanced economies that have a strong influence on the global economic framework. This study is aimed to fill in the above literature gap and point out the effects of global oil and gas price fluctuations on the Greek consumer and producer inflation rates. In addition to the above, this paper also examines possible asymmetries of the effects of oil price swings on the Greek Producer Price Index and Consumer Price Index during periods of increasing and decreasing energy prices. Following the results of the above questions, this research will then provide potential policies to be implemented by the Greek government to mitigate possible negative impacts originating from global oil price fluctuations on the Greek households and businesses.

Figure 1. Global price of Brent Crude oil (in USD per barrel).

Figure 2. Greek Consumer Price Index (Index 2017=100) and Producer Price Index (Index 2017=100).



Sources: Elstat, Bank of Greece, IMF and Student's Calculations after the use of the respective collected data regarding the period from 2012 until 2022.

Figure 1. presents the fluctuations of global oil prices between January of 2012 until December of 2022 originated from data extracted from the IMF, while Figure 2. shows the behavior of the Greek domestic inflation during the same period. For the purposes of our topic, this paper focuses on this ten-year period which includes the latest global economic crisis such as the COVID-19 pandemic and the Russian invasion in Ukraine which have had a major impact on the European energy market. The inclusion of such events is ideal, since it provides valuable information on the effects of global oil price fluctuation on the Greek CPI and PPI before, during and after periods of global economic crisis. With a first glance at the graph, we can observe the instability of the global oil prices for the period in examination. The sharp fall of the global oil prices from the second quarter of 2014 until the end of the same year can be explained by the oversupply of petroleum relative to its demand during that period, mainly due to excessive production from the U.S. (Mead and Stiger,2015). After that the world oil prices follow an inconsistent route of small ups and downs before reaching a stunning low of 27 dollars per barrel due to the hammering of the U.S. oil industry from the impacts of the COVID-19 pandemic (OECD, 2020). After that we can see the sharp increase of the world oil prices until the mid of 2022, before dropping again during the last year of our sample. The increase during this period can be clarified by the effects of the war between Russia and Ukraine while the decline is accounted on the global concerns regarding a possible future recession which led to sharp decrease in global demand for oil (EIA, 2023). Taking the mentioned evidence under consideration, we can assume the periods that will divulge the impact that energy price volatility may have on the Greek domestic inflation.

2. Literature review

2.1. Effects of oil and gas price volatility on inflation

Badel et al. (2016) examined the link between oil prices and inflation in the euro area, the UK and the USA. By collecting weekly data during July 2007- January 2016, regarding oil prices and inflation expectations, they identified the existence of a correlation between inflation expectations and shocks originated from oil price changes. This state seems to be originating from the outbreak of the financial crisis, while evidence shows that before the crisis the correlation between inflation expectations and oil prices was weaker. The correlation seems to be stronger in the US than in the UK regarding short term forecasting and similar for long term expectations. The euro area seems to experience a smaller but notable impact between the variables tested. The researchers also concluded that falling inflation based on the market cannot be used as proof against the usefulness of the ECB's quantitative easing, because of the existing link between oil prices and falling inflation suppositions. At the same time, as far as it concerns the financial market forecasts, the researchers suggest a cautious evaluation due to their highly responsive character against oil price volatility, even in cases of longer and more complicating maturities.

The above study is contradicted by Cristadoro and Conflitti (2018). According to their own research, despite the statistical evidence of a strong relationship between oil prices and long-term inflation expectations in the euro area after the outbreak of the financial crisis, other factors may be hiding behind these effects. This is because during the period in question, oil prices shifted together with other economic indicators. Simultaneously, the link between short- and long-term expectations has become stronger. Taking the above factors into consideration the researchers concluded that the

relationship between oil prices and inflation is unimportant in the long run. More precisely, the link between long-term inflation expectations and oil prices is the outcome of the influence of the extended weak economic conditions and failure of price stability due to long-term inflation expectations.

Bragoudakis and Kyriopoulos (2021) examine the possible effects of the reduction in the world oil prices, that occurred from January 2014 to December 2014, on Greece's GDP growth and inflation. Taking under consideration the euro depreciation that followed the decline of the oil prices and the relative literature, the researchers achieved to provide empirical evidence that this reduction of international oil prices had a significant effect on both Greek inflation rates and GDP growth rates. Evidence shows that the decline of the world oil prices resulted in a significant positive impact on the nation's GDP. At the same time, the impact on the Greek inflation rates was negative, which hints an increase in disposable income and private consumption.

Filis (2010) examines the relationship between consumer inflation, industrial production, stock market and Brent oil price for the case of Greece. The researcher used monthly data from January 1996 until June 2008 and employed a VAR model to examine this relationship. As far as their long run relationship is concerned, oil prices seem to have a positive effect on the CPI of Greece. Moreover, there is a negative influence from oil prices on the stock market. Along with the above conclusions, the researchers showed the absence of links from oil prices to industrial production and consumer price index. No relationship was also determined between the Greek stock market and industrial production.

Gros and Shamsfakhr (2022) were able to identify a positive relationship between oil, gas prices and inflation, in an attempt to determine the link between energy prices and inflation regarding the US and the euro area. For the case of the oil and gas prices,

the researchers relied on quarterly data from 2004 until 2021 and used both contemporaneous and lagged variables. The results of their model point out a positive relationship between energy prices and inflation that seems to be stronger in the case of the euro area relative to the case of the US. According to the researchers, this difference is mainly a result of gas and electricity price gaps between the two regions, alongside with other factors, such as different national policies and tariffs used by each nation.

By using the augmented Phillips curve framework as a tool, LeBlanc and Chinn (2004) measured the impact of oil prices for the major industrial nations of the Group of Five (G5). They proceeded with their research considering the possibility that the relationship between oil prices and output may be underlined by nonlinearity, asymmetry and structural instability. The statistical evidence that resulted indicated that the oil prices of the year tested (2014), may have a small impact on inflation in the nations of US, Japan and the overall European region. Inflation in the US and Europe was expected to face an increase of around 0,1%-0,8%, resulting from an increase of 10% in the oil prices. Even though Europe is thought to be more responsive to oil price changes relative to the US, evidence showed that the sensitivity between the two regions will be similar and even less that the sensitivity of other nations.

For the purposes of the next paper, Balcilar et.al (2018) tried to capture the evolution of the relationship between oil prices and inflation in South Africa. Time series data were used from January of 1922 until July of 2013. With the use of both symmetric and asymmetric dynamic conditional correlation GARCH, the analysts proved that as oil prices increase, inflation rates follow towards the same direction. At the same time, the correlation between them is low, ranging between 0.07-0.08. During periods of oil crises, the time series – patterns reveal a short-term positive shift in the pair-wise conditional correlations. The South Africa oil embargo in 1986 caused an upward shift in correlation. Additionally to the above, positive shocks seemed to have a much more significant

consequence on inflation rates than negative shocks. A final observation was that, as time passed, the correlation faced a constant, gradual decrease. This condition is explained by the researchers as an outcome of the South Africa Bank's attempt to stabilize inflation in the recent years in the appearance of external shocks.

Živkova et.al (2019) examine the dependence of consumer price inflation on changes in oil prices. The existence of this dependence was examined in eleven European counties with the use of Markov switching method to differentiate between the effects of oil prices on inflation for different periods. The analysts concluded that oil price changes have a small effect on inflation rates in Europe since a hypothetical increase of the oil prices by 100% results in an approximate 1% - 6% increase in inflation. Despite that, changes in oil prices seem to have a severe impact on inflation for long term periods for most of the European nations. In other words, the spillover effect has a bigger impact than the short-term effect. The results of this research also reveal that the relationship between oil prices and inflation is not affected by the exchange rates, except in cases of excessive depreciation. Finally, nations with high oil import/GDP ratios (Bulgaria and Slovakia) experience the most significant and enduring pass - through effects amongst the nations tested.

Renou-Maissant (2019) investigates the relations between oil prices and inflation for eight industrial countries from 1991 to 2016. The countries in question are Canada, USA, Japan, France, Germany, Australia, UK and Italy. An oil-augmented Phillips curve is used for the purposes of this investigation. The researchers also use lagged variables for the purposes of their investigation, to capture the behavior of inflation over time. The outcomes of this method reveal that there is a strong magnitude on inflation from changes in the oil prices, even in periods when inflation is known and stable. From 2000 until the global financial crisis in 2008, evidence showed that the effect of oil price alterations on inflation has grown at a constant rate, with Germany being the only

exception. The most extreme case belongs to the USA since the oil pass- through into the nations' inflation has almost doubled in less than two decades time. The analysts, based on the findings of their research, suggest that central banks must observe oil prices with great caution for the years to follow.

Tural et.al (2016) aims to show the effect of oil price swaps towards consumer price inflation in Azerbaijan, Kazakhstan and Russia. The analysts test the response of the economies of these three nations in a case of international market disturbance resulting from an oil price shock. To measure the importance of these shocks towards inflation rates, the researchers follow the same methodology as Sims and Zha (1995), constructing a VAR model, after collecting data on world oil prices, domestic oil production, trade partners' CPI, real fiscal expenditures and domestic CPI from 2000-2014. The results from this approach imply that there is a very sensitive relationship between oil prices shocks and inflation rates for these oil exporting nations. In other words, oil prices have a huge effect on domestic inflation rates and due to new evidence regarding these oil- exporting countries the researchers offer some guidance to the central banks to maintain price stability. According to the researchers, additional policies could be Counter-cyclical fiscal policies and effectively binding fiscal rules.

2.2. Asymmetries of the impact on inflation between periods of energy price fluctuations

Bragoudakis and Sideris (2021) attempt to identify the effects of asymmetric adjustments of gas prices on oil price alterations in the case of the Greek market. In addition, the researchers also test the influence of the post 2010's structural reforms on the performance of the Greek market. After taking into account recent, low frequency observations and using a cointegration approach, the analysts resulted that the Greek

market operates with symmetry. According to the researchers, this result implies a competitive behavior from the suppliers' side since they were obliged to operate according to the new reforms.

Polemis (2012) focuses on the Greek gas market and investigates the asymmetric nature of how shocks on the cost of creating a product and on the exchange rate are transmitted on the retail and wholesale price. The researcher uses an error-correction technique after collecting monthly data from January of 1988 until June of 2006. Moreover, they utilize an impulse response function to examine the relationship between competition and gasoline price adjustment for the period in question. The outcomes from this research point out a positive asymmetric correlation between retail gasoline prices and changes in cost prices which is higher for upward movements, both in the short and the long run. On the other hand, the researchers identify a symmetric behavior of spot gas prices towards the adaptation to short-run reactions of the exchange rate. A final observation from the researchers is that gasoline prices revert to equilibrium after the effects of a price shock.

Filis et.al (2019) aims to point out the asymmetric relationship between the global oil prices and the Greek fuel prices. The researchers focus on both refineries and the retail fuel sector to go forth with their investigation. Their first step is to examine the probability of an asymmetric link between the international oil prices and price increases by the refineries. In addition, the researchers examine the asymmetric relations between this price increase from the retailers and alterations in the prices by the refineries. The results from this study referring to Greece, show that the price increases from the fuel retailers' side are not affected by the refined fuel prices. In contrast to the above, the researchers observe evidence of a negative asymmetric response of the refineries mark-up respectively to alteration in the international oil prices, which then seem to infiltrate to the consumers and the retailers. As a last remark, the researchers share their concern

that according to evidence that arises from this study, the use of monthly or daily data seem to be misleading and overlook possible asymmetric relationships.

Palaios and Papapetrou (2022) focus on the spillover effects between oil prices and the volatility of the oil prices in the Greek labor market. The researchers, after the use of static and dynamic quantile connectedness methodology, discover that oil prices influence hirings and firings. The researchers then proceed to discover, after the use of a VAR model, differences of the connectedness index which is significantly influenced by exogenous shocks. Furthermore, this study reveals significant spillover effects that emanate from the COVID—19 outbreak and the measures used by the government on the Greek labor market, in an attempt to deal with the pandemic. The study divulges a negative asymmetric relationship between alterations in oil prices and the Greek labor market in good and bad economic periods, rather than normal periods.

Bala and Chin (2018) concentrate on the nations of Algeria, Libya, Nigeria, and Angola to point out the existence of asymmetric effects of changes in oil prices and inflation. To proceed with their investigation, the researchers collected three different oil price data. These oil price data collected were the genuine spot oil price of single countries, the Organization of the Petroleum Exporting Countries (OPEC) oil prices and the average Dubai, West Texas Intermediate (WTI) and Brent oil prices. Short and long run effects were estimated with the use of autoregressive distribution lag dynamic panel. Evidence of this research showed that inflation has a positive response to oil price changes, especially when oil prices face a decrease. Other evidence that arose from this research implies that money supply, exchange rate and Gross domestic product have, as well, a positive relationship with inflation. On the other hand, inflation has a negative relationship with food production. Following the above results as an example, policy makers should be very careful while formulating policies during periods of oil price changes. In an attempt to reduce inflation, a reasonable policy that should be

implemented would be a contractionary monetary policy. Finally, the researchers propose governmental support towards domestic food production to achieve a reduction in inflation.

2.3. Government policies to deal with oil price volatility

Arregui et.al (2022) provide focused, applicable and practical measures to help the European households from the effects of an energy crisis. The researchers argue that the process of dealing with the challenges of an energy crisis by allowing price signals to function freely, while providing financial assistance to the people in need has very negative long run effects since most of the European governments are then forced to implement price- suppressing measures with increased fiscal costs. Targeted and easily applicable policies to make positive alterations on the current European policy structures are proposed, such as the provision of refunds on energy bills and tariff subsidies. To deal with the issue of inflation in the stock prices, assistance towards energy bills should be pared with the implementation of an offsetting fiscal policy. Such policies could include income taxation that would expand the effects of the support.

Bacon and Kojima (2006) focus on the oil price increase that was initiated in the beginning of 2004 and its negative effects on every petroleum user around the world during this period. Research evidence points out that after the increase of the global oil prices, the vast majority of developing nations faced huge pressures to minimize the negative effects and burdens from this crisis. Simultaneously, plans to limit budgetary assistance have been treated with hostility. The researchers note that the characteristics of petroleum products have a significant effect on the way people react to any policy being implemented by the government. Policies that might have a notable impact on

other products will not necessarily have the same magnitude and efficiency on petroleum products.

Baffes et.al (2015) reveal the sources of the oil price decrease that occurred in 2014 and analyze its macroeconomic, financial and policy implications. The researchers believe that the increased production of crude oil extracted through unconventional methods, the general decrease in demand for oil, the important alteration of the OPEC strategy only partially offset by the appreciation of the US dollar are some of the reasons hiding behind the oil price decrease in 2014. Concluding the researchers propose the implementation of fiscal, monetary and structural measures to sustain global growth rates and smooth inflation fluctuations.

Another research by Kojima (2009) investigates the policies implemented by each of 49 developing nations to counter the national oil price fluctuations that occurred from 2004 to 2008. The researcher's sample including nations from Africa, Asia and Latin America, follows the path paved by other researchers regarding possible countermeasures towards oil price volatility and includes the magnitude of the pass-through of global oil price increases. As of previous research, this study focuses on the level of the oil prices and volatility in various sectors linked with oil, such as the petroleum sector, agriculture, fisheries and transportation. This paper concentrates mainly on fiscal and structural policies implemented by each nation and does not underline monetary or exchange rate policies.

Aregbeyen and Fasanya (2017) examined the fiscal policies implemented by the Nigerian government to face challenges originating from the oil price fluctuations from 1970 to 2013. To go forth with their investigation, the researchers implemented a vector Auto regression model and revealed that the volatility of the oil prices had increased significantly the Nigeran government's expenditures. In addition to the above, the

researchers were able to identify a long run connection between oil prices and government spending, economic growth, inflation and discount rates. The analysts also state that with the use of an alternative methodology and the inclusion of more, different variables the results are still strong. Finally, the researchers propose the Nigerian government to buy different foreign currencies and issue local currency to the public in order to deal with the issue in question.

Alleyne et al. (2023) provided various examples on ways to reform energy subsidies. To provide the relevant information in this paper, the researchers investigated the results of 22 country case studies conducted by the IMF and additional surveys of other institutes. In the beginning of the paper, the researchers present possible barriers that the investigated countries point out against a successful subsidy reform. Such barriers are lack of information, lack of governmental confidence, weak macroeconomic conditions, concerns over negative impacts on the poor and concerns over negative economic impacts. Then the investigators point out the need for a communication strategy and transparency to enhance political and public acceptance towards the possible reforms. Finally, the paper provides possible reforms to mitigate the impact of energy price fluctuations, such as targeted cash transfers, automatic price mechanisms, smoothing rules and affordable alternative energy.

Sgaravatti et al. (2023) provided a detailed analysis of fiscal policies implemented by numerous European nations against the threats of the recent energy crisis. The researchers discuss the funding processes implemented by the investigated nations, aiming to support the households and firms from the increasing energy prices from September of 2021 until January of 2023. Moreover, the research distinguishes seven types of responses and groups them as ‘discussed’, ‘proposed’ and ‘enacted’ for each of the investigated nations. Furthermore, the researchers separate the implemented measures by each nation according to their targeted purpose.

3. Data collection and methodology

3.1. Data collection

To advance with our research, we use monthly, hand collected data for a 10-year period, starting from January 1st of 2012 until December 31st of 2022. Data on the global oil prices and the natural gas prices are collected from accessible data provided by the International Monetary Fund[1]. Data regarding the Greek Consumer Price Index and the Greek interest rates are extracted from the Bank of Greece[2,4]. The Greek unemployment rate's data and the Greek PPI rates are collected from the Hellenic Statistic Authority[3] and the data regarding the last independent variable of the model, which is Industry Utilization Index of Greece, is extracted from the Foundation for Economic and Industrial Research (IOBE). It is necessary to mention that, as expected, the Brent oil prices and the natural gas prices are extracted in USD, then transformed in euros per barrel (for oil) and

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[1] We use OIL and GAS data which are available here: **https://www.imf.org/en/Research/commodity-prices**

[2] We use CPI data which are available here: **https://www.bankofgreece.gr/en/statistics/domestic-economy-prices**

[3] We use PPI data and UR data that are available here: **https://www.statistics.gr/en/statistics/eco**

[4] We use IR data that are available here: **https://www.bankofgreece.gr/statistika/nomismatikh-kai-trapezikh-statistiki/epitokia-katathesewn-kai-daneiwn**

euros per million metric British thermal unit (for gas) respectively, after the use of monthly euro/dollar exchange rate's data that are derived from DataStream. After gathering the data needed for this project,132 monthly observations were obtained for each one of the above variables, enabling us to go forth with the specification of our model.

Table 1 – Variables

Panel A: Description of variables

Variable	Coding	Definition
Consumer Price Index	CPI	Consumer price index of Greece
Producer Price Index	PPI	Producer price index of Greece
Price of Brent Oil	OIL	Price of Brent crude oil in € per barrel
Price of Natural Gas	GAS	Price of natural gas in € per million metric British thermal unit
Interest Rates	IR	Weighted average of Greek interest rates on new loans in euros
Unemployment Rates	UR	Unemployment rate of Greece

Utilization Rates	TR	Industrial capacity utilization rates of Greece

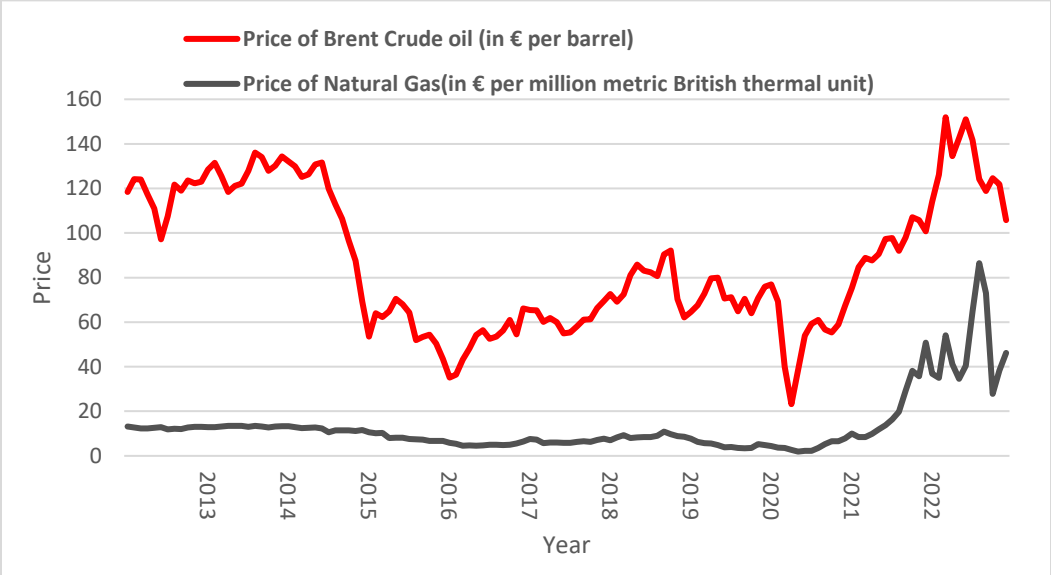
Panel B of Table 1, presents the descriptive statistics for the variables used in our study (Oil and Gas prices are expressed in euros per barrel and euros per million metric British thermal unit respectively, after the implementation of the Eurodollar exchange rate's data).

Panel B: Descriptive statistics

	Mean	Median	Maximum	Minimum	Std. Dev.
CPI	102.13	101.17	114.47	97.81	3.43
PPI	106.06	104.05	142.00	89.20	10.29
OIL	87.20	79.78	151.93	23.21	31.01
GAS	13.15	8.73	86.46	1.92	13.79
IR	4.81	4.79	6.63	3.71	0.66
UR	21.10	21.70	29.30	10.80	5.01
TR	69.65	69.38	79.60	61.29	4.08

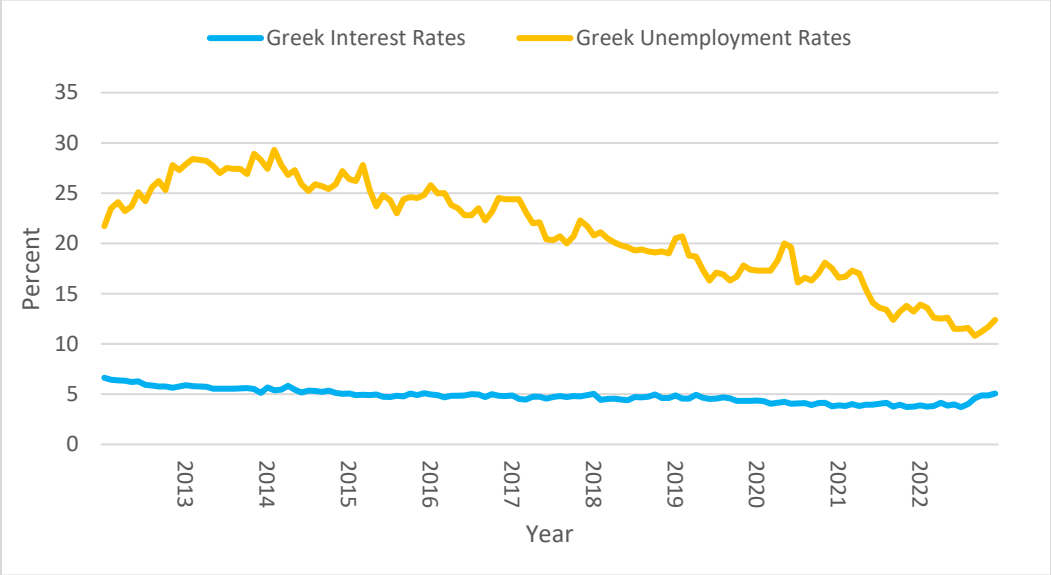
Figure 3. presents the prices of Brent Crude oil and the European gas prices, Figure 4. depicts the Greek interest rates and the Greek unemployment rates, while Figure 5. shows the Greek industrial capacity utilization rates for the 10-year period in examination, from January of 2012 until December of 2022.

Figure 3. Price of Brent Crude oil (in € per barrel) and price of Natural Gas (in € per MMBTU).



Sources: IMF and Student's Calculations after the use of the respective collected data regarding the period from 2012 until 2022.

Figure 4. Greek interest rates (in %) and Greek unemployment rate (in %).



Sources: Elstat, Bank of Greece and Student's Calculations after the use of the respective collected data regarding the period from 2012 until 2022.

Figure 5. Greek industrial capacity utilization rates.

Sources: Foundation for Economic and Industrial Research (IOBE) and Student's Calculations after the use of the respective collected data regarding the period from 2012 until 2022.

3.2. Methodology

3.2.1. Main model

As already discussed, the main purpose of this study is to identify the effects of global oil and gas price fluctuations on the Greek consumer and producer inflation rates from January of 2012 until December of 2022. For the purposes of our study, we assume the following equations respectively:

$$\boldsymbol{CPI_{t+1} = \beta_0 + \beta_1 OIL_t + \beta_2 GAS_t + \beta_3 IR_t + \beta_4 UR_t + \beta_5 TR_t + \varepsilon_t} \quad (1)$$

$$\boldsymbol{PPI_t = \beta_0 + \beta_1 OIL_t + \beta_2 GAS_t + \beta_3 IR_t + \beta_4 UR_t + \beta_5 TR_t + \varepsilon_t} \quad (2)$$

Where CPI is the Consumer Price Index of Greece, OIL is the price of Brent crude oil in euros per barrel, GAS is the Price of natural gas in euros per million metric British thermal, IR represents the Greek interest rates, UR is the Greek unemployment rates, TR represents the Greek industrial capacity utilization rates and ε_t is the error term .As far as it concerns the above equations, IR, UR and TR are control variables that are in line with the relevant literature framework and are included to enhance the efficiency of our model.

First, the implementation of a set of pre-tests to be able to continue with our analysis is considered as a necessity. The initial step is to run a set of unit root tests in order to identify the integration sequence of the variables included in the study's model and avoid the existence of I(2) series. The two test that are implemented to deal with this issue are the Augmented Dickey Fuller test and the Kwiatkowski- Phillips -Schmidt- Shin test (ADF

and KPPS tests respectively). After the implementation of the ADF and KPSS tests and the verification of existence or absence of a unit root in the series, we will be able to determine if the series is stationary or not. Once the first step of this process is completed, we use the Ordinary Least Squares method (OLS) to estimate equations (1) and (2) and identify the effects of our independent variables on the Greek producer and consumer inflation.

3.2.2. Asymmetric effects

A very important issue that is highly linked with the main question of this paper is whether domestic consumer and producer inflation respond asymmetrically to the global oil and gas price fluctuations, or, in other words, whether the sign and significance of the impact is different during separate periods. This question has triggered the interest of multiple researchers due to its importance. According to the relative literature, most researchers seem to focus more on the effects that oil price changes have on inflation and less on possible asymmetries that may exist between gas price volatility and domestic prices. By identifying the existence or absence of such asymmetries between domestic inflation and global energy price volatility, policy makers can draw evidence on whether domestic markets are suffering from lack of competition. The existence of an asymmetric link in the domestic price adjustments may have severe negative results for the consumers, to the extent that final prices adjust quicker and to a fuller extent in cases of energy price hikes, compared to energy price drops. This could come with significant consequences for the economy. In the face of such a threat, it is essential for the relative authorities to take regulatory measures in a way that enhances competition. In a case of recession, this behavior by the authorities becomes even more critical, since during such periods of economic crisis, consumers are burdened by reductions in their income and standard of living. Understanding the importance of this issue and for the purposes of the secondary topic of this paper, we proceed to identify the asymmetric, or symmetric, impact of global

oil and gas price fluctuations on the Greek consumer and producer inflation. The estimation covers the same ten-year period that we used to investigate the relationship between the global oil and gas price volatility and the Greek domestic inflation.

Since we were able to identify the positive effects of global oil and gas price fluctuations on the Greek domestic inflation we can now proceed with the secondary topic of our research. We apply the already collected data that were used for the purposes of the main research question of this study, and we begin the formulation our new model.

The model aims to capture the asymmetric effects that arise from the global oil and gas price changes. Based on the empirical evidence of Cunado and Gracia (2005), we assume a non-linear specification model that includes four dummy variables, capturing the upside and downside fluctuations of global oil and gas prices over the ten-year period in question. Such a model can be specified as follows:

$$\boldsymbol{CPI_{t+1} = \beta_0 + \beta_{11} * OIL * dumUPoil_t + \beta_{12} * OIL * dumDOWNoil_t + \beta_{21} * GAS * dumUPgas_t + \beta_{22} * GAS * dumDOWNgas_t + \beta_3 X_t + \varepsilon_t} \quad (3)$$

$$\boldsymbol{PPI_{t+1} = \beta_0 + \beta_{11} * OIL * dumUPoil_t + \beta_{12} * OIL * dumDOWNoil_t + \beta_{21} * GAS * dumUPgas_t + \beta_{22} * GAS * dumDOWNgas_t + \beta_3 X_t + \varepsilon_t} \quad (4)$$

Were β_i represents a vector of long run coefficients. The variables dumUPoil and dumDOWNoil represent dummies that take a value equal to one in case the oil price level increased or decreased over a specific month respectively. Similarly, to the above, dumUPgas is a dummy variable that takes the value of 1 if the gas prices have increased over a specific month, while dumDOWNgas represents a dummy variable that is equal to 1 if the gas prices have decreased over a specific month.

4. Empirical findings and discussion

4.1. Main model

Proceeding with the empirical part of the dissertation, we perform ADF and KPSS stationarity tests for our variables at level and at first difference, adjusting constant and time trend in both methods. The findings of the respective tests are presented in Table 2. Through the interpretation of the ADF test results we can identify that Brent crude oil prices and Greek interest rates become stationary only after being transformed to first difference. At the same time, natural gas prices, Greek interest rates and Greek utilization rates remain stationary before and after being converted to the first difference. As far as it concerns the variable regarding the Greek PPI, it seems to be stationary at level but nonstationary when converted to first difference. Given the above conditions, we can say with certainty that the mentioned variables are I(1). On the other hand, the Greek CPI seems to contain a unit root, both at level and at first difference. As a next step, the implementation of the KPSS test gives more valuable feedback on the nature of the variables. According to the results presented in Table 2, the KPSS test identifies stationarity at first difference for the Greek PPI, oil prices, the Greek interest rates, and the Greek unemployment rates. Furthermore, our second unit root test reveals stationarity at both level and first difference for the Greek utilization rates, while gas prices remain non-stationary at level and first difference. The Greek CPI seems to contain a unit root at level but appears to be stationary at 5% level of significant after being converted to first difference. Taking the above results under consideration we identified the variables that need to be converted to first difference and become I(1) and we can continue with the estimation of equations (1) and (2).

Table 2. ADF and KPSS tests

Stationarity tests				
	Level		First Difference	
Variable	ADF	KPSS	ADF	KPSS
CPI	-0.074 [0.041]	0.232***	-0.663 [0.263]	0.144*
PPI	-0.035 [0.020]	0.236***	-0.699*** [0.088]	0.069
OIL	-0.045 [0.022]	0.259***	-0.924*** [0.110]	0.056
GAS	-0.433** [0.112]	0.237***	-1.568** [0.431]	0.164**
IR	-0.581 [0.073]	0.171**	-1.640*** [0.138]	0.097
UR	-0.216*** [0.047]	0.217***	-2.095*** [0.323]	0.101
TR	-0.305*** [0.063]	0.081	-1.187*** [0.086]	0.071
Note: Figures in [ ] are standard errors. *, **, and *, indicate significance at the 10%, 5% and 1% levels, respectively.**				

Following the results of the stationarity tests, CPI, PPI, OIL and GAS are converted to the first percentage difference and both system equations are estimated though the implementation of an ARMA model specification by taking under consideration the Akaike Information Criterion (AIC) and the Schwartz Information Criteria (SIC), to correct for arising autocorrelation and bring the Durbin Watson coefficient close to 2. For the selected ARMA specification, we use one period lagged explanatory variables for the case of the Greek consumer inflation, since the prices of goods and services need some time to adjust to inflation effects. On the other hand, for the relative model concerning the Greek PPI we use contemporaneous explanatory variables. The slower adjustment of CPI in the face of inflation can be assumed by the investigation of O'Takoun and Ramachandran (2022), who revealed how rising producer prices have a positive impact on consumer prices over time. As already mentioned, equation (1) aims to capture the relationship between our independent variables and the Greek CPI, while equation (2) intents to identify a link between our independent variables and the Greek PPI. The results of the respective equations are presented in Table 3.

Table 3. CPI and PPI Regression Results

Equation Estimations		
Independent variables	Dep. Var. CPI_{t+1}	Dep. Var. PPI_t
PDOIL	0.005 ***[0.022]	0.074 ***[0.003]
PDGAS	0.001***[0.0005]	0.004* [0.002]
DIR	-0.005***[0.002]	0.013 [0.01]

UR	-0.0001 [0.0005]	-0.003***[0.0005]
TR	0.0001 [0.0001]	0.001***[0.0005]
Specification	ARMA (1,0)	ARMA (1,0)
R squared	97.3	96.05
Number of observations	132	132
Note: Figures in [ ] are standard errors. *, **, and *, indicate significance at the 10%, 5% and 1% levels, respectively.**		

By looking at the results presented on Table 3, we can see that oil and gas prices are both significant at 1% level of significance while defining the Greek CPI. Concerning the Greek PPI, oil prices are significant at 1 % level of significance while the gas prices variable is significant at 10% level of significance. The impact of oil price fluctuations is higher on the Greek producer prices. More specifically, 1% increase in oil prices would result in a 0.5 ppt increase of Greek CPI and a 7.4 ppt of Greek PPI in the subsequent month. This positive impact of larger global oil prices towards domestic producer inflation is reasonable, since oil price increases force the manufacturers of consumer goods to raise their prices, so that they are able to cover the extra expenses linked with production and transportation procedures (Renou-Maissant, 2019). Moreover, aside the mentioned direct effects linked with the producers' side, rising oil prices have an indirect effect on domestic consumer inflation that passes through a spillover effect from the already positively affected PPI to CPI (Pistilli, 2022). Regarding our findings, similar responses of domestic inflation against oil price changes have also been observed by Renou-Maissant (2019) for the cases of USA, Japan, Australia, Canada, UK, France, Italy and Germany, after the implementation of a nonlinear autoregressive distributed lag model (NARDL) and the

use of lagged variables to capture inflation persistence over time. This positive impact of global oil prices towards domestic inflation has also been observed by Husaini et. Al. (2021) for the cases of Indonesia, Malaysia and Thailand after the use of a similar methodology as Renou-Maissant, but with contemporaneous variables. Additionally to the above, historical evidence point out a significantly more effective impact of oil price volatility on the prices of goods at a wholesale level (Pistilli, 2022). In accordance with the Federal Reserve Bank of St. Louis (FRED), data regarding the link between oil prices and inflation for the case of the US economy from 1970 until 2017, suggest a correlation of 0.71 regarding oil price level and US producer inflation. Simultaneously to the above, the same data reveal a 0.27 correlation between oil prices and US's consumer inflation (FRED,2022).

Table 3 also points out that gas price fluctuations have a more pronounced impact on the Greek producer inflation rather than the Greek consumer inflation, but not as powerful as the impact of oil prices. In greater detail, a 1-unit increase in gas prices would result in a 0.1 ppt increase on consumer inflation in the subsequent month, and a 0.4 ppt increase in PPI in the same month. Gros and Shamsfakhr (2022) have identified this relationship between gas prices and domestic inflation for Germany, Spain, France, Italy, Poland and Estonia by using both lagged and contemporaneous variables. It is worth mentioning that, by using the same methodology, the researchers were also able to point out a positive relationship between global oil prices and national inflation for the same European nations, giving a strong leverage to our findings related to this topic.

As far as it concerns the additional explanatory variables of our model, the Greek unemployment and utilization rates appear to be insignificant when it comes to the case of the Greek CPI. On the contrary, they both seem to be significant at 1% level of significance and have a small effect on the Greek PPI. An increase on the Greek unemployment rates by 1 percentage point will have a negative impact on the Greek

producer prices by 0.3 ppt. This negative relationship between unemployment rates and inflation has been proven by Bhosale (2016), but it can also be identified as a reasonable outcome, taking under consideration the concept of the Phillips Curve that suggests an inverse relationship between unemployment and inflation. On the other hand, for this study, an increase of 1 percentage point of the Greek industry utilization rates, which means producing closer to full capacity, causes a positive effect of 0.1 ppt on the Greek PPI. This small, positive link utilization capacity and inflation has been proven by Storrie et.al (2019), who revealed that utilization capacity and inflation move towards the same direction, after using data regarding the US economy for the period between 1984 and 2018. Referring to the same relationship, Dotsey and Stark (2005) discovered that the significance that underlines the link between utilization capacity and inflation can change from time to time after studying US data. The researchers claim that this lack of robustness between those variables can be explained by the different effects of dissimilar policies implemented by the respective authorities over a period. This can explain the difference in significance between utilization rates, PPI and CPI presented in Table 3. As a last remark relative to our model, Greek interest rates have a negative and significant impact on the Greek CPI and a positive, though insignificant effect on the Greek PPI. The inverse relationship between interest rates and CPI that is presented in our model is sensible since raising interest rates tend to reduce overall money supply and the level of demand for goods and services, which in turn reduces inflation. This tendence of interest rates and inflation to move on a separate direction is also mentioned by Jahan (2012) in attempt to present the effects of inflation targeting policies referring to multiple nations. According to Table 3, 1 ppt increase on the Greek interest rates results to a decrease of 0. 5 ppts on the Greek CPI.

The R squared of 0.973 for the equation (1) implies that 97.3% of the total variation in Greece's consumer inflation rate is explained by the independent variables of the model.

Regarding equation (2), the R squared of 0.9605 suggests that 96.05 % of Greece's producer inflation rate is explained by the independent variables of the model. We can thus say that the explanatory variables of the model explain a large share of the variation of consumer and producer inflation in Greece.

4.2. Asymmetric effects

The first step before proceeding with the estimation of equations (3) and (4), would be to perform a set a stationarity tests to ensure that our model does not suffer from non-stationarity issues. With the results we have calculated for the first part of the dissertation by using the ADF and KPSS stationarity tests, we are already aware about the nature of the independent variables included in equations (3) and (4). As far as it concerns the dummy variables introduced to capture the asymmetric impact between global energy price changes and inflation, they cannot be non-stationary. However, we use the ADF and KPPS tests one more time to ensure that this generalized statement holds for this model. The dummy variables are examined on level and the results are presented on Table 3.

As expected, the variables concerning the increasing and decreasing oil price changes are I(1) at level according to both stationarity tests in use. Nevertheless, the ADF test results reveal non- stationarity issues for the additional dummies which capture the fluctuation of gas prices. This could be explained by the fact that both dummy variables are very stable and, as a result, the ADF test identifies them as heavily autoregressive. Contradicting the above finding, the KPSS test views both dummies as stationary at level.

Table 3. ADF and KPSS tests

Stationarity tests	
	Level

Variable	ADF	KPSS
PDOIL*DUMUPOIL	-0.208 *** [0.056]	0.146
PDOIL*DUMDOWNOIL	-0.208 *** [0.056]	0.146
PDGAS*DUMUPGAS	-0.109 [0.049]	0.193
PDGAS*DUMDOWNGAS	-0.109 [0.049]	0.193
Note: Figures in [ ] are standard errors. *, **, and *, indicate significance at the 10%, 5% and 1% levels, respectively.**		

After the results of the stationarity tests, we proceed to convert CPI, PPI, OIL and GAS to the first percentage difference and estimate equations (3) and (4) though the implementation of an ARMA model specification after using the AIC and SIC. In addition, we include the four selected dummy variables, DUMUPOIL, DUMDOWNOIL, DUMUPGAS and DUMDOWNGAS. Table 4. Provides the results of the model.

Table 4. CPI and PPI Regression Results

Equation Estimations		
Independent variables	Dep. Var. CPI_{t+1}	Dep. Var. PPI_{t+1}

PDOIL*DUMUPOIL	0.003 ***[0.001]	0.062 ***[0.003]
PDOIL*DUMDOWNOIL	0.016*** [0.005]	0.1903***[0.037]
PDGAS*DUMUPGAS	0.001*** [0.0006]	0.003* [0.002]
PDGAS*DUMDOWNGAS	-0.003 [0.002]	-0.001 [0.035]
DIR	-0.004***[0.002]	0.004 [0.009]
UR	-0.0001 [0.0005]	-0.003***[0.001]
TR	0.00001 [0.0001]	0.001***[0.0003]
Specification	ARMA (2,2)	ARMA (2,1)
R squared	97.5	96.7
Number of observations	132	132
Note: Figures in [ ] are standard errors. *, **, and *, indicate significance at the 10%, 5% and 1% levels, respectively.**		

The outcomes of the non-linear specification model reveal some interesting results regarding the asymmetric impact of oil price changes on the Greek domestic inflation. First of all, by looking at Table 4, we can identify that both increasing and decreasing oil price changes have a positive, asymmetric effect on the Greek CPI and PPI. The model indicates that 1% oil price shock during periods of increasing oil prices, is associated with 1-month lagged Greek CPI increases by 0.3 ppt, while in periods of decreasing global oil prices, it is associated with Greek CPI increases by a larger 1.6 ppt. At the same time, the coefficients of the respective dummy variables are significant at 1% level of significance. Regarding equation (4), 1% increase in oil prices is associated with contemporaneous PPI

increases equal to 6.2 ppts, while 1% drop of oil prices, is associated with a much more sensitive response of the Greek PPI by 19.03 ppts. Such positive asymmetric relationship between oil price changes and domestic inflation has also been identified by Bala and Chin (2018) who successfully presented the asymmetric effects of oil price volatility on the domestic inflation of Algeria, Angola, Libya and Nigeria.

Concerning the relationship between gas price volatility and the Greek domestic inflation, by looking at Table 4 we can pin out that during periods of increasing gas prices there is a reasonable positive effect on the Greek producer and consumer inflation. To be more precise, global gas price increases are associated with 1-month lagged Greek CPI increase by 0.1 ppt. During similar time periods, the Greek PPI seems to increase by 0.3ppt. At the same time, the coefficient of increasing gas prices is significant at 1% level of significance when it comes to define the Greek CPI, while it also seems to have a significant impact on the Greek PPI at a 10% level of significance. While gas price increases affect both consumer and producer inflation with one and zero month lag respectively, findings suggest that gas price drops do not have a significant impact on either CPI or PPI in Greece. Taking under consideration the above findings and the insignificance that underlines the coefficients linked with negative changes on gas prices, we conclude that there is a striking asymmetric relationship between gas price fluctuations and inflation trend, depending on the sign of the gas price change.

The remaining explanatory variables of the model seem to behave similarly to the results presented for equations (1) and (2). In greater detail, a 1 ppt increase on Greek interest rates results to a decrease by 0.4 ppt on the Greek CPI in the subsequent month, significant at 1% level of significance. Contrary to the above, interest rates do not have a significant effect on the Greek producer inflation. A 1 ppt increase on the unemployment rate of Greece has a negative effect on both Greek CPI and PPI, equal to 0.01 ppt and 0.3 ppts, respectively. Similarly to the results of the model in the previous section, the effect

of unemployment rates on the Greek CPI is insignificant, while its effect on PPI appears to be significant at 1% level of significance. Lastly, the Greek industry's utilization rates have an insignificant impact on the Greek consumer inflation and a small, positive, significant impact on the Greek producer inflation. According to the findings of Table 4, a 1 ppt increase on the Greek industry's utilization rates (meaning industrial companies producing closer to full capacity) results to a 0.1 ppt increase on the Greek PPI.

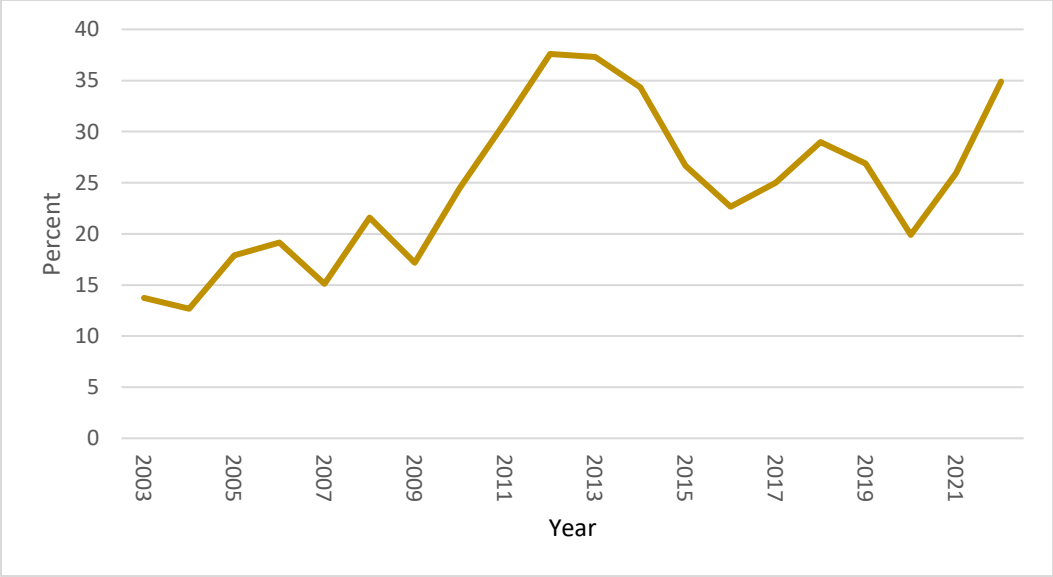
Equation (3) has an R-squared equal to 0.975 which indicates that 97.5 % of the total variation of Greek CPI can be explained by the selected independent variables included in the model. Furthermore, the R-squared of equation (2) equal to 0.967 implies that 96.5% of the total variation of the Greek producer inflation is explained by the independent variables of the model. With such high R-squared indicators, the explanatory variables of the model explain a large share of the variation of consumer and producer inflation in Greece.

5. Policy evidence from Greece and abroad

Throughout recent years, the production of oil in Greece has decreased significantly, forcing the county to depend on large quantities of imported crude oil in order to meet the needs of the Greek households and businesses. According to the Greek Energy Market Report of 2022 that was initiated by the Hellenic Association for Energy Economics (HAEE) and the National Bank of Greece concerning the Greek energy sector, the main crude oil sources for Greece originated mainly from Iraq and Russia, which respectively contributed to 36% and 18% of the total crude oil imports for Greece during 2022. Thus, as an oil importing nation, Greece is highly exposed to global oil price fluctuations which can cause severe problems for the nation's economy. This state of the Greek nation should be alarming considering the highly volatile global energy

market during 2022. Figure 6. that follows presents the fuel imports of Greece for the latest 20-year period, from 2003 until 2022.

Figure 6. Fuel imports of Greece (% of merchandise imports).



Sources: World Bank and Student's Calculations after the use of the respective collected data regarding the period from 2012 until 2022.

From 2021 to 2022, the global prices of non - renewable energy sources have faced a significant increase. The starting point of this state was initiated after the outbreak of the COVID-19 pandemic, since the global demand regarding fossil fuels started to rise again while the supply remained low to its "pandemic" levels (IMF, 2022). The price increases in the energy sector met even higher levels due to the invasion of Russia to the land of Ukraine in February of 2022. A key factor behind this historically high energy price levels was the fact that Russia has always been the main supplier of energy sources towards global markets and this dependency became visible a few months after the

invasion since the prices of crude oil, coal and especially natural gas increased dramatically (Ari et al,2022). In addition to the above, even more pressure was put on the global oil market after the OPEC statement on the beginning of April 2023, announcing a stunning cut of crude oil production, estimated at more than 1.2 million barrels per day, in an attempt to counter the global decrease in demand and their fear regarding the possible outbreak of global recession due to the turmoil in the US and Swiss banking sectors in March 2023 (OPEC, 2023). This decision from Russia, Saudi Arabia and their oil-producing allies was expected to heighten pressure on global inflation, challenging monetary authorities and many nations around the world that amongst other issues, have been taking measures to combat inflation, in aim to protect their citizens and businesses from the effects of such a crisis. Greece, as every oil importing nation, has been challenged by the crisis, inter alia because of its reliance to the Russian energy market. The application of targeted, accurate and applicable policies is a vital priority that must be adopted by the Greek government to deal with the current state of the global energy sector and its effects on the Greek economy.

5.1. Past measures

On the 14th of September of 2021, the Greek government supported the Greek households and businesses by providing subsidies on their electricity bills. The initial value of the subsidy that was 9 euros for the first 300 kilowatt per hour, was then increased up to 42 euros for the first kilowatt per hour and 65 euros for every megawatt per hour by the beginning of 2022, for the Greek households and businesses respectively. The already established discount policy was also boosted by various retails, including the Public Power Corporation. Simultaneously, numerous heating allowances were expanded and granted to 1 million beneficiaries from around 600,000 in 2020. Until December of 2021, the Special Support Fund was able to shield the Greek consumers by providing a notable

amount of funds to cover the topic of energy alterations. 100 million euros originating from the Recovery and Resilience Fund were also granted to the citizens for the establishment of photovoltaic stations to provide a source of energy to the needful households (Sgaravatti, 2022). As of 2022, the Greek government focused on aspects concerning natural gas, providing subsidies for both households and businesses. In March of the same year, the subsidies that were offered to the Greek industry sector and businesses failed to cover the sharp increase in electricity prices that were triggered after the Russian invasion in the nation of Ukraine. According to estimations by Reuters, 3.6 billion euros were spent by the Greek government over a year for purposes linked with subsidies and financial assistance towards poor households. Halfway through 2022, an additional package of 3.2 billion euros was announced by the Greek Finance Minister to give a boost to Greek households and businesses against the increasing energy prices. Finally, not only did the government adopt policies in order to limit electricity costs but also covered the expenses of the Greek electricity consumers for the surcharges that they had already paid from December of 2022 to May of 2022 (Giovanni Sgaravatti,2023). All in all, public debate and criticism occasionally focused on the degree of targeting and adequacy of the measures.

5.2. Forward looking and recommendations

5.2.1. Effective use of fiscal resources

As a first suggestion, the Greek government should consider implementing targeted measures in order to minimize the impact of increasing oil prices on struggling households with low income. To be able to turn these measures into reality, the Greek authorities must evolve or create new social programs to shield the needful households. Such programs could include targeted cash transfers that offer the advantage of

purchasing the amount and type of energy sources that best meet the nation' s needs during a period of increasing oil price level. Through the above policy, the Greek government could protect the vulnerable households with a relatively low amount of costs due to the procedure (Grosh et al,2008). Many historical examples can underline the importance of targeted cash transfers, especially in the cases of Indonesia and Chile. In 2005, Indonesia experienced a staggering increase as far as it concerns its fuel prices. In order to convince the citizens of the nation and avoid further conflicts, the government of Indonesia proceeded to offer a cash transfer program to aid the poor population. In addition, the Indonesian authorities put a lot of emphasis on informing the nation regarding this compensation tool by forming multiple campaigns with clear instructions (Reuters,2008). During the same year, a similar compensation mechanism was implemented by the Chilean government in an attempt to deal with the increasing world oil prices. A notable remark according to the events that followed, is that a targeted cash transfers mechanism can be very effective if monitored with caution.

Another approach that can assist the Greek government against the issue of increasing world oil prices, is the implementation of smoothing mechanisms. Smoothing mechanisms can be distinguished between price brand (PB) mechanisms and moving average mechanisms (MA). PB mechanisms are of high importance, since they minimize the effects of global oil price changes on the domestic retail prices. For instance, by implementing this smoothing mechanism, if we assume a 2% price band and the global oil prices increase by 10%, the changes of the domestic retail prices would face a small increase of 2%. If the global oil prices stay the same for the period to come, the domestic retail prices will still face a small increase of 2%. As expected, this allows the domestic retail prices to have a smooth adjustment to the increasing global oil price levels and minimize their negative effects. Similarly to the PB mechanisms, MA mechanisms can also reduce the effects of global oil price changes by relying on the average cost of past

imports. An MA mechanism mainly sets retail prices based on the average import costs from a previous period, secures the full pass-through of these alterations, avoids the long-lasting maintenance of fixed prices and finally eliminates the chance of a further increase in the domestic prices in case of possible everlasting international oil price increases (Coady et al.,2013).

5.2.2. Diversification of energy sources

To deal with the current and future emerging oil prices, Greece can also consider the implementation of alternative energy sources. The attractiveness of this long-term policy will become more appealing as the world oil prices continue to remain volatile or high and it is already viewed as a very efficient tool for every government. Wind energy, solar energy and biofuels are some renewables that can be used to minimize the dependence of every Greek household and business against the use of oil (Bacon and Kojima,2006). However, a very important standard that must be covered in advance to secure the effectiveness of such a policy is the necessity of targeted spending from the producer's side towards new capital equipment and applications that allow the introduction of the new energy sources. With the creation of the RePowerEU plan, the European Commission gives emphasis on the investment and sharing of alternative energy sources, in an attempt to minimize the European dependency from the Russian energy market and archive a 'greener' future (European Commission, 2022). It is estimated that in order to meet the objectives of the RePowerEU plan, investments up to 300 billion euros will be necessary till the end of 2030. Some of the nations that have already started implementing similar policies are Italy, which has focused on the establishment of photovoltaic and wind renewables, and Belgium, where the government

has also started increasing investments towards renewable energy sources through spending 1 billion euros for projects in relation to wind and solar energy (Alleyne et al.,2013). Fiscal incentives and broader green tax policy reforms for meeting climate targets, licensing simplification and supervision.

Highly correlated to the alternative energy source policy, the implementation of regulations aiming to speed up the process of transitioning towards zero emission vehicles and efficient buildings can also be a very helpful tool regarding the relevant topic. In contrast with the power and industry sectors, transportation and building sectors are more resistant against energy price volatility and thus more complex when it comes to the achievement of their independence from fuel energy sources. The solution to this problem comes with the adaptation of fiscal incentives and regulations (Alleyne et al.,2013). An example of such incentives is the declaration of strict vehicle tax systems, that encourage the citizens of a nation to focus their interest on electric vehicles. It is notable to mention that this transition is now considered so important, not only for resisting against the increasing world oil prices, but also for environmental reasons. In Sweden, the government even took the initiative to provide funds that are estimated at 370 million euros to encourage the purchasing of electric vehicles (Sgaravatti et al., 2022). Concerning the building sector, the elimination of emission demands can be initiated through the adjustment of efficient characteristics to new buildings. Real estate taxes set by the Greek government can also set more demanding emission standards and energy ratings to encourage reconstruction (Alleyne et al.,2013). With Germany's ruling coalition agreement, identical measures were implemented by the German government earlier this year including the replacement of gas boilers with heat pumps, new heating systems and expansion of biogas production for every new building constructed (Sgaravatti et al., 2023).

As already mentioned briefly, the trustworthiness and long-term strategy of a government is a very important aspect since it is a prerequisite for investments and affects the level of public support on the polices that aim to counter the increasing global oil prices. If the government fails to convince the citizens regarding the usefulness of the implemented policies, then these policies will face resistance in implementation and this will result to ineffective outcomes. Policies that include harsh measures must be accompanied by alternative benefits. For instance, a hypothetical policy that removes subsidies can become more appealing to the public if followed by an increase in targeted welfare expenditures (Alleyne et al., 2013). In the case of Greece, the government has implemented various policies in the past that have led to disappointing results and have been forced to be withdrawn after strong opposition from the people. For Greece to be able to implement the policies needed to deal with the problem of volatile world oil prices while having the support of the Greek people, a more intensive and transparent information campaign is mandatory. Besides, the government should review and reform past policies that failed to meet their objectives or develop new ones leading to a successful outcome by communicating all of them in a proper way.

6. Conclusions

The oscillation of energy prices has always been a very concerning issue in the global economic world. The pass-through effects of energy price changes on a country's domestic inflation could affect its economic wellbeing and cause various disruptions. Following the importance of this relationship, this paper attempts to identify the impact of global oil and gas prices changes on the national inflation rates of Greece from January of 2012 until December of 2022. In addition to the above, this research also seeks to investigate possible asymmetries between the global oil and gas price changes and the

Greek consumer and producer inflation, while the final part of the dissertation contains suggestions for the Greek government to counter any negative impacts linked with future global oil price changes. For the purposes of the main question, after formulating our equations and applying the necessary pre-tests, we use an ARMA model specification to estimate the relationship between global oil and gas price changes and the Greek domestic inflation. The results point out the positive impact that global oil and gas price changes have on the Greek consumer inflation with one period lag and on producer inflation contemporaneously. At the same time, the impact of oil and gas price changes seems to be more significant for the case of the Greek PPI. The above findings are aligned with the relevant literature, since the exact same effects have been observed for various other economies and different nations, such as Indonesia, Malaysia and China. Following a non-linear specification model that includes a set of dummies, capturing the upward and downward fluctuations of the global oil and gas prices, allowing us to identify the existence of any asymmetries of the association between the dependent and independent variables of our model. Surprisingly enough, our findings reveal that oil price changes have a positive, asymmetric effect on the Greek domestic inflation rates, since oil price changes appear to have a positive effect on the Greek domestic inflation which is larger during periods they decrease. With respect to the relationship between global gas prices and the Greek consumer and producer inflation, our model divulges that during periods of increasing gas prices, there is a positive effect on the Greek PPI and CPI. At the same time, gas price drops turn out to have no effects on the Greek domestic inflation rates, pointing out another asymmetry. These findings are in line with the relevant literature, that engages with nations such as Algeria, Angola and Nigeria.

The final part of the dissertation takes under consideration the above findings and, after providing information regarding recent policy evidence from Greece and abroad, proposes a number of policies that could protect the Greek households and

businesses against global energy price shocks. One approach presented refers to the use of fiscal resources in an efficient way, which could be achieved by the implementation of targeted cash transfers and smoothing mechanisms. Furthermore, this paper presents additional ideas linked with the diversification of energy sources. In greater detail, such diversifications could include the use of alternative sources of energy to minimize the dependence of the Greek households and businesses from oil and gas. Another solution included refers to green transition policies through the implementation of green tax policy reforms. Finally, this dissertation highlights the importance of the credibility of the government, which is necessary to enable the adaptation and the success of the recommended policies.

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