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Oil Price Shocks and Stock Market Returns:

A study on Portugal, Ireland, Italy, Greece and Spain

Supervisor:

Martin Strieborny

Authors:

Anette Brose Olsen
Paul Henriz

ABSTRACT

Following the oil price shocks of the 1970s, a great deal of research has been focused on the relationship between oil price changes and macroeconomic variables. However, the body of literature focusing on oil price shocks and stock markets are more limited. In our thesis, we have decided to focus on five OECD countries: Portugal, Ireland, Italy, Greece and Spain, commonly known as the PIIGS economies in financial markets due to their high levels of debt and budget deficits in the aftermath of the Eurozone crisis of 2008/2009.

The primary purpose of this study is to examine the relationship between oil price shocks and stock market returns. We employ an unrestricted vector autoregressive (VAR) model containing five variables in order to assess the different effects. We have chosen a linear specification of the world real oil price, and also included other variables connected to stock market returns. These variables are short-term interest rate, long-term interest rate and industrial production. The sample period contains monthly observations from 1993m07 to 2014m01. We have also divided the sample into a subsample covering the years from 1993m07 to 2008m08, to be able to compare the period with and without the financial crisis. Our main results show indications of a negative impact of linear oil price shocks on real stock returns in all countries. This effect was, however, statistically insignificant. The same applies for the interest rates. When dividing the sample, and excluding the financial crisis, we saw from the forecast error variance decomposition results an increase in the contribution of the real oil price to the variability in real stock returns.

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1. Introduction

Following the 1970's, the until then, fairly steady oil price behavior changed and there was an increased interest in investigating the relationship between the oil price and macroeconomic variables. One of the first to examine this relationship was Hamilton (1983) demonstrating a negative relation between the oil price and economic growth. Jones and Kaul (1996) made a contribution to the literature on oil price and stock markets by demonstrating a negative oil price effect on aggregate stock returns. Since then, there is a growing body of literature on the subject employing different samples, time periods and estimation techniques. Furthermore, there are also variations in which variables that are included in the analyses. Besides including the variable on the oil price, there is an understanding on the importance of including other variables that also might be able to explain changes in stock market returns. In this context, previous studies on the oil price effect using a VAR model have included variables such as short-term interest rates, industrial production and inflation rates.

In our thesis, following existing literature e.g. Sadorsky (1999) and Park and Ratti (2008), we will be investigating the effect of oil price shocks on real stock returns in five OECD countries. We have decided to focus on Portugal, Ireland, Italy, Spain and Greece, also known as the PIIGS economies. This acronym gained popularity in financial markets after the Eurozone crisis, referring to the heavily indebted countries. No other empirical studies, as we are aware of, have examined this group of countries together, in the context we are interested in. Furthermore, we are also including the variable long-term interest rate in order to see if the impact on real stock returns will differ.

In our empirical analysis we have employed an unrestricted vector autoregressive (VAR) model consisting of five variables. These variables are; short-term interest rate, long-term interest rate, world real oil price, industrial production and real stock returns. Hence, we will also look at the effect on real stock returns of shocks to other variables as well. Regarding the oil price, we have decided to focus our analyses on a linear specification and hence will no other specifications be applied. Neither will we make the distinction between oil price shocks driven by supply and demand as documented by Killian (2008).

Our chosen sample period contains monthly observations from 1993m07 to 2014m01. We have also investigated a subsample from 1993m07 to 2008m08 in order to assess the 'normal' macroeconomic conditions before the financial crisis peaked. Furthermore, we can then compare the results from the different samples in order to see whether the results will greatly differ or not.

We found little evidence of an impact of linear oil price shocks on real stock returns in all sample countries. We were able to determine the direction of the effect, which was as expected and according to theory, but our results were however statistically insignificant. The same applies for the results on both interest rates. When dividing the sample, and excluding the financial crisis period, we saw from the forecast error variance decomposition results an increase in the contribution of the real oil price to the variability in real stock returns.

The thesis will be structured in the following way. First we will consider some theoretical background, where we have included some history on oil price fluctuations and the link between oil price and stock returns is investigated. We have also included a short section on the relation between interest rates and stock returns. The following chapter is a literature review assessing the relation between both oil price shocks and the macroeconomy, and oil price shocks and stock markets. In chapter 4 we describe the data used in our analyses and chapter 5 explains the empirical models applied. The results from the empirical analyses are presented in chapter 6 and discussed in chapter 7. Finally, the last chapter concludes and proposes suggestions for further research.

2. Theoretical Background

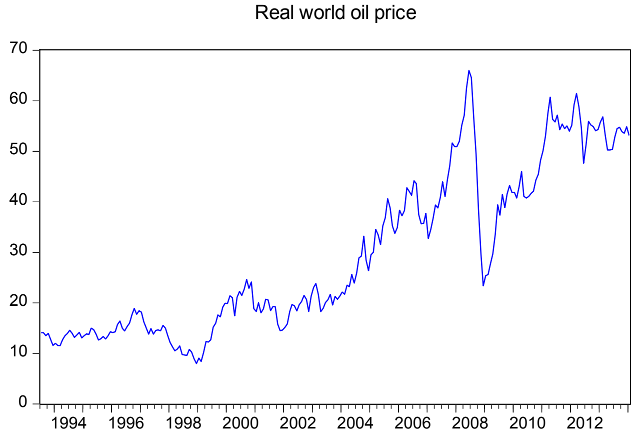
2.1. Oil Price Fluctuations

Crude oil is one of the most basic global commodities, making every country dependent on oil from both a producers' and consumers' point of view. This implies that fluctuations in crude oil prices have great impact on the global economy. Important factors that are considered to drive crude oil prices are production, inventory, natural causes and demand for oil (URL 1). The majority of global oil production comes from the Organization of Petroleum Exporting Countries (OPEC) nations. According to OPEC's annual Statistical Bulletin 2013, more than 81 % of the world's oil reserves are located in the OPEC member countries (URL 2). Consequently, the decisions made by these nations regarding raising the price of oil or reducing the production will affect the price of crude oil on the international market. When it comes to the demand side, global demand is affected by both current conditions and future expectations. The demand for crude oil is considered to rise with increased economic growth and demand from emerging countries. Yan (2012) argues that the relation between oil supply and oil demand in the international market is the most obvious and direct factor affecting the international oil price, where he mentions that limited supply capability and instability of oil production in OPEC affect oil supply.

When analyzing the fluctuations in the price for crude oil on a global basis it is commonly accepted to start at the period after World War II due to the infant stage of the oil industry prior to this (Yan 2012). Following the years after World War II, there were no major oil price fluctuations until the 1970s where several oil price shocks took place. In 1986, following the Iran-Iraq War in the early 1980s, the world experienced an oil prices collapse where the price of oil dropped from $27/barrel in 1985 to $12/barrel in 1986. Following this, the oil price was stabilized and increased to more normal levels. During the Persian Gulf War in 1990-1991 the oil price experienced a spike, which was followed by a drop after the war ended. The same applies for the Asian financial crisis in 1997, where one could see historically low levels in 1998 when the price dropped below $12 a barrel (Hamilton, 2010). After this there was a period of resumed growth.

World oil price experienced an exceptional volatility during the 2008 financial crisis, with prices ranging from a peak at nearly $150 per barrel in July to a low of around $40 per barrel in December (EIA report 2013). In the following years the oil price moved in a range between $90 and $130 per barrel. Future expectations for improved economic growth in the years following the global recession of 2008-2009 and unrest in North Africa and the Middle East have helped keeping prices relatively high, with Brent crude oil spot price averaged $112 per barrel in 2012.

Figure 1: Brent crude oil price fluctuations (1993m07-2014m01)



2.2. Oil Price and Stock Returns

From a theoretical point of view, oil price fluctuations can affect financial markets through various channels. An increase in the price of oil, by affecting economic activity, corporate earnings, inflation and monetary policy has implications for asset prices and hence also financial markets (Mussa 2002 p.26, IMF working paper).

The link between oil and stock prices can be explained by considering the valuation method based on the Discounted Cash Flows (DCF) approach, following previous work of Huang et al. (1996). According to this approach, the value of a company and hence the value of its stock is said to be equal to the sum of expected future cash flows discounted by the discount rate (e.g. average cost of capital). Hence, systematic movements in expected cash flows and discount rates will have an effect on stock returns. The price of oil can affect these two "channels" in various ways due to different causes. Oil is a real resource and an essential input in the production of many goods, implying that future oil prices can have an impact on expected cash flows. Higher crude oil prices lead to higher energy prices, which will have an effect on costs for all business and industry aspects dependent on energy. Hence, expected changes in energy prices result in similar changes in expected costs and opposite changes in stock prices. Regarding the effect on a specific stock, the outcome depends on whether the company is a net producer or net consumer of oil in which an oil price increase would result in higher earnings for the producer and decreased earnings for the consumer. For the world economy as a whole however, oil is an input and therefore increases in oil prices would depress aggregate stock returns (Huang et al 1996 p.5).

Oil prices can also affect stock returns through the discount rate. According to economic theory, expected discount rate consists of the expected inflation rate and the expected real interest rate both which may also depend on expected oil prices. In this context, for a net oil importing country, higher oil prices will have a negative effect on the trade balance and hence put a downward pressure on the country's foreign exchange rate and an upward pressure on the domestic inflation rate. Therefore, a higher expected inflation rate is positively related to the discount rate and negatively related to stock returns. Since oil is a major resource in the economy, the real interest rate is also affected by the oil price. Considering a situation with higher oil prices relative to the general price level, the real interest rate may increase forcing a rise in the rate of return on corporate investment which in turn lead to a decline in stock prices (Huang et al. 1996 p.6).

2.3. Interest Rates and Stock Returns

As mentioned above, the discount rate in the DCF model is a risk adjusted required rate of return, which is said to be equalized the level of interest rates in the economy (Panda, 2008 p.107). From a theoretical point of view, according to this model, the relationship between interest rates and stock prices is found to be negative in which an increase in the interest rates directly leads to a decline in the present values of stocks resulting in a decline in stock prices. Furthermore, increasing interest rates also reduce the profitability of firms, leading to a reduction in cash flows and a decrease in stock prices.

Panda (2008) also mentions another reason for the negative relationship. When taking into account that interest rates are risk free returns on bonds, one can demonstrate that when interest rates on bonds increase the attractiveness of bonds compared to stocks also increase. Hence, there is a reallocation in assets in favor of the bonds market where funds move from the stock market to the bond market increasing the demand for bonds and reducing the demand for stocks. This again leads to a decline in the price of stocks, which in turn lowers stock returns. The opposite holds for an interest rate reduction.

Regarding the empirical work on interest rates and stock prices, various studies such as Rigobon and Sack (2004), have found a negative relation between short-term interest rates and stock returns. However, there are a limited number of studies focusing on the effect of long-term interest rates in this context. In his study, Panda (2008) investigated the relationship between the Indian stock market and both short-term and long-term interest rates for the period 1996-2006. In his analysis, the short-term interest rate had a positive effect on stock prices. Furthermore, he used the month-end yields on 10-year government security as a proxy for the long-term interest rate, and found its effect on stock prices to be negative. Zhou (1996) emphasizes the importance of long-term interest rates in explaining the fluctuations in the stock markets. He found that the short-term interest rate contains very little information on the movements in the stock market, while the long-term rate played an important role in relation to the changes. Durre and Giot (2005), found a short-term impact of long-term government bond yield on the stock market in their cointegration analysis on 13 countries from 1973-2003.

3. Literature Review

3.1. Oil Price Shocks and the Macroeconomy

Following the oil price shocks of the 1970s, there has been an increasing amount of studies focusing on how oil price shocks affect economic activity and macroeconomic performance. One of the first to investigate this relationship is Hamilton (1983) who found a strong correlation between oil price changes and gross national product growth using a vector autoreggresion (VAR) methodology, where he demonstrated that increases in oil price led to a fall in real GNP in the U.S. Following this result, Hamilton argued that oil price increases has been responsible for almost every recession in the U.S. between the end of World War II and 1973. Gisser and Goodwin (1986) also provide supporting evidence on Hamilton's findings for the U.S. macroeconomy, using alternative data and estimation techniques. Since then, Hamilton's research has been expanded using different samples and different estimation techniques.

Following the 1986 oil price collapse and the resulting macroeconomic fluctuations, Mork (1989) extended Hamilton (1993)'s analysis by allowing for asymmetric effects in the oil price changes where he looked at both oil price increases and decreases. Research on the asymmetric effects of oil price fluctuations received support after it became evident that the sharp decrease in crude oil prices in 1986 was in fact not followed by economic expansion, as one might expect (Kilian 2008 p.889). Studies had demonstrated that the oil price increase of 1979 was followed by a recession, so after the decrease in 1986 an economic expansion was viewed as a reasonable outcome.

In his paper, Mork (1989) found support for Hamilton's results on the strong negative correlation between oil price increases and real GNP, which also showed persistency in a longer sample covering the oil price drop in 1986 and also after the introduction of price controls. He did not, however, find any significant effects on oil price decreases although he concluded that the two effects are significantly different. Mork et al. (1994) again expanded the analysis on oil price movements and GDP fluctuations by including another six OECD countries in the sample, in addition to the U.S. They also found evidence for the negative correlation when extending the sample through 1992. Furthermore, they demonstrated the presence of asymmetric effects in the results for most of the countries in which the U.S. showed the strongest effect. The only exception where Norway, where oil price increases showed a positive effect on the economy and decreases resulted in a negative effect.

In more recent studies Cuñando and Pérez de Gracia (2003) and Cologni and Manera (2008) shed light on other macroeconomic variables as well. Cuñando and Pérez de Gracia (2003) investigates the effect of oil price shocks on inflation and industrial production growth rates in 15 European countries using quarterly data from 1960 to 1999 and four different proxies for oil price shocks. They found that shocks to the oil price have permanent effect on inflation while the effect on industrial production is short-lived and asymmetric. Furthermore, their results become more significant when using national oil price instead of world oil price. Cologni and Manera (2008) also find a long-run equilibrium relationship between oil prices and inflation rates for the G7 countries using a structural co-integrated VAR model with quarterly data for the period 1980 to 2003.

3.2. Oil Price Shocks and Stock Markets

Previous studies have demonstrated various results on the effects of oil price shocks on international stock markets, and no consensus has been made on the matter. One of the first papers to examine the relationship between oil price shocks and stock markets is a study by Jones and Kaul (1996), focusing on the U.S., Canada, The U.K. and Japan, using quarterly data for the period 1947-1991. They use the Producer Price Index for Fuels as a measure for oil price, and investigate whether oil price shocks' impact on stock markets can be explained by current and future cash flows and/or changes in expected returns. Their results demonstrate a negative oil price effect on aggregate stock returns. The effect, however, was not that strong for the U.K. and Japan.

Opposing the finding of Jones and Kaul, is a study by Huang et al. (1996). They focus their research on the relationship between daily oil futures returns and daily U.S. stock returns for the sample period 1979-1990. By using a VAR approach they find evidence that oil future returns do lead some individual oil company stock returns, but do not find any impact on aggregate stock returns. Supporting this result by looking into economic forces and the stock market, Chen et al. (1986) find no overall effect of oil price changes on asset prices in the U.S. for the period 1959 to 1984.

Since then, there is a growing body of literature and empirical studies investigating the relationship between oil prices and stock market activity. Sadorsky (1999) estimates an unrestricted VAR model using monthly data from the U.S. for the period 1947:1-1996:4. By defining real stock return as the difference between continuously compounded return on the S&P 500 and the consumer price index (as a measure for inflation), he investigates the importance of oil prices and oil price volatility in explaining movements in stock returns. In his paper, Sadorsky finds evidence of a negative oil price effect by demonstrating that positive oil price shocks depress stock returns. His results also show evidence of a change in oil price dynamics after 1986 by demonstrating that movements in the price of oil explains a greater fraction of the forecast error variance in real stock returns than the interest rate after this year.

Adding to the list of papers finding a negative oil price effect in the U.S. stock market is Killian and Park (2009) who uses a structural VAR model with monthly data covering the period 1973-2006. One of their main results states that in the long run, on average, 22 % of variations in aggregate stock returns can be explained by shocks to the oil price. They, as Killian (2009), also make the distinction between demand and supply shocks and emphasizes in their study the importance of the demand-shock channel.

Extending the analysis to other industrialized countries is, among others, Papapetrou (2001) using a multivariate VAR approach to investigate the dynamic relationship between oil prices, real stock prices, interest rates, real economic activity and employment for Greece using monthly data for the period 1989:1 to 1999:6. She demonstrates that oil price shocks have a negative effect on stock prices through its immediate negative impact on output and employment.

Park and Ratti (2008) find that oil price shocks have a negative statistical significant impact on stock returns for the U.S. and 13 European countries, where the results are more significant using world real oil price. They estimate a multivariate VAR model with monthly data from 1986:1 to 2003:4 using both linear and non-linear specifications of oil price. Apergis and Miller (2009), on the other hand, only find a small effect of oil price shocks on international stock markets using a VAR methodology with monthly observations from 1981 to 2007 for sample countries Austria, Canada, France, Germany, Italy, Japan, the U.K. and the U.S.

Nandha and Faff (2008) focus their analysis on industry level by investigating 35 global industry indices from DataStream for the period 1983:4 to 2005:9. They find that oil price increases have a negative impact on equity returns for all sectors, except for mining and oil & gas industries. Moreover, they oppose results by Mork (1989) and Mork et al. (1994) by showing evidence of a symmetric oil price effect.

There are also various papers emphasizing the importance of emerging economies and their economic importance regarding both oil production and consumption. Basher et al. (2012) investigating the dynamics between oil prices, emerging market stock prices and exchange rates, find that positive shocks to oil price tends to depress stock prices. They use a six-variable structural VAR methodology with monthly data from 1988:1 to 2008:12. Also adding to the literature on emerging stock markets are Basher and Sadorsky (2006) who looks into oil price risk and its impact on stock market returns. They evaluate the relationship between movements in oil price and stock market returns in 21 emerging markets by using both unconditional and conditional risk analysis finding. Their results show that oil price risk to be positive and statistical significant in pricing emerging market stock returns in the majority of the models.

In a more recent study, Cunando and Perez de Gracia (2013) studies 12 European oil-importing countries using a VAR and VECM methodology for the period 1973-2011. They find that oil price changes have a significant and negative impact on stock market returns in most of the countries in the sample. By making the distinction between oil supply and demand shocks, they also show that oil supply shocks demonstrate a greater negative effect on real returns using both world oil price and local oil prices.

The distinction between oil exporting and oil importing countries has also been made in the literature on oil price shocks and stock markets. Examples of studies with this focus are Bjornland (2008), Wang et al. (2013) and Güntner (2011). Bjornland (2008) look at how oil price changes affect stock prices indirectly through monetary policy responses in Norway, an oil exporting country. She demonstrates a positive effect of oil price increases where higher oil prices increase stock returns through the economy’s response to increase in prices by increasing aggregate wealth and demand.

In our thesis, by employing an unrestricted VAR model, we will be using the same linear specification for the world real oil price as Park and Ratti (2008). We will, however, be investigating a group of countries not studied together in this context before, as far as we are aware of. Furthermore, by including data on both short-term and long-term interest rates we are trying to shed light on the different effects these two different rates may have on real stock returns.

4. Data

4.2. Data Collection

The literature review reveals a broad range of empirical research covering a variety of data series, countries, time periods and use of methodology. In this thesis we will examine how oil price shocks affect stock markets in five OECD countries, namely Portugal, Ireland, Italy, Greece and Spain. Our sample period contains monthly observations for the period April 1993 to January 2014. The starting point for our sample is justified by difficulties collecting data for all variables for all the countries for periods previous to this. Furthermore, our main purpose of the study is to investigate how oil price shocks affect stock market returns, with and without the period around the financial crisis in 2008/2009. We therefore believe that we have enough observations from our chosen sample period to be able to draw some conclusions and make indications.

In accordance with economic theory and previous empirical studies we include the following variables in our empirical analysis: stock prices, oil price, real industrial production and short-term interest rates. We also include the variable long-term interest rate to make distinctions between the effects of the two interest rates.

Data on stock price indices and industrial production was collected from the Organization for Economic Cooperation and Development (OECD) from their Main Economic Indicator (MEI) database. Short-term and long-term interest rates were also taken from OECD, except for the series for Greece which were collected from Thomson Reuters DataStream (DS) due to missing observations for the period prior to 2001 in the OECD database. Data on the oil price is from the U.S. Energy Information Administration (EIA).

4.3. Data Description

Data on the stock price indices refer to quoted prices, excluded dividend payments, from the Dow Jones EURO STOXX Index for the Euro area (OECD Factbook 2010). The monthly indices are generally computed as averages of daily closing quotes with 2005 as a base year, and prices are expressed in nominal terms.

In line with previous empirical literature, see for example Park & Ratti (2008), Cunando & Perez de Gracia (2014) and Sadorsky (1999), we define real stock market returns as the difference between continuously compounded returns on stock price index and the log difference in the consumer price index as a proxy for inflation. The variable, real stock return, measures the return on investment after taking inflation into account.

$$Real\ Stock\ Return = ln\left(\frac{Stock\ price\ index_{t+1}}{Stock\ price\ index_{t}}\right) - ln\left(\frac{Consumer\ price\ index_{t+1}}{Consumer\ price\ index_{t}}\right)$$

In the world market for crude oil, there are three different oil price measures considered main benchmarks, namely West Texas Intermediate, Brent and Dubai. Since our study considers European countries we chose to use the Europe Brent Spot Price FOB expressed in dollars per barrel. Furthermore, although Brent is essentially drawn from oil fields located in the North Sea, it is considered to be a good indicator of global oil prices (URL 3). The world oil price is adjusted for inflation by deflating the nominal price by the U.S. Producer Price Index for fuels & related products & power to get the world real oil price.

Real industrial production is defined as the nominal industrial production deflated by the consumer price index of each country. The real industrial production variable is included in the analysis as a measure of real economic activity, following previous studies such as Cunando and Perez de Gracia (2014), Sadorsky (1999) and Park and Ratti (2008). Empirical evidence from Fama (1990) and Chen et al. (1996) have found correlation between stock returns and aggregate real activity in the U.S., and others have found similar results for other sample countries.

Like other existing empirical articles we include the variable short-term interest rate. According to the OECD's MEI database, short-term interest rates are usually associated with Treasury bill, Certificates of Deposit or comparable instruments, each of three-month maturity (URL 4). For the Euro-area the OECD database uses 3-month "European Interbank Offered Rate" from the date which the country joined the Euro. Since Greece did not join the

Euro until 2001, we collected data on short-term interest rate for this specific country from DataStream where the variable is defined as the IMF-IFS 3-month Treasury bill.

The interest rate may affect stock returns in different ways through different channels. The Neoclassical theory argues that increases in interest rates raise the cost of capital making loans more expensive for business owners. This again may result in reduced investment activity, lower spending and output, reduced profits and hence reduced stock market value. (Blanchard 1981). As mentioned in the theoretical background section, higher interest rates may also affect stock markets by increasing the attractiveness of investing in bonds, implying a decrease in equity-investments, which again depresses stock returns

The long-term interest rate refers to government bonds with a residual maturity of about ten years (OECD Factbook 2014). The same definition applies for Greece, where the data was collected from DS. The long-term interest rate is included in the analysis due to the findings listed in the theoretical background section emphasizing the importance of the rate.

Other variables used in the analysis are the consumer price index and the producer price index. The producer price index was collected from the Federal Reserve Economic Database of the U.S. Federal Reserve Bank of St. Louis, while the consumer price index is from the OECD database.

All variables, except the interest rate variables, which are already in ratios, are in natural logarithms.

4.4. Descriptive Statistics

In table 1 below, the summary statistics for the world real oil price variable, dlog(op), is listed.

Table 1:
Summary statistics for world real oil price, dlog(op).

	dlog(op)
Mean	0.5581
Maximum	20.26
Minimum	-22.77
Std. Dev.	7.538
Skewness	-0.459
Kurtosis	3.792
No. of obs.	246

Notes: Mean, maximum, minimum and std. dev is in percent.

As seen from the table, the summary statistics for the world real oil price changes demonstrates a slightly positive mean, which indicate that oil price increases has been somewhat larger than oil price decreases in our sample period. The highest increase is 20.26% took place at 1999m03. The minimum value of -22.77% corresponds to the greatest decrease in the sample. This decrease was observed in 2008m11, which was during the financial crisis. Regarding the standard deviation of 7.54 %, it is clear that the real oil price demonstrates a high volatility.

The summary statistics demonstrates a skewness of -0.459 and kurtosis of 3.792, indicating a non-normal distribution.

Table 2:

Summary statistics for real stock returns (rsr)

Variable	Mean	Maximum	Minimum	St.Dev	Skewness	Kurtosis	No. of obs.
Portugal	0.325	14.416	-23.081	4.729	-0.751	5.615	246
Ireland	0.231	11.149	-30.389	4.887	-1.592	9.359	246
Italy	0.042	13.663	-24.083	5.029	-0.979	7.052	246
Greece	-2.221	30.017	-33.337	7.445	-0.078	5.406	246
Spain	0.291	14.933	-18.579	4.858	-0.777	4.838	246

Notes: Summary statistics for real stock returns. Mean, maximum, minimum and standard deviation are denoted in percent.

Table 2 displays the summary statistics for the real stock return, rsr, variable for the five countries. As seen from the table, the mean returns of all countries, except for Greece, is positive. The highest standard deviation (volatility in stock returns) is found in Greece, while the lowest is observed in Portugal. Here, one can also see evidence of non-normal distribution properties.

5. Methodology

The following section outlines the methodology and the empirical tests performed in our analysis. The choice of empirical models was based upon previous research on oil price shocks and stock market activity. All regressions have been carried out using the software package EViews.

5.1. Unit Root Tests

The first step in the statistical analysis, when working with time series, is to examine the necessary condition of stationarity in the variables. Considering a time series, Y_t, the series is said to be stationary if the distribution of the variable does not depend upon time, that is the mean and the variance of the time series are constant over time (Verbeek, 2012). The presence of unit roots in the times series can lead to non-stationarity in the variables. When running regressions on non-stationary time series the regression might be spurious, resulting in a non-reliable t-statistic. Furthermore, results from spurious regressions might also show a significant economic relationship, even when this is not the case (Brooks, 2008).

There are several methods to test for stationarity in time series. In this thesis we will apply the Augmented Dickey-Fuller (ADF) test and the DF-GLS test. The ADF test is based on the Dickey-Fuller test introduced in the 1970s by David Dickey and Wayne Fuller. The basic test was employed to investigate the presence of unit roots in first-order autoregressive models. Considering an AR(1) process:

$$y_t = \rho y_{t-1} + \varepsilon_t$$

For ease of computation and interpretation, the process is transformed to the following expression where $\gamma = \rho - 1$:

$$\Delta y_t = \gamma y_{t-1} + \varepsilon_t$$

Testing for stationarity implies to test the null hypothesis that states that the time series is non-stationary, against the alternative hypothesis. That is:

$$H_0: \gamma = 0 \; and \; H_1: \gamma < 0.$$

Since the Dickey-Fuller test is restricted to include only one lag, the Agumented Dickey-Fuller (ADF) test was introduced to test for stationarty in models with more complicated dynamics. The hypothesis for stationarity is the same as for the original DF test. The extended test equation is now expressed by:

$$\Delta y_t = \propto + \gamma y_{t-1} + \sum_{l}^{n} a_l \, \Delta y_{t-l} + \varepsilon_t$$

The other unit root test that will be applied in the thesis, the DF-GLS unit root test, is a modified Dickey-Fuller test introduced by Elliott, Rothenberg and Stock in their 1996 Econometrica article. With their test, they proposed a more efficient test with higher power by modifying the Dickey-Fuller test statistic using a generalized least squares rationale (Elliott et al., 1996).

5.2. Cointegration Test

After testing the variables for stationarity, we conduct the Johansen and Juselius (1990) test for cointegration for the variables containing a unit root in order to check for any common stochastic trend in the non-stationary variables. In this context, two non-stationary time series are cointegrated if there is a linear combination of them that is stationary.

The Johansen and Juselius framework applied allows for the testing of more than one cointegrating vectors in the data by estimating the maximum likelihood estimates on these vectors. Two test statistics, trace statistic (λ_{trace}) and max-eigenvalue (λ_{max}), are used to determine the number of cointegrating vectors (Brooks, 2008). The two test statistics are expressed as follows:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{g} \ln(1 - \hat{\lambda}_i)$$

$$\lambda_{max}(r, r+1) = -T \ln(1 - \hat{\lambda}_{r+1})$$

where r is the number of cointegrating vectors under the null hypothesis, g is the number of variables and λ_i are the ordered eigenvalues. For each value of r, for the given orders: (*r*=0, 1, 2, 3...*g-1*), the test statistic is compared to the critical value to determine the number of cointegrating vectors. If the test statistic is greater than the critical value, then the null hypothesis of r=0 cointegrating vector is rejected in favor of the alternative hypothesis and one check the critical value for r=1. If the test statistic is lower than the critical value, however, the null hypothesis of no cointegrating vectors is not rejected.

For the λ_{trace} test, the null hypothesis is that the number of cointegrating vectors is less than or equal to r, against an unspecified or general alternative that there are more than r (Brooks, 2008 p. 351). For the λ_{max} test, the null hypothesis is that there is r cointegrating vectors, against the alternative of r+1.

5.3. Vector Autoregressive Model

In line with previous empirical research on the relationship between oil price shocks, economic activity and stock markets, we have chosen to use an unrestricted Vector autoregressive (VAR) model to study the interactions between the oil price and the stock market return. The main advantage of this model, introduced by Sims (1980), is its ability to capture the dynamic relationship among the variables of interest. A VAR model consists of a system of equations that expresses each variable in the system as a linear function of its own lagged value and the lagged value of all the other variables in the system (Park and Ratti, 2008 p.2594). A VAR model of order p, where p denotes the number of lags, that includes k variables, can be expressed as:

$$y_t = A_0 + \sum_{i=1}^{p} A_i y_{t-1} + u_t$$

where $y_t = [y_{1t} \dots y_{kt}]'$ is a column vector of observations on the current values of all variables in the model, $A_i$is a $k \times k$ matrix of unknown coefficients to be estimated, A_0 is a column vector of deterministic constant terms and u_t is a column vector of error terms. The error terms are assumed to be zero-mean independent white noise processes. Furthermore, they are uncorrelated but may be contemporaneously correlated (Park and Ratti, 2008).

5.4. Lag Length Selection

When applying an unrestricted VAR model it is required that the same number of lags of all of the variables is used in all the equations of the system. Therefore, the optimal lag length for the VAR model has to be determined by employing information criteria. Verbeek (2012, p.310) suggests the use of Akaike's information criterion (AIC) or the Schwarz's Bayesian information criterion (BIC) when deciding the appropriate lag length. Information criteria include two factors: a term that is a function of the residual sum of squares (RSS) and a penalty term which is the loss of degrees of freedom from adding extra parameters Brooks (2008, p.232). Hence, adding a new variable or an additional lag to the model will have to effects on the information criterion where the RSS will fall but the value of the penalty term will increase. Therefore, the object is to choose the number of parameters that minimizes the value of the information criteria. In general, the model with the lowest AIC or BIC will be preferred. The question then becomes which model should be the preferred model. As seen from the formulas:

Akaike (1974) information criterion (AIC):

$$AIC = log\frac{1}{N}\sum_{i=1}^{N} e_i^2 + \frac{2K}{N}$$

Schwarz Bayesian (1979) information criterion (BIC):

$$BIC = log\frac{1}{N}\sum_{i=1}^{N} e_i^2 + \frac{K}{N}logN$$

BIC tends to favor a more parsimonious model since it gives a bigger "penalty" then AIC does. According to Brooks (2008), BIC is strongly consistent, but AIC is generally more efficient. Moreover, the BIC will be consistent to show the true model in the data set (Verbeek, 2012, p.66) However, one can also argue that AIC is a more preferable in smaller samples due to the fact that extra parameters may approximate misspecifications in the model (Verbeek, 2012 p.310). We will apply both of these information criterions and compare the results in order to choose the appropriate number of lags for our model.

5.6. Impulse Response

An impulse response function examines the responsiveness of the endogenous variables in the VAR to shocks to each of the variables (Brooks, 2008 p. 299). That is, for each variable from each equation separately, a unit shock is applied to the error and the effects upon the VAR over time is demonstrated. A shock to the i-th variable will have a direct effect on the i-th variable, but is also transmitted to the other endogenous variables through the dynamic structure of the VAR model. Given that the system is stable, the shock should gradually die away. A shock to each of the n variables in the VAR system results in n impulse response functions and graphs, giving a total of n x n graphs showing these impulse response functions (Wang, 2003, p. 65).

5.7. Variance Decomposition

Another test used to interpret VAR models is the forecast error variance decomposition. According to Brooks (2008, p. 300), variance decompositions give the proportion of the movements in the endogenous variables that are caused by their "own" shocks versus shocks to the other variables in the model. Hence, the variance decompositions provides evidence about the relative importance of each random innovation in affecting the variation of the variables in the VAR (EViews 7 User's Guide II, p.470). Furthermore, it is generally observed that own series shocks explain the larger fraction of the forecast error variance of the series in the VAR.

5.8. Ordering

When estimating a VAR model, the ordering of the variables has an effect on the impulse responses and variance decompositions. The ordering of the variables should therefore be based on economic theory and/or supported by sensitivity analysis (Brooks, 2008 p. 314).

6. Results

6.1. Unit Root Tests

In order to test whether the variables are stationary or not, unit root tests are conducted. We have chosen to apply both the Augmented Dickey Fuller test (ADF) and the DF-GLS test. The null hypothesis for both tests is that the series contain a unit root, that is that the series are non-stationary. The results from the tests are reported in table 3.

Starting with the variable real stock returns (rsr), the variable is already first differenced in the data transformation prior to regressions in EViews. We have therefore only included the values for the unit root test in 1st difference for this variable. As sees from the table, rsr is stationary in its first difference for all five countries. The oil price variable, log(op), is non-stationary in level form leading to a failure to reject the null hypothesis of non-stationary at the 5 % significance level. This also applies for the variables: irs, irl and log(ip). When inducing first difference transformations on these variables, that is converting them to percentage growth forms, all the time series become stationary and one can reject the null hypothesis.

Hence, the following variables, in following forms are included in the VAR model:

d(irs): first difference of short term interest rate
d(irl): first difference of long term interest rate
dlog(op): first difference of natural logarithms of world real oil price
dlog(ip): first difference of natural logarithms of real industrial production
rsr: real stock returns

We will therefore be working with differentiated data (I(1)) in our analyses. These variables can now be interpreted as monthly growth rates. Furthermore, all variables are seasonally adjusted after the transformations making it easier to observe the underlying trends in the data, and assess monthly fluctuations.

6.2. Cointegration Test

The Johansen cointegration test is used to test for long-term equilibrium relationships between non-stationary variables. Since we will be working with first differenced variables in our analyses, which are all stationary in their respective differenced form, it will not be necessary to employ a cointegration test. Consequently, we can run an unrestricted vector autoregressive model on all five countries in our sample.

If we were to use non-stationary time series, and therefore would have to apply the cointegration test, and detect presence of cointegrating vectors, econometric theory suggests applying the vector error correction model (VECM). This model allows for built in specifications restricting the long-run behavior of the endogenous variables to converge to their cointegrating relationship while at the same time allowing for short-run adjustment dynamics.

Table 3: ADF and DF-GLS unit root tests

	irs		irl		log(op)		log(ip)		rsr	
	ADF	DF-GLS	ADF	DF-GLS	ADF	DF-GLS	ADF	DF_GLS	ADF	DF-GL
Variables in levels										
Greece	-2.76*	-0.88	-2.36*	-0.49	-1.23	-0.30	0.88	3.98		
Ireland	-1.78	-0.47	-1.90	-1.16	-1.23	-0.30	-3.77**	0.79		
Italy	-1.61	0.08	-1.63	-0.02	-1.23	-0.30	-0.03	0.78		
Portugal	-2.60*	1.10	-2.15	0.91	-1.23	-0.30	0.78	0.18		
Spain	-1.72	0.30	-1.52	-0.06	-1.23	-0.30	1.22	1.78		
Variables in first differences										
Greece	-8.21***	-4.08***	-5.24***	-3.30***	-6.52***	-6.35***	-8.45***	-3.89***	-6.05***	-4.61***
Ireland	-5.23***	-2.77***	-5.29***	-3.94***	-6.52***	-6.35***	-8.83***	-8.65***	-4.70***	-3.52***
Italy	-4.81***	-1.91*	-6.08***	-0.74*	-6.52***	-6.35***	-4.68***	-4.32***	-5.29***	-2.04**
Portugal	-7.13***	-0.79*	-4.47***	-3.13***	-6.52***	-6.35***	-8.39***	-2.17** -	5.18***-	1.87*
Spain	-4.69***	0.76*	-5.67***	-1.66*	-6.52***	-6.35***	-5.05***	-2.23***	-5.93***	-2.10**

Notes. ADF: Augmented Dickey-Fuller unit root tests, and DF-GLS unit root tests. *,** and *** means significant at 10%, 5% and 1% level respectively. Oil price (op) and real industrial production (ip) are in logs, and rsr are computed according to the formula in the data description section.

However, studies by Engle and Yoo (1987), Clements and Hendry (1995) and Hoffman and Rasche (1996) argue that an unrestricted VAR is a preferred model in the short-run setting (especially regarding forecast error variance). Furthermore, Naka and Tufte (1997) find in their stimulations that the two models perform almost identical at short-run impulse response functions.

6.3. Vector Autoregressive Models

The VAR model is employed to investigate the dynamic relationship between the variables in question. The model will be investigated containing five variables.

The ordering of the variables is in line with earlier studies by Sadorsky (1999), Park and Ratti (2008) and Cong et al. (2008). We have employed the following ordering: first difference of short-term interest rate (d(irs)), first difference of long-term interest rate (d(irl)), first log difference of world real oil price (dlog(op)), first log difference of real industrial production (dlog(ip)) and real stock returns (rsr). Hence we are estimating the following model: VAR (d(irs), d(irl), dlog(op), dlog(ip), rsr). This ordering will assume that interest rate shocks are independent of contemporaneous disturbances to the other variables. This means that all variables may have a contemporary effect on real stock returns but not the other way around. Furthermore, real stock returns are placed last in the ordering (Sadorsky, 1999 p.455). Ferderer (1996) also argues that by following an ordering with interest rate prior to oil price, the influence of interest rates on real oil prices can be captured.We have also conducted sensitivity analyses where we performed the tests with different orderings and got the same results.

The optimal number of lags was chosen based on the information criterions, AIC and BIC, mentioned in the methodology section. The number of lags that minimizes the value of Schwarz's Bayesian's information criterion (BIC) is 1 for all five countries. The number that minimizes the value of Akaike's criterion (AIC) on the other hand is greater than BIC´s. AIC suggests 2 lags for Portugal, 3 for Ireland, Italy and Spain, and 6 for Greece. Since the two information criterions do not agree on the number of lags to be included in the VAR model, we will estimate our model using both the lag length suggested by both BIC and AIC to see whether the results become significantly different depending on which criterion we apply.

In order to be able to interpret the VAR model it is necessary to estimate impulse response and variance decomposition functions, we therefor employ these analyses in order to investigate the effect of oil price shocks on stock returns in our sample countries. We will also look at how the other variables affect real stock returns by looking at their impulse responses and variance decomposition functions as well.

We have performed tests covering the whole sample period, and then divided the sample into a pre-crisis subsample from 1993m07 to 2008m08. We chose this end date for the sample since according to Keeley and Love (2010), the crisis peaked around the time the Lehman Brothers went bankrupt in September 2008. The pre-crisis subsample allows us to examine the normal macroeconomic conditions before the financial crisis and its fluctuations hit the economy. Initially, we also wanted to look at the financial crisis period in order to assess how the results would be during this period. Unfortunately, there was not sufficient information in this period to run regressions in EViews. We will therefore not be discussing the financial crisis exclusively.

The VAR estimation outputs are presented in appendix A.

6.5. Impulse Response

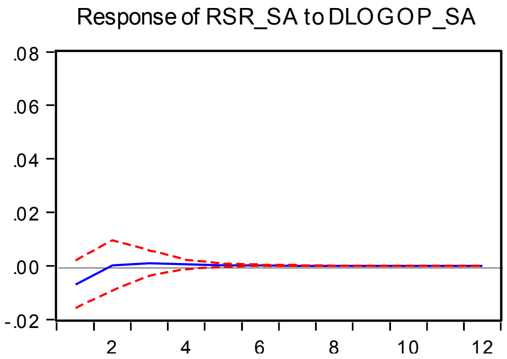
In this section we will assess the results from the impulse response functions to see the effect on real stock returns due to shocks to short-term interest rate, long-term interest rate, world real oil price and industrial production for the five different sample countries.

Whole sample: 1993m07-2014m01

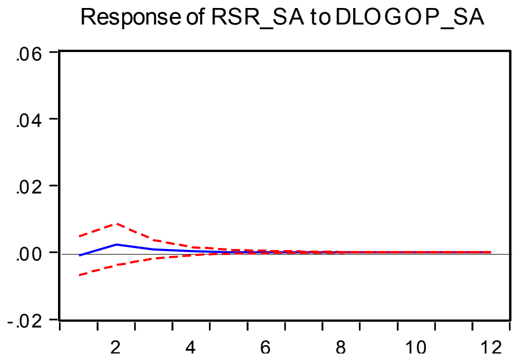
Impulse response functions (IRF's) are estimated for the whole sample period from 1993m07 to 2014m01. Figure 2 shows the orthogonalized impulse response curves of real stock returns from a one standard deviation shock to world real oil price. The analytical IRF's are applied to investigate the statistical significance of the impulse response functions. The impulse response graphs of real stock returns due to shocks to the other variables are listed in appendix B1.

Figure 2: Orthogonalized impulse response function of real stock returns to world real oil price shocks in VAR (d(irs), d(irl), dlog(op), dlog(ip), rsr).

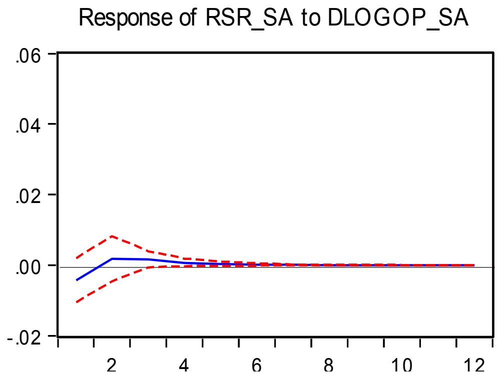
Greece



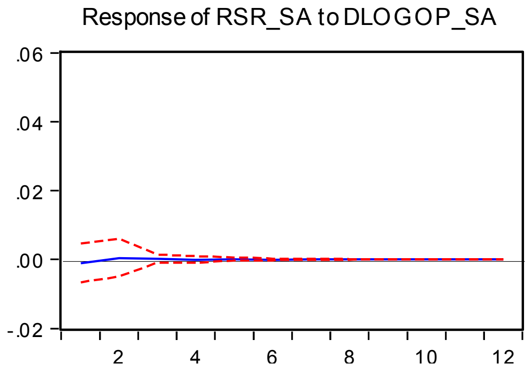
Ireland



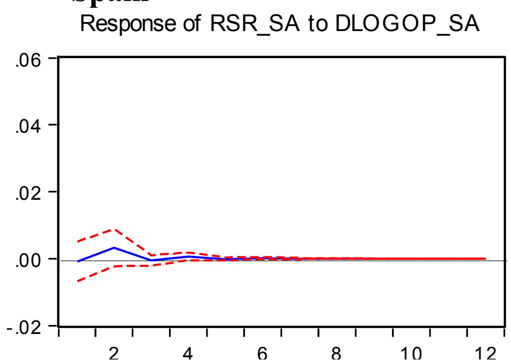
Italy



Portugal



Spain



Notes: Model estimated with 1 lag according to BIC information criterion.

Table 4: Summarizing table of the results of the impulse response of real stock returns to shocks to short-term interest rate, long-term interest rate, world real oil price and industrial production, with a 95% confidence level, for the whole sample period.

	Greece	Ireland	Italy	Portugal	Spain
Short-term interest rate shock	p	n	n	n	n
Long-term interest rate shock	p	n	n	n	n
World real oil price shock	n	n	n	n	n
Industrial production shock	p	n	p	p	p

Notes: n (p) indicates negative (positive) orthogonalized impulse responses. Oil price shocks are measured as the first log difference in the world real oil price.

As we can see from the table above, an oil price shock has a negative impact on real stock returns for all five countries in the same month and/or within one month. They are during the period also statistically insignificant. We can also see that the shock will revert towards zero (die out) during period 7 for Greece, 6 for Ireland and Portugal, 9 for Italy and Spain.

A unit shock to the industrial production shows us that the results for the five countries will vary. Greece, Italy, Portugal and Spain will experience a positive effect on real stock returns, while Ireland on the other hand demonstrates a negative reaction. All countries except for Ireland will also be statistically insignificant. The shock will revert towards zero during period 6 for Greece, 9 for Ireland 8 for Italy and Spain and 10 for Portugal.

In the case of short-term and long-term interest rates we can see that stock returns in all countries except for Greece are negatively affected and statistically insignificant. The IRS shock will revert towards zero during period 8 for Greece, 10 for Ireland, 11 for Italy, 7 for Portugal and 9 for Spain. Considering IRL we se that the shock will revert toward zero during period 9 for Greece, Ireland and Italy, 8 for Portugal and 7 for Spain.

Pre-crisis subsample: 1993m07-2008m08

Allowing for a structural break in our dataset, around the financial crisis we divide our sample into a pre-crisis subsample from 1993m07-2008m08. Table 5 displays the results of the impulse responses of real stock return due to shocks to the variables in the model. As we can see from the graphs in appendix B2, when comparing the whole period and the first subsample, we do not see any great differences in the response of the real stock returns due to oil price shocks. Shocks to oil price will revert towards zero in period 8 for Greece and Portugal, in period 9 for Ireland and Spain and period 6 for Italy.

Table 5: Summarizing table of the results of the impulse response (pre-crisis) of real stock returns to shocks to short-term interest rate, long-term interest rate, world real oil price and industrial production, with a 95% confidence level

	Greece	Ireland	Italy	Portugal	Spain
Short-term interest rate shock (irs)	p	n	n	n	n
Long-term interest rate shock	n	n	p	n	n
World real oil price shock	n	n	n	n	n
Industrial production shock	p	n	p	p	p

Notes: n (p) indicates negative (positive) orthogonalized impulse responses. Oil price shocks are measured as the first log difference in the world real oil price.

Furthermore, by looking at the other variables in our VAR model we see that only shocks to long-term interest rate will change from being positive to negative for Greece, and from negative to positive for Italy. The shocks will die out in period 9 for Greece and Ireland, 8 for Italy and period 11 for Portugal. For Spain, the shock does not revert towards zero during our time period. Shocks to short-term interest rate will revert towards zero in period 10 for Greece, 9 for Ireland and Portugal and 8 for Italy and Spain. Industrial production shocks will revert towards zero in period 9 for Greece, Ireland, Portugal and Spain and 7 for Italy.

6.6. Variance Decomposition

Whole sample: 1993m07-2014m01

Table 6 summarizes the results from the forecast error variance decomposition (FEVD) analysis for the whole sample period from 1993m07 to 2014m01. The reported values indicate the percentage of the forecast error in each variable that can be attributed to innovations in other variables after 12 months. That is; how much of the unanticipated changes in real stock return that can be attributed to shocks to short-term interest rate, long-term interest rate, real oil price and industrial production.

Table 6: Variance decomposition of forecast error variance of real stock returns due to irs, irl, op and ip after 12 months.

1993m07-2014m01	**VAR model: (d(irs), d(irl), dlog(op), dlog(ip))**			
	Due to IRS	**Due to IRL**	**Due to OP**	**Due to IP**
Greece	0.289802	1.071242	0.870618	0.632609
	(1.41401)	(1.79016)	(1.30514)	(1.10898)
Ireland	0.434757	2.428866	0.299273	3.333035
	(1.38404)	(2.67275)	(1.34418)	(2.10176)
Italy	0.617540	0.105200	0.960630	1.908604
	(1.25806)	(0.92076)	(1.20442)	(1.91390)
Portugal	1.222487	0.364675	0.366649	1.312333
	(1.46951)	(1.38309)	(1.09318)	(1.85537)
Spain	0.682147	0.494875	0.424114	1.884003
	(1.37083)	(1.32911)	(1.08238)	(1.86365)

Notes: The table presents the variance decomposition of the forecast error variance of the real stock returns due to IRS, IRL, OP and IP. The model is performed with 1 lag (BIC information criterion) and the table shows the results after 12 months. Monte Carlo constructed errors are shown in parenthesis.

As seen from the table above, own shocks explain the greatest fraction of the forecast error variance of real stock returns in both short run and long run, as expected according to theory.

The contribution of oil price shocks in the variability of stock returns after 12 months varies from 0.29% (for Ireland) to 0.96% (for Italy). Regarding the short-term interest rate the contribution varies from 0.28 %in Greece to 1.22% in Portugal. Innovations to long-term interest rate demonstrate that Ireland has the highest contribution to the forecast variance in real stock returns with 2.43% and Italy the lowest with 0.10%. Lastly, the contribution of industrial production is highest in Ireland (3.33%) and lowest in Portugal (0.63%).

In Greece the largest fraction explaining the forecast error variance of real stock returns is explained by shocks to long-term interest rate. In Ireland and Italy, shocks to industrial production contribute the most. This applies for Portugal and Spain as well, and here industrial production is followed by the short-term interest rate.

Pre-crisis subsample: 1993m07-2008m08

The following table demonstrates the results from the variance decomposition of real stock returns after dividing the sample into a pre-crisis subsample. Table 7 lists the percentages of variation in real stock returns due to short-term and long-term interest rate shocks, real oil price shocks and industrial production shocks.

Table 7: Variance decomposition of forecast error variance in real stock returns due to irs, irl, op and ip after 12 months.

1993m07-2008m08	**VAR model: (d(irs), d(irl), dlog(op), dlog(ip))**			
	Due to IRS	**Due to IRL**	**Due to OP**	**Due to IP**
Greece	3.142980	0.848962	1.655739	0.963178
	(2.93726)	(2.36151)	(1.91156)	(1.40093)
Ireland	0.707454	0.834221	1.367082	5.363761
	(1.83781)	(1.69764)	(2.62296)	(2.37273)
Italy	0.597554	0.999402	2.103127	2.350280
	(1.55090)	(1.64411)	(1.89755)	(2.02136)
Portugal	1.212167	0.043428	1.541819	0.322786
	(1.89928)	(0.88410)	(2.10963)	(1.05541)
Spain	0.522926	0.894830	1.797242	4.165913
	(1.65129)	(1.74007)	(2.74922)	(3.13008)

Notes: The table presents the variance decomposition of the forecast error variance of the real stock returns due to IRS, IRL, OP and IP. The model is performed with 1 lag (BIC information criterion) and the table shows the results after 12 months. Monte Carlo constructed errors are shown in parenthesis.

This time period will now be regarded to cover the 'normal' macroeconomic conditions without the financial crisis period, and we can now examine these results to see if there are any great changes to the results when comparing them to the whole sample. If we start with the contribution of the real oil price to the forecast variance of real stock returns, it is obvious that the contribution has increased in all countries. The largest contribution can be found in Italy (2.10%), while the lowest is seen in Ireland (1.37%).

Regarding the decomposition of the shocks in the forecast error variance of real stock returns, the largest contribution for Portugal is now the oil price, followed by the short-term interest rate. For Greece, the contribution of short-term interest rate has now increased and consequently explains the largest variance in real stock returns, followed by the oil price. From the table we can see that in Ireland, Italy and Spain, industrial production still contributes the most to the forecast error variance in real stock returns.

Alternative VAR specifications

Sine the lags suggested by the information criterions, BIC and AIC, did not agree on the number of lags that should be included in the model, we have estimated our VAR model with the number of lags suggested by AIC as well to be able to check whether our results will differ from when using the lags suggested by BIC. As mentioned earlier AIC criterion suggests the following for the different countries: 2 lags for Portugal, 3 for Ireland, Italy and Spain, and 6 for Greece. The results from the impulse response functions and variance decomposition functions are listed in appendix C1.

As we can see from the graphs in the appendix the impulse responses demonstrates quite similar results as when estimating the model according to lags suggested by BIC. The real stock returns in all countries display the same signs of the effects from the shocks to the various variables. We now also see that shocks to industrial production become marginally statistically significant for Spain.

The results from the variance decomposition functions with AIC information criterion are listed in appendix C2. When introducing a greater number of lags, the contribution of oil price in the forecast error variance of real stock returns after 12 months, increases in all countries. The contribution of industrial production also increases with a substantial amount for all countries, except for Ireland where the share somewhat decreases. After 12 months, we can also see an increase in the contribution of both interest rates. In Greece, the contribution of both interest rates increased by around 3 % when adding more lags, however, for Greece AIC suggested a rather large lag length (6) comparing to the other countries.

7. Discussion

In this section we will discuss the results from our analysis, and put them into context with other studies from the literature on oil price shocks and international stock markets. We will also assess what might be the reason for the results we got.

Analyzing the oil price shocks effect, we see that shocks to the world real oil price have a negative effect on the real stock returns for all the countries in our sample. This effect also holds when excluding the financial crisis from the sample. The negative oil price effect found in our analysis is consistent with findings from, among others, Park and Ratti (2008), Papapetrou (2001) and Cunando and Perez de Gracia (2013) where all studies find a negative oil price effect on real stock market returns. Moreover, Park and Ratti used a linear specification of the oil price displaying percentage changes, which is the specification we are using as well, giving further support to our findings. However, Killian and Park (2009) argues that, at best, the estimates from an analysis with this variable represent the stock markets response to an average oil price shock during the sample period in question.

We did not, however, find the oil price effect to be statistically significant for our sample period. As mentioned in our literature review, there are other studies finding similar limited results. Apergis and Miller (2009) only found a small effect in their VAR model for sample period 1981-2007 in eight different countries (in which Italy was on of them). A reason for our statistically insignificant results might have to do with the estimation of the model. As mentioned earlier, both the impulse responses and variance decompositions are sensitive to the ordering of the variables. We did, however, try different orderings without getting any more significant results.

Furthermore, Lütkepohl (2005, p.66) argues that the results might be different when altering the system of equations in the VAR model, either by adding more variables or deleting variables that are already in the system. We are aware of the omitted variable-bias that might occur, but since we have followed other similar empirical studies when deciding which variables to include, this should not be a great issue. Moreover, there is a possibility that measurement error in the preliminary data transformation of the variables. We did not, however, have capacity to look further into this possibility but are aware of it. Although our results are insignificant, we know the direction of the responses, which are as excepted, and can make indications based on this.

The negative oil price effect can also be seen in comparison to the fact that all five countries are net importers of oil (URL 5). Wang et al. shows evidence that the stock market response to oil price shocks, depends on a country's net position in the crude oil market. They find that in oil-importing countries, an increase in the price of oil will result in higher industry costs, which will negatively affect stock markets. According to the World Factbook (URL 6), Italy is the country ranked highest when it comes to oil imports, making Italy the country most dependent on oil out of our sample countries. In our variance decomposition analysis, we found that regarding the contribution of oil price shocks in the variation of stock returns, Italy had the largest contribution in both subsamples. This is consistent with the argument by Wang et al.

When dividing the sample, and excluding the period around the financial crisis, we saw an increase in the contribution of oil price shocks in the variability of real stock returns compared to the sample containing observations for the whole period. This might be a result of the more stable conditions during that time period (pre-crisis). In the subsample the oil price innovations contribute more to the variability in real stock returns, than that of the interest rate, for all countries except Greece. In the whole sample, however, short-term interest rate shocks contributed more than oil price shocks for Ireland, Portugal and Spain. When seen in relation to the financial crisis one can argue that the greater contribution can be due to the interest rate policy adapted as a response to the decreased economic growth caused by the recession, in which banks tried to push down the interest rate in order to encourage increased economic activity.

We also employed an alternative specification of the VAR model and conducted the analyses with the lag length suggested by AIC information criterion. The results were pretty much the same as when estimating the model with lags according to BIC, and we saw that none of the already insignificant effects became significant when introducing more lags.

Considering the different effects of shocks to short-term and long-term interest rate both type of shocks demonstrates a negative impact on real stock returns, with the exception being Greece in which shocks to both rates yield a positive effect on real stock returns and Italy when excluding the financial crisis from the sample. After 2 periods the shock to short-term interest rate becomes marginally statistically significant. Hence, the results for the majority of our sample countries are in line with economic theory emphasizing a negative relationship between interest rates and stock returns, although we do not find this negative relationship to be statistically significant in our sample.

Regarding the comparison between the effects of the two different interest rates, we do not see any clear patterns indicating whether one rate is more important in explaining the variability of real stock returns. For the whole sample period, the long-term interest rate contributes more than the short-term for Greece and Ireland, while for the other countries the short-term rate contributes the most.

Shocks to industrial production demonstrate a positive effect on real stock returns for all countries, except for Ireland, in both sample periods analyzed. This result is in line with previous work by among others Papapetrou (2001) who found a positive effect of industrial production shocks on real stock returns in Greece. The effect is however, not statistically significant for both samples. The only exception is Spain, where shocks to industrial production show a positive and statistically significant effect on real stock returns after two periods. Shocks to industrial production in Ireland are, on the other hand, negative and statistically significant during the first month. This also holds, when analyzing the subsample without the financial crisis.

8. Conclusion

In this thesis we have studied the effect of oil price shock on real stock returns in the five OECD countries; Portugal, Ireland, Italy, Greece and Spain. We found little evidence of an impact of linear oil price shocks on real stock returns for all sample countries. We were able to evaluate the direction of the effect, but did not find any statistically significant results regarding the oil price shocks' effect on real stock returns. The direction of our results is in line with existing studies demonstrating a negative oil price effect in which shocks to the real oil price depresses stock returns. We also saw indications of the relation between oil dependency and the effect of stock returns, in which the contribution of oil price shocks to the variability in real stock results was highest in Italy, the country displaying the highest dependency on oil. Furthermore, when excluding the financial crisis from the sample we found that the contribution of the oil price shocks in the variability of real stock returns, increased.

By adding other economic variables to our analysis we were able to investigate the effect of shocks to these variables as well. We found that, for the majority of the countries, shocks to both interest rates demonstrates a negative impact on real stock returns, which is in line with economic theory. The effects were, however, not statistically significant. Furthermore, we were not able to see any important differences between the effects of shocks to short-term and long-term interest rates. There may be several reasons for our statistically insignificant results. The fact that our thesis shows different results then other papers can be dependent on the data used in the analyses, and the time period investigated.

For further research we suggest to look into other specifications of the oil price to be able to compare the effects from the different specifications, and investigate if one gets more significant results applying other specifications. Mork (1989) stresses the use of an asymmetric specification of the oil price where one makes the distinction between oil price increases and decreases and assess the different effects on the stock market returns due to these changes. Another interesting aspect one could look into is the decomposition of oil price shocks into supply and demand driven shocks. Killian (2008) argues that estimates may be sensitive to the choice of sample period since the composition of underlying demand and supply shocks evolves over time.

It could also be interesting to include net oil exporting countries in the analysis in order to make distinctions between the effects on real stock returns in importing and exporting countries within the OECD.

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Appendices

Appendix A: VAR coefficients

A.1. Whole sample (1993m07-2014m01)

Greece

	dIRS	dIRL	dlogOP	dlogIP	RSR
dIRS(-1)	0.162181	0.078740	-0.011330	0.007868	0.006849
dIRL(-1)	0.028159	0.081615	0.000958	-0.001038	0.006523
dlogOP(-1)	0.360052	0.191403	0.125696	0.010061	0.041215
dlogIP(-1)	0.684562	4.033829	0.043103	-0.467545	0.090599
RSR(-1)	-0.775918	-4.385290	0.168909	0.013789	0.382362
C	-0.068023	-0.036940	0.004487	-0.004532	-0.000156

Ireland

	dIRS	dIRL	dlogOP	dlogIP	RSR
dIRS(-1)	0.433229	-0.057447	0.028593	0.003822	-0.006946
dIRL(-1)	0.433229	0.205243	0.016179	-0.005674	-0.007672
dlogOP(-1)	0.261717	0.060066	0.097338	-0.025982	0.037246
dlogIP(-1)	0.120066	-0.466621	-0.098876	-0.476237	0.035638
RSR(-1)	0.308483	0.414780	0.184430	0.037938	0.350776
C	-0.016710	-0.010381	0.005905	0.005079	0.000977

Italy

	dIRS	dIRL	dlogOP	dlogIP	RSR
dIRS(-1)	0.324402	-0.019502	0.009295	0.010028	0.000859
dIRL(-1)	0.004269	0.274159	0.018692	0.001403	0.000524
dlogOP(-1)	0.443844	0.114117	0.109480	0.025873	0.034453
dlogIP(-1)	1.790788	1.067951	0.273262	-0.114238	0.556023
RSR(-1)	-0.524530	-1.119061	0.332692	0.048368	0.216928
C	-0.021705	-0.013809	0.006357	-0.002130	0.001363

Portugal

	dIRS	dIRL	dlogOP	dlogIP	RSR
dIRS(-1)	-0.040586	0.110580	0.022468	0.009911	0.002535

dIRL(-1)	0.084689	0.239817	0.010088	-0.001635	0.000909
dlogOP(-1)	0.435642	0.241694	0.103076	0.002807	0.008654
dlogIP(-1)	-0.029595	-1.136830	0.040916	-0.415464	0.187701
RSR(-1)	-0.442506	-0.516048	0.250189	0.045404	0.331184
C	-0.047450	-0.010556	0.005640	-0.002294	0.002424

Spain

	dIRS	**dIRL**	**dlogOP**	**dlogIP**	**RSR**
dIRS(-1)	0.478821	-0.052108	0.048162	0.003564	-0.002001
dIRL(-1)	0.003240	0.295054	0.024384	0.000981	-0.006821
dlogOP(-1)	0.277886	0.150730	0.105847	0.008381	0.017573
dlogIP(-1)	-0.272569	0.280262	-0.190462	-0.273443	0.456782
RSR(-1)	-0.181910	-1.028891	0.202081	0.055528	0.262916
C	-0.021655	-0.015478	0.006788	-0.002616	0.002633

A.2. Subsample (1993m07-2008m08)

Greece

	dIRS	**dIRL**	**dlogOP**	**dlogIP**	**RSR**
dIRS(-1)	-0.074806	-0.047747	-0.020428	0.005997	0.027993
dIRL(-1)	0.468667	0.332365	0.031066	0.005102	-0.017363
dlogOP(-1)	-0.093175	0.595337	-0.000169	0.014913	-0.026391
dlogIP(-1)	1.298497	0.328699	0.057074	-0.361839	-0.265635
RSR(-1)	-1.116100	-1.702635	0.011415	0.010359	0.346283
C	-0.037132	-0.064892	0.008905	-0.002471	0.002482

Ireland

	dIRS	**dIRL**	**dlogOP**	**dlogIP**	**RSR**
dIRS(-1)	0.325540	-0.051668	0.037287	-0.005050	-0.005641
dIRL(-1)	0.086653	0.106159	0.053957	-0.007899	-0.007647
dlogOP(-1)	0.040870	0.210813	-0.020947	-0.019940	-0.026680
dlogIP(-1)	0.103996	-0.403096	-0.186180	-0.460944	0.064573
RSR(-1)	0.262073	-0.262614	-0.170848	0.083051	0.340498

C	-0.006941	-0.011066	0.009975	0.006984	0.001198

Italy

	dIRS	**dIRL**	**dlogOP**	**dlogIP**	**RSR**
dIRS(-1)	0.204002	-0.094395	0.014191	0.002485	0.019384
dIRL(-1)	0.057914	0.354220	0.033834	0.002527	-0.022991
dlogOP(-1)	0.193138	0.174527	0.007012	0.007254	0.020263
dlogIP(-1)	0.304351	0.612568	-0.335566	-0.218277	0.586278
RSR(-1)	-1.035182	-1.088961	0.155254	0.017310	0.234581
C	-0.014699	-0.014633	0.008115	-0.001582	0.001856

Portugal

	dIRS	**dIRL**	**dlogOP**	**dlogIP**	**RSR**
dIRS(-1)	-0.152784	0.081789	0.017780	0.007376	0.007757
dIRL(-1)	0.306127	0.390013	0.047322	0.004746	0.002907
dlogOP(-1)	0.112916	0.259701	-0.014954	-0.006855	-0.027827
dlogIP(-1)	-0.505955	-0.478666	0.047411	-0.461573	0.108059
RSR(-1)	-0.709598	-0.129338	0.011907	-0.461573	0.382480
C	-0.032273	-0.016637	0.009904	-0.001910	0.003285

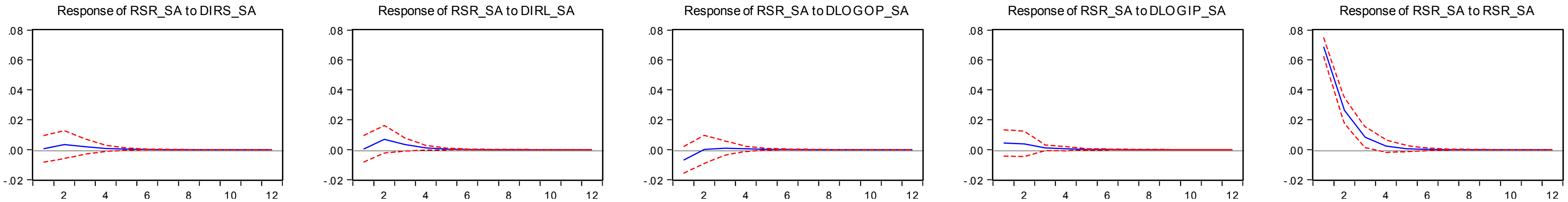
Spain

	dIRS	**dIRL**	**dlogOP**	**dlogIP**	**RSR**
dIRS(-1)	0.373450	-0.102830	0.059951	-0.004404	0.000344
dIRL(-1)	0.011718	0.432930	0.041913	0.003085	-0.017424
dlogOP(-1)	-0.005681	0.122127	-0.005001	-0.009142	-0.002369
dlogIP(-1)	-1.430795	-0.198852	-0.583885	-0.347030	0.635767
RSR(-1)	-0.588650	-0.863751	0.001396	0.025208	0.276568
C	-0.015767	-0.013986	0.010348	-0.001453	0.003679

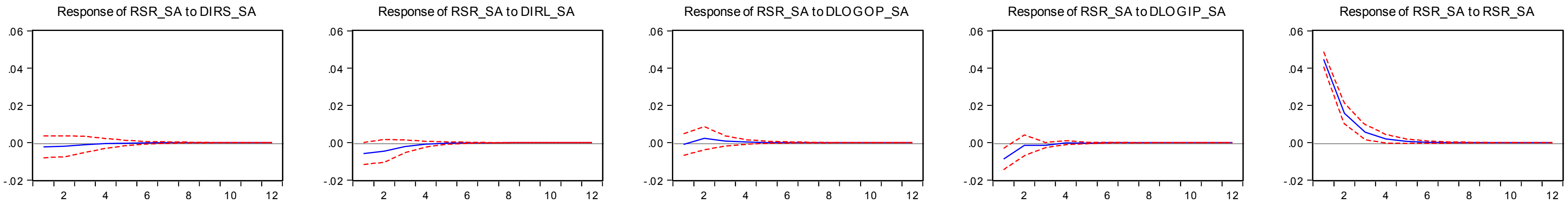
Appendix B: Orthogonalized impulse response function of real stock returns to world real oil price shocks in VAR (d(irs), d(irl), dlog(op), dlog(ip), rsr).

B.1. Whole sample (1993m07-2014m01)

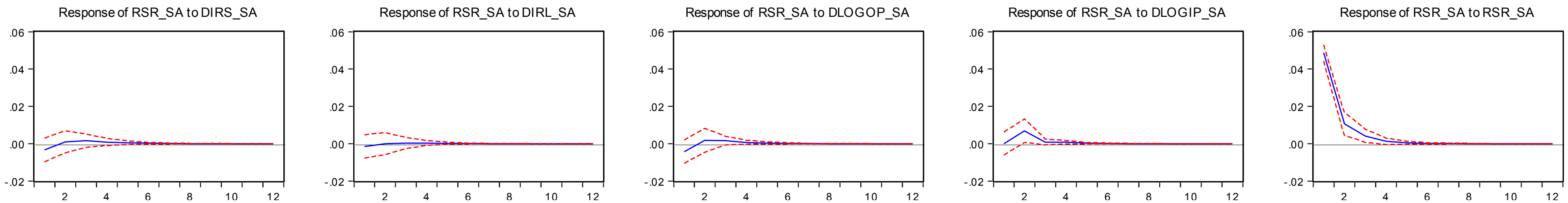
Greece



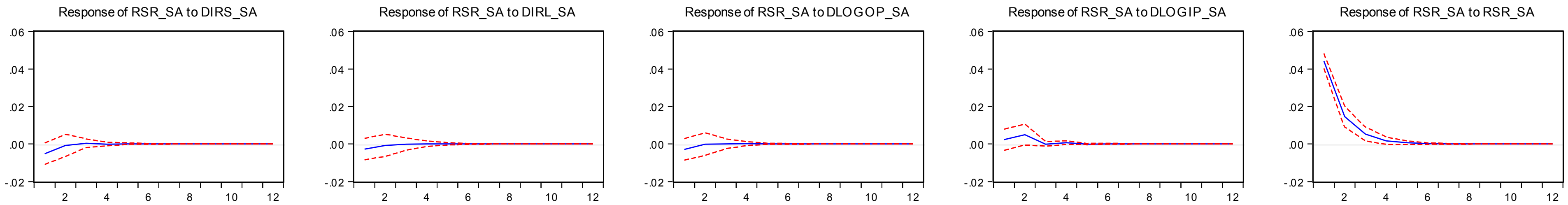
Ireland



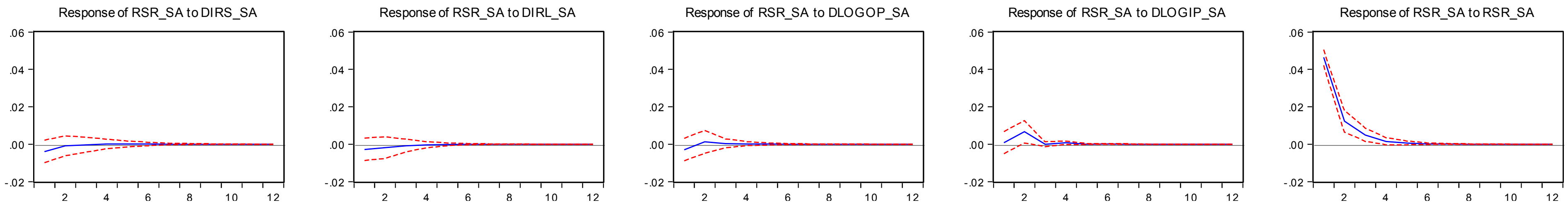
Italy



Portugal

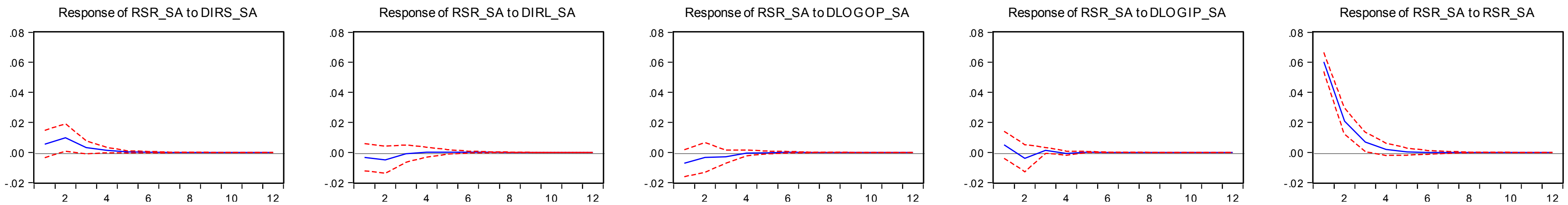


Spain

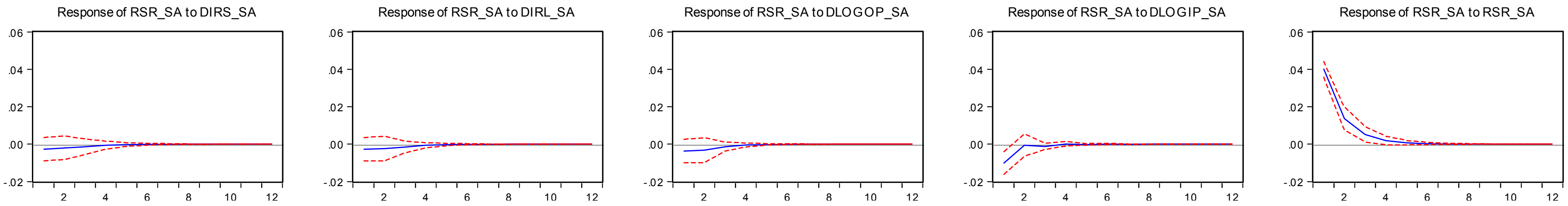


B.2. Subsample: 1997m03-2008m08

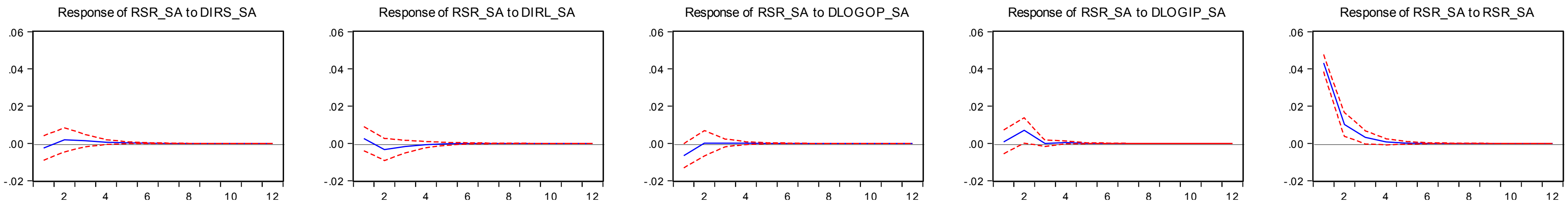
Greece



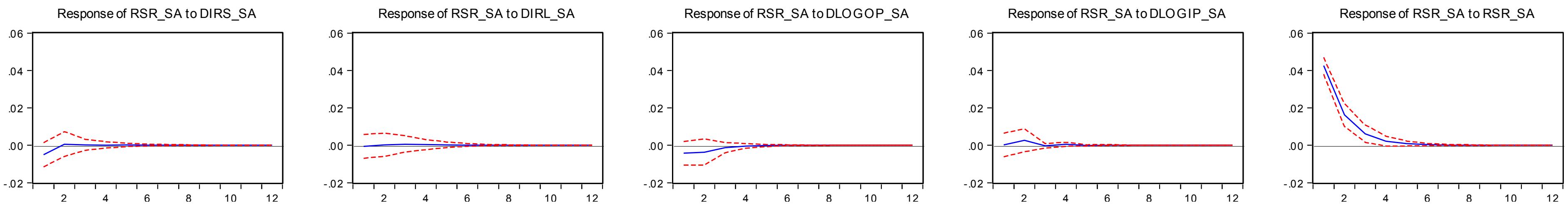
Ireland



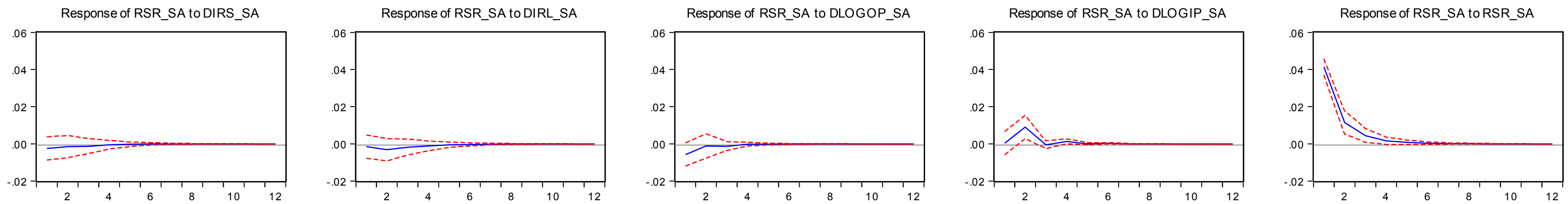
Italy



Portugal



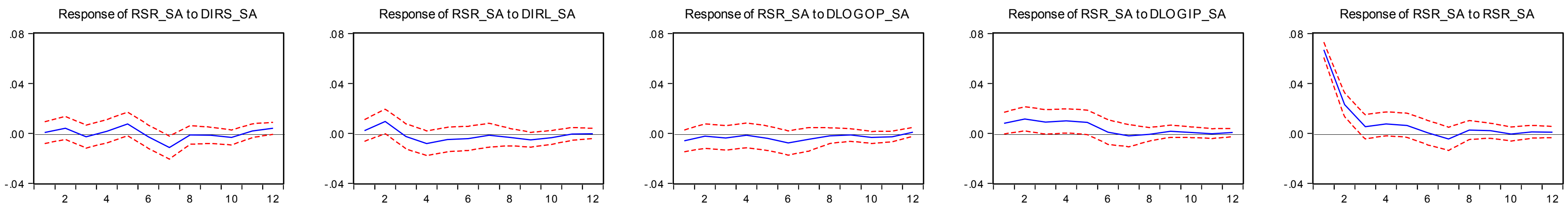
Spain



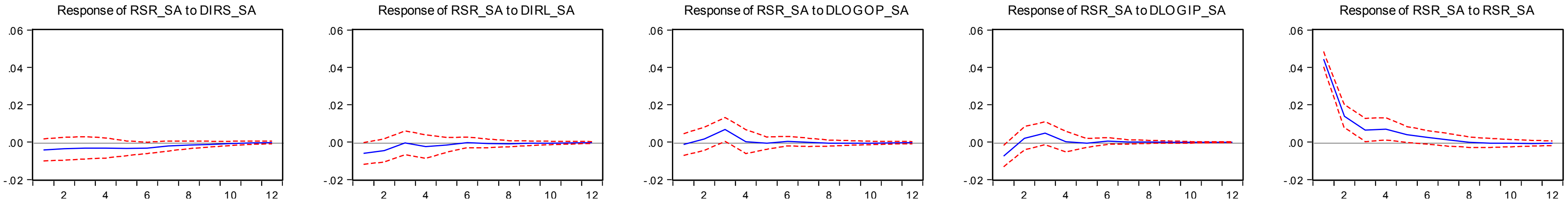
Appendix C: Alternative VAR specification

C.1: Impulse responses (AIC). Whole sample (1993m07-2014m01): Orthogonalized impulse response function of real stock returns to world real oil price shocks in VAR (d(irs), d(irl), dlog(op), dlog(ip), rsr).

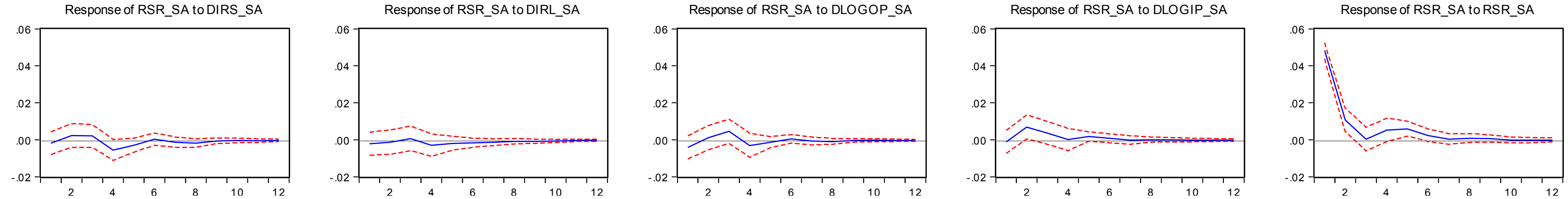
Greece AIC (6 lags)



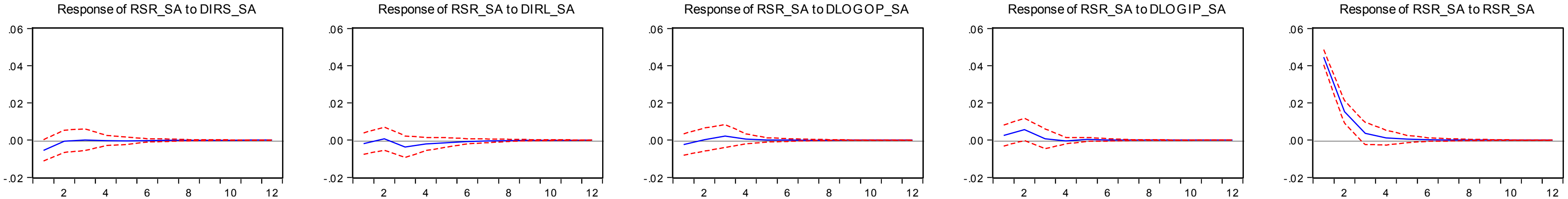
Ireland AIC (3 lags)



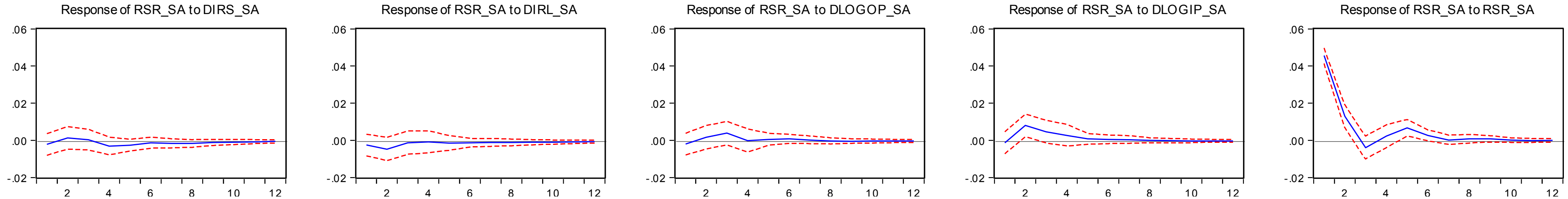
Italy AIC (3 lags)



Portugal AIC (2 lags)



Spain AIC (3 lags)



C.2: Variance decomposition of rsr due to irs, irl, op and ip. Lags applied in the model according to AIC information criterion.

1993m07-2014m01	**VAR model: d(irs), d(irl), dlog(op), dlog(ip) and rsr.**			
	Due to IRS	**Due to IRL**	**Due to OP**	**Due to IP**
Greece (lags=6)	4.063076	4.162242	2.943797	7.272448
	(2.95032)	(2.76901)	(3.3188)	(3.60811)
Ireland (lags=3)	3.215934	2.682940	2.047296	3.274634
	(3.09682)	(2.79990)	(2.01868)	(2.15910)
Italy (lags=3)	2.21009	0.998711	1.956151	2.437694
	(1.90592)	(2.06379)	(2.06411)	(1.91327)
Portugal(lags=2)	1.340319	1.058939	0.459827	1.649212
	(1.60406)	(1.84566)	(1.49844)	(1.96584)
Spain (lags=3)	1.363326	1.675968	0.926731	3.754831
	(1.98220)	(2.05614)	(1.61887)	(2.72843)

Notes: The table presents the Variance decomposition of forecast variance, of the real stock returns to IRS, IRL, OP and IP after 12 months. The model is performed with lags according to AIC information criterion. Monte Carlo constructed errors are shown in parenthesis.