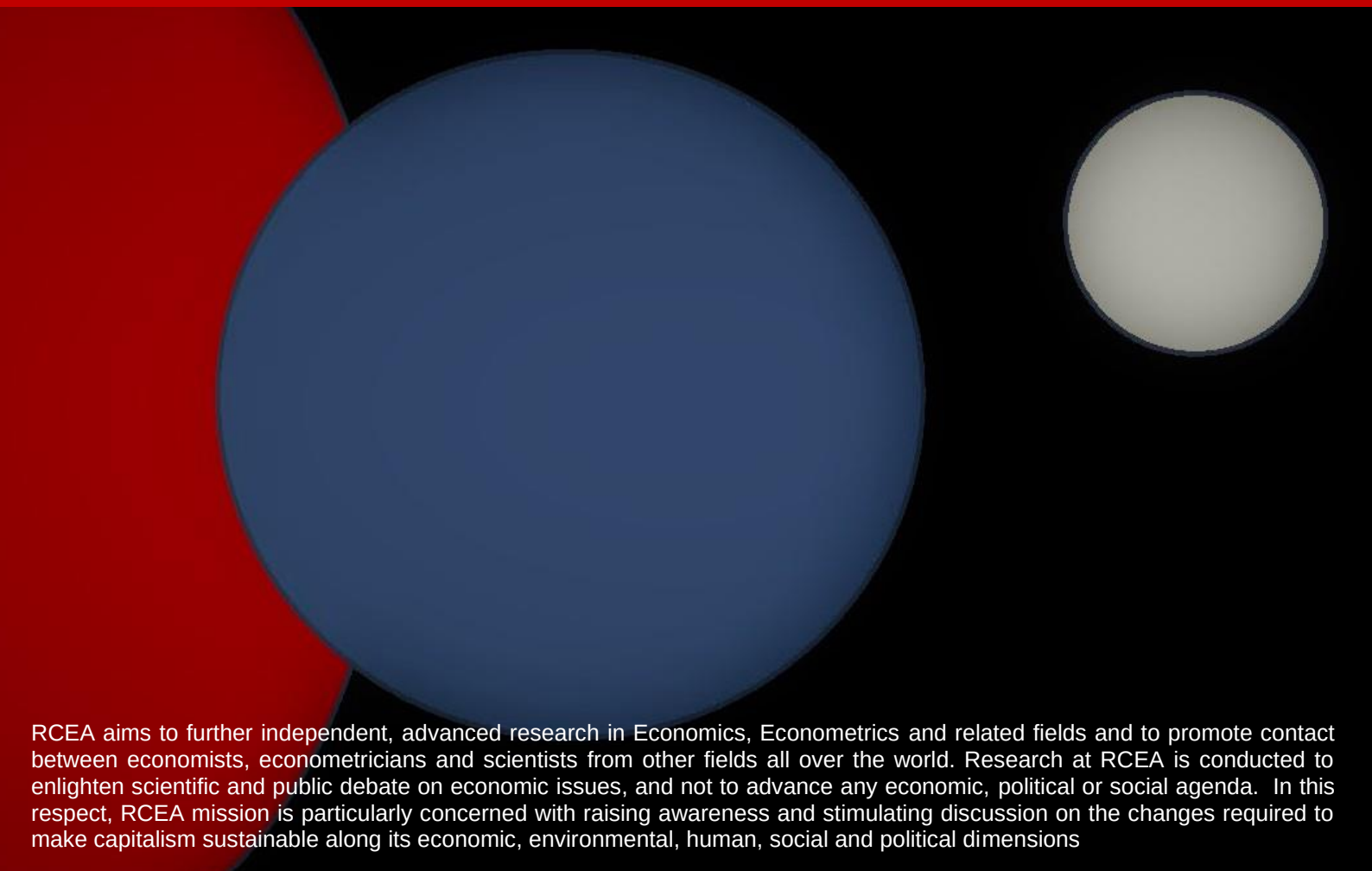
RCEA Network

Rimini Centre for Economic Analysis
Working Paper Series

wp 20-22

What matters for consumer sentiment? World oil price or retail gasoline price?

Sofronis Clerides
Styliani-Iris Krokida
Neophytos Lambertides
Dimitris Tsouknidis



What matters for consumer sentiment? World oil price or retail gasoline price?

Sofronis Clerides[a] Styliani-Iris Krokida[b] Neophytos Lambertides[c]
Dimitris Tsouknidis[d*]
[a]University of Cyprus,[b]Athens University of Economics and Business,
[c]Cyprus University of Technology,[d]University of Piraeus

May 27, 2020

Abstract

This paper examines the impact of oil supply and demand shocks on gasoline prices and consumer sentiment in the Euro Area. Results reveal that aggregate consumer sentiment and its components deteriorate notably as a response to positive shocks to real gasoline prices. On the contrary, positive oil-specific demand shocks do not trigger a deterioration of consumer sentiment. In other words, consumer sentiment is affected primarily by unexpected changes in gasoline prices at the pump rather than unexpected changes in crude oil prices. The analysis is further refined to analyze the effects of these shocks to six subcomponents of consumer sentiment.

Keywords: oil supply and demand shocks; gasoline prices; consumer sentiment; euro area.
JEL classification: G10, G11, G12, G14.

*Corresponding author. Postal Address: Department of Maritime Studies, University of Piraeus, 21 Grigoriou Labraki Distomou, TK 18533, Piraeus, Greece. Email addresses: s.clerides@ucy.ac.cy (Professor S. Clerides), stkrokida@aueb.gr (S.I. Krokida, Post-Doc Researcher), n.lambertides@cut.ac.cy (N. Lambertides, Associate Professor), dtsouknidis@unipi.gr (D. A. Tsouknidis, Assistant Professor).

1 Introduction

The effects of crude oil price movements on global economic activity and capital markets have been an important research topic over several decades (Kling, 1985; Chen, Roll and Ross, 1986; Sadorsky, 1999; Huang, Masulis and Stoll, 1996). More recent contributions have focused on disentangling oil price changes into oil supply and demand shocks, and on quantifying their effects on the U.S. economy and equity markets (Barsky and Kilian, 2002, 2004; Kilian, 2009; Kilian and Park, 2009; Kilian and Zhou, 2018; Lambertides, Savva and Tsouknidis, 2017). A number of studies propose that such relationships are demand driven, i.e. an increase in the real price of oil translates into higher retail gasoline prices, which decrease households disposal income and reduce their overall consumption and investment expenditures (Edelstein and Kilian, 2009; Baumeister and Kilian, 2017). Depressed expectations about future household and country economic conditions due to oil price changes might further depress consumer sentiment and households' propensity to consume (Güntner and Linsbauer, 2018). Thus, consumer behavior seems to be a promising transmitting channel of the effects of oil supply and demand shocks in the economy. According to Eurostat, the EU-28 total household expenditure amounted to 54.3% of its GDP in 2018. Almost 24% of the total household expenditure across EU (or 13.0% of GDP) was devoted to housing, water, electricity, gas and other fuels.[1]

In this paper we aim to contribute to this literature by investigating a different transmission mechanism, that between crude oil prices, retail gasoline prices, and consumer sentiment. We build upon the structural vector autoregressive (SVAR) approach of Kilian (2009) in order to identify mutually orthogonal structural oil shocks and obtain the corresponding impulse response functions of real gasoline prices over household disposable income and consumer sentiment. We augment Güntner and Linsbauer's (2018) (GL hereafter) structure with the addition of retail gasoline prices as an extra link to the system.[2] This allows us to capture the transmission mechanism from world oil prices to retail gasoline prices to consumer sentiment. In order to reveal the transmission channels of oil price and gasoline price shocks, we consider the consumer responses to key specific survey questions included in the aggregate consumer sentiment index, such as consumers' views regarding the financial situation of their household, the overall state of the national econ-

[1] Source: https://ec.europa.eu/eurostat/statistics-explained/index.php/Household_consumption_by_purpose (last access: December 2, 2019).

[2] We use final retail gasoline prices, inclusive of all taxes. These are the most relevant prices to consider as they represent what consumers pay.

omy, inflation, unemployment and whether conditions are favorable for purchases of major items (durables) such as furniture and electrical devices.

Our most striking result is that aggregate consumer sentiment, along with its household and national economy components, deteriorates notably as a response to positive shocks on real gasoline price. On the contrary, positive oil-specific demand shocks do not always trigger a notable deterioration of consumer sentiment variables. In other words, consumer sentiment is affected primarily by unexpected changes in gasoline prices at the pump rather than unexpected changes in the benchmark crude Brent oil prices. Regarding the effect of oil supply and demand shocks on consumer sentiment in EA, our results are overall consistent with GL who focus on the US. In line with GL, an unexpected aggregate demand shock increases consumer sentiment sharply but later reverses; while an oil-specific demand shock exerts a modest negative effect on consumer sentiment. By contrast to GL, who find that an oil supply disruption triggers a small and transitory negative effect on consumer sentiment, we also find that this effect is small and transitory but positive.

By introducing the real gasoline price in our model, we provide an explanation for GL's somewhat surprising result that oil price shocks only weakly affect consumer sentiment in the US. We argue this is because consumers primary concern is the gasoline price at the pump, and show that, in the Euro Area (EA), consumers do care about energy prices, but they care about the retail price at the pump, not the world oil price.[3] The reason may be that pass-through of oil prices to gasoline is only partial, as the latter include high taxes and other costs, and often comes with a delay. This creates uncertainty with regard to the size and timing of the impact on final pump prices. Due to this uncertainty, consumer sentiment does not react until consumers observe changes in the price they pay. Indeed, Edelstein and Kilian (2009) also use retail energy price shocks in their work and find that they have been an important factor in explaining historical U.S. real consumption growth. Our finding is therefore consistent with theirs, although it should be noted that there are two important differences between the two studies: first, they look at the impact on consumption, not consumer sentiment; and second, they do not distinguish between different oil supply and demand shocks, which we do along the lines of GL.

Our analysis uses data from the Euro Area (EA). Our consumer sentiment measure is the consumer component of the Economic Sentiment Index (ESI) for the EA published by

[3]In order to ensure that our finding is not due to our focus on the EA rather than the US, we have also estimated the GL (2018) model using EA data, i.e. without the gasoline price at the pump. The results obtained are qualitatively the same as those found with US data.

Eurostat.[4] Figure 1 plots this measure (left y-axis, denominated in index points), along with the real price of Brent oil and the real final price of gasoline (right y-axis, in euros per barrel). There are clear co-movements across these variables. Over the long run, higher oil prices correlate negatively with consumer sentiment, as in the period 2011-2014. But there are also periods of movements in the same direction; for example, both consumer sentiment and the real price of oil are on a positive trajectory throughout 2009. Following the empirical evidence presented in Güntner and Linsbauer (2018) and Kilian (2009), we do not assign a causal interpretation to these observations, as an observed increase of crude oil price might have a range of different effects on consumers expenditure and real economic activity. We also show that the drop of the aggregate ESI Consumer sentiment index as a response to a positive shock on real gasoline price with taxes, as opposed to oil-specific demand shocks, is primarily transmitted through specific consumer sentiment questions (components) regarding household finance, country's economy, macroeconomic indicators and buying conditions for durables.

The primary contribution of our work is that it elucidates the linkages between world oil prices, retail gasoline prices and consumer sentiment. In addition, ours is the first study analyzing the transmission of oil price shocks to consider sentiment in Europe. Existing studies examining the transmission of oil price shocks report that shocks on aggregate demand can explain a large portion of the observed fluctuations in real oil prices and equity returns. For instance, Scholtens and Yurtsever (2012) examine the effects of oil price shocks on European equity industry returns, while Degiannakis, Filis and Kizys (2014) focus on the effects of oil price shocks to European stock market volatility. Short-run movements in consumers' confidence in Europe have been shown to be driven by country-specific shocks and/or differing reactions to common shocks (Lemmens, Croux and Dekimpe, 2007). There are no studies that we are aware of that examine the effects of oil supply and demand shocks on gasoline prices and eventually on consumer sentiment in Europe.

The rest of this paper is organized as follows. Section 2 outlines the methodology and presents the identification strategy; section 3 describes the dataset used for the empirical analysis; section 4 presents the results including impulse response functions (IRF), forecast error variance decomposition (FEVD) and historical decomposition (HD); while section 5 concludes the paper.

[4]The EA ESI Consumers index is one out of the five components of the Economic Sentiment Index (ESI), the rest being: industrial production, services, retail trade and construction components.

2 Methodology

In order to account for the potential endogeneity of the real price of crude oil and to distinguish between different types of oil supply and demand shocks we build on the SVAR approach of Kilian (2009) and Kilian and Park (2009). Specifically, we distinguish three structural oil price shocks that affect the real price of crude oil, a gasoline price shock and a fifth sentiment shock as follows: oil supply shock, aggregate demand shock, oil-specific demand shock, gasoline price shock and consumer sentiment shock. The SVAR model incorporates monthly data for the vector time series y, consisting of the percent change in global crude oil production, a measure of real activity in global industrial commodity markets, the real price of crude oil, the real price of gasoline with taxes and a consumer sentiment index. The structural representation of the VAR model of order p is:

$$A_0 y_t = c_0 + \sum_{i=1}^{p} A_i y_{t-i} + \varepsilon_t \tag{1}$$

where $y_t = (\Delta prod_t, rea_t, rpo_t, gas_t, senti_t)$, is a 5x1 vector of endogenous variables, A_0 refers to the 5x5 contemporaneous coefficient matrix, c_0 represents a 5x1 vector of constant returns, A_i denotes the 5x5 autoregressive coefficient matrices and ε_t stands for the 5x1 vector of structural disturbances, assumed to have zero covariance and being serially uncorrelated. $\Delta prod_t$ is the percentage change in world oil production, rea_t is the global real economic activity for all industrial commodities.[5] Rpo_t are the real prices of oil, gas_t is the ratio of the real gasoline prices with taxes over the household disposal income and $senti_t$ is the consumer sentiment aggregate index. In order to also capture the response of consumers to specific questions we replace the aggregate consumer sentiment index with six out of the twelve questions in total it contains (one at a time).[6]

[5]The global real economic activity refers to equally weighted growth rates of freight rates for individual voyages of bulk dry cargoes. These freight rates are deflated using the US consumer price index and linearly de-trended to remove long-term trends in demand for sea transport and the effects of technological advances in ship building (Kilian, 2009). Note that we use the corrected version of this index in the spirit of Kilian (2018).

[6]To investigate the issue further, we also use the real gasoline price with taxes and the consumer sentiment variables for the G5 European countries, being: Germany (DE), Spain (ES), France (FR), Italy (IT) and United Kingdom (UK). The results are qualitatively similar to the ones reported for the EA across all the G5 European countries examined apart from the UK, and available from the authors upon request. The G6 (Group of Six) was established originally as G5 in 2003 (without Poland) to deal with immigration, terrorism and law and order. The G6 in the European Union is an unofficial group of the

A long lag length of 24 months (p=24) is used to allow for potential delays between structural oil demand and oil supply shocks and their effect on the economy. In addition, such a long number of lags removes serial correlation effects. Kilian (2009) and Kilian and Park (2009) have shown that introducing long lags is important in structural models of the global oil market as they take into account the low frequency co-movement between the real price of oil and the global economic activity. In order to arrive to the reduced form VAR model we multiply both sides of Eq. (1) with A_0^{-1} which follows a recursive structure for the reduced form errors e_t to be linear combinations of the structural errors ε_t as follows:

$$e_t = \begin{bmatrix} e_{1t}^{\Delta \text{ global oil production}} \\ e_{2t}^{\text{global real activity}} \\ e_{3t}^{\text{real price of oil}} \\ e_{4t}^{\text{real gasoline price}} \\ e_{5t}^{\text{sentiment}} \end{bmatrix} = \begin{bmatrix} \alpha_{11} & 0 & 0 & 0 & 0 \\ \alpha_{21} & \alpha_{22} & 0 & 0 & 0 \\ \alpha_{31} & \alpha_{32} & \alpha_{33} & 0 & 0 \\ \alpha_{41} & \alpha_{42} & \alpha_{43} & \alpha_{44} & 0 \\ \alpha_{51} & \alpha_{52} & \alpha_{53} & \alpha_{54} & \alpha_{55} \end{bmatrix} \begin{bmatrix} \varepsilon_{1t}^{\text{oil supply shock}} \\ \varepsilon_{2t}^{\text{aggregate demand shock}} \\ \varepsilon_{3t}^{\text{oil specific-demand shock}} \\ \varepsilon_{4t}^{\text{gasoline price shock}} \\ \varepsilon_{5t}^{\text{other sentiment shock}} \end{bmatrix} \quad (2)$$

where, $\varepsilon_{1t}^{\text{oil supply shock}}$ stands for the oil supply side shock, $\varepsilon_{2t}^{\text{aggregate demand shock}}$ denotes the aggregate demand shock, $\varepsilon_{3t}^{\text{oil specific-demand shock}}$ captures the oil market-specific demand shock, $\varepsilon_{4t}^{\text{gasoline price shock}}$ captures the real gasoline price shock and $\varepsilon_{5t}^{\text{other sentiment shock}}$ is the residual or other shock to sentiment.

The economic rationale for the identifying restrictions imposed in A_0^{-1} is explained in detail in Kilian (2009). Specifically, the oil production is assumed not to respond contemporaneously to an oil demand shock within a given month due to the high adjustment costs of oil production and uncertainty regarding whether a change in oil demand is a transitory shock or a permanent shift. Thus, assuming a vertical short-run supply curve seems highly plausible (Kilian, 2009). This assumption is further supported by Anderson, Kellogg and Salant (2018) who reveal that oil price changes have no effect on oil production from existing wells. Therefore it seems plausible to assume that only oil supply shocks can affect world crude oil production within the same month. In contrast, oil supply shocks are allowed to influence the global economic activity, the price of oil and sentiment within the same month.

Next, the global real economic activity *(rea)* is used as in Kilian (2009) to capture

interior ministers of the six European Union member states (France, Germany, Italy, Poland, Spain, and the United Kingdom) with the largest populations and thus with the majority of votes in the Council of the European Union.

exogenous fluctuations in the demand for all kinds of industrial commodities transported through dry-bulk ocean-going vessels (iron ore, coal, grain) and is associated with the global business cycle. *Rea* is assumed not to be responding contemporaneously to shocks of the real price of oil within a given month, gasoline prices and sentiment because of the time that is required for the world economy to react. However, a global economic activity shock will have an immediate effect on oil prices and sentiment, considering the low reaction time of commodities markets and economic/consumer sentiment.

Real oil price innovations are assumed not to respond contemporaneously to changes on sentiment, but both oil supply shocks and global economic activity shocks can influence oil prices within the same month. In turn, real gasoline prices are assumed to react contemporaneously to oil demand and supply shocks but not to consumer sentiment shocks as it is expected that the sentiment of consumers is largely affected by shocks on gasoline price. Finally, the economic/consumer sentiment is assumed to react contemporaneously to all aforementioned shocks. Using the block-recursive structure of the identification in (2) suggests that oil price shocks are predetermined within the same month with respect to other shocks on sentiment. Kilian and Vega (2011) support this assumption as they report no feedback within the same month from U.S. macroeconomic aggregates to crude oil price. Thus, we do not allow for reverse causality within the same month from *senti* to the world oil production, the measure of real economic activity and oil price. Furthermore, we do not attempt to disentangle further the shocks driving consumer sentiment, as in this paper we only examine the impact of structural oil demand, oil supply shocks and gasoline price shocks on consumer sentiment. Therefore, any remaining innovations in sentiment that cannot be attributed to the oil market are captured in the residual (or other shock) category, which does not have an economic interpretation. These other shocks to sentiment might be driven by monetary or fiscal shocks unrelated to the oil market or other exogenous changes on consumers' sentiment due to for instance, economic policy uncertainty or geopolitical risks, etc. The recursive representation in (2) allows us to obtain $\mathbf{A_0^{-1}}$ by Cholesky decomposing the sample covariance matrix of reduced form residuals (see also Kilian, 2009). The structural oil shocks have been normalized as to tend to increase oil's price, i.e. the oil supply shock represents a negative shock (an oil supply disruption), whereas the global real economic activity and oil-market specific demand shocks represent positive shocks. Point estimates of impulse responses functions are accompanied by the computation of statistical significance bands of one-standard and two-standard errors, which correspond to approximate 68% and 95% confidence intervals. These intervals

have been computed based on a recursive-design wild bootstrap with 5,000 replications, which accounts for potential heteroskedasticity of unknown form in the VAR residuals, see Goncalves and Kilian (2004).

3 Data description

The data examined in this paper are monthly for a period of almost fourteen years (January 2005 to December 2018). The time series dictating the starting date is the gasoline prices reported in EU's Weekly Oil Bulletin. In addition, we collect historical data for the world's oil production, a measure of global economic activity and crude Brent oil prices. The US Department of Energy provides historical observations on world oil production measured in millions of barrels pumped per day and averaged by month. We transform the original series into its percent change as 100 x log difference. Next, the global real economic activity is measured by the index constructed by Kilian (2009).[7] This index has the advantage that it incorporates activity in important emerging economies such as China and India, which are not included in conventional measures of global economic activity for OECD countries. Next, Europe's Spot Brent Oil fob (free on board) price denominated in euros is collected through Thomson Reuters Eikon. In order to be comparable with gasoline retail prices we convert the price of Spot Brent Oil to euro per 1000 litres using the correspondence 1 barrel = 158.987295 litres. Furthermore, in order to obtain real oil (and gasoline) prices we deflate the respective series with the All Items Seasonally Adjusted Harmonised Index of Consumer Prices (HICP) published by Eurostat and designed for international comparisons of consumer price inflation. We transform the real price of crude oil in terms of log deviations from the sample mean. Finally, we obtain the with taxes (WT) gasoline prices from EU's Weekly Oil Bulletin, as these are more relevant for consumers.

In addition to the oil-related series above we collect data from the Joint Harmonised EU Programme of Business and Consumer Surveys.[8] Specifically, we collect the consumer sentiment indicator (EAconsSENTI) which is one of the components of the aggregate Eco-

[7]The index is available through Lutz Kilian's webpage: https://sites.google.com/site/lkilian2019/research/data-sets.

[8]Data are freely available in the following website (last access: December 1, 2019): https://ec.europa.eu/info/business-economy-euro/indicators-statistics/economic-databases/business-and-consumer-surveys/download-business-and-consumer-survey-data/time-series_en

nomic Sentiment Indicator (ESI) for EA. ESI is made up of five individual components for the following sectors of the economy (weights in the parentheses): Industrial Production (40%), Services (30%), Consumers (20%), Construction (5%) and Retail Trade (5%).[9] These sub-components are available for all EU28 countries with different starting dates for each country. However, in this paper we primarily focus on the effects of structural oil price shocks on consumers' sentiment and for this reason we only include in our analysis the aggregate EU ESI Consumers component and the responses of six key questions included in the Consumers component as part of the harmonized survey consumers confidence questionnaire. All sentiment-related time series are seasonally adjusted as published by Eurostat.

The question-level analysis is expected to yield further insight into what drives fluctuations in consumer confidence by inquiring information on the past and future financial situation of households, the economic situation of the country as a whole, the expected inflation and unemployment, along with perceived buying conditions for durable products (furniture, electrical/electronic devices). The corresponding survey questions are as follows:

- "How has the financial situation of your household changed over the last 12 months?" *(EAconsSENTI1)*
- "How do you expect the financial position of your household to change over the next 12 months?" *(EAconsSENTI2)*
- "How do you expect the general economic situation in this country to develop over the next 12 months?" *(EAconsSENTI4)*
- "By comparison with the past 12 months, how do you expect that consumer prices will develop in the next 12 months?" *(EAconsSENTI6)*
- "How do you expect the number of people unemployed in this country to change over the next 12 months?" *(EAconsSENTI7)*
- "In view of the general economic situation, do you think that now it is the right moment for people to make major purchases such as furniture, electrical/electronic devices, etc.?" *(EAconsSENTI8)*

[9]For full details on the construction of the ESI and its sub-components please refer to the user guide "The Joint Harmonised EU Programme of Business and Consumer Services" published by the European Commission Directorate-General for Economic and Financial Affairs, available in the following website (last access: December 1, 2019): https://ec.europa.eu/info/sites/info/files/bcs_user_guide_en_0.pdf

The possible answers to the questions above are: got a lot better, got a little better, stayed the same, got a little worse, got a lot worse, don't know. According to the user guide of the "Joint Harmonised EU Programme of Business and Consumer Surveys", answers obtained from the surveys are aggregated in the form of "balances". Balances are constructed as the difference between the percentages of respondents giving positive and negative replies. The Commission calculates Euro Area (EA) aggregates on the basis of the national results and adjusts seasonally the balance series. The balance series are used to build composite indicators. Specifically, for each surveyed sector, the Commission calculates confidence indicators as arithmetic means of answers (the seasonally adjusted balances) to a selection of questions closely related to the reference variable they are supposed to track, for instance the consumers sentiment for the consumer confidence indicator. The results of the five surveyed sectors (industrial production, services, consumers, construction and retail trade) are eventually aggregated according to their respective weights reported earlier to construct the EU-and-EA-wide Economic Sentiment Indicator (ESI). We do not transform further the variables used since all indices are expressed in terms of fluctuations around their long-run mean of 100 and for this reason they are stationary by construction.

4 Empirical results

The VAR model, and the identifying restrictions presented earlier in the paper, treat all five variables included in the model as endogenous and in this way enable the computation of impulse responses to one-off shocks of these variables. Specifically, we investigate how oil price shocks and gasoline price shocks affect consumers' sentiment, by repeatedly estimating the reduced-form VAR model, each time replacing *senti* in vector y with a more refined measure of sentiment, i.e. initially the Consumers Confidence component of the ESI index for EA (EAconsSENTI), followed by the responses to the following six questions out of twelve in total comprising the Consumers Confidence component. The results of this procedure are reported in Figure 2 row-wise.[10]

[10]The responses of sentiment variables to the fifth shock identified previously - the residual or other shock category - are not reported since they lack an economic interpretation. We also do not discuss the impulse responses of the real price of oil to oil supply and demand shocks, as these are qualitatively consistent with the ones originally obtained by Kilian (2009), i.e. on average, the price of crude oil responds strongly and persistently to aggregate demand and oil-specific demand shocks, while oil supply shocks only trigger weak and marginally statistically significant responses.

This investigation allows a more detailed examination of the channels through which oil and gasoline price shocks affect aggregate consumers sentiment for the EA. Specifically, we investigate consumers' responses to the following key questions as discussed in the dataset section of the paper: current household financial condition in comparison with a year before (EAconsSENTI1), expected future household condition over the next year (EAconsSENTI2), expected country economic conditions over the next year (EAconsSENTI4), expected consumer prices over the next year (EAconsSENTI6), expected unemployment over the next year (EAconsSENTI7) and current buying conditions for major household items - durables (EAconsSENTI8).[11]

Reading Figure 2 row-wise shows that both an unexpected oil supply disruption and an unexpected increase in aggregate demand trigger an increase on the aggregate consumer sentiment in EA, which builds up to 10 months ahead of the shock, but it is notably larger in the case of the aggregate demand shock. The lower impact of an oil supply disruption on consumer sentiment in comparison to the one of an aggregate demand shock may be explained by the limited effect that world oil supply shocks have on oil prices (Kilian and Murphy, 2014) and the fact that the lower production of oil in one part of the world can be offset to some extent by higher production in another part. Next, an oil-specific demand shock triggers an immediate modest decline in consumer sentiment that builds up for the first 2-3 months and then exhibits a reversal, but remains negative and statistically significant for up to 24 months ahead of the shock. Finally, an unexpected increase in real gasoline prices triggers a notable and sharp decrease in consumer sentiment that reaches its lower point 10 months after the shock; albeit then it reverses gradually. These results reveal that as expected not all oil price shocks have the same effects on EA consumers' sentiment. When comparing the results reported in this paper for EA, to the ones reported in Güntner and Linsbauer (2018) for the US, who however do not examine the effect of gasoline price shocks on consumer sentiment, a number of interesting observations emerge. Specifically, in agreement to the results of this paper, Güntner and Linsbauer (2018) report for the U.S. that an aggregate demand shock triggers a positive consumer sentiment effect that reverses to a negative one after 7-8 months ahead of the shock; while an oil-specific demand shock triggers a small negative but sustained shock on consumer sentiment. In contrast to the results of this paper, an oil supply disruption triggers a small negative response of consumer sentiment for the U.S., although weak in

[11] The same analysis is performed for each G5 European country, i.e. Germany (DE), Spain (ES), France (FR), Italy (IT) and United Kingdom (UK). The results are available from the authors upon request.

statistical significance. Most notably, this paper reveals that for the EA, a real gasoline price shock triggers a notable and persistent decrease of consumer sentiment, which is also highly significant and larger in impact when compared to all other shocks examined. This confirms our expectation that consumer sentiment is largely affected by shocks on gasoline expenses and to a lesser extent by unexpected changes on other oil supply and demand shocks.

The most striking results of the rest of the rows of Figure 2 are discussed next. Notably, rows 2 and 3 of Figure 2, reveal that the consumer sentiment on household finance during the previous year (EAconsSENTI1) and for the upcoming year (EAconsSENTI2), both exhibit a strong negative response to unexpected increases in real gasoline prices; which are more evident when compared to the negative responses to oil-specific demand shocks. Next, consumers' sentiment regarding the country's economy during the next year (EAconsSENTI4) exhibits a strong negative response to shocks on gasoline prices; again larger in magnitude when compared to the response to shocks on oil-specific demand. In addition, aggregate demand shocks result into sharp increases for perceptions of the country's economy over the next year; while oil supply shocks do not trigger a clear in direction and statistically significant response. In turn, consumers' views regarding consumer prices over the next year (consSENTI6) respond with a strong increase to positive shocks on gasoline prices. This result reveals that consumers' expectations regarding the evolution of consumer prices are strongly affected by the gasoline price at the pump station. The same effect is also true for the aggregate demand shocks; while oil-specific demand shocks trigger a positive but only short-lived response of the expectations on consumer prices. Turning to another macroeconomic indicator, the unemployment rate over the next year (consSENTI7), results suggest that consumers' views exhibit a robust negative response to positive aggregate demand shocks, suggesting the expected strong negative relationship of unemployment with aggregate demand. Oil-specific demand shocks and gasoline price shocks exhibit mixed sign and weak in terms of statistical significance responses of consumers' sentiment regarding unemployment. Finally, consumers' sentiment for the buying conditions of durables products (consSENTI8) exhibit a modest but persistent negative response to unexpected increases in gasoline price; while this effect is also true but smaller for oil-specific demand shocks.

4.1 Forecast Error Variance Decomposition

The FEVD presented in Table 1 quantifies how important are shocks on oil supply, aggregate demand and gasoline prices in explaining the variability observed in the EA Consumer sentiment, at four different forecast horizons: 1 month, 12 months, 24 months and long-run.[12] As observed, in the short-run (h=1), only the effects of oil-specific demand shocks exhibit respectable percentages of explained variance for EA CONS SENTI1 (12.97%, household finance last year), EA CONS SENTI4 (20.17%, country's economy next year) and EA CONS SENTI6 (10.37%, consumer prices next year). In turn, aggregate demand shocks explain 12.62% of EA CONS SENTI2 (household finance next year) and 14.55% of EA CONS SENTI7 (unemployment next year); while oil supply shocks explain 14.41% for EA CONS SENTI2 (household finance next year). Interestingly, gasoline price shocks in the short-run exhibit mostly low one-digit percentage rates of explaining variation across all consumer sentiment variables.

Next, for time horizons of one (h=12) and two years (h=24), gasoline price shocks exhibit impressive percentages of explained variability observed in the overall consumer sentiment index (EA CONS SENTI) along with SENTI1 and SENTI2 (i.e. household finance last year and next year, respectively), and SENTI4 (i.e. country's economy next year). Oil-specific demand shocks account for large percentages of variation on SENTI1 and SENTI7, i.e. unemployment next year; while aggregate demand shocks account for large percentages on SENTI4 (country's economy next year) and the overall consumer sentiment index (EA CONS SENTI). Oil supply shocks account for large percentage of variation only for h=24 and mainly for SENTI1 and SENTI2. In the long-run (h=∞), aggregate demand shocks explain 49.61% of variability of the aggregate consumer sentiment index and 44.70% for EA CONS SENTI4 (country's economy next year); while oil-specific demand shocks explain 41.72% of the variability in SENTI7 (unemployment next year) and gasoline price shocks account for 38.69% of EA CONS SENTI2 (household finance next year). Overall, these results suggest that shocks in gasoline prices followed by oil-specific demand and aggregate demand shocks account for large percentages of the variability on consumers perceptions about their household finance, the country's economy and unemployment rates.

[12]The contribution of other (residual) shocks to EA Consumer sentiment component at forecast horizon h equals 100% minus the sum of the three oil shocks contributions as presented in Table 1.

4.2 Historical Decomposition of EA Consumer Sentiment

The impulse response functions presented earlier are informative for the timing and magnitude of responses of sentiment variables to one-time oil and gasoline price shocks. However, they are not informative about the cumulative effect of these shocks on consumer sentiment. Therefore, it is necessary to conduct a historical decomposition (HD) of the effect of each shock on EA's consumer sentiment. Figure 3 plots the historical decomposition of fluctuations in EA CONS SENTI due to different shocks for the period 2007:02 to 2018:12, i.e. the sample period examined minus the number of 24 lags. As observed, oil supply shocks play on average a secondary role, which translates into less attention by consumers to such oil supply disruptions. As discussed earlier, such a result might be expected, on the basis that oil supply shocks are often interpreted as temporary, since oil supply can be offset by higher production in other places of the world or through accumulated inventories (Alquist and Kilian, 2010; Kilian and Lee, 2014). By contrast, historical fluctuations of EA's consumer sentiment are shown to be driven mainly from a combination of aggregate demand and oil-specific demand shocks. Specifically, aggregate demand shocks exhibit positive contributions to sentiment over the period 2007 to late-2008 and negative over the period late-2008 to 2010. These periods correspond with developments in the global business cycle. In turn, oil-specific demand shocks exhibit mixed results with their contributions to sentiment reversing between positive and negative signs over the whole period examined, with peaks on early-2016 and early-2018 and troughs on mid-2015 and early-2017. It is interesting to note that the contributions of the aggregate demand shocks and oil-specific demand shocks follow almost exact opposite patterns over the period 2012-2018. Finally, shocks on real gasoline prices exhibit overall modest and noisy contributions to the variance of the EA Consumer Sentiment index. Specifically, they trigger an increase of consumer sentiment during the year 2014 and early-2018; while they decrease consumer sentiment during the years of 2015 and 2017.

5 Conclusion

This paper provides novel evidence on the relationships between oil supply and demand shocks, gasoline price shocks and consumer sentiment for the EA. The effects reported are in several cases considerable and statistically significant. Taken together, the results of this paper reveal that aggregate consumer sentiment decreases notably as a response to a posi-

tive shock on real gasoline price with taxes, as opposed to oil-specific demand shocks, which do not always trigger a sizable and statistically significant decrease in consumer sentiment. This main result is transmitted through specific consumer sentiment components regarding household finance, country's economy, macroeconomic indicators and buying conditions for durables. These results, reveal that consumer sentiment is primarily affected by real gasoline prices with taxes, i.e. gasoline prices at the pump station, rather than the international price of Brent crude oil. Furthermore, as expected, positive aggregate demand shocks trigger a notable increase in aggregate consumer sentiment and its components. This result also holds when we examine specific components of the aggregate consumer sentiment index. Finally, oil supply shocks trigger mixed in sign and weak in statistical terms responses of the aggregate consumer sentiment index and its components.

References

Alquist, R., Kilian, L., 2010. What do we learn from the price of crude oil futures? Journal of Applied Econometrics 25, 539–573.

Anderson, S.T., Kellogg, R., Salant, S.W., 2018. Hotelling under pressure. Journal of Political Economy 126, 984–1026.

Barsky, R.B., Kilian, L., 2002. Do We Really Know That Oil Caused the Great Stagflation? A Monetary Alternative, in: NBER Macroeconomics Annual 2001, Volume 16. MIT Press, pp. 137–198.

Barsky, R.B., Kilian, L., 2004. Oil and the Macroeconomy Since the 1970s. Journal of Economic Perspectives 18, 115–134.

Baumeister, C., Kilian, L., 2017. Lower Oil Prices and the U.S. Economy: Is This Time Different? Brookings Papers on Economic Activity , 287–357.

Chen, N.F., Roll, R., Ross, S.A., 1986. Economic Forces and the Stock Market. Journal of Business 59, 383–403.

Degiannakis, S., Filis, G., Kizys, R., 2014. The Effects of Oil Price Shocks on Stock Market Volatility: Evidence from European Data. The Energy Journal 35.

Edelstein, P., Kilian, L., 2009. How Sensitive are Consumer Expenditures to Retail Energy Prices? Journal of Monetary Economics 56, 766–779.

Goncalves, S., Kilian, L., 2004. Bootstrapping Autoregressions with Conditional Heteroskedasticity of Unknown Form. Journal of Econometrics 123, 89–120.

Güntner, J.H.F., Linsbauer, K., 2018. The Effects of Oil Supply and Demand Shocks on U.S. Consumer Sentiment. Journal of Money, Credit and Banking 50, 1617–1644.

Huang, R.D., Masulis, R.W., Stoll, H.R., 1996. Energy Shocks and Financial Markets. Journal of Futures Markets 16, 1–27.

Kilian, L., 2009. Not All Oil Price Shocks are Alike: Disentangling Demand and Supply Shocks in the Crude Oil Market. American Economic Review 99, 1053–1069.

Kilian, L., 2018. Measuring Global Economic Activity: Reply. Working Paper. University of Michigan.

Kilian, L., Lee, T.K., 2014. Quantifying the speculative component in the real price of oil: The role of global oil inventories. Journal of International Money and Finance 42, 71 – 87.

Kilian, L., Murphy, D.P., 2014. The role of inventories and speculative trading in the global market for oil. Journal of Applied Econometrics 29, 454–478.

Kilian, L., Park, C., 2009. The Impact of Oil Price Shocks on the U.S. Stock Market. International Economic Review 50, 1267–1287.

Kilian, L., Vega, C., 2011. Do Energy Prices Respond to U.S. Macroeconomic News? A Test of the Hypothesis of Predetermined Energy Prices. Review of Economics and Statistics 93, 660–671.

Kilian, L., Zhou, X., 2018. Modeling fluctuations in the global demand for commodities. Journal of International Money and Finance 88, 54 – 78.

Kling, J.L., 1985. Oil Price Shocks and Stock Market Behavior. Journal of Portfolio Management 12, 34–39.

Lambertides, N., Savva, C.S., Tsouknidis, D.A., 2017. The effects of oil price shocks on U.S. stock order flow imbalances and stock returns. Journal of International Money and Finance 74, 137–146.

Lemmens, A., Croux, C., Dekimpe, M.G., 2007. Consumer confidence in Europe: United in diversity? International Journal of Research in Marketing 24, 113 – 127.

Sadorsky, P., 1999. Oil Price Shocks and Stock Market Activity. Energy Economics 21, 449–469.

Scholtens, B., Yurtsever, C., 2012. Oil price shocks and European industries. Energy Economics 34, 1187–1195.

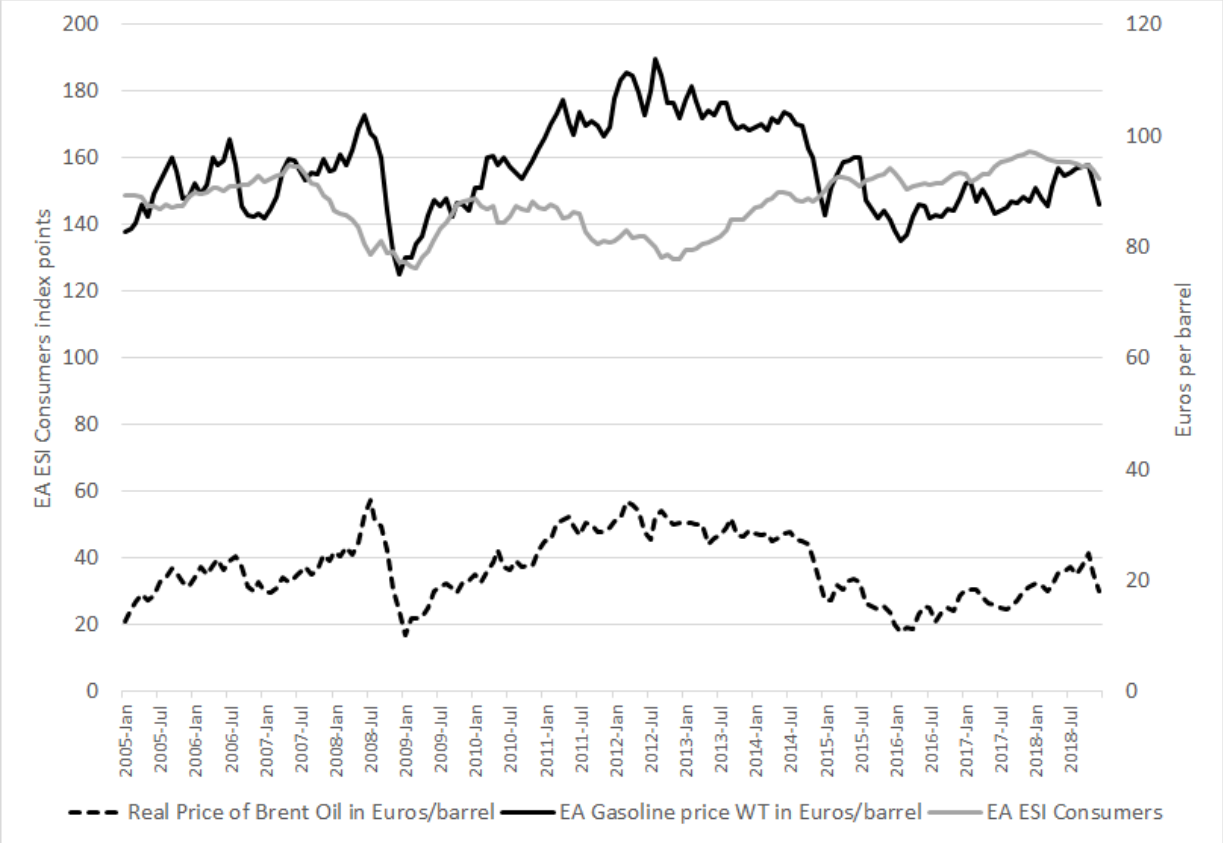


Figure 1: Relationship between the Euro Area Economic Sentiment Index Consumers Component (EA ESI Consumers), the Real Price of Brent Oil and the Real Price of Gasoline in the Euro Area with taxes (WT).

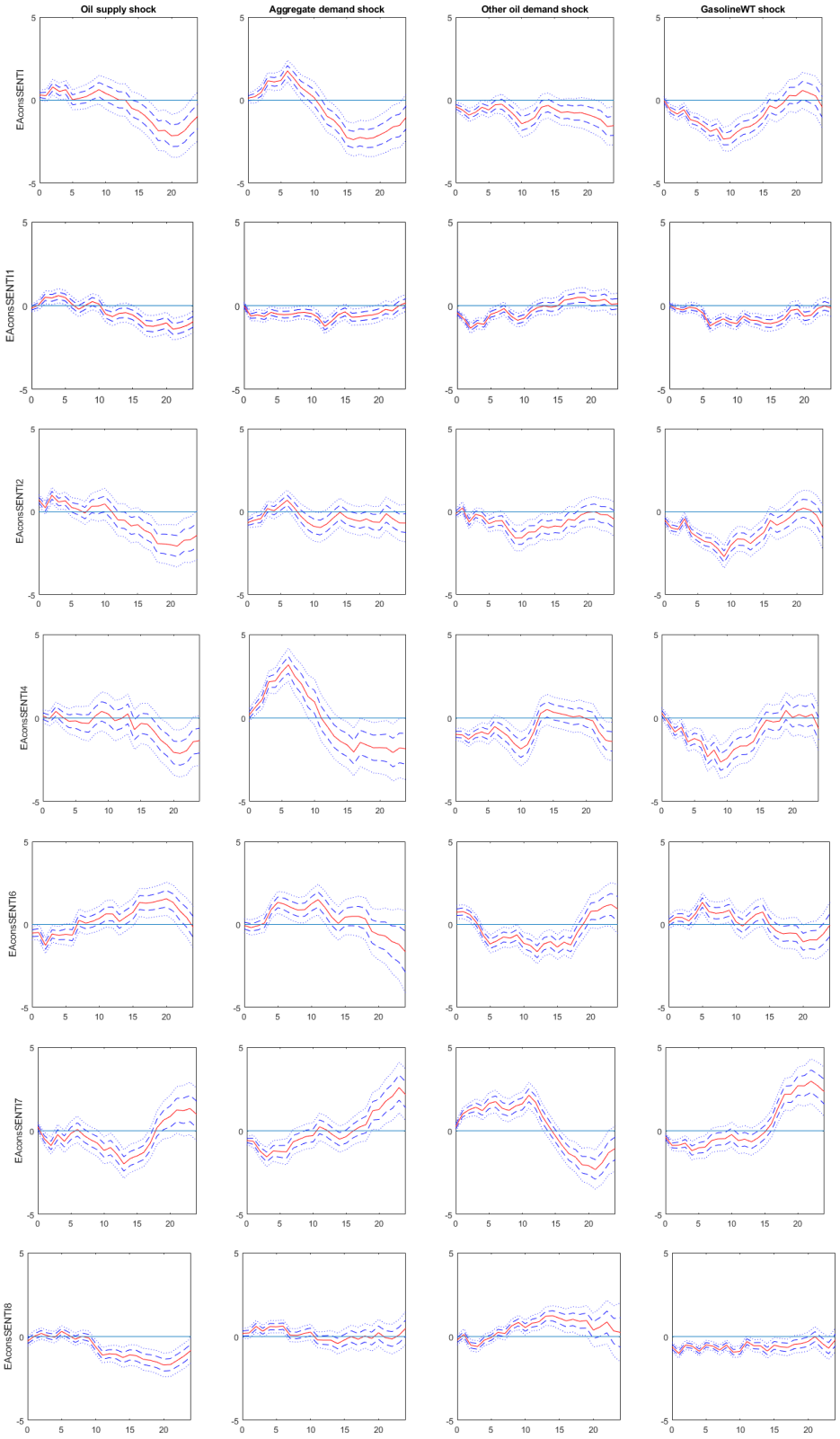


Figure 2: Impulse Response Functions of selected components of consumers sentiment (EAconsSENTI1 to EAconsSENTI8) for the Euro Area (EA) to one standard deviation oil supply and demand shocks and real gasoline price with taxes shocks (GasolineWT). Dashed and dotted lines are one- and two-standard errors bands, respectively. Y-axis in percentage, X-axis in months.

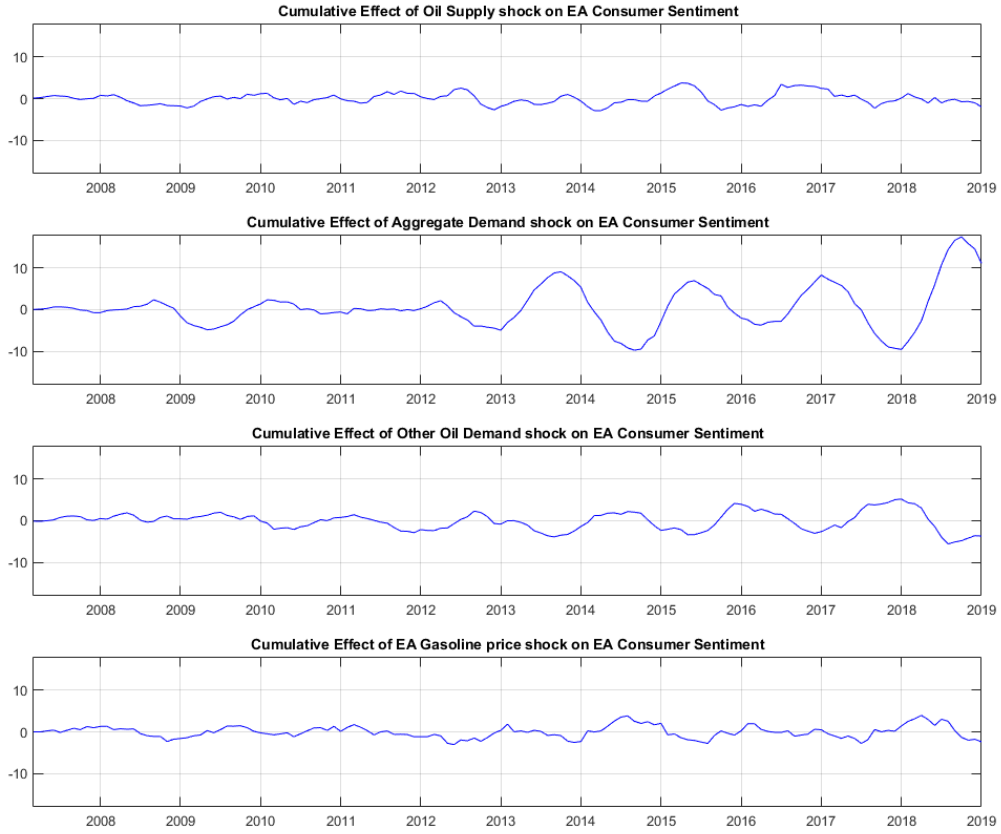


Figure 3: Historical Decomposition (HD) of EA Consumer Sentiment index for 2007:02-2018:12.

Table 1: Percent contribution of structural oil and gasoline price shocks to the forecast error variance of the variable in line

	Oil Supply Shock				Aggregate Demand Shock				Oil-specific demand shock				EAgasolineWT shock				Residual shock			
Variable	h=1	h=12	h=24	h=∞	h=1	h=12	h=24	h=∞	h=1	h=12	h=24	h=∞	h=1	h=12	h=24	h=∞	h=1	h=12	h=24	h=∞
EA CONS SENTI	3.58	3.38	16.55	15.05	0.52	14.70	33.64	49.61	5.88	10.85	10.49	20.91	0.04	41.11	23.07	10.96	89.96	29.94	16.23	3.44
EA CONS SENTI1	1.48	7.10	29.27	3.90	0.01	15.64	16.87	15.70	12.97	35.53	17.54	11.04	0.04	29.23	25.78	21.75	85.47	12.47	10.52	47.57
EA CONS SENTI2	14.41	4.88	27.30	21.23	12.62	6.44	6.32	9.91	0.31	16.21	13.82	17.44	7.18	55.28	41.34	38.69	65.45	17.16	11.20	12.71
EA CONS SENTI4	0.26	0.66	12.25	15.93	0.66	39.89	43.01	44.70	20.17	15.77	11.84	22.41	1.79	30.55	23.63	8.97	77.10	13.11	9.25	7.96
EA CONS SENTI6	5.17	8.32	18.91	10.88	0.07	20.56	17.20	27.56	10.37	17.28	24.23	30.81	0.27	9.64	10.82	19.08	84.11	44.17	28.81	11.65
EA CONS SENTI7	2.43	7.64	13.54	13.72	14.55	15.94	15.79	8.82	2.60	38.38	29.75	41.72	6.38	10.66	28.18	30.41	74.01	27.36	12.70	5.30
EA CONS SENTI8	2.61	11.13	43.43	19.10	1.09	10.47	4.08	29.24	1.48	17.04	23.90	29.82	13.31	35.43	17.66	12.27	81.47	25.90	10.91	9.54

Notes: Based on variance decomposition of the SVAR model and the identifying restrictions in Equation (1).