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Oil price shocks and trade

A study on ten Euro area countries

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Abstract

This study aims to examine the effects of oil price shocks on the overall trade- and the non-oil trade balances for ten oil-importing Euro area countries. Theory suggests that the effects from an oil price shock on the oil component of the trade balance for oil importers is negative, but that the effect on the non-oil component is positive. Thus, the effect on the overall trade balance is ambiguous. When studying the relationship between the price of oil and trade, the Euro area is often considered as a homogeneous group and the results are presented at an aggregate level. The different economic structure and proneness to adjust to shocks among the countries motivate a study on an individual level. Using a data-set, spanning from 1980Q1 to 2014Q4, we set up an unrestricted Vector Autoregressive (VAR) model to perform Granger causality tests, Impulse Response Functions (IRF:s) and variance decomposition analysis. The causality tests show that the price of oil only causes the non-oil trade balance. Moreover, the IRF:s indicate that the Euro area countries' non-oil trade balances respond similarly to oil price shocks. However, the results for the overall trade balances are mixed, indicating that there are discrepancies between the countries. Further, by dividing the sample we investigated the proposition that the role of oil has declined during the last decades, this hypothesis could not be confirmed for all countries.

Keywords: Oil price shocks, trade balance, VAR, Orthogonalized Impulse Response Functions, Euro area

Table of Contents

List of Figures and Tables

1. Introduction

Oil is a vital component in the economy as it is the most traded commodity in the world and rapid movements in the price of oil often coincide with economic turmoil (Hamilton, 2008). The recent slump in the price of oil has reignited the discussion about how the relationship between oil prices and the macroeconomy looks like (Baumeister and Kilian, 2016). However, this is not a new concern, the major oil crises in the 1970s combined with the finding that oil price shocks was causing recessions in the U.S (Hamilton, 1983) first inspired economists to study this connection. A large amount of the recent empirical studies have focused on large economies such as the U.S and the aggregated Euro area and have investigated the responses of mainly GDP and inflation. However, an analysis relating the price of oil to the trade balances of the individual European countries is, as far as we know, not yet conducted.

For a long time, oil was considered to be such a critical factor for economic performance that forecasts often included a caveat for oil price fluctuations (Perry, 1999). Furthermore, there are strong linkages between international trade and economic performance, since it accounts for a vast part of economic growth and trade deficits may dampen economic growth (Le and Chang, 2013). Considering this, the lack of research on the effect of oil price shocks on trade balances is a bit surprising. Further, there is a concern that international risk sharing is not enough to mitigate the negative effect on the external balances that oil price shocks implies for oil-importing countries, thus it is crucial from a political point of view to study the impact (ibid). The Euro area is often referred to as a homogeneous group with deep financial integration due to the common currency. However, the structure, oil dependency and trade patterns are not uniform for the countries, which raise questions regarding the possibility of oil price shocks affecting the Euro area countries differently.

This thesis aims at distinguishing the effect from oil price shocks on the overall trade balance, where the oil component is included, and the non-oil trade balance of the individual Euro area countries. Looking at the overall trade balance is relevant given that there are two theories that predicts opposite effects from oil price shocks. On the one hand, rising oil prices imposes higher import bills for oil-importing countries, which worsens the oil component, that in turn affect producers and consumers. At the same time, higher oil prices also have indirect effects that might bring depreciation of the domestic currency, boosting exports and in turn improving the non-oil trade balance (Kilian, 2008). It is easy to argue that oil has lost some of its significance the last decades in industrialized countries, as its share of consumers' and producers' costs have declined (Blanchard and Galí, 2008). Although, oil price shocks still affects consumers and firms economic decisions in a number of ways that makes it a critical commodity (Forni et al, 2015). The purpose of examining the non-oil trade balance is to see how much the results differ when the oil component is removed and also that the Euro area as a whole is considered a major oil importer and fluctuations in the price of oil are beyond their control. Thereby, it is interesting to look at the non-oil trade balance that, to a larger extent, can be influenced by national policies.

The above reasoning leads us to expect that the effect from oil price shocks is not unison for the countries and that the role of oil has changed over time. Thus, the hypotheses this essay aims at evaluating and answering can be formulated as:

- *Does an oil price shock affect the trade balances of European countries in a similar way?*
- *Have the impact of oil price shocks on the trade balances decreased over time?*

Previous empirical work examining the impact of oil price shocks on trade balances focus on major oil-importing countries, see Kilian et al (2009), or looks specifically at the aggregated Euro area (Forni et al, 2015). We contribute to the existing literature by examining if the effect differs between the individual Euro area countries and also if the impact for these countries has changed over time. Further, we use a slightly different econometric methodology and a more updated data-set, spanning from 1980Q1 to 2014Q4.

The econometric approach in this thesis consists of specifying an unrestricted Vector Autoregressive (VAR) model and with the help of Granger-causality tests, orthogonalized Impulse Response Functions (IRF:s) and variance decompositions analyze the research questions. The approach chosen limits us from disentangling the different sources of oil price shocks. The causality tests show that the price of oil only causes the non-oil trade balance. Our main findings for the IRF:s are that the response of the overall trade balance from oil price shocks is different across the countries and that the effect on the non-oil trade balance is positive and unison for the entire sample. We could not find support for the hypothesis stating that the role of oil has declined since the introduction of the Euro.

The remainder of this paper is organized as follows. Section 2 gives a review of the previous relevant literature regarding the relation between oil and the macroeconomy. After that, the theoretical framework is laid out where more emphasis is put on explaining the mechanisms of oil price shocks and how it specifically affects the trade balance. Section 4 presents the collected data, which is followed by a description of the econometric method. Section 6 reports the estimated results, a discussion and robustness checks. Finally, section 7 contains our conclusions.

2. Literature review

There is extensive empirical research on the role of oil in the economy. Much of it aims at explain the fact that rapid oil price movements and economic turmoil seems to coincide. The first paper discussing oil and the macroeconomy that gained attention was authored by Hamilton in 1983. He used a Vector Autoregressive (VAR) model to investigate the relationship between oil prices and gross national product and concluded that nearly all of the recessions between 1945 and 1972 in the U.S. were preceded by a significant increase in the price of oil (Hamilton, 1983). Mork (1989) developed the work of Hamilton and by looking at both oil price increases and decreases he found that oil price decreases were not followed by economic expansions, something he observed after the sharp drop in the price of oil in 1986. A major part of the literature has continuously focused on oil and the U.S. economy (see for example Barsky and Kilian (2004), Hamilton (2009), Bodenstein et al (2011) and Kilian (2008)). This collection of academic papers overall concludes that oil price shocks significantly affect macroeconomic activity in the U.S. economy, but that the effect was more pronounced during the 1970s and 1980s.

The relationship between oil and trade is a relatively new concern for economists and fewer studies has been conducted on this subject. Going through the literature, Lutz Kilian has provided plenty of work in this field. He concludes that the economic response of an oil price shock is expected to be different depending on whether the origin is from the supply side or the demand side of the economy (Kilian 2009). In another study together with Alessandro Rebucci and Nikola Spatafora (2009), they estimate the impact of oil supply- and demand shocks on several measures of country's external balances, including the overall- and non-oil trade balance, which will also be examined throughout this thesis. Comparing the effects from oil price shocks on the different balances gives a broader picture on how oil affects trade and more specifically how the non-oil trade balance offsets the oil component. One of their main findings is that the response of the non-oil trade balance after an oil price shock for oil-importers is positive, while the response for the overall trade balance is mixed since it depends on the source of the shock. Furthermore, the authors analyzed major oil-importers, including the Euro area as a whole. In this thesis, we will instead look at individual countries to see if they respond in a uniform way. However, their findings for oil-importing countries can be used to cross-check our results.

One of the theories that this thesis is based on is laid out in Kilian (2008), which is that an oil price shock causes both a reduction in aggregate demand, through decreased consumption, and imposes larger production costs for firms, leading to declining investments. A somewhat cautious stance towards this theory is in place due to differences between the U.S. and the Euro area. Despite this, the theory is still relevant and can be compared to Peersman and Van Robays (2009). They focus on the macroeconomic effects of oil price shocks in the Euro area and stress the fact that the underlying source of oil price shocks is important to consider when deciding what policy measures to adapt. They also conclude that the European Central Bank and the Federal Reserve has different objectives and hence responds differently to oil price shocks, which woke our idea of stepping away from previous literature and analyzing oil-importing countries in the Euro area instead of the U.S. or oil-exporting countries.

The empirical methodology used in Le and Chang (2013) provides a good foundation for our approach of analyzing the data. The authors use a VAR model and investigate whether volatility in different components of the trade balance is linked to fluctuations in oil prices. In a well-structured step-by-step fashion they perform tests for unit root, structural breaks and cointegration before they look at the dynamics of the variables by employing a Granger-causality test and estimating Impulse Response Functions (IRF:s). One of the countries in their analysis is Japan, which share the characteristic of being an oil-importer as the countries included in this study. They conclude that the causality only runs from the price of oil to the oil- and non-oil trade balance and the IRF-analysis show that Japans non-oil trade balance responded positively to oil price shocks. These results can be compared to a study by Jiménez-Rodríguez and Sánchez (2004), in which the main takeaway is that real GDP growth of oil-importing countries (the Euro area being among them) decreases when oil prices increase. Hence, the papers observe that oil price shocks positively affects the trade balance and negatively affects real GDP growth, providing strength to the idea that oil plays an ambiguous role for the macroeconomy. What is also concluded in Jiménez-Rodríguez and Sánchez (2004) is that oil price shocks are, together with monetary shocks, the main source of volatility for real GDP. The econometric methodology used for estimation follows from this paper along with Le and Chang (2013) and Park and Ratti (2008).

Using a different method compared to the one described above, Bodenstein et al (2011) assess the impact of oil price shocks on macroeconomic variables in the U.S. They employ a two country Dynamic Stochastic General Equilibrium model, similarly to Forni et al (2015). The latter paper is more relevant for our purpose since they investigate the effects on the aggregated Euro area. The main conclusion they draw is that the non-oil trade balance improves due to both a supply- and a demand shock. Further, for a supply shock, the overall trade balance deteriorates but it improves following a demand shock. The results are roughly in line with Kilian et al (2009).

Blanchard and Galí (2008) add another angle to the role of oil compared to most of other studies reviewed. They argue that the effects of oil price shocks most likely have coincided with other shocks, which could not be identified, and thus downplays the impact of oil price shocks in economic downturns. Furthermore, they find that the effects of oil price shocks mainly in the U.S have become muted for the Consumer Price Index and GDP over time, due to a couple of reasons. Firstly, the monetary policy conducted has become more credible and secondly, today oil stands for a smaller share of oil in consumption and production. The second reason, decreased share of oil in production, will be further examined in this study as we make a comparison between Euro area countries and by looking at how the responses on the trade balances of oil price shocks has evolved over time.

3. Theoretical framework

The relationship between oil price shocks and the macroeconomy is a complex one and will be investigated thoroughly in this section. First, the relationship between oil and the macroeconomy will be described. This is followed by a deeper theoretical analysis regarding trade balances and the different sources of oil price shocks. Finally, the responsiveness of the Euro area countries and the role of oil in the economy will be discussed.

3.1. Oil and the macroeconomy

The relationship between oil and the macroeconomy stretches far back. In early empirical work, the price of oil was treated as an exogenous variable while holding every else in the model constant. This approach is questionable since empirical studies have found evidence for a reversed causality from macroeconomic performance (GDP growth for example) to the price of oil (Barsky and Kilian, 2004). The limitation with this approach is that it does not allow for endogenous responses of an oil price shock (Kilian et al, 2009). Despite this, there is a consensus regarding some basic facts and assumptions on the subject.

Firstly, it is important to distinguish that the effects of oil price shocks depends on whether a country is a net oil-importer or a net oil-exporter. One indirect effect that is present for both types of countries is that a rise in the price of oil is associated with higher domestic inflation and higher prices in trading partner countries. To counter this effect, monetary policies aimed at cooling down the economy through increased interest rates are not unusual (Le and Chang, 2013). Higher interest rates may bring lower consumption, investment and economic growth, both domestically and internationally, which also lowers demand. There is possibly an opposing effect if interest rates rises relatively more domestically than in other countries, which is that the country might attract foreign capital that brings more liquidity to the economy (Huntington, 2015). Peersman and Van Robays (2009) shows that the indirect effect of oil price shocks on output and inflation is larger and also that the transmission is faster in the U.S than in the E.U.

The previous section described how the indirect effect of an increase in the price of oil is transmitted through the economy. There is obviously also a direct effect from an oil price shock that works primarily through international trade, which in turn affects GDP. Therefore, we will include real GDP in our estimation as a control variable. The direct effect of rising oil prices for oil-exporters are two folded. The extra revenue from exporting oil at a higher price is partly offset by lower demand from oil-importers that suffer from overall rising prices, relating to the macroeconomic effects. However, oil-exporters are in theory expected to enjoy a positive net effect of an increased oil price (Le and Chang, 2013). The direct effect from an oil price shock is negative for oil-importing countries, as the input costs rise for firms using oil in its production process and hence the trade balance worsens (Jiménez-Rodríguez and Sánchez, 2004).

Another linkage between the oil market and the real economy is through the exchange rate market and in particular the U.S. dollar, since oil is both settled and priced in that currency. What happens when the U.S. dollar depreciates is that oil becomes relatively cheaper for foreigners compared to the price of their own commodities in foreign currencies, thereby increasing their purchasing power. When oil prices increases this might imply depreciation (appreciation) of the currencies of oil-importing (oil-exporting) countries, excluding the U.S (Reboredo, 2012). This paper will control for exchange rate movements between the U.S. dollar and the Euro area countries chosen to account for this possible linkage.

3.2. Trade balance and oil

As described briefly above, there are several channels of transmission of how oil price shocks impact economic performance and growth. Less attention in the empirical literature has been devoted to the impact on the external balances. However, in the last couple of decades, there has been a larger debate and concern among policymakers about the external imbalances in the world (Schmitz and Von Hagen, 2011). An interesting subject is how the external accounts, and in particular the different measures of the trade balance among countries, are affected by dramatic changes in the price of oil. Figure 1 gives a view of the real price of crude oil between 1980 and 2014. From this we can observe that the oil price has experienced periods of great volatility, but also some more stable periods.

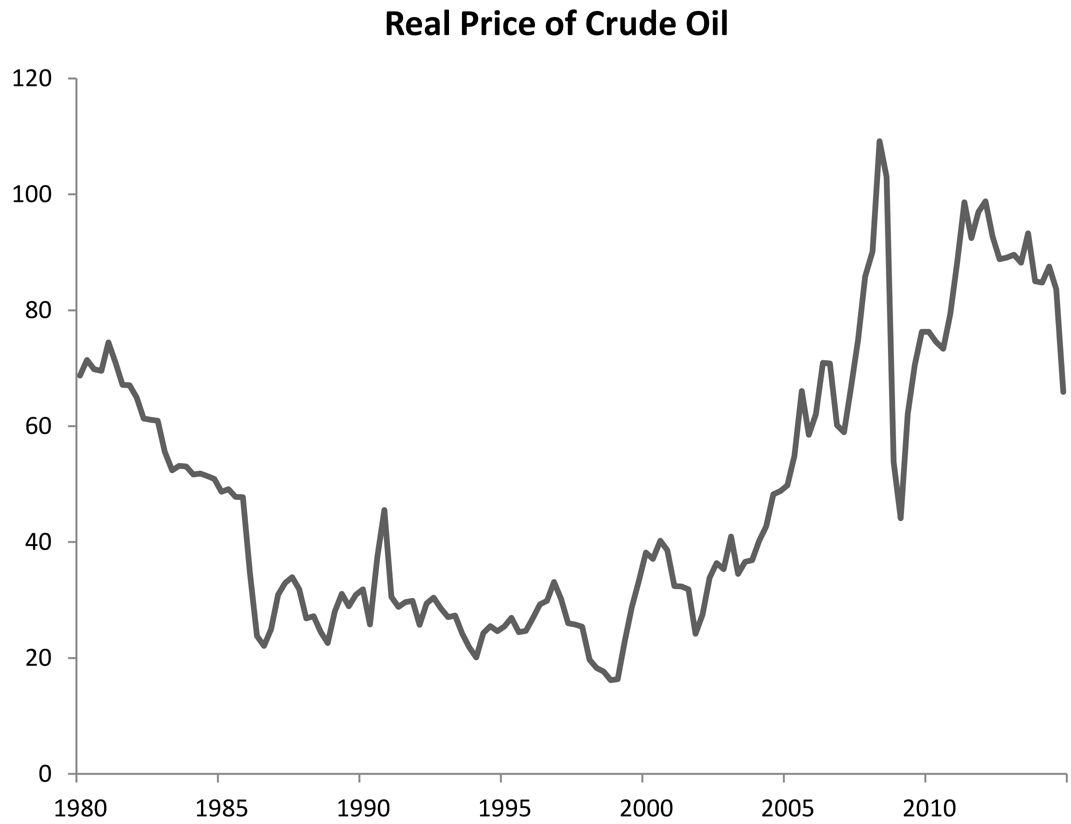

Figure 1. Real price of crude oil per barrel, U.S dollar 2010 constant prices. Source: See Appendix

The link between oil price shocks and the external balances works through the trade channel and the financial channel, which sometimes are called the macroeconomic- and valuation channel (Le and Chang, 2013). The trade channel is the traditional view and most straightforward way of thinking of the impact on trade balances of an oil price shock. The transmission is through changes in prices and quantities (Kilian et al, 2009). On the other hand, the valuation channel relates to the impact on the external portfolio position and asset prices. For the trade channel there are two opposing effects. The oil trade balance worsens for importers when a shock in the oil price occur, which is partly offset by an improved non-oil trade balance (Bodenstein et al, 2011). The improvement stems from that higher oil prices induces a negative wealth effect and then, all else equal, imports of other goods also decrease and hence the non-oil trade balance improves (ibid). Additionally, since there is plenty of intra trade in the Euro area, a severe oil price shock will harm exports and consequently worsen the non-oil trade balances as well (Huntington, 2015). Further adjustments might also occur that affect both the trade channel and the financial channel, such as shifts in factor costs and redirection of income (ibid).

According to theory, the oil component of the overall trade balance will be worsened for oil-importing countries after a shock in the price of oil. This will inevitably affect the countries since the price of oil is beyond their control. Thus, it will be appropriate to look at the non-oil component to capture the potential offsetting effect from the non-oil trade balance that also can be influenced to a greater extent by the individual countries. The overall impact on trade depends on the oil price elasticity of demand, the relative oil endowment and the extension of international risk-sharing (Bodenstein et al, 2011). If a country is not prone to adjust to oil price shocks, the negative oil component must be balanced by an even larger surplus in the non-oil trade balance and a similar reasoning can be applied in the case where countries have a relative small oil endowment. The availability of risk-sharing reduces the need to increase the non-oil component in times of oil price hikes, but too much borrowing is associated with other risks such as potential unsustainable deficits in the public sector (ibid). Due to the expected dissimilarities among the Euro area countries in these regards, the countries may respond differently and thus motivating an analysis on country level. Moreover, in times of financial distress, the risk-appetite usually goes down and this would mean that oil-importing countries trade balances is more vulnerable to oil price shocks in these times (Park and Ratti, 2008).

3.3. Sources of oil price shocks

Oil price shocks may arise from either disturbances in supply or enhanced demand and it may affect the trade balances in different ways. Regardless of what type of shock that is in play, similar responses for firms and individuals are expected. The different type of shocks, their impact and how it transmits to the rest of the economy will be presented in this section.

3.3.1. Demand channel

An oil price shock from the demand side can be either in a general form or oil specific and the macroeconomic effects are expected to be slightly different between them. An oil price shock caused by increased global demand can be exemplified by the rapid economic growth of India and China in the early 2000s (Peersman and van Robays, 2009). In this case, the price of oil along with other commodities and inputs rises. This particular shock has different theoretical implications apart from the oil specific demand shock in the sense that it implies two opposing effects. First, the oil price shock results in an overall increased demand that raises imports in the economy that yields a non-oil trade deficit. The second effect relates to that the import-bill of oil increases, which decreases the oil trade balance and induces a non-oil trade balance surplus. The second argument is based on the assumption of incomplete financial markets, which require that the oil trade deficit is offset by a non-oil surplus (Kilian et al, 2009).

An oil-specific demand shock relates to changed precautionary- or speculative demand due to concerns about future supply and the resulting hike in oil prices are characterized to have a negative impact on global economic activity (Peersman and Van Robays, 2009). As for the overall trade balance, theory predicts small or no response from a shock and the response of the non-oil trade balance will be positive, assuming incomplete markets. An oil-specific demand shock will result in a flatter response (less effect) the less oil that is used in a country's production and the smaller the elasticity of substitution is between oil and alternative factors of production (Bodenstein et al, 2011).

Moving on to the transmission to the demand side of the economy, an oil price shock has a negative impact on demand for goods and services in oil-importing countries. Regardless of the underlying source of an oil price shock, it affects firms' investment decisions and lowers demand for their products (Hamilton, 2008). Kilian (2008) states two reasons why declines in investment is expected, which is that the marginal cost of production increases and a reduced demand for the output of firms. In a study conducted on the U.S it is shown that firms that do not use oil directly in their production is also affected by shocks in the oil price and the disruption in demand for those firms has severe effects on the overall economy (Hamilton, 2008). For the consumer demand, Kilian (2010) provides an extensive account on the negative effects that oil price shocks imposes. The transmission channel in this case relates to retail energy prices rather than crude oil and the author divide the mechanisms into four direct effects; discretionary income effect, uncertainty effect, increased precautionary savings and operating cost effect. All of these effects are expected to be stronger the longer the shock last.

Oil price volatility also brings uncertainty to the financial markets. In a study by Park and Ratti (2008) significant results is found saying that real return on stocks in many European countries is depressed by increased volatility of oil prices. This corresponds well with the theory which states that oil-importers face increased financial risk and uncertainty following an oil price shock driven by demand, which in turn hurt stock prices. Furthermore, interest rate hikes is a mean to counter the inflationary pressures coming from increased demand, which has affects stocks in a similar way (Cashin et al, 2014).

3.3.2. Supply channel

An oil supply shock is different from the demand shock in the sense that it does not imply a positive correlation between production and the price of oil. The common reasons for oil supply shocks are conflicts in the Middle East and imposition of quotas from key oil exporters that declines oil-production and hence increases the price of oil (Kilian, 2008). Recently, we have witnessed reversed shocks on the supply side of oil. New techniques to extract shale gas in combination with increased production in the OPEC countries has mounted pressure on the price of oil downwards (Morse et al, 2012). The transmission of oil price shocks to the rest of the economy follows the same pattern as for an oil-specific demand shock mentioned in the previous section, namely that it results in an oil trade deficit in an oil-importing economy, which is offset by an improved non-oil trade balance relative to oil-exporters. The impact of this kind of shock is expected to be smaller, less persistent and not as immediate as a demand shock (Kilian et al, 2009).

3.4. Responsiveness of the Euro area countries

The theory outlaid until this point provides a basis on what to be expected from the empirical analysis. The response on the overall trade balance of an oil-importing country after an oil price shock is hard to predict, while there is stronger support for a positive response in the non-oil trade balance. Although the including countries are considered homogenous in many aspects, we do believe that the difference in economic size and oil dependence will be expressed in the results. Peersman and Van Robays (2009), Cashin et al (2014) and Kilian et al (2011) aggregate a number of European countries by assigning weights in accordance with their size. Therefore, it is difficult to draw direct comparisons with their results since we investigate individual countries. Furthermore, the persistence of a shock is expected to be longer the larger the relative oil component is in the overall trade balance. Those less dependent on oil will perhaps have a smaller and less persistent response. Overall, we do believe that the responses of the non-oil trade balances should be similar across countries, in accordance with theory and previous empirical studies. The effect on the overall trade balances is not as easy to predict since it depends on how prone countries are to adjust to shocks.

3.5. Declining role of oil?

Oil is still the most traded commodity and extensively used in production and consumption. Nevertheless, there is reason to believe that the impact of oil price shocks on the economy has decreased over time. Since the beginning of the industrialization, the development has created a need for energy that has reached extraordinary levels. While the population since 1870 has grown by a factor of four, the consumption of fossil fuels has increased by a factor of 60 (Müller-Steinhagen and Nitsch, 2005). In addition, a deeper concern over the problems associated with the climate change has spurred the technology development and usage of alternative energy sources that challenges the prominent role that oil has. According to reports, the share of oil in total energy production has decreased significantly during the time period of interest (IEA, 2016), even though actual production has increased.

Blanchard and Galí (2008) investigate the hypothesis of a declining role of oil in order to find an explanation to why the shocks in the 1970s are different to the ones in the 2000s. They find that for GDP and consumer price index, the response has become mitigated post 1984 compared to prior, even though the fluctuations in the price of oil are of similar or even greater size (Huntington, 2015). The result for the U.S in Blanchard and Galí (2008) also holds for some of the Euro area countries. This should mean that, all else equal, the responses of oil price shocks on the trade balances would be decreased over time as well.

However, there is a counter argument to the declining role of oil in the economy. Since the beginning of the 21st century, empirical research has argued that the oil price shocks observed has originated from the demand side of the economy (van de Ven and Fouquet, 2014). According to theory, this would imply that the responses from the shocks are more persistent and larger compared to shocks coming from the supply side. These two opposing arguments motivate an analysis on a divided data sample, which will be further discussed in the methodology section.

4. Data

The empirical analysis includes ten European countries; Austria, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal and Spain. All countries mentioned joined the European Monetary Union (EMU) in 1999, except for Greece that joined in 2001. Belgium and Luxembourg also joined the EMU in 1999 but due to data limitations in several of the important variables they were excluded from the sample. As far as we know, no study have focused on the above stated Euro area countries on an individual level and explicitly analyzed the effect on trade balances of oil price shocks. As discussed in the literature review, most of the research of oil price shocks has focused on the U.S. Some studies, for example Kilian et al (2009), have looked at the response in the Euro area at an aggregated level. Even if the countries that joined the monetary union at the early stage can be seen as a homogenous group, there are differences in their composition and therefore the response of an oil price shock can differ among them.

The sample covers 35 years, using quarterly data spanning from 1980Q1 to 2014Q4. At first, the aim was to include the oil crises and the consequent spikes in the price of oil during the 1970s. Two shocks occurred during this period, the first was caused by an oil embargo imposed by some OPEC countries and the second by the Iranian Revolution (Bodenstein et al, 2011). The lack of reliable quarterly data prior to the 1980s restricted the sample to the above stated period. In order to examine the research questions and control for some of the important transmission channels explained in the theory section, the following variables are included in the empirical analysis: Real price of oil, real GDP, overall trade balance, non-oil trade balance and the bilateral exchange rate towards the U.S. dollar.

In the literature there is no consensus on what measure of the price of oil that should be used. Although, according to Peersman and Van Robays (2009), the correlation between different measures is high, despite important differences in attributes and should therefore not affect the results. Data on the price of oil is collected from the International Energy Agency (IEA) and following Peersman and Van Robays (2009) definition we use the refiner acquisition cost of imported crude oil. This proxy is frequently used and considered to be the best for the free market global price of imported crude oil. Furthermore, the nominal crude oil price variable is measured in U.S. dollar per barrel and is deflated using the U.S. Producer Price Index (PPI), in order to get the real price of crude oil.

The overall trade balance includes both oil- and the non-oil trade balance and is referred to as the merchandise trade balance, i.e. it excludes trade in services since the quality and reliability of trade in services are low. This measure is used in the existing literature as a proxy for current account (see for example Schmitz and Von Hagen, 2011). This particular definition of the overall trade balance is further supporting the exclusion of Luxembourg from the sample because trade in services is considered to be a large fraction of their overall trade balance. Data for the ten countries are acquired from IMF's International Financial Statistics (IFS) using the difference between the standardly used value of export in goods (Free On Board) and the value of imports (Cost, Insurance, Freight) and then deflated by U.S. PPI, in order to get the variable in real terms.

The non-oil trade balance is calculated by subtracting the oil trade balance from the overall trade balance. Data on exports and imports of oil along with most of the macroeconomic variables are only available at annual frequency. However, data on exports and imports was collected in metric tons of oil equivalent from Oxford Economics (through Datastream) at quarterly frequency. This data was then recalculated to barrels and multiplied by the real price of oil. A more detailed description of the trade balances and the other variables included in this study are provided in the data appendix.

Data on GDP is acquired from the OECD Statistics database and collected in real terms. Furthermore, the exchange rates consist of an index of the bilateral exchange rate towards the U.S. dollar for each of the included countries. The index is constructed as the exchange rate of each country's national currency to the U.S. dollar up until they joined the monetary union and after that date, it is the exchange rate of the Euro. These two variables are included as control variables in the analysis, since they might influence the relationship between the trade balances and the price of oil.

4.1. Descriptive statistics

Table 1 introduces some descriptive statistics for key variables. The real price of oil is a variable that have fluctuated a lot during the sample period, having a maximum value of

109.17 right before the 07'-08' crisis and a minimum value of 16.20 in 1999. As for the trade balances, Germany has the largest trade surplus but also the highest standard deviation, as a result of their economic size. The mean of the overall trade balances of the countries display both positive and negative values. However, when the oil component is removed from the overall trade balances, only the mean values of Greece remains negative while the rest is positive. By looking at the discrepancies between the trade balances, we detect that the oil component has a significant impact on the overall trade balance. Le and Chang (2013) includes similar key statistics for three Asian countries, which seems to be roughly in line with our figures. What can be further noted is that there are two missing values of the trade balances for Greece and Portugal, thus these countries only have 138 observations.

Table 1. Descriptive statistics for key variables at level data. 1980Q1-2014Q4

Variable	**Mean**	**Max**	**Min**	**St. Dev**	**Obs.**
Oil price	48.56618	109.1717	16.20407	23.8643	140
Trade balance (USD million)	**Mean**	**Max**	**Min**	**St. Dev**	**Obs.**
Austria	-1978.925	1095.933	-4909.821	1235.121	140
Finland	1376.961	5118.733	-2014.872	1817.057	140
France	-8109.701	8646.052	-31731.43	10167.3	140
Germany	32476.74	78291.53	-1681.56	21020.59	140
Greece	-6591.03	-664.5138	-16914.15	3880.016	138
Ireland	6204.515	17167.95	-2155.901	5403.218	140
Italy	-181.8678	19968.46	-17511.08	7681.523	140
Netherlands	6661.119	17180.54	-2192.916	4940.118	140
Portugal	-4058.876	-844.2013	-9640.875	2066.525	138
Spain	-12579.89	-1797.593	-42015.61	8895.366	140
Non-oil Trade balance (USD million)	**Mean**	**Max**	**Min**	**St. Dev**	**Obs.**
Austria	1989.644	10321.94	-3047.114	2950.933	140
Finland	5050.786	10330.72	1359.012	1791.796	140
France	22735.22	51635.74	6779.219	8449.847	140
Germany	75209.37	161490.3	27285.79	33578.7	140
Greece	-966.8194	6184.56	-7857.934	2799.009	138
Ireland	8527.703	20576.14	667.8265	6448.893	140
Italy	26869.21	56084.67	5156.462	9964.762	140
Netherlands	20596.37	50981	4751.639	12824.67	140
Portugal	393.255	5277.57	-4682.841	1942.396	138
Spain	9155.138	35174.11	-4663.598	10437.25	140

Note: Variables are expressed in real terms using 2010 as base year

5. Empirical method

In this section the empirical methodology will be presented. The model specification and an explanation of the econometric tests performed will be given. Further, the methodology of the Granger-causality test, impulse response analysis and variance decomposition will be discussed.

5.1. Unit root tests

Before investigating the impact of oil price shocks, the analysis starts by looking at the properties of the series and their order of integration. To analyze the presence of unit roots in the series, and thereby examine whether our series are stationary or not, the Augmented Dickey Fuller (ADF) test is performed on the series in levels and in first difference. This is done to make sure that we do not work with variables with different order of integration (Dickey and Fuller, 1979). This is a common procedure since many macroeconomic variables grows over time and are likely to be non-stationary. Failing to address the issue of non-stationary time series when estimating regressions might give spurious regression, and in turn unreliable t-statistics, therefore it is necessary to examine the stationarity condition of the variables (Verbeek, 2012). Nevertheless, tests for unit roots often exhibit low power and therefore it is a good idea to perform additional tests to robustness check and to get a second opinion (Cashin et al, 2014). Consequently, the Kwiatkowski, Phillips, Schmidt and Shin (KPSS) test for unit roots will also be applied. The ADF test was proposed by Dickey and Fuller (1979) and the KPSS test by Kwiatkowski et al (1992). Selection of these tests is in line with previous literature, see for example Le and Chang (2013) and Park and Ratti (2008). The null hypothesis in the ADF test is that the series has a unit root, i.e. is non-stationary. In the KPSS test stationarity is the null and the alternative suggest existence of a unit root, thus the setup is reversed.

The results from both the ADF- and the KPSS tests in first difference are presented in Table 2 for each country. In line with the existing literature, some of the variables occasionally indicate stationarity in levels. However, all variables for all countries are stationary in first difference according to the ADF test, i.e. all series are I(1), except for real GDP for Greece. According to the KPSS test we cannot reject that this series has a unit root, however the series is I(2). Thus, we will continue estimating the model based on the assumption that all variables are integrated of order 1.

Table 2. Unit root tests in first difference, 1980Q1-2014Q4

		ADF T-statistic	**KPSS**
All countries	Real oil price	-10.66717***	0.116358
Austria	Real GDP	-9.565065***	0.143366*
	Trade balance	-19.34585***	0.040511
	Non-oil trade balance	-9.979859***	0.156752**
	U.S dollar exchange rate	-8.024641***	0.066801
Finland	Real GDP	-4.093619***	0.112247
	Trade balance	-12.25372***	0.091748
	Non-oil trade balance	-12.88468***	0.119106*
	U.S dollar exchange rate	-8.496177***	0.053253
France	Real GDP	-6.565313***	0.121749*
	Trade balance	-15.64285***	0.100814
	Non-oil trade balance	-7.663756***	0.135873*
	U.S dollar exchange rate	-7.869861***	0.083912
Germany	Real GDP	-9.357986***	0.049129
	Trade balance	-14.08125***	0.035754
	Non-oil trade balance	-9.415299***	0.119188*
	U.S dollar exchange rate	-7.987844***	0.068502
Greece	Real GDP	-2.780325	0.210784**
	Trade balance	-18.60323***	0.113114
	Non-oil trade balance	-16.45791***	0.021907
	U.S dollar exchange rate	-9.224678***	0.071518
Ireland	Real GDP	-4.171348***	0.175085**
	Trade balance	-11.33854***	0.073745
	Non-oil trade balance	-12.50827***	0.151910**
	U.S dollar exchange rate	-8.115977***	0.075550
Italy	Real GDP	-7.134885***	0.118418
	Trade balance	-3.784365**	0.124865*
	Non-oil trade balance	-6.737822***	0.047909
	U.S dollar exchange rate	-8.284304***	0.064563
Netherlands	Real GDP	-8.950325***	0.180954**
	Trade balance	-12.07098***	0.034691
	Non-oil trade balance	-12.66958***	0.132472*
	U.S dollar exchange rate	-7.974283***	0.068546
Portugal	Real GDP	-5.754728***	0.174068**
	Trade balance	-20.80774***	0.071973
	Non-oil trade balance	-19.26041***	0.027581
	U.S dollar exchange rate	-8.376310***	0.065664
Spain	Real GDP	-3.568642**	0.191597**
	Trade balance	-4.826334***	0.101119
	Non-oil trade balance	-7.662789***	0.041960
	U.S dollar exchange rate	-8.200529***	0.076700

Note: The critical values for the ADF- and KPSS tests are respectively: at 1% = -4.026 and 0.216; at 5 % = -3.44 and 0.146; at 10 % = -3.15 and 0.119. *, ** and *** indicates significance at 10%, 5% and 1% respectively. The test regression includes both trend and intercept.

5.2. The Vector Autoregressive Model

The model considered in this study follows from the existing literature and an unrestricted Vector Autoregressive (VAR) model with p lags, or simply VAR (p), will be used. A VAR model is a multi-equation Autoregressive Distributed Lag (ADL) model (Verbeek, 2012), which is the most common selection of model when investigating the impact of oil price shocks on macroeconomic variables (Park and Ratti, 2008). In a VAR model, each variable in the system is modelled as a function of previous values of all included variables. The advantage of using VAR is that each variable in the system is treated as endogenous and that it captures the dynamic relationship among the endogenous variables (Brooks, 2014). The VAR model for each country consists of four country-specific variables and one common variable, the real price of oil. The inclusion of the real price of oil and the trade balances is motivated by the fact that our objective is to analyze the effect of the former on the latter. Real GDP and the bilateral exchange rate towards the U.S dollar are incorporated as control variables to capture some of the transmission channels. The model is expressed as follows:

$$Y_t = \alpha + \sum_{i=1}^{P} A_i \, Y_{t-i} + \varepsilon_t \qquad \text{Eq. (1)}$$

Y_t is a vector of endogenous variables (real price of oil, real GDP, trade balance, non-oil trade balance and the bilateral exchange rate against the U.S dollar), α is a vector of intercepts, A_i is a matrix of autoregressive coefficients that will be estimated and ε_t is the vector of error terms. These error terms are assumed to be white noise terms, i.e. have a zero mean and are independent of each other but they can be contemporaneously correlated (Park and Ratti, 2008).

The model estimated is an unrestricted VAR. An alternative is to use a restricted VAR model such as the Vector Error Correction Model (VECM). A VECM is used when working with non-stationary series that are known to be cointegrated and thus has cointegration restrictions in the estimated VAR model (Hashem et al, 2000). Two series that are non-stationary are said to be cointegrated if there exists a linear combination of the two that is stationary (Engle and Granger, 1987). However, the results from the unit root tests imply that the series are stationary in first difference and our model will therefore be specified in first difference. Furthermore, as Naka and Tufte (1997) points out, the estimates from a VECM is known to be outperformed by those from an unrestricted VAR at a short horizon. Their findings also suggest that the results from an unrestricted VAR and a VECM, when analyzing the impulse response in the short-run, are almost identical. As a result, we will run unrestricted VAR:s for all countries. Making this choice means that it is not possible to disentangle the shocks. That is, by using an unrestricted VAR model, we are not able to capture and identify different types of oil price shocks, first identified by Kilian (2008). As argued in the theoretical framework, the source of the shocks might have different effects on oil-importing countries. However, due to time limitations this approach was not used.

The only restriction when choosing an appropriate VAR model is the lag length (p). The lag length specifies the number of lags of the variables that should be included in the model. The selection of a suitable lag length is often made somewhat arbitrary in the literature, since economic theory does not provide information about the appropriate lag length for a VAR model (Brooks, 2014). The most widely used tests for determining lag length are based on different information criteria (Verbeek, 2012). There is a tradeoff when choosing the optimal lag length between goodness-of-fit and the number of parameters used in order to fit the model (ibid). The most popular tests are the Akaike's Information Criterion (AIC) and the Schwarz's Bayesian Information Criterion (BIC), where the model containing the smallest value of the AIC or BIC is preferred (Verbeek, 2012). In this thesis, BIC will be employed since it has better large sample properties, is more consistent and is also able to detect the true model if it is in range (Burnham and Anderson, 2004). The counter-arguments supporting AIC are that the test can be used when the true model is not in the range of models and that it has better small sample properties, however AIC tends to overestimate the number lags (ibid). To summarize the test results, BIC indicates one lag for all countries except zero for Austria and Ireland and two for Italy. Including too few lags raises suspicions whether or not the serial correlation in the residuals is eliminated (Dekker et al, 2001). Consequently, for the countries indicating zero- and one lag, the model will be estimated with one lag and for Italy the model will be estimated with two lags.

Having specified the appropriate model and deciding the lag length for each country, the next step is the model estimation. In the VAR framework the standard tools for analysis are the Granger-causality tests, Impulse Response Functions (IRF:s) and the forecast error variance decompositions (Stock and Watson, 2001). In the following subsections, the methodology of these approaches will be presented.

5.3. Granger Causality

The next step in the estimation process is to test for non-Granger causality among the variables. Clive Granger introduced the test that provides information whether past lagged values of one variable, X_{t-i} in a VAR model helps to predict another variable, Y_t, in the system, apart from past values of Y_{t-i}, itself (Granger, 1969). If this is true, then X_t is said to Granger-cause Y_t. For example, if the price of oil does not help to predict the trade balance, then the coefficients of the lagged values of the price of oil will be zero in the equation for the trade balance (Stock and Watson, 2001). Formally, the null hypothesis states "no Granger-causality" from one variable to another, which is tested against the alternative of Granger-causality. Hence, a rejection of the null implies support of the presence of Granger-causality.

The purpose of this test is to find the direction of the causality between the price of oil and the trade balances for the countries. A cautious stance towards interpreting the Granger-causality test is in place since it has received some criticism for being subject to specification bias and resulting in spurious regressions (Gujarati, 1995). Although being subject to possible errors, performing Granger-causality analysis is supported by Cuñado and Pérez de Gracia (2003). The authors find evidence that the oil price Granger-causes real economic activity for most of the European countries between 1960 and 1999. Similar results are found by Jiménez-Rodríguez and Sánchez (2004). It is not only through the inflation channel that oil prices have an effect according to the authors, but also through some other mechanism. The fact that the price of oil also Granger-causes the trade balances would thus not be unlikely. Le and Chang (2013) conclude that the price of oil Granger-causes the oil- and non-oil trade balances for Japan, which makes it interesting to see if this could be found for the Euro area countries as well.

5.4. Impulse response analysis

In order to further evaluate the short run dynamics among the variables in the VAR model for each country, we examine the impact of a shock in the price of oil on the overall trade balance and the non-oil trade balance. This is done by calculating the Impulse Response Functions (IRF:s). An IRF traces the effect of shocks in the endogenous variables. That is, a shock in one of the variables not only affects the current and future values of that variable, it also spreads to the other variables through the lag structure of the model (Dekker et al, 2001).

In the analysis we consider orthogonalized IRF:s, using the Cholesky decomposition. When using a VAR model to calculate the IRF:s, there usually exists contemporaneous correlation among the error terms. Isolating the effect of a shock to one variable within the system may not be feasible since the shock to that variable may coincide with a shock in another variable (Swanson and Granger, 1997). To provide context, a shock to the price of oil may occur at the same time as a shock to the trade balances. However, using Cholesky decomposition makes sure that the error terms is not contemporaneously correlated and that the shocks in the system are unidirectional (ibid). Then, for our case, a shock in the price of oil can impact the trade balances but the reverse is not possible. Ensuring the unidirectional restriction requires a pre specification of the order of the variables within the system (Dekker et al, 2001). By specifying the order, the first variable in the system is not contemporaneously affected by shocks in the rest of the variables, but does affect the rest. The second variable is contemporaneously affected by shocks in the first variable, but not by the rest of the variables, and so forth. Applying Cholesky decomposition hence requires that ordering of the variables is made carefully based on economic theory, since changing the ordering can have large impact on the impulse responses (Brooks, 2014).

Jiménez-Rodríguez and Sánchez (2004) use the Cholesky decomposition and provides a suggestion on how to order the variables, in which they put real GDP first, the price of oil second and the exchange rate last of their seven variables. This ordering is supported by the recently found evidence of reverse causality, going from macroeconomic variables, such as real GDP, to the price of oil (Barsky and Kilian, 2004). Accordingly, the exchange rate will be ordered last in the system. However, it is reasonable to argue that the price of oil should be ordered first in the VAR system, instead of real GDP. Despite the evidence of reversed causality, a major part of the research still supports the traditional theory where oil price fluctuations impact real GDP. The second argument behind the ordering follows from the exogeneity of the price of oil, since the price of oil is determined on the global market while real GDP and the trade balances are country specific. Further, Park and Ratti (2008) order the price of oil ahead of industrial production which is, similar to real GDP, a country specific variable. The orthogonalized IRF:s will be analyzed using the following order of the variables: Real price of oil, real GDP, trade balance, non-oil trade balance and the bilateral exchange rate against the U.S dollar. A disadvantage of using the Cholesky decomposition mentioned above is that the results can be sensitive to changes in the ordering. Therefore, sensitivity analyses to robustness check our results, where real GDP and the price of oil have switched places, will be performed.

5.5. Variance decomposition

To further analyze and interpret the VAR model, we use the forecast error variance decomposition or just variance decomposition. The IRF:s shows the impact of oil price shocks on the trade balances. On the other hand, the variance decomposition tells us how much of each variable's forecast error variance can be explained by their own shocks and how much that can be explained by shocks to the other variables (Brooks, 2014). Due to the structure of the VAR, a shock to one variable will also spread to the other variables in the system and have an effect on these (ibid). The variance decomposition can therefore help to explain the relative importance of each shock at a given horizon (Stock and Watson, 2001).

5.6. Subsample estimation

In order to test the hypothesis that the role of oil has changed over time for the countries at hand, subsample estimation is performed. The main argument of dividing the sample into two, the first spanning from 1980Q1 to 1998Q4 and the second from 1999Q1 to 2014Q4, is to test if the shape of the IRF:s are different. If oil really has become a less significant commodity as predicted in theory, the responses of oil price shocks should die out faster in the second subsample compared to the first.

The specific breakpoint is chosen because it coincides with the introduction of the Euro and that the price of oil started to go up rapidly in that period up until the crash of the IT-bubble. The foundation of a common currency brought a major structural shift in the economy, maybe not affecting the oil market in particular, but certainly worked as a trade facilitating event that influenced the trade balances, in which we are interested in. This selection is also convenient as it divides the sample into two parts with almost equal number of observations.

6. Empirical results

In this section the results from the causality tests and the link between the price of oil and the trade balances are shown. Further, the Impulse Response Functions (IRF:s) will be presented to investigate the effect of an oil price shock on the trade balances. The results from the estimations on the entire sample will be presented and discussed first, followed by the subsample estimations.

6.1. Granger-causality

To analyze if there is causality running from the price of oil to the overall trade balance and the non-oil trade balance, Table 3 presents the results from the Granger-causality tests for each country.

Table 3. Granger-causality tests, 1980Q1-2014Q4

Granger-causality	Austria	Finland	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain
Oil price causes TB	0.0229**	0.7230	0.3824	0.7588	0.2095	0.1429	0.0025***	0.3654	0.6258	0.7526
Oil price causes Non-oil TB	0.0005***	0.0321**	0.0000***	0.0001***	0.0000***	0.3294	0.0000***	0.0000***	0.0064***	0.0012***

Note: *, ** and *** indicates significant P-values at 10%, 5% and 1% level respectively.

For nine out of ten countries the results indicate that the price of oil significantly Granger-causes the non-oil trade balance, having excluded the oil component, at a 5 percent level. This implies that there is a causality running from the price of oil to the non-oil trade balance. The exception is Ireland with a P-value of 0.3290. With the null stating no Granger-causality, the price of oil does not Granger-cause the non-oil trade balance for Ireland. Interestingly, for a majority of the countries the price of oil does not cause the overall trade balance, with the exceptions of Austria and Italy which are significant at a 5 percent level. Ireland is the only country that shows no causality for neither of the balances.

Establishing a link between the obtained results from the Granger-causality tests and previous research, the findings for a vast majority of the oil importing countries in the Euro area is consistent with the results in Le and Chang (2013). They find that for Japan, also a major oil importer, both the oil- and the non-oil component of the trade balance is Granger-caused by the price of oil. In line with our results, the authors also find no causality running from the price of oil to the overall trade balance. In our analysis, the oil component itself is not of particular interest. However, our results are consistent with Le and Chang (2013), suggesting that the effect of the two components of the overall trade balance have opposite signs and therefore cancels out the effect on the overall trade balance. The expected effect on the oil trade balance after a shock in the oil price is negative due to the fact that the countries are oil importers and that an increased price implies a larger import-bill. This would imply that the non-oil trade balance is expected to have a positive sign, in order for the overall trade balance to net to zero. Jiménez-Rodríguez and Sánchez (2004) finds that the price of oil causes macroeconomic variables such as GDP growth. Our results suggest that the non-oil trade balance is also caused by the price of oil, which is reasonable since trade is an important determinant of economic growth.

The results from the Granger-causality tests in general, excluding Ireland, suggest that the individual countries are similar in the sense that the price of oil causes the non-oil trade balance. Furthermore, there are indications that the members of the monetary union are equal in the sense that the price of oil do not cause the overall trade balance, the only exceptions are Austria and Italy where causality runs to both balances.

6.2. Impulse response analysis for the entire sample

The Granger-causality tests showed an almost unison picture for the ten Euro area-countries, however the tests does not reveal how the different trade balances respond to a shock in the price of oil. There may still be temporary effects in the short-run from a shock to one of the variables within the system, something that require an additional analytical tool. Therefore, to answer the first research question, the orthogonalized IRF:s of the two trade balances from a one standard deviation shock to the price of oil is estimated for each country, from the VAR model that includes: Oil price, real GDP, overall trade balance, non-oil trade balance and the U.S dollar bilateral exchange rate. The analytical standard errors are applied to indicate the statistical significance of the IRF:s. The dashed lines indicate the upper- and lower bound of the ± 2 standard errors. The results for the IRF:s for the ten countries are presented in Figure 2a and 2b.

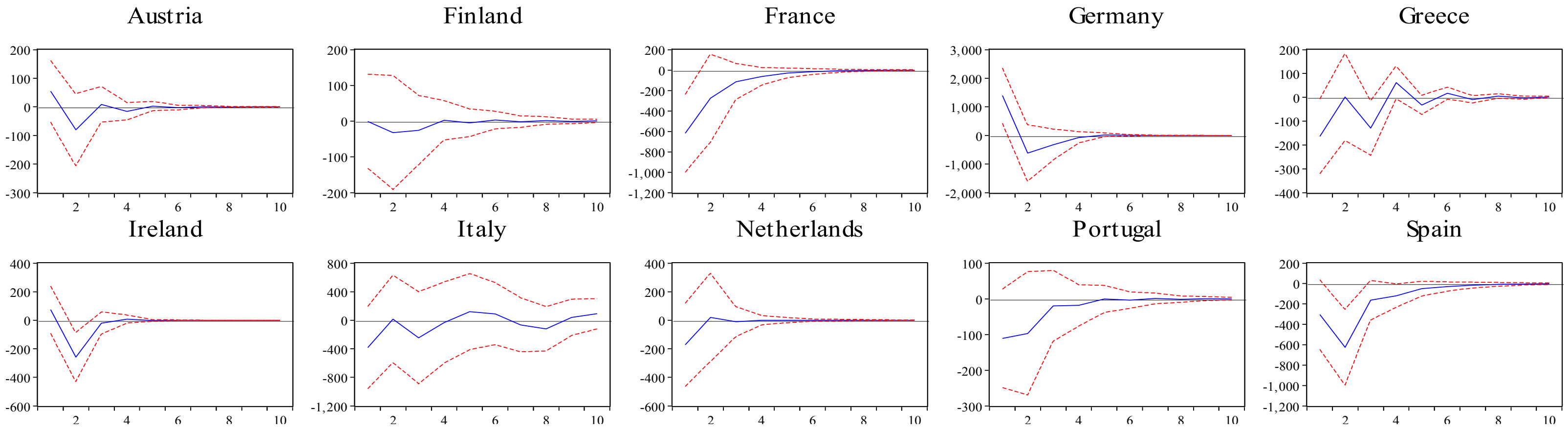

Figure 2a. Orthogonalized impulse response functions of the overall trade balance to a one-standard-deviation oil price shock. 1980Q1-2014Q4

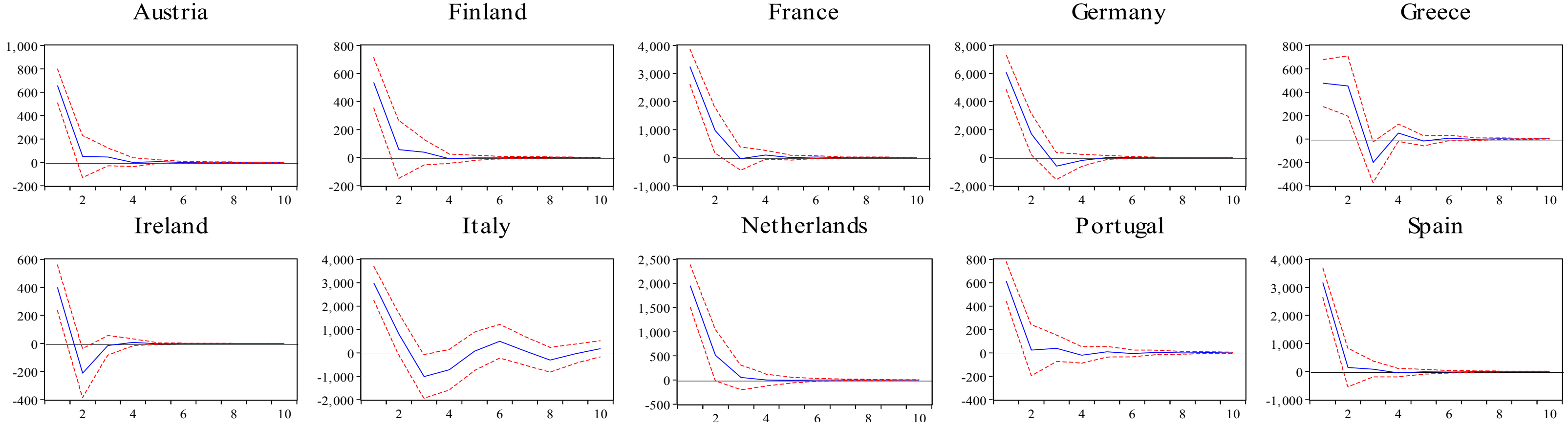

Figure 2b. Orthogonalized impulse response functions of the non-oil trade balance to a one-standard-deviation oil price shock. 1980Q1-2014Q4

Note: X-axes denote quarters following an oil price shock. The dashed (red) lines indicate ± 2 standard errors.

The estimated responses of the overall trade balances and the non-oil trade balances are presented in Figure 2a and 2b, respectively. In Figure 2a, the response of a shock provides insignificant results for all countries except for France and Germany. The overall trade balance for France shows a statistically significant immediate decrease following a shock, lasting a quarter, while Germany shows the opposite effect for about half a quarter. Providing a general picture, ignoring the insignificance of the results, is difficult since the initial responses are positive for some countries (Austria, Germany, Ireland), negative for most (France, Greece, Italy, Netherlands, Portugal, Spain) and flat for Finland. The responses vanish within six quarters for the all of the countries except for Italy.

The mixed results are in line with the theory presented. The net effect on the overall trade balance is indeed expected to be ambiguous. This is due to that the oil component is worsened from an oil price shock and to what extent the non-oil trade balance is improved. The improvement stems from the negative wealth effect that makes imports more expensive and thus improves the balance (Bodenstein et al, 2011) and the depreciating exchange rate that boosts exports (Forni et al, 2015). The effect working for a worsened overall trade balance seems to be stronger for those countries whose immediate response is negative and the offsetting, positive effect for the overall trade balance is larger for those countries where the negative wealth effect is more pronounced. Further, in the theory it was argued that all countries may not be equally willing to adjust to oil price shocks because of an expected worsening of the oil trade balance. The effect on the overall trade balance further depends on the reaction from countries in response to an oil price shock, what measures used to counter the shock and the time lag before these measures has an effect due to the different economic structure of the countries. Our expectation was that the countries' overall trade balances would react differently to oil price shocks, which is strengthened by our results.

It is possible to evaluate the first research question proposed in the introduction at this stage. We can conclude that the response of the overall trade balance for the countries is not similar following an oil price shock. Although, it remains difficult to see a pattern on how the results differ due to the insignificance. Kilian et al (2009) finds insignificant negative responses of the merchandise trade balance (in which the oil component is included) from an oil supply shock. Moreover, they do find a statistical significant merchandise trade deficit from especially an oil specific demand shock but also from an oil price shock from increased global demand. The sample of oil-importing countries the authors used included the U.S, the Euro area as a whole and Japan. This could partly explain the difference in the results they obtained compared to those in our study. Especially incorporating the U.S yields a more negative effect on the overall trade balance since oil is a more vital component in their trade balance and has a more direct effect on the economy through inflation (Peersman and van Robays, 2009). In another study solely conducted on Japan, Le and Chang (2013) concludes that the overall trade balance has a direct insignificant positive response which turns negative in the first quarter. This is consistent with the response for some of our countries. In summary, the diffuse results obtained are supported by the fact that the choice of countries and sample periods matters greatly. Thus, aggregating the Euro area countries into one unit might not be feasible.

Turning to the responses of the non-oil trade balances, the results differ quite a lot from those for the overall trade balances. All countries have an immediate positive and significant effect following an oil price shock, similarly to the results in Forni et al (2015), that finds positive responses for both supply- and demand shocks. The effects die out for almost all countries within the first year following the shock. This is in line with the expected sign for the non-oil trade balance, as explained in the theoretical framework. Assuming incomplete markets, the theory predicts that the response of the non-oil trade balance should be positive (Kilian et al, 2009). Furthermore, even though it is not the main purpose to detect the underlying source of the oil price shocks, the immediate positive response of the non-oil trade balance suggests, according to theory, that the underlying shock comes from the demand side. The argument would be that supply- and demand shocks are expected to have the same sign but demand shocks are supposed to have a more direct and persistent effect on the non-oil trade balances. However, since we do not disentangle the sources, it is hard to conclude that it truly is a demand shock. We cannot be sure that the responses obtained are more direct and persistent than it would have been in the case of a supply shock.

The immediate effect for the non-oil trade balances is similar for all countries. However, there are some differences in the subsequent quarters. For Austria, Finland, France, Netherlands, Portugal and Spain the response is quite similar, where the effect of the shock dies out more rapidly than the others and the effects disappears completely within the fourth or fifth quarter. The response for these countries turns insignificant in the second quarter following the shock. Le and Chang (2013) finds similar results for Japan for the non-oil trade balance, where it is concluded that the positive effect dies out after eight months. The results for the first mentioned countries are also in line with what was concluded in the causality tests. The remaining four countries show a different response following the common immediate effect. For Germany, Greece, Ireland and Italy the response in the second and third quarter after the shock turns negative. The results indicating that the effect turns negative cannot be supported by theory, since it states that the positive response should die out, not turn negative. For Germany and Ireland the responses die out after one or two quarters. Greece and Italy is a bit different, they also turns insignificant in the second quarter but the response lasts for longer time and varies between positive and negative. Despite the small differences after the direct positive effect on the non-oil trade balances, the results provide a straight positive answer to the question regarding that the countries responses are similar, which was expected.

In contrast to the discrepancies regarding the overall trade balance responses, the non-oil responses are more similar to each other. Both are, however, consistent with theory for oil-importing countries. The net response for the overall trade balances depends on if the positive effect of the non-oil component is large enough to offset the negative effect on the oil component following an oil price shock. This makes it hard to conclude that a specific effect seems to dominate on average for the countries at hand. Furthermore, for half of the countries the responses of the non-oil trade balances are in line with recent empirical findings. Nevertheless, the results indicated some differences among the countries from the second quarter and onwards, which make the distinction of the Euro area countries relevant. The inconsistencies suggest that the countries within the monetary union are heterogeneous to some extent, even though one should be cautious about the insignificant results. It is reasonable to conclude that for those countries where we found a positive response on the non-oil trade balance and a negative response on the overall trade balance (France, Netherlands, Portugal and Spain), the oil and non-oil component seems not to have netted out each other. For countries like Finland, where the response of the overall trade balance is only slightly negative, the effects of the oil- and the non-oil components seems to have canceled out each other, assuming that the effect on the oil component is negative. Linking the results to our previous expectations, saying that the persistence of the oil price shocks should be larger for countries that have a large oil component and less persistent for countries where oil is not as important, we can conclude that this was not the case. The length of the responses seems to be roughly the same, regardless of the size of the oil component.

6.3. Variance decomposition

By investigating the relative importance of each shock using variance decomposition, we complement the impulse response analysis. The estimated variance decomposition at the 8-period horizon for the overall trade balances and the non-oil trade balances is reported in Table 4a and 4b, respectively.

Table 4a. Variance decomposition Overall trade balance

Country	Price of oil	Real GDP	Overall trade balance	Non-oil trade balance	U.S dollar exchange rate
Austria	1.683126	3.721118	84.65174	8.774056	1.169962
Finland	0.168849	2.374577	97.01677	0.320846	0.118963
France	7.365146	2.794124	87.39289	0.004999	2.442843
Germany	6.903126	7.341236	85.64981	0.032603	0.073224
Greece	3.639810	9.970086	76.07707	2.861453	7.451578
Ireland	6.794767	3.322850	88.76281	0.874646	0.244926
Italy	1.291896	2.270552	78.87436	14.62506	2.938136
Netherlands	0.940832	0.387824	97.39310	1.267801	0.010448
Portugal	1.984565	5.144006	87.46000	0.022631	5.388796
Spain	10.80611	12.92706	74.27650	0.926540	1.063784

Table 4b. Variance decomposition Non-oil trade balance

Country	Price of oil	Real GDP	Overall trade balance	Non-oil trade balance	U.S dollar exchange rate
Austria	38.16523	0.652490	34.66632	25.79929	0.716671
Finland	20.01605	0.137311	26.36481	53.21607	0.265762
France	48.51440	0.452859	17.45743	33.05372	0.521595
Germany	50.51993	2.372896	30.87291	16.18592	0.048352
Greece	18.86686	8.810349	23.55917	46.14350	2.620120
Ireland	18.84561	2.580367	69.91339	8.551100	0.109537
Italy	26.36996	0.398661	37.37663	33.51309	2.341665
Netherlands	41.26224	1.319397	16.84950	40.50724	0.061632
Portugal	21.36643	2.155466	58.38902	14.86549	3.223592
Spain	63.22999	1.452673	17.74888	17.49884	0.069625

Note: The results for the estimated variance decomposition at 8 periods (2 years) horizon are used.

Starting with the overall trade balance, most of the forecast error variance can be attributed to the own shocks. The oil price shocks explains very little of the fluctuations in the overall trade balance, spanning from 0.17 percent for Finland to 10.81 percent for Spain. The results are not that surprising, considering what was found previously in the Granger-causality tests. The forecast error variance of the overall trade balances seems to be more explained by shocks in real GDP, for the majority of the countries, than oil price shocks.

In contrast, the variance decomposition suggests that oil price shocks are the largest source of volatility for the non-oil trade balance for five out of ten countries. For the rest of the countries, it is either shocks in the overall trade balances or the non-oil trade balances that are relatively more important in explaining the forecast error variance. However, the importance of the price of oil is larger for all of the countries' non-oil trade balances than the overall trade balances. This is also in line with the previously found causality running from the price of oil to the non-oil trade balances for all countries except for Ireland. Shocks in the U.S dollar bilateral exchange rate and real GDP explain relatively little of the fluctuations in the non-oil trade balances.

6.4. Subsample estimation

After analyzing the impact of oil price shocks for the entire sample, we will now examine the subsamples, spanning from 1980Q1-1998Q4 and 1999Q1-2014Q4, in a similar way. The purpose here is to seek an answer to the second research question, in which we are interested to see how the impact of an oil price shock on the trade balances has changed over time. Previous scholars suggest that oil has lost some of its importance the last decades when looking at the response of GDP and consumer price index (Blanchard and Galí, 2008). Thus, we are interested to see if the shocks die out more rapidly in the second subsample compared to the first. The subsample estimations are presented in Figure 3 and 4.

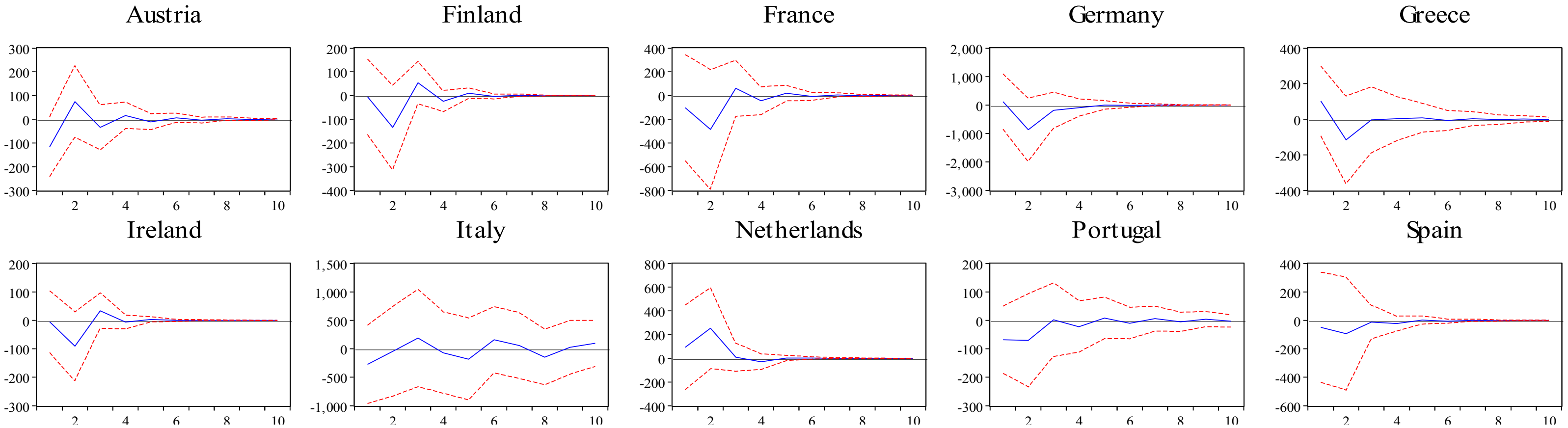

Figure 3a. Orthogonalized impulse response functions of the overall trade balance to a one-standard-deviation oil price shock. 1980Q1-1998Q4

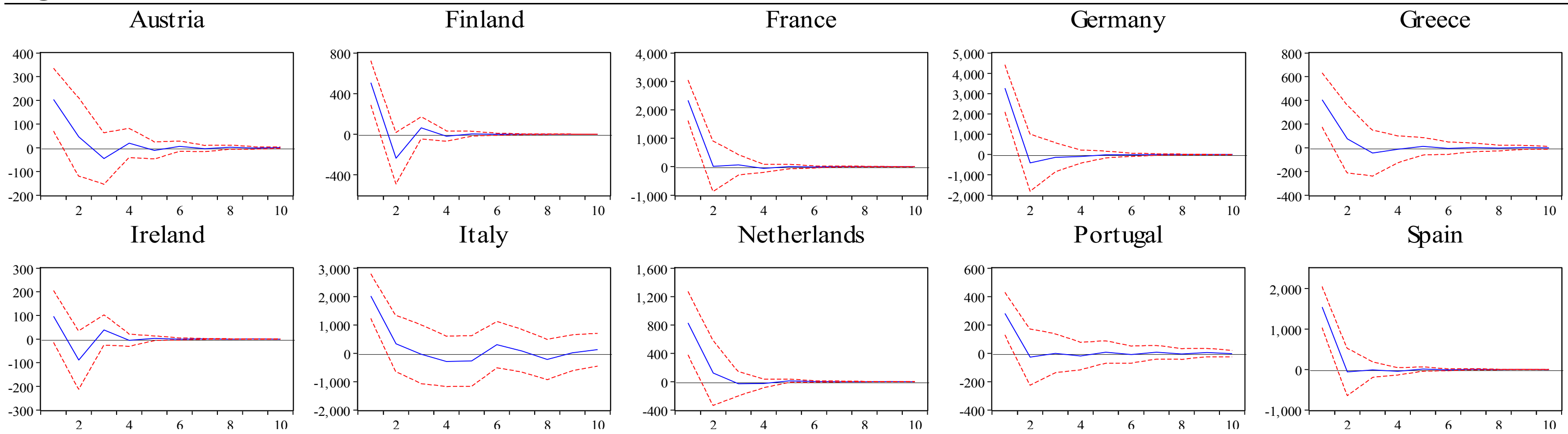

Figure 3b. Orthogonalized impulse response functions of the non-oil trade balance to a one-standard-deviation oil price shock. 1980Q1-1998Q4

Note: X-axes denote quarters following an oil price shock. The dashed (red) lines indicate ± 2 standard errors.

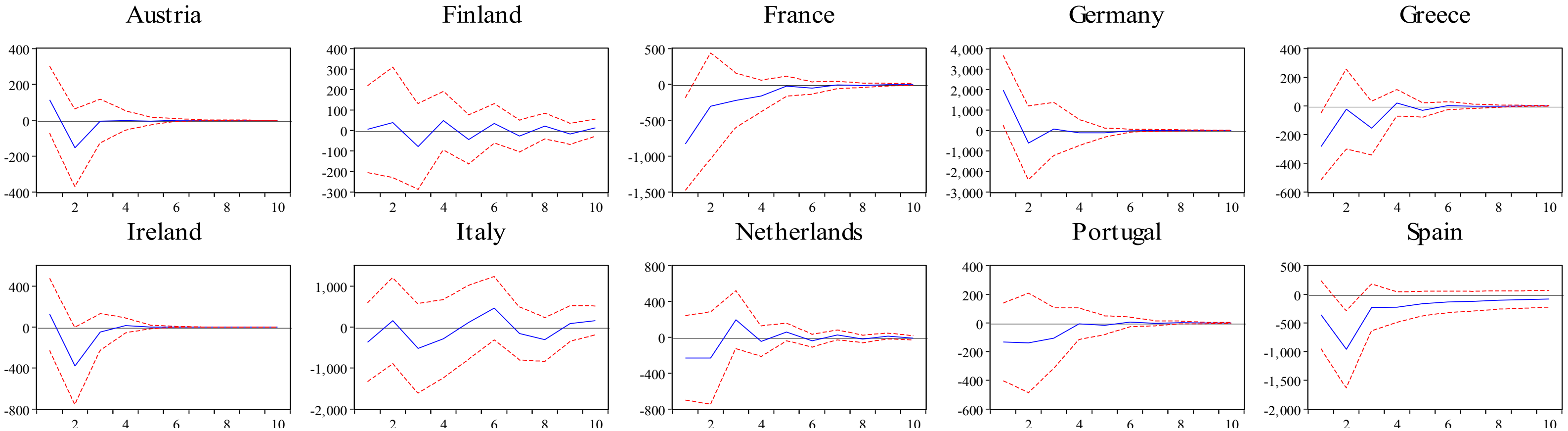

Figure 4a. Orthogonalized impulse response functions of the overall trade balance to a one-standard-deviation oil price shock. 1999Q1-2014Q4

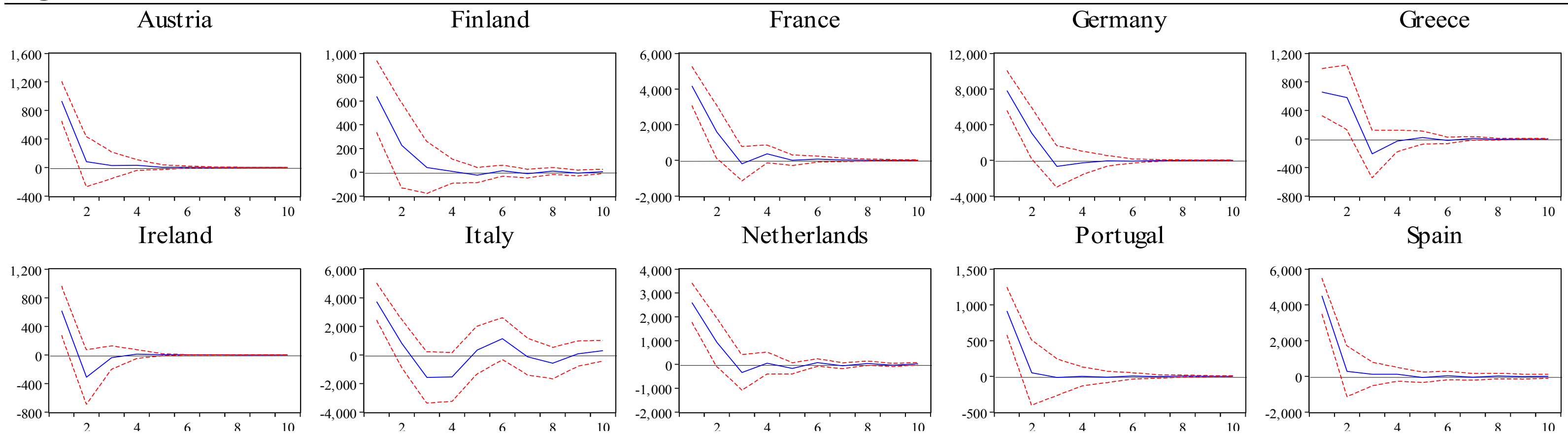

Figure 4b. Orthogonalized impulse response functions of the non-oil trade balance to a one-standard-deviation oil price shock. 1999Q1-2014Q4

Note: X-axes denote quarters following an oil price shock. The dashed (red) lines indicate ± 2 standard errors.

Comparing Figure 3a and 4a, we note that the results regarding the responses of the overall trade balances for the first period provides no significance for any country, while the responses for France, Germany and Greece provides slightly significant results for the second period. There is no clear evidence that the shocks are more persistent in the first period. The hypothesis of smaller and less persistent responses to oil price shocks in the second period cannot be confirmed. For some countries, the IRF:s seems to die out faster, in line with the decline role of oil. However, the opposite is true for other countries and we thus cannot make a distinct conclusion of the role of oil. Interestingly, for Austria, Greece and Netherlands the sign of the initial response is different between the periods which imply that these countries' response to an oil price shock has changed over time. Although, the results should be interpreted with caution due to the insignificance, similarly to the entire sample period. The responses of the non-oil trade balances to a shock in the price of oil are rather equal across the two periods and we do not detect any major differences between the subsamples and the entire period estimates. Neither the persistence, nor the initial sign differs here compared to the entire sample.

Previous empirical research has found that an oil price shock originating from the demand side is more severe and persistent than an oil supply shock, consistent with theory. Several empirical papers argue that from the beginning of the 21st century and onwards, there is a strong case saying that the price of oil was driven by increased aggregate demand (van de Ven and Fouquet, 2014). One exception is the very recent slump that started in the summer of 2014, which more likely was caused by disruptions in supply. However, our sample ends in 2014Q4 and thus our argument saying that the major part of the oil price shocks in the second subsample was caused by increased demand still holds. The picture for the first period is not as clear, both supply- and demand shocks seem to have occurred during that period. We do not disentangle the source of the shocks, it could thus be the case that we are not detecting the two opposing effects that are in play. The first effect is that the responses actually have decreased since the introduction of the Euro, due to the declining role of oil for producers and consumers. Secondly, the responses are expected to be larger and more persistent due to the fact that demand shocks are more pronounced, which mitigates the first effect. In conclusion, this reasoning need to be further investigated and preferably by looking at the specific shocks individually.

Moving on to the variance decomposition for the subsample estimation, the results are presented in Table 5 and 6 below.

Table 5a. Variance decomposition, Overall trade balance.
Period 1, 1980Q1-1998Q4

Country	Price of oil	Real GDP	Overall trade balance	Non-oil trade balance	U.S dollar exchange rate
Austria	4.315062	1.732271	87.20475	2.519748	4.228165
Finland	3.671905	3.846149	91.73852	0.543548	0.199875
France	1.975834	1.199622	92.12668	2.939958	1.757908
Germany	3.319492	9.318293	84.25251	2.235475	0.874234
Greece	1.664815	7.844740	86.08200	4.158357	0.250090
Ireland	3.347025	7.638763	83.15951	5.257204	0.597497
Italy	1.102327	7.278839	75.32096	15.17261	1.125255
Netherlands	2.842975	0.411358	95.82229	0.804229	0.119147
Portugal	1.394071	3.121261	82.11691	0.860431	12.50733
Spain	0.403280	9.064816	88.84959	0.848846	0.833471

Table 5b. Variance decomposition, Non-oil trade balance.
Period 1, 1980Q1-1998Q4

Country	Price of oil	Real GDP	Overall trade balance	Non-oil trade balance	U.S dollar exchange rate
Austria	8.051469	0.346035	75.04010	9.590807	6.971588
Finland	27.10437	0.568066	6.593832	65.53950	0.194237
France	36.82820	0.159907	21.94218	39.15568	1.914031
Germany	28.44507	6.713160	52.43011	11.00696	1.404693
Greece	9.669430	10.31074	59.02323	20.57121	0.425388
Ireland	6.160104	8.904856	73.39086	11.12326	0.420912
Italy	14.69773	2.864128	43.71191	37.18369	1.542539
Netherlands	15.20229	0.947923	50.39243	33.43018	0.027183
Portugal	7.975862	0.680484	60.63261	21.19871	9.512331
Spain	36.91046	5.010186	43.40914	14.32328	0.346942

Note: The results for the estimated variance decomposition at 8 periods (2 years) horizon are used.

Table 6a. Variance decomposition, Overall trade balance.
Period 2, 1999Q1-2014Q4

Country	Price of oil	Real GDP	Overall trade balance	Non-oil trade balance	U.S dollar exchange rate
Austria	4.872605	11.51983	72.20230	10.98045	0.424819
Finland	0.868051	7.008581	83.18679	8.888212	0.048365
France	9.997808	4.580803	80.13934	1.881702	3.400343
Germany	8.113064	13.90436	69.32014	0.031185	8.631250
Greece	7.884749	17.40910	56.99538	1.646687	16.06409
Ireland	7.521473	3.945208	87.77858	0.593848	0.160891
Italy	3.707582	4.563737	72.18387	16.72674	2.818071
Netherlands	3.625207	7.412981	80.92561	6.183863	1.852336
Portugal	2.746182	7.177357	82.00270	0.803391	7.270370
Spain	16.19041	18.11285	62.42663	0.314835	2.955275

Table 6b. Variance decomposition, Non-oil trade balance.
Period 2, 1999Q1-2014Q4

Country	Price of oil	Real GDP	Overall trade balance	Non-oil trade balance	U.S dollar exchange rate
Austria	45.79661	1.649232	23.13378	28.36149	1.058881
Finland	23.36136	0.757011	41.02191	34.67361	0.186113
France	54.65753	1.401371	13.97413	29.49518	0.471791
Germany	51.08687	2.734412	23.99922	18.63728	3.542212
Greece	22.41952	12.01572	9.998859	50.84524	4.720665
Ireland	22.12080	2.664405	67.33148	7.817914	0.065404
Italy	32.08259	3.420184	33.77708	27.12772	3.592427
Netherlands	44.74098	2.969220	14.40635	37.62664	0.256812
Portugal	27.84046	4.569787	52.49883	11.21809	3.872836
Spain	68.96265	1.123223	13.35886	16.42420	0.131067

Note: The results for the estimated variance decomposition at 8 periods (2 years) horizon are used.

The results presented for the overall trade balances are in line with the findings for the entire sample. In both subsample periods most of the overall trade balances forecast error variance comes from the own shocks. The relative importance of the own shocks is smaller for the later subsample period, except for Ireland. Shocks in the price of oil instead have greater relative importance for all countries excluding Finland. Real GDP is also more important for most of the countries. These findings contradict our hypothesis stating that oil has less impact on the overall trade balance in recent years. Furthermore, oil price shocks explains much more of the forecast error variance for the non-oil trade balance than for the overall trade balance, similarly to the entire sample. For nearly all countries, oil price shocks are relatively more important in the second subsample period in explaining the forecast error variance. These results also contradict a declining role of oil, but are in line with the observation that during the second subsample, oil price shocks mainly originated from the demand side. The forecast error variance for the non-oil trade balance in the first period can to larger extent be explained by own shocks. On a final note, for the overall trade balances, the Euro area as a whole seems to have lower dependence on fluctuations on the oil market, while for the non-oil trade balances the dependence is much higher. Kilian et al (2009) finds similar results from the variance decompositions for major oil importers non-oil trade balance.

6.5. Robustness checks

The disadvantage of using the Cholesky decomposition, as argued in the methodology section, is that the results can be sensitive to the ordering of the variables and thereby provide less reliability. As a final step, a robustness check accounting for a different ordering of the variables for each country is conducted. Previous empirical papers have found a reversed causality going from macroeconomic variables to the oil price, which is an argument for letting GDP be the first variable. Consequently, the ordering of the variables in this robustness check will be: real GDP, the price of oil, overall trade balance, non-oil trade balance and the bilateral exchange rate towards the U.S dollar. The estimated IRF:s are presented in Appendix, Figure 5a and 5b. The results of these estimates are in line with the main results using the preferred ordering since there are almost no differences, which strengthens our results. This leaves us with the same conclusions regarding the IRF:s.

According to econometric theory, estimating a model that spans over major economic events that brings instability to the relationship between the variables might cause misleading results, especially when the parameters are used for forecasting (Gujarati, 2007). Therefore, as a second robustness check, we perform IRF analysis on the period 1980Q1 to 2007Q4. The financial crisis that peaked during 2008 affected the whole world and there are signs of structural breaks in the data at this time. We therefore account for this by limiting the data to 2007Q4. Figure 6a and 6b in Appendix shows the results for the corresponding estimated IRF:s. The results do not imply any strong evidence for differences when the crisis period is removed. This makes us stay with the same conclusions as in the previous sections.

7. Concluding remarks

The Euro area is often considered to be a homogenous group of countries and the existing literature generalize the effects of oil price shocks to be common for all countries. This study examines the impact of oil price shocks on the overall- and the non-oil trade balance of ten oil-importing European countries to see if these are affected in unison and if there are indications that the pattern has changed over time. This is investigated by using an unrestricted Vector Autoregressive (VAR) model and with the help of Granger-causality tests, orthogonalized Impulse Response Functions (IRF:s) and variance decomposition perform an analysis.

Using a data set spanning from 1980Q1 to 2014Q4, we are capturing how a common shock in the price of oil affects the countries different trade balances. Having a long time span and several oil importing countries helps us investigate the proposition suggested that the importance of oil has declined. The results of the Granger-causality tests indicate poor causation going from the price of oil to the overall trade balances but high causation to the non-oil trade balances. The main results from the IRF:s indicate similar patterns, with mixed responses of the overall trade balances but significant, positive responses for the non-oil trade balances. We thus conclude that the countries' responses are similar to each other for the non-oil trade balances but not for the overall trade balances. On the contrary, the second hypothesis regarding a changing pattern over time could not be answered to the same extent. The IRF:s does not support a decline for all countries responses in the second subsample and we thereby conclude that the oil component still is vital in determining the effects on trade in Europe. We argue that two opposing effects have somewhat cancelled out each other, making the results of the comparison of the two subsamples not as clear as we expected prior to the empirical analysis.

Oil price shocks are recurrent and will probably have continued implications for the Euro area. We propose to actively working towards a less oil-dependent economy in order to take advantage of the improvement in the non-oil trade balance that follows from an oil price shock. The differences found for the overall trade balances gives us reason to believe that interventions and policies may not be suitable at a supranational level. The dissimilarities in the responses of the overall trade balances make us question if a common monetary policy are favoring all countries within the union. The policy response to dampen the effects on the trade balances could be more appropriate set on an individual level. Furthermore, drawing conclusions and policy implications for the Euro area on an aggregate level and then compare it with the U.S should be done carefully since the structure and the channels of transmission in play may differ significantly.

Finally, the lack of evidence for a declining role of oil calls for further evaluation. We propose that future research should focus on determining the oil dependency and the underlying transmissions from oil price shocks to the trade balances for the individual countries. The discussion regarding the two opposing effects that may have cancelled out the responses makes the subject even more interesting. To find an answer to if this is the case, it would be interesting to see if a declining role of oil can be found when comparing shocks coming from the demand- or supply side of the economy for the different time periods.

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9. Appendix

Data appendix

Description, country specific variables	Variable	Calculation	Unit	Source
Gross domestic product, constant prices 2010, U.S. Dollars	Real GDP		Millions of US Dollars, constant prices	OECD Statistics database
Nominal exchange rate. Index, 2002Q4 = 1	Exchange rate			OECD Main economic Indicators (MEI)
Trade balance for goods	Trade balance	Value of export of goods (FOB), current U.S. Dollars - Value of imports of goods (CIF), current U.S. Dollars. Deflated using U.S. PPI	Millions of US Dollars, constant prices	IMF, International Financial statistics (IFS)
Oil trade balance	Oil trade balance	Oil export - oil import, recalculated from metric tons of oil equivalent to barrels, multiplied by Oil Price	Millions of US Dollars, constant prices	Oxford economics
Non-oil trade balance	Non-oil trade balance	Trade balance - Oil trade balance	Millions of US Dollars, constant prices	
Description, global variables	**Variable**	**Calculation**	**Unit**	**Source**
U.S. Producer Price Index	U.S. PPI			IMF, International Financial statistics (IFS)
Real Price of Crude Oil	Oil price	U.S. Crude Oil Imported Acquisition Cost by Refiners, U.S. dollars current prices, deflated using U.S. PPI	Dollars per Barrel	International Energy Agency (IEA)

Note: Data on all variables are collected and available on quarterly frequency for the sample period 1980Q1-2014Q4

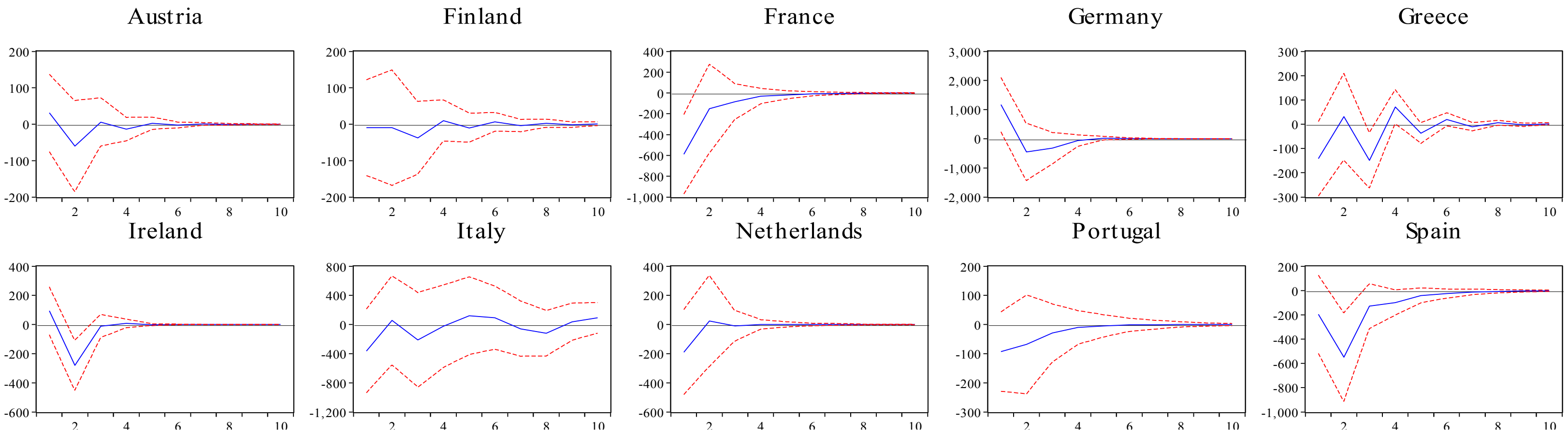

Figure 5a. Orthogonalized impulse response functions *with changed ordering of the variables* of the overall trade balance to a one-standard-deviation oil price shock. 1980Q1-2014Q4

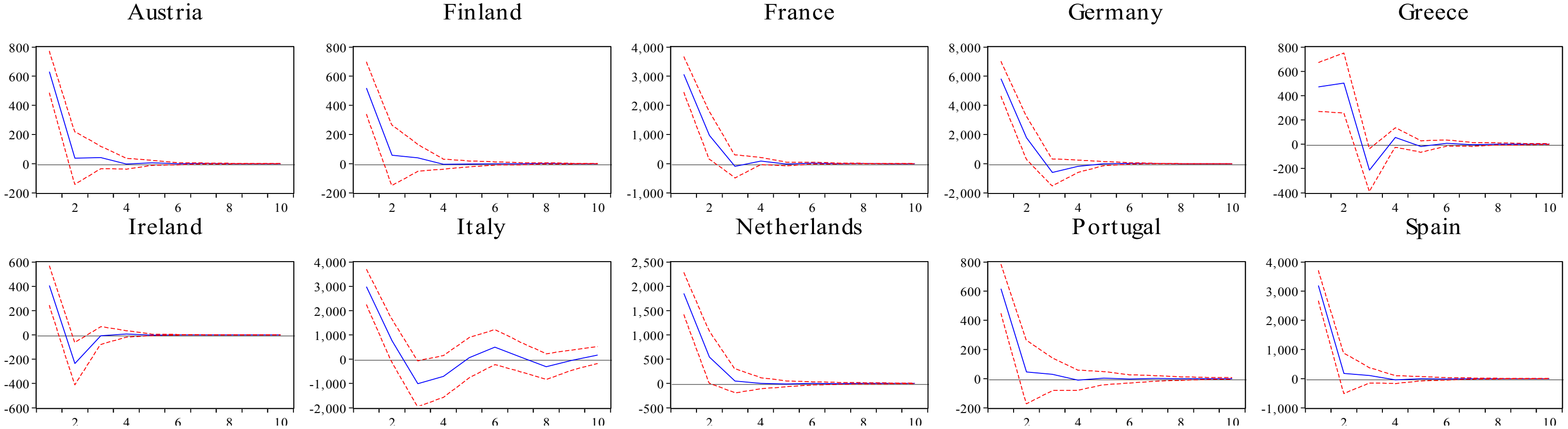

Figure 5b. Orthogonalized impulse response functions *with changed ordering of the variables* of the non-oil trade balance to a one-standard-deviation oil price shock. 1980Q1-2014Q4

Note: X-axes denote quarters following an oil price shock. The dashed (red) lines indicate ± 2 standard errors.

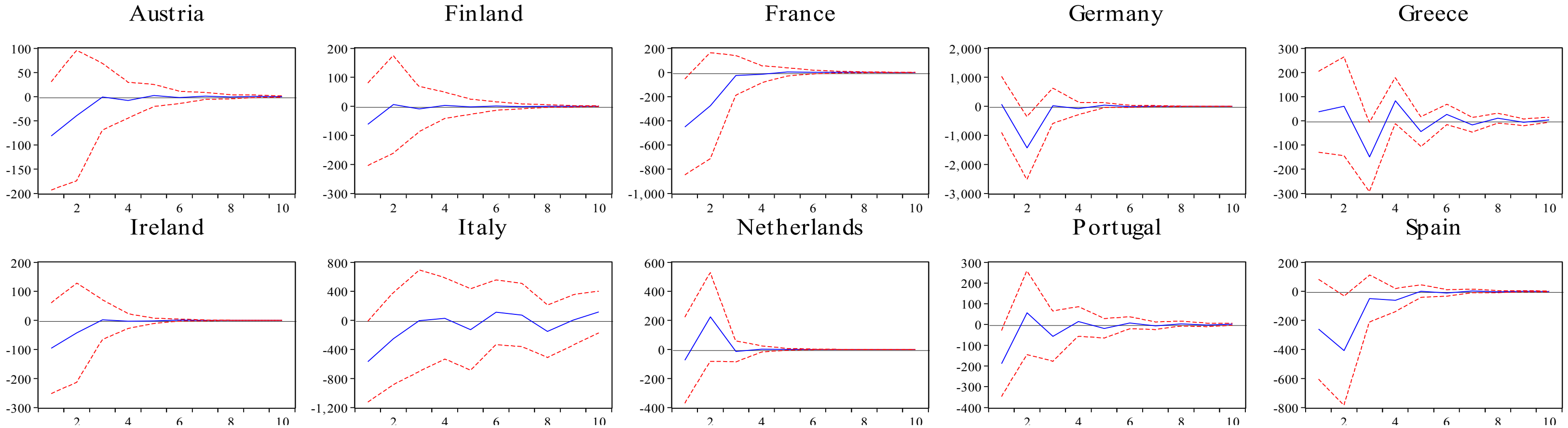

Figure 6a. Orthogonalized impulse response functions of the overall trade balance to a one-standard-deviation oil price shock. Period *1980Q1-2007Q4, excluding the crisis*.

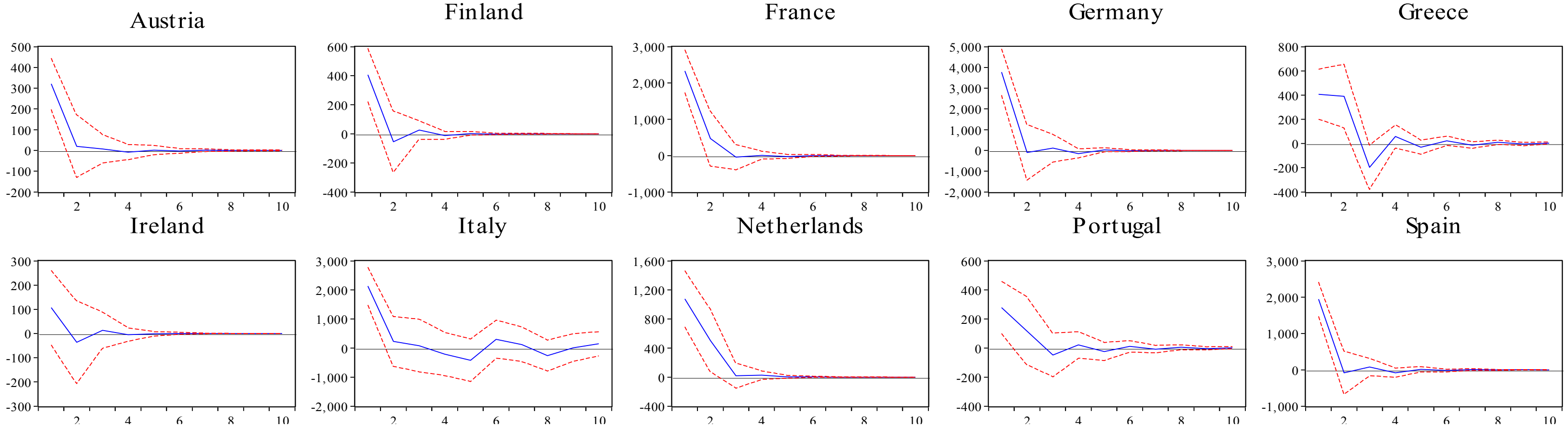

Figure 6b. Orthogonalized impulse response functions of the non-oil trade balance to a one-standard-deviation oil price shock. Period *1980Q1-2007Q4, excluding the crisis*.

Note: X-axes denote quarters following an oil price shock. The dashed (red) lines indicate ± 2 standard errors.