The Effects of Oil Supply and Demand Shocks on U.S. Consumer Sentiment

This paper investigates how the University of Michigan’s Index of Consumer Sentiment responds to oil price shocks. While oil supply shocks play only a limited role, the effect of aggregate demand shocks is positive for the first few months and negative thereafter. A typical other oil demand shock has a significant negative impact for up to 2 years. By studying the responses of individual survey questions, we find that expectations of future inflation and a change in real household income as well as perceived vehicle and house buying conditions are the main transmission channels of oil supply and demand shocks.

JEL codes: C32, E30, N50, Q41

Keywords: consumer sentiment, oil price shocks, structural VAR estimation, transmission channels.

THE UNPRECEDENTED BOOM AND BUST in the price of crude oil since 2000 has revived the interest of economists and policymakers alike in the effects of oil price fluctuations on macroeconomic variables such as GDP, inflation, and stock returns. While introductory economic textbooks interpret them as exogenous shifts in the aggregate supply curve, Barsky and Kilian (2002), Lee and Ni (2002), Hamilton (2009), and Baumeister and Kilian (2017), among others, do not find much evidence in favor of the cost-push shock interpretation. Instead, oil price shocks might impact real economic activity through the demand side due to actual or perceived changes

We thank the editor, Pok-sang Lam, and two anonymous referees for helpful comments.

JOCHEN H. F. GÜNTNER is Assistant Professor at Johannes Kepler University Linz (E-mail: jochen.guentner@jku.at). KATHARINA LINSBAUER was a graduate student in Economics at Johannes Kepler University Linz (E-mail: k.linsbauer@gmx.at).

Received December 13, 2016; and accepted in revised form January 2, 2018.

Journal of Money, Credit and Banking, Vol. 50, No. 7 (October 2018) © 2018 The Authors. Journal of Money, Credit and Banking published by Wiley Periodicals, Inc. on behalf of Ohio State University

This is an open access article under the terms of the Creative Commons Attribution License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.
in the purchasing power of disposable income, increased uncertainty about future economic conditions, or a reduction in consumer and investor sentiment, which induces households and firms to cut back on their consumption and investment expenditures, respectively.

Following an increase in the real price of crude oil, higher gasoline and energy prices reduce household disposable income excluding energy and tighten the budget for other expenditures. At the same time, higher gasoline prices raise the operating cost of vehicles, making purchases less attractive (see Baumeister and Kilian 2017, Baumeister, Kilian, and Zhou 2018). Beyond the reduction in current disposable income, gloomy expectations about future economic conditions due to oil price fluctuations might depress consumer spending further. Carroll, Fuhrer, and Wilcox (1994) and Souleles (2004), for example, have shown that lagged U.S. consumer sentiment has explanatory power for changes in household spending. Given that personal consumption expenditures account for more than two-thirds of U.S. GDP, understanding the response of households’ expectations is a prerequisite for understanding the transmission of oil price shocks to the larger economy.

In this paper, we use aggregate time series data from the University of Michigan’s Surveys of Consumers to investigate how oil demand and supply shocks affect U.S. households’ perception of their personal financial situation and their expectations about current and future economic conditions. Building on the structural vector autoregressive (VAR) approach in Kilian (2009a) and Kilian and Park (2009), we identify mutually orthogonal oil supply, aggregate demand, and other oil demand shocks in order to be able to interpret the corresponding impulse response functions of U.S. consumer sentiment. Besides the widely used Index of Consumer Sentiment (ICS), we consider its five component indices and further interesting survey questions, such as whether consumers expected higher future inflation or thought that now was a good time for buying a car or house, in order to gain insight into the transmission channels of oil supply and demand shocks. Closely related to our work, Edelstein and Kilian (2009) study the response of U.S. consumer sentiment to gasoline price shocks, while Wong (2015) investigates whether oil price changes have an effect on the inflation expectations of U.S. consumers and whether this translates into higher actual inflation.

Figure 1 plots the ICS against the real price of crude oil, illustrating the strong comovement between the two series. In particular, consumers tend to be more pessimistic in times of high oil prices, while consumer sentiment drops sharply as the oil price spikes, for example, in 1991 and 2008. Although the ICS tracks the ups and downs in oil prices closely during our sample period, this does not seem to be the case during the historical oil price surge between 2003 and 2008. Despite the substantial negative unconditional correlation between U.S. consumer sentiment and the price of crude oil, we refrain from assigning a causal interpretation to these observations, as the empirical evidence in Kilian (2009a) and the theoretical findings in Bodenstein, Guerrieri, and Kilian (2012) suggest that an observed increase in the price of crude oil might have very different consequences for personal consumption expenditures and real economic activity.
Kilian’s (2009a) finding that not all oil price shocks are the same implies that the estimation of economically interpretable impulse response functions requires using a structural econometric model that identifies the origin of an observed oil price fluctuation, whereas reduced-form regressions of macroeconomic variables on the real price of crude oil can capture the average effect of oil price changes, at best. Various authors adopted and extended Kilian’s (2009a) identifying strategy to investigate the effects of oil supply, aggregate demand, and other oil demand shocks on real GDP growth, inflation, and stock returns (see, e.g., Kilian 2009b, Kilian and Park 2009, Güntner 2014a). We contribute to the existing literature by providing empirical evidence on the effects of oil supply and demand shocks on U.S. consumers’ expectations about current and future economic conditions, real household income, unemployment, and their contentment with economic policy. While Edelstein and Kilian (2009) estimate the response of the ICS to a purchasing power shock arising from an exogenous increase in energy prices, the authors do not distinguish between different oil supply and demand shocks. Finally, it is important to note that our sample covers the period from January of 1978 through December of 2015 and includes thus the unprecedented surge in the price of oil before the financial crisis of 2008 as well as the recent period of historically low oil prices starting in 2014.

The remainder of this paper is organized as follows. Section 1 describes the data used for our empirical analysis. Section 2 presents the econometric methodology and identification strategy. Impulse response functions, forecast error variance decompositions (FEVDs), and the effects of structural oil supply and demand shocks on the ICS during selected historical episodes are discussed in Section 3. Section 4 investigates the robustness of our results, while Section 5 concludes.
1. THE DATA

In our analysis, we use monthly series of world crude oil production, global real economic activity, the real price of crude oil, and various measures of consumer confidence for 1978:1–2015:12.

1.1 Oil Market Variables

Monthly data on world crude oil production in thousand barrels per day (tbpd) are available from the U.S. Energy Information Administration’s (EIA) Monthly Energy Review. Following the previous literature, world crude oil production enters our vector of endogenous variables in terms of annualized percentage changes, denoted by $\Delta prod_t$.

As a monthly measure of worldwide real economic activity, we use the real economic activity index created by Kilian (2009a), which is based on single-voyage dry cargo ocean shipping freight rates and expressed in terms of the deviation of real freight rates from their long-run trend. The idea is that increased global demand for industrial commodities will raise ocean shipping freight rates due to the inelastic supply of shipping space in the short run. Given that Kilian’s (2009a) index is a global business cycle measure and stationary by construction, it enters the structural VAR model in levels, denoted by $rea_t$.

As a measure for the world price of crude oil, we use the EIA’s monthly refiner acquisition cost of imported crude oil in dollars per barrel. We deflate the nominal price series by the U.S. Consumer Price Index (CPI) obtained from the Bureau of Labor Statistics (BLS). Following Kilian (2009a) and others, the real price of crude oil enters the vector of endogenous variables in terms of log deviations from the mean, multiplied by 100 ($rpo_t$).

1.2 Measures of Consumer Confidence

To investigate the impact of oil supply and demand shocks on and their transmission through consumer confidence, we use the well-known ICS, denoted $senti_t$, its five components, and seven more detailed indices from the University of Michigan’s Surveys of Consumers. At monthly frequency, all variables are available since 1978:1.

1. For a detailed account of the construction of the index, its benefits, and possible limitations, see Kilian (2009a) and Kilian and Zhou (2017).

2. The Michigan consumer survey is conducted monthly, asking approximately 50 questions about attitudes and expectations regarding financial, business, and buying conditions to a representative sample of U.S. households in the form of 500 telephone interviews. The various indices constructed based on the survey are widely used in the literature as an indicator of uncertainty among consumers and an accurate predictor of economic developments. For example, the Index of Consumer Expectations is included in the U.S. Bureau of Economic Analysis’ (BEA) Composite Index of Leading Indicators. For a detailed description of the survey see the University of Michigan’s Survey Information website (https://data.sca.isr.umich.edu/survey-info.php).
The ICS is based on five subindices concerning current personal financial conditions and expected future economic developments. The corresponding survey questions are as follows:

1. “We are interested in how people are getting along financially these days. Would you say that you (and your family living there) are better off or worse off financially than you were a year ago?” (\(p_{ago}\))

2. “Now looking ahead – do you think that a year from now you (and your family living there) will be better off financially, or worse off, or just about the same as now?” (\(p_{exp}\))

3. “Now turning to business conditions in the country as a whole – do you think that during the next twelve months we’ll have good times financially, or bad times, or what?” (\(bus_{12}\))

4. “Looking ahead, which would you say is more likely – that in the country as a whole we’ll have continuous good times during the next five years or so, or that we will have periods of widespread unemployment or depression, or what?” (\(bus_{5}\))

5. “About the big things people buy for their homes – such as furniture, a refrigerator, stove, television, and things like that. Generally speaking, do you think now is a good or bad time for people to buy major household items?” (\(dur\))

Index scores are computed as 100 plus the difference between the percentages of favorable and unfavorable replies to the respective survey question. The ICS is then constructed as the sum of the five subindices divided by its value for the 1966 base period. Accordingly, a higher value of the ICS indicates greater optimism among private households.

Moreover, we consider seven indices constructed from more specific survey questions. These additional indices are supposed to yield further insight into what drives fluctuations in consumer confidence by inquiring information on inflation and interest rate expectations, expected real income and unemployment, as well as perceived vehicle or house buying conditions and opinions about the government’s economic policy. The corresponding survey questions are as follows:

6. “During the next 12 months, do you think that prices in general will go up, or go down, or stay where they are now?” And “By what percent do you expect prices to go up, on the average, during the next 12 months?” (\(infl\))

7. “No one can say for sure, but what do you think will happen to interest rates for borrowing money during the next 12 months – will they go up, stay the same, or go down?” (\(ratex\))

8. “During the next year or two – do you expect that your (family) income will go up more than prices will go up, about the same, or less than prices will go up?” (\(rinc\))

3. Detailed information on index calculations can be obtained from the website of the University of Michigan’s Surveys of Consumers (https://data.sca.isr.umich.edu/fetchdoc.php?docid=24770).

9. “How about people out of work during the coming 12 months – do you think that there will be more unemployment than now, about the same, or less?” (unext)

10. “Speaking now of the automobile market – do you think the next 12 months or so will be a good time or a bad time to buy a vehicle, such as a car, pickup, van, or sport utility vehicle?” (veh_t)

11. “Generally speaking, do you think now is a good time or a bad time to buy a house?” (house_t)

12. “As to the economic policy of the government – I mean steps taken to fight inflation or unemployment – would you say the government is doing a good job, only fair, or a poor job?” (epol_t)

The computation of index scores is identical to those for 1–5, except for inflation expectations, which are expressed in terms of the median across households in percent. It is also important to note that interest rate and unemployment expectations are defined such that a higher index corresponds to lower expected interest rates and unemployment, respectively. Given that all indices are expressed in terms of fluctuations around their long-run mean of 100 and stationary by construction, no further transformation is required.

2. ECONOMETRIC METHODOLOGY

Our econometric methodology builds on the structural V AR approach in Kilian (2009a) along the lines of Kilian and Park (2009). Thus, we account for the potential endogeneity of the real price of crude oil and distinguish between different types of oil supply and demand shocks, addressing Kilian’s (2009a) critique of the prior literature.

2.1 VAR Specification

Following Kilian and Park (2009), we set up a four-variable autoregressive model in the vector \( z_t = (\Delta prod_t, rea_t, rpo_t, senti_t)' \), where \( \Delta prod_t \) denotes the annualized percentage change in world crude oil production, \( rea_t \), Kilian’s (2009a) global real economic activity index, \( rpo_t \) the real price of crude oil in log deviations from the sample mean, and \( senti_t \) the University of Michigan’s ICS. All data are monthly, while our sample period is 1978:1–2015:12.

We are interested in estimating the following structural V AR(\( p \)) model:

\[
A_0 z_t = \alpha + \sum_{l=1}^{24} A_l z_{t-l} + \varepsilon_t, \quad t = 1, \ldots, 456, \quad (1)
\]

Note that we replace the fourth equation for real stock market returns in Kilian and Park (2009) and Günther (2014a) by an equation for various measures of consumer confidence.
where \( \alpha \) denotes a \( 4 \times 1 \) vector of intercept terms, \( A_0 \) a \( 4 \times 4 \) matrix of contemporaneous coefficients, \( \sum_{l=1}^{24} A_l z_{t-l} \) a lag polynomial of order 24, and \( \varepsilon_t \) a \( 4 \times 1 \) vector of mutually orthogonal structural innovations.\(^{6}\) Conditional on \( A_0^{-1} \) being invertible, the reduced-form representation of (1) is given by

\[
\begin{align*}
    z_t &= A_0^{-1} \alpha + \sum_{l=1}^{24} A_l z_{t-l} + A_0^{-1} \varepsilon_t \\
    &= \beta + \sum_{l=1}^{24} B_l z_{t-l} + e_t,
\end{align*}
\]

where \( e_t \) denotes a \( 4 \times 1 \) vector of possibly contemporaneously correlated reduced-form innovations. Straightforward multivariate least-squares estimation of (2) yields consistent estimates of the coefficients in \( \hat{B} \equiv [\hat{\beta}, \hat{B}_1, \ldots, \hat{B}_{24}] \) and the innovations in \( \hat{e}_t \). In what follows, we assume a recursive ordering of the matrix of contemporaneous coefficients, \( A_0 \), in order to back out the structural shocks and coefficients in (1) from the reduced-form estimates in (2). Although this assumption is particularly convenient, we must ensure that the implied exclusion restrictions are economically plausible.

2.2 Identifying Strategy

Building on Kilian (2009a), we distinguish three structural supply and demand shocks that affect the real price of crude oil: (i) unpredictable changes in world crude oil production (oil supply shocks), (ii) changes in the current demand for crude oil due to fluctuations in global real economic activity (aggregate demand shocks), and (iii) changes in the demand for crude oil that are unrelated to the global business cycle (other oil demand shocks). Any remaining innovations in consumer sentiment that cannot be attributed to the oil market are summarized in a residual category (other shocks to consumer sentiment), which does not have an economic interpretation. This category might contain changes in consumer sentiment due to fiscal or monetary policy shocks that are unrelated to the oil market as well as exogenous changes in consumer sentiment, also know as fluctuations in “animal spirits.”

\(^{6}\) Hamilton and Herrera (2004) emphasize the importance of using a sufficient number of lags in order to account for possible seasonality in the endogenous variables and because the effects of oil price shocks on macroeconomic variables are highest after around 9–12 months. In our robustness checks, we replicated all regressions using 12 and 36 lags of the vector \( z_t \), respectively. In both cases, the results were qualitatively unchanged.
Suppose that the decomposition of the $4 \times 1$ vector of reduced-form error terms, $e_t \equiv A_0^{-1} \epsilon_t$, has the following recursive representation:

$$
e_t \equiv \begin{pmatrix} 
\epsilon_{t, \Delta prod} \\
\epsilon_{t, \text{rea}} \\
\epsilon_{t, \text{reprod}} \\
\epsilon_{t, \text{senti}} 
\end{pmatrix} = 
\begin{pmatrix} 
a_{11} & 0 & 0 & 0 \\
a_{21} & a_{22} & 0 & 0 \\
a_{31} & a_{32} & a_{33} & 0 \\
a_{41} & a_{42} & a_{43} & a_{44} 
\end{pmatrix} 
\begin{pmatrix} 
\epsilon_{t, \text{oil supply shock}} \\
\epsilon_{t, \text{aggregate demand shock}} \\
\epsilon_{t, \text{other oil demand shock}} \\
\epsilon_{t, \text{other shocks to consumer sentiment}} 
\end{pmatrix}.
$$

(3)

Following the existing literature, the identification in (3) implies that aggregate demand shocks or other oil demand shocks as well as shocks to consumer sentiment that are unrelated to the oil market do not affect world crude oil production within the same month. In light of nontrivial adjustment costs in petroleum extraction and uncertainty about whether an observed change in oil demand represents a transitory shock or a permanent shift, the assumption of a vertical short-run supply curve appears highly plausible (see Hamilton 2009, Kilian 2009a). For example, Güntner (2014b) shows that the short-run price elasticity of country-level crude oil supply in response to aggregate demand and other oil demand shocks is statistically indistinguishable from zero. Using well-level data from Texas, Anderson, Kellogg, and Salant (2018) find that oil price changes have neither economically nor statistically significant effects on oil production from preexisting wells, estimating an elasticity of production with respect to the price in the previous month of 0.0009. As a consequence, we assume that only shocks to the supply curve affect world crude oil production on impact.

Following Kilian (2009a), real economic activity is assumed to react contemporaneously to oil supply and aggregate demand shocks only. The latter represent the structural counterpart of innovations in $\text{rea}_t$, which capture exogenous fluctuations in the demand for all kinds of industrial commodities associated with the global business cycle. In contrast, the real price of crude oil is free to respond to disruptions of the physical supply of crude oil, shifts in global aggregate demand for industrial commodities, and other oil demand shocks that are orthogonal to the global business cycle within the same month.

The block-recursive structure of the identification in (3) implies that the global oil market block is contemporaneously predetermined with respect to other shocks to consumer sentiment. Formally testing the widely used identifying assumption of predeterminedness of energy prices, Kilian and Vega (2011) find no evidence of feedback from a wide range of U.S. macroeconomic aggregates to the price of West Texas Intermediate (WTI) crude oil at monthly frequency. For this reason, we do not allow for reverse causality from $\text{senti}_t$ to world crude oil production, the global business cycle, and the real price of crude oil within the same month. In contrast,

---

7. Given that providers of shipping services hold large buffer stocks of bunker fuels—a residual product in the petroleum refining process—the use of monthly data suggests also imposing a vertical short-run demand curve. As a consequence, oil price changes will not affect real economic activity within the same month, regardless of whether they are induced by oil supply or aggregate demand shocks. Imposing the overidentifying restriction $a_{21} = 0$ in (3) hardly affects the results in Kilian (2009a). Conditional on the correctness of the other exclusion restrictions, Hansen’s $J$-test does not reject the null hypothesis of a vertical aggregate demand curve (see chapter 12.13.3 of Kilian and Lütkepohl 2017).
U.S. consumer sentiment may respond immediately to oil supply, aggregate demand, and other oil demand shocks.

By imposing six exclusion restrictions on the matrix of contemporaneous coefficients the structural VAR model in (1) is exactly identified. The recursive representation in (3) allows us to obtain $A_0^{-1}$ by Cholesky decomposing the sample covariance matrix of reduced-form residuals, $\Sigma_{\hat{e}}$, that is,

$$A_0^{-1} = \text{chol}(\Sigma_{\hat{e}}) = \text{chol}(E[\hat{e}\hat{e}']) .$$

(4)

Our second research question concerns the channels through which oil supply and demand shocks affect the ICS. For this purpose, we replace $senti$ by one of its five components as well as by the index for one of seven more specific survey questions in the vector $z_t$ and compute the impulse response functions after a typical oil supply shock, aggregate demand shock, and other oil demand shock, respectively. The alternative indices reflect U.S. households’ perception of current personal financial conditions ($pago_t$); expected future personal financial conditions ($pexp_t$); expected business conditions in the next 12 months ($bus_{12t}$); expected business conditions in the next 5 years ($bus_{5t}$); perceived conditions for buying major household items ($dur_t$), motor vehicles ($veh_t$), and houses ($house_t$); expectations about future real household income ($rinc_t$), inflation ($infl_t$), interest rate ($ratex_t$), and unemployment expectations ($unex_t$); as well as opinions about the government’s economic policies ($epol_t$). The survey questions corresponding to each of these indices are listed in Section 1.

3. EMPIRICAL RESULTS

3.1 Impulse Response Functions

Based on the structural VAR model in (1) and the identifying restrictions in (3), we can compute the impulse responses of the endogenous variables in the vector $z_t = (\Delta prod_t, rea_t, rpo_t, senti_t)'$ to each of the three structural oil supply and demand shocks. In order to investigate the channels through which these shocks affect the ICS, we repeatedly estimate the reduced-form VAR model and apply the identifying strategy, each time replacing $senti$ in the vector $z_t$ by an alternative measure of consumer sentiment. Following Kilian (2009a) and others, we normalize impulses, so that each structural innovation tends to raise the real price of crude oil, in order to facilitate their comparison. Accordingly, we plot the impulse response functions for a negative oil supply shock against those for positive aggregate demand and other oil demand shocks. One- and two-standard-error confidence bands are computed based on 5,000 replications of a recursive-design wild bootstrap that accounts for potential conditional heteroskedasticity of unknown form in the VAR residuals.\(^8\) These bands correspond to approximate 68% and 95% confidence intervals.

\(^8\) For details on the procedure and its asymptotic validity, see Gonçalves and Kilian (2004).
Given that other shocks to consumer sentiment do not have a structural interpretation, we refrain from plotting and discussing the impulse response functions for this residual category. Moreover, we focus on the responses of the ICS, its five component indices, and seven specific survey questions, while the responses of oil market variables are deferred to the Supporting Information. It suffices to say that the impulse response functions of the real price of crude oil are qualitatively consistent with those in Kilian (2009a). On average over the sample period, the price of crude oil responds strongly and persistently to aggregate demand shocks and other oil demand shocks, while the effect of a typical oil supply shock is quantitatively less important and only marginally statistically significant.

The ICS. Consider first the effects of oil supply and demand shocks on the ICS. The corresponding impulse response functions in Figure 2 indicate whether and how U.S. consumers’ perception of their personal financial situation and expectations about future economic conditions change in response to a typical oil supply, aggregate demand, and other oil demand shock, respectively.

The response in the first row and first column suggests that an exogenous disruption of global production, which raises the real price of crude oil, depresses the ICS at least temporarily, albeit the effect is small and only marginally significant in Months 4–6 and 17–19. Accordingly, a typical negative oil supply shock irritates U.S. consumers with a lag rather than on impact, possibly reflecting the delayed pass-through of a change in the oil price to gasoline and retail energy prices. In the medium run, lower output in one oil-producing country is compensated by higher output elsewhere. As a consequence, the negative response of U.S. consumer sentiment is short-lived and only marginally statistically significant.

In response to a positive aggregate demand shock, the ICS initially increases by 0.8 index points after 4 months before decreasing to −1.1 index points during the next 7 months. Both the peak and the trough are statistically significant at the approximate 5% level. After an initial bout of optimism, U.S. households seem to become more pessimistic about the effects of an oil price increase driven by global real economic activity. It is important to note that the same qualitative pattern can be found in U.S. real GDP and cumulative real stock returns. In response to a positive aggregate demand shock, both increase initially before turning negative after about 1 year (see Kilian 2009a, 2009b, Kilian and Park 2009, Güntner 2014a).

Finally, a typical positive other oil demand shock, which raises the real price of crude oil significantly and for the entire 2-year horizon, also has a statistically significant negative effect on the ICS during the first 6 months. The maximum effect of −1.0 index points is reached after 4 months. While the effect is quantitatively smaller thereafter, it remains at least marginally significant for most of the 2-year horizon. Accordingly, there is strong evidence that other oil demand shocks such as...
a precautionary oil demand shock, for example, have a persistent negative impact on U.S. consumer confidence.

The results in this section confirm that not all oil price shocks are the same also from the perspective of U.S. consumers. Figure 2 illustrates the quantitative and qualitative differences in the response of the ICS to oil supply, aggregate demand, and other oil demand shocks. Yet, without further analysis, we can only conjecture

Fig. 2. Impulse Response Functions of the Index of Consumer Sentiment and Its Five Component Indices to One-Standard-Deviation Structural Oil Market Shocks.

Note: Point estimates with one- and two-standard-error confidence intervals based on 5,000 replications of a recursive-design wild bootstrap (see Gonçalves and Kilian 2004).
how structural oil supply and demand shocks are transmitted to consumer sentiment. In what follows, we therefore take a closer look at the impulse response functions of the five subindices of the ICS and seven more specific indices from the University of Michigan’s Surveys of Consumers.

**Personal financial and economic conditions.** Consider now the five component indices \( pago_t \) (current personal financial condition), \( pexp_t \) (expected future personal finances), \( bus12_t \) (expected business conditions during next 12 months), \( bus5_t \) (expected business conditions during next 5 years), and \( dur_t \) (current buying conditions for major household items).\(^{10}\) In Figure 2, each column plots the impulse responses to a typical oil supply, aggregate demand, and other oil demand shock, respectively.

While we already know that oil supply shocks have a small negative effect on the ICS that is only marginally significant in Months 4–6, the first column of Figure 2 suggests that this result is mainly driven by the impulse response functions of \( pago_t \) and \( dur_t \), for which we find a (marginally) significant reduction after 3 and 4 months, respectively. Qualitatively similar, albeit less persistent patterns can be found in the impulse response functions of \( pexp_t \), \( bus12_t \), and \( bus5_t \). Accordingly, a reduction in the ICS in response to a disruption of world crude oil production mainly reflects U.S. consumers’ perception that it is not a good time for buying major household items such as furniture or a refrigerator, for example, and that they are financially worse off than a year ago. We will get back to possible reasons for this result when discussing the impulse response functions of more specific survey questions below.

In response to a positive aggregate demand shock associated with the global business cycle, we found an initial increase of up to 0.8 index points followed by a persistent decrease in the ICS, both statistically significant. The second column of Figure 2 illustrates that the temporary hike comes mainly from the responses of \( bus12_t \) and \( dur_t \), which increase by up to 1.7 and 1.8 index points, respectively, while all five subindices contribute to the reduction in consumer sentiment over the rest of the 2-year horizon. In contrast to the other components, the impulse response functions of \( pago_t \) and \( pexp_t \) display a marginally significant dip in the second month after the shock before turning increasingly negative and statistically significant during the second year. Hence, households feel worse off financially despite an expansion in the global business cycle. A candidate explanation might be that consumers suffer disproportionately from higher gas and retail energy prices as well as higher commodity and real estate prices. About three quarters after a positive aggregate demand shock and modest initial optimism, consumers therefore feel worse off financially than a year ago, believe that now is a bad time for buying large household items, and hold more pessimistic expectations about future personal financial and economic conditions in the United States as a whole. Interestingly, we find no trace of initial optimism about their personal financial situation. In contrast to oil supply shocks, a typical aggregate demand shock also affects household expectations about economic conditions during the next 12 months (\( bus12_t \)) and, to a minor degree, during the next

\(^{10}\) For an exact definition of these subindices and the corresponding survey questions see Section 1.
5 years (bus5). The results in Figure 2 do not yield much insight into the reasons for growing pessimism among consumers in response to the shock. We will therefore get back to this question when considering the impulse responses to survey questions concerning future expected unemployment and inflation.

The third column plots the impulse response functions of the five subindices to a typical positive other oil demand shock, which induces an immediate and persistent increase in the real price of crude oil. As we already know, the ICS falls permanently and its response is at least marginally significant for most of the 2-year horizon. In Figure 2, we find only minor differences in the response patterns across the five subindices. The drop in consumer confidence during the first year is particularly pronounced and statistically significant for pexp, which falls to −1.2 index points after 2 months. While somewhat less significant, bus12, falls by 2.2 index points already in the first month after the shock. In contrast, pago and dur respond more gradually, reaching a minimum of −0.95 and −1.6 index points, respectively, after 5 months. Consistent with the impulse response function of the ICS, all five subindices display a (partial) recovery over the course of the first year and a renewed decrease during the second year, which is especially pronounced and statistically significant for pago and dur. Accordingly, other oil demand shocks such as a precautionary demand shock, for example, trigger persistent waves of pessimism about current personal financial and expected future economic conditions among U.S. consumers. It is therefore plausible to interpret these structural shocks as jumps in uncertainty arising from natural disasters or armed conflicts including terrorist attacks in oil-producing countries. In what follows, we investigate whether the observed fall in consumer confidence is due to concerns about rising inflation, widespread unemployment, or economic policy.

From the results in Figure 2, we conclude that oil supply shocks mainly affect the ICS by making U.S. households feel worse about their current personal finances and short-run business conditions, whereas aggregate demand and other oil demand shocks have a negative effect on both perceived current and expected future personal financial and economic conditions. To learn more about the underlying reasons for the observed responses of the ICS and its five subindices, we investigate the responses of household expectations about macroeconomic variables such as inflation, interest, and unemployment rates as well as vehicle and house buying conditions.

Expectations about macroeconomic variables and buying conditions. The University of Michigan’s Surveys of Consumers comprise around 50 questions, albeit not all of them are available since 1978 at a monthly frequency. In this section, we focus on six selected survey questions concerning household expectations about inflation (infl), interest rates (ratex), and unemployment rates (umex) during the next 12 months, real family income (rinc) during the next 24 months, and current perceived vehicle (veh) and house (house) buying conditions. Figure 3

11. The exact formulation of each survey question and the computation of the corresponding indices can be found in Section 1. In the case of inflation expectations, the response of the median expected inflation rate is reported.
**Fig. 3.** Impulse Response Functions of the Index of Consumer Sentiment and Seven Alternative Measures of Consumer Confidence to One-Standard-Deviation Structural Oil Market Shocks.

**Note:** Point estimates with one- and two-standard-error confidence intervals based on 5,000 replications of a recursive-design wild bootstrap (see Gonçalves and Kilian 2004).
plots the impulse response functions of the corresponding indices against those of senti_1.

Consider first the impulse responses to a typical negative oil supply shock in the left column. While this generates only a small, temporary, and marginally significant decline in the ICS, the effect is stronger and more persistent for certain alternative measures of consumer confidence. For example, ratex_t trends upward and rises significantly above its long-run mean after 1 year and again from 16 months onward, peaking at +4.1 index points after 19 months. Moreover, perceived vehicle and house buying conditions deteriorate in response to a negative oil supply shock. While the reduction in veh_t is statistically significant only during the fourth month, that of house_t remains significant from 5 to 9 months after the shock. Despite a partially significant increase in the real price of crude oil, the median expected inflation rate (infl_t) increases only slightly during the first few months before decreasing until the end of the first year. The corresponding impulse response function is not significantly different from zero. Note that the increase in ratex_t indicates lower expected interest rates in the near future. This could be due to expansionary monetary policy, consistent with the view that a disruption of petroleum production leads to a contraction of demand, which is reflected in the deterioration of perceived vehicle and house buying conditions rather than higher inflation. U.S. consumers’ expectations about unemployment (umex_t) and real household income (rinc_t) during the next 1 or 2 years are not affected significantly, despite a tendency for rinc_t to fall short of its long-run mean in the first 6 months and rise above thereafter. While none of these indices enters the ICS directly, the drop in overall consumer sentiment after a negative oil supply shock seems to reflect a perceived deterioration of buying conditions, in general.

Consider now the effects of a typical positive aggregate demand shock in the second column of Figure 3. With the exception of interest rate expectations (ratex_t), the impulse responses are statistically significant and diverse. After 22 months, for example, U.S. consumers expect prices to rise by an additional 0.12 percentage points during the next year. The corresponding impulse response function is statistically significant from the fifth month on. After 5 months, consumers also expect higher interest rates in the future, indicating a contractionary monetary stance, although this effect quickly vanishes. Despite higher expected inflation and interest rates, the ICS initially increases in response to higher demand for industrial commodities associated with the global business cycle. The reason is that U.S. consumers initially expect an increase in real household income, no change in unemployment rates, and slightly better vehicle and house buying conditions on impact. Accordingly, the perceived improvement of future economic and buying conditions overcompensates concerns about higher expected oil prices and inflation in the first months after the shock. Consistent with a reversal of the responses of bus12_t and bus5_t in Figure 2, consumers then become increasingly pessimistic about future economic conditions. The reason is a sudden increase in expected unemployment (umex_t) by 1.5 index points between Months 8–10, accompanied by a drop in expected real household income by 0.8 index points, and a substantial deterioration of perceived vehicle buying
conditions to $-1.8$ index points after 10 months. The fall in $rinc_t$ is consistent with a persistent increase in the real price of crude oil and expected inflation, although inflation expectations seem to be firmly anchored, remaining within a narrow band over the entire 2-year horizon. While an aggregate demand shock causes an initial bout of optimism, expectations of a future surge in inflation and unemployment rates, a deterioration of perceived vehicle and house buying conditions, and lower expected real income depress consumer sentiment in the medium run, reflecting the response of U.S. real output and stock returns in Kilian (2009a), Kilian and Park (2009), and Güntner (2014a).

The fall in $rinc_t$ is consistent with a persistent increase in the real price of crude oil and expected inflation, although inflation expectations seem to be firmly anchored, remaining within a narrow band over the entire 2-year horizon. While an aggregate demand shock causes an initial bout of optimism, expectations of a future surge in inflation and unemployment rates, a deterioration of perceived vehicle and house buying conditions, and lower expected real income depress consumer sentiment in the medium run, reflecting the response of U.S. real output and stock returns in Kilian (2009a), Kilian and Park (2009), and Güntner (2014a).

The third column of Figure 3 plots the impulse responses to a typical positive other oil demand shock such as a precautionary demand shock, for example. The (largely) significant drop in the ICS during the first year resonates with a pronounced increase in expected future inflation and interest rates, as $infl_t$ rises by 16 basis points after 4 months, while $ratex_t$ falls by 3 index points after 1 month. Consistently, U.S. consumers expect a statistically significant reduction in their real household income during the first year, whereas unemployment expectations are virtually unaffected over the entire 2-year horizon. On average across households, the survey responses are thus consistent with an "income Euler equation" (see also Dräger, Lamla, and Pfajfar 2016). Similarly, perceived vehicle and house buying conditions deteriorate significantly in response to a positive other oil demand shock, dropping by $-2.4$ and $-2.0$ index points after 3 and 2 months, respectively. About 6 months after the shock, $infl_t$ and $ratex_t$ start to converge toward their long-run mean. We also find evidence of overshooting in interest rate expectations during the second year. On their way to recovery, the impulse response functions of $veh_t$ and $house_t$ turn significantly negative again after 12 and 13 months, respectively. Accordingly, sudden increases in the real price of crude oil arising from higher precautionary or speculative demand due to political or military events in the Middle East rather than disruptions of the physical supply of crude oil affect the ICS mainly through inflation and interest rate expectations as well as perceived vehicle and house buying conditions. Importantly, survey participants do not expect a major disruption of the U.S. job market.

The detailed analysis of the impulse response functions of alternative measures of consumer confidence in this section contributes to our understanding of how the three structural oil supply and demand shocks affect the ICS. Apparently, U.S. consumers agree with Kilian’s (2009a) conclusion that not all oil price shocks are the same. As a consequence, oil supply, aggregate demand, and other oil demand shocks have qualitatively and quantitatively different effects on the ICS, its five component indices, and the six selected other indices in Figure 3.

**Contentment with economic policy.** Besides inquiring households’ perception of their personal financial situation and expectations about future economic conditions, the
University of Michigan’s Surveys of Consumers also ask survey participants about their satisfaction with the government’s economic policy, in particular “steps taken to fight inflation or unemployment.” Making use of the corresponding index, we now investigate the potential effects of structural oil supply and demand shocks on U.S. consumers’ contentment with economic policy ($epol_t$).

The bottom line of Figure 3 illustrates that a negative oil supply shock has a short-lived, marginally significant effect on $epol_t$. While the impulse response function falls to $-0.8$ index points after 3 months before rising to $+1.0$ index points after 13 months, only the former estimate is marginally significant. Despite an increase in the real price of crude oil, oil supply shocks do not seem to affect consumers’ opinion about economic policy.

In response to a positive aggregate demand shock associated with the global business cycle, $epol_t$ starts to fall from the third month onward and peaks at $-1.9$ basis points after 1 year. The corresponding impulse response function is at least marginally significant throughout the entire 2-year horizon, recovering only in the last 2 months. Besides depressing consumer sentiment after an initial bout of optimism, increased demand for all industrial commodities including crude oil has a persistent negative effect on households’ opinion about economic policy.

Finally, consider the response to a positive other oil demand shock such as a precautionary demand shock, for example. During the first year, $epol_t$ decreases by up to $-1.8$ index points, and the impulse response function is statistically significant for 10 months before recovering. In line with our findings for inflation, real income, and interest rate expectations, the response is concentrated in the first year following the shock, while U.S. households on average reply that the government is doing a fair job in fighting inflation and unemployment after that.

When triggering higher inflation and unemployment expectations, oil supply and demand shocks also put economic policy to the test, regardless of the fact that these shocks are beyond the control of the U.S. government and the Federal Reserve.\(^\text{13}\)

### 3.2 Forecast Error Variance Decomposition

We conclude our empirical study by performing an FEVD based on the structural VAR model in equation (1) and the identifying restrictions in equation (3). Table 1 reports the percentage contribution of each of the three structural oil market shocks to the forecast error variance (FEV) of the ICS, its five component indices, and the seven alternative measures of U.S. consumer confidence at four different forecast horizons.\(^\text{14}\)

---

\(^\text{13}\) It is important to note that the impulse response functions in Figures 2 and 3 are free to respond on impact. The fact that several of the indices respond to oil supply, aggregate demand, or other oil demand shocks with a lag is determined by the data rather than by our identifying restrictions in (3).

\(^\text{14}\) By construction, the contribution of other shocks to consumer confidence at forecast horizon $h$ equals 100% minus the sum of the three corresponding columns in Table 1. Recall that this residual category has no structural interpretation and is therefore not discussed in this section.
<table>
<thead>
<tr>
<th>Time series</th>
<th>Oil supply shock</th>
<th>Aggregate demand shock</th>
<th>Other oil demand shock</th>
</tr>
</thead>
<tbody>
<tr>
<td>h = 1</td>
<td>h = 12</td>
<td>h = 24</td>
<td>h = 1</td>
</tr>
<tr>
<td>senti</td>
<td>0.0200</td>
<td>1.5342</td>
<td>2.4324</td>
</tr>
<tr>
<td></td>
<td>2.4324</td>
<td>1.6756</td>
<td>13.554</td>
</tr>
<tr>
<td></td>
<td>13.554</td>
<td>44.038</td>
<td>4.2736</td>
</tr>
<tr>
<td></td>
<td>4.2736</td>
<td>11.224</td>
<td>11.110</td>
</tr>
<tr>
<td>pago,</td>
<td>0.0003</td>
<td>1.8897</td>
<td>2.0208</td>
</tr>
<tr>
<td></td>
<td>2.0208</td>
<td>1.6108</td>
<td>12.517</td>
</tr>
<tr>
<td></td>
<td>12.517</td>
<td>47.983</td>
<td>4.2736</td>
</tr>
<tr>
<td></td>
<td>4.2736</td>
<td>8.4207</td>
<td>11.110</td>
</tr>
<tr>
<td>pexp,</td>
<td>0.5995</td>
<td>1.4078</td>
<td>2.696</td>
</tr>
<tr>
<td></td>
<td>2.696</td>
<td>1.781</td>
<td>15.472</td>
</tr>
<tr>
<td></td>
<td>15.472</td>
<td>46.243</td>
<td>4.2736</td>
</tr>
<tr>
<td></td>
<td>4.2736</td>
<td>14.327</td>
<td>11.110</td>
</tr>
<tr>
<td>bus12,</td>
<td>0.0021</td>
<td>1.1486</td>
<td>2.053</td>
</tr>
<tr>
<td></td>
<td>2.053</td>
<td>1.984</td>
<td>12.761</td>
</tr>
<tr>
<td></td>
<td>12.761</td>
<td>33.407</td>
<td>4.2736</td>
</tr>
<tr>
<td></td>
<td>4.2736</td>
<td>11.520</td>
<td>11.110</td>
</tr>
<tr>
<td>bus5</td>
<td>0.3807</td>
<td>1.5662</td>
<td>1.685</td>
</tr>
<tr>
<td></td>
<td>1.685</td>
<td>1.392</td>
<td>8.345</td>
</tr>
<tr>
<td></td>
<td>8.345</td>
<td>30.961</td>
<td>4.2736</td>
</tr>
<tr>
<td></td>
<td>4.2736</td>
<td>6.6387</td>
<td>11.110</td>
</tr>
<tr>
<td>dur</td>
<td>0.0920</td>
<td>6.1883</td>
<td>10.843</td>
</tr>
<tr>
<td></td>
<td>10.843</td>
<td>8.522</td>
<td>10.775</td>
</tr>
<tr>
<td></td>
<td>10.775</td>
<td>35.618</td>
<td>4.2736</td>
</tr>
<tr>
<td></td>
<td>4.2736</td>
<td>12.934</td>
<td>11.110</td>
</tr>
<tr>
<td>infl</td>
<td>0.6448</td>
<td>2.5503</td>
<td>3.328</td>
</tr>
<tr>
<td></td>
<td>3.328</td>
<td>3.800</td>
<td>19.009</td>
</tr>
<tr>
<td></td>
<td>19.009</td>
<td>21.610</td>
<td>4.2736</td>
</tr>
<tr>
<td></td>
<td>4.2736</td>
<td>28.354</td>
<td>11.110</td>
</tr>
<tr>
<td>rate</td>
<td>0.0332</td>
<td>7.1029</td>
<td>19.729</td>
</tr>
<tr>
<td></td>
<td>19.729</td>
<td>21.922</td>
<td>1.887</td>
</tr>
<tr>
<td></td>
<td>1.887</td>
<td>6.149</td>
<td>4.2736</td>
</tr>
<tr>
<td></td>
<td>4.2736</td>
<td>8.9772</td>
<td>11.110</td>
</tr>
<tr>
<td>rinc</td>
<td>0.1243</td>
<td>2.3854</td>
<td>5.146</td>
</tr>
<tr>
<td></td>
<td>5.146</td>
<td>3.815</td>
<td>14.016</td>
</tr>
<tr>
<td></td>
<td>14.016</td>
<td>45.348</td>
<td>4.2736</td>
</tr>
<tr>
<td></td>
<td>4.2736</td>
<td>10.730</td>
<td>11.110</td>
</tr>
<tr>
<td>umex</td>
<td>0.0064</td>
<td>0.7123</td>
<td>1.989</td>
</tr>
<tr>
<td></td>
<td>1.989</td>
<td>2.923</td>
<td>11.718</td>
</tr>
<tr>
<td></td>
<td>11.718</td>
<td>17.856</td>
<td>4.2736</td>
</tr>
<tr>
<td></td>
<td>4.2736</td>
<td>9.393</td>
<td>11.110</td>
</tr>
<tr>
<td>veh</td>
<td>0.0103</td>
<td>3.2635</td>
<td>4.937</td>
</tr>
<tr>
<td></td>
<td>4.937</td>
<td>4.956</td>
<td>21.796</td>
</tr>
<tr>
<td></td>
<td>21.796</td>
<td>39.209</td>
<td>4.2736</td>
</tr>
<tr>
<td></td>
<td>4.2736</td>
<td>9.437</td>
<td>11.110</td>
</tr>
<tr>
<td>house</td>
<td>0.0568</td>
<td>5.9519</td>
<td>6.684</td>
</tr>
<tr>
<td></td>
<td>6.684</td>
<td>5.964</td>
<td>6.842</td>
</tr>
<tr>
<td></td>
<td>6.842</td>
<td>11.349</td>
<td>4.2736</td>
</tr>
<tr>
<td></td>
<td>4.2736</td>
<td>5.7460</td>
<td>11.110</td>
</tr>
<tr>
<td>epol</td>
<td>0.2354</td>
<td>1.0383</td>
<td>1.589</td>
</tr>
<tr>
<td></td>
<td>1.589</td>
<td>1.688</td>
<td>9.017</td>
</tr>
<tr>
<td></td>
<td>9.017</td>
<td>30.565</td>
<td>4.2736</td>
</tr>
<tr>
<td></td>
<td>4.2736</td>
<td>9.4064</td>
<td>11.110</td>
</tr>
</tbody>
</table>

Note: Percent contribution of structural oil market shocks to the forecast error variance of the variable in line at a forecast horizon of $h = 1, 12, 24$, and $\infty$ months.
Consistent with the small impact responses of consumer sentiment in Figures 2 and 3, the contribution of each oil market shock taken separately to the FEV at $h = 1$ is generally smaller than 1%, with the exception of other oil demand shocks, which contribute 4.3% to the FEV of future expected inflation ($infl_t$) in the very short run. Hence, we conclude that U.S. consumer sentiment tends to respond to structural oil supply and demand shocks with a lag.

At longer forecast horizons, the contribution of oil market shocks tends to increase, albeit with varying intensity across shocks and variables. After 1 year, oil supply shocks contribute a mere 0.7% to the FEV of unemployment expectations, whereas the contribution to the FEV of $dur_t$ and $ratex_t$ amounts to 6.2% and 7.1%, respectively. Both types of oil demand shocks affect primarily consumers’ inflation expectations. While the contribution of other oil demand shocks to the FEV of $infl_t$ amounts to 31% at $h = 12$, (slowly) declining thereafter, that of aggregate demand shocks continuously increases to about 21.6% in the very long run.

In line with existing evidence that oil price shocks are transmitted through the demand side, both aggregate demand and other oil demand shocks contribute substantially to the FEV of consumers’ perception of buying conditions for large household items ($dur_t$) and vehicles ($veh_t$), while oil supply shocks contribute comparatively more to the FEV of perceived house buying conditions ($house_t$). As we already know from Figure 3, household contentment with economic policy is influenced more by oil demand than by oil supply shocks. The bottom line in Table 1 reveals that the contribution of aggregate demand shocks to the FEV of epol$_t$ amounts to 30.6% in the very long run, while that of other oil demand shocks remains below 10% throughout.

### 3.3 Historical Decomposition

The impulse response functions in Figures 2 and 3 illustrate the effect of a typical oil supply, aggregate demand, and other oil demand shock, respectively, on the ICS, its five component indices, and further questions from the University of Michigan’s Surveys of Consumers. Yet, they are not informative about the contribution of oil demand and supply shocks to fluctuations in consumer sentiment during specific historical episodes. In this section, we therefore conduct a historical decomposition (HD) of the ICS.\(^{15}\)

Figure 4 plots the cumulative effects of oil supply, aggregate demand, and other oil demand shocks to fluctuations in the ICS for 1985:1–2015:12, while we discard the period 1980:1–1984:12 in an effort to remove potential transition dynamics (see Kilian and Murphy 2014). On average over the sample period, oil supply shocks play a relatively minor role, suggesting that consumers were not overly concerned. This seems rational insofar as disruptions of the physical supply of crude oil are expected to be only temporary and to be compensated through inventories, that is, oil reserves above the ground (see, e.g., Alquist and Kilian 2010, Kilian and Lee 2014, Kilian and

\(^{15}\) Given that our HD of the real price of crude oil largely coincides with that found in previous studies (see, e.g., Kilian 2009a, Kilian and Park 2009, Güntner 2014a), we defer the corresponding figure to the Supporting Information.
Murphy 2014). Similarly, other oil demand shocks such as a precautionary demand shock, for example, had a quantitatively limited, albeit somewhat more persistent cumulative effect on U.S. consumer sentiment. In line with prior findings of an important role for aggregate demand shocks associated with the global business cycle in fluctuations of the real price of crude oil, we find that aggregate demand shocks generate low-frequency and high-amplitude fluctuations in the ICS. To facilitate our understanding of the relevance of oil demand and supply shocks for fluctuations in U.S. consumer sentiment, in what follows, we focus on the HD of the ICS during selected historical episodes.

The collapse of OPEC in 1986. Following a systematic decline in the real price of oil during the early 1980s (see Figure 1) and a simultaneous drop in OPEC’s global market share from 43% in 1980 to 28% in 1985, OPEC took a proactive role in trying to stabilize the price of oil. As many OPEC members cheated and efforts to restrict common oil production failed, in 1985, Saudi Arabia decided to stabilize the price of oil on its own by restricting domestic production (see Baumeister and Kilian 2016b). The corresponding reduction in world crude oil production is reflected in the negative cumulative effect of oil supply shocks on the ICS for September through November of 1985 in Panel (a) of Figure 5. When Saudi Arabia was forced to reverse its policy at the end of 1985, however, the downward pressure of oil supply shocks on the ICS quickly subsided. Moreover, concerns about the future availability of crude oil, illustrated by a negative cumulative effect of other oil demand shocks on the ICS in Panel (a), also abated, as the price of oil fell sharply in 1986.

The Persian Gulf war. In August of 1990, the invasion of Kuwait by Iraq and the subsequent Persian Gulf War caused a spike in the real price of crude oil as well
Fig. 5. Contribution of Structural Oil Demand and Supply Shocks to Fluctuations in the Index of Consumer Sentiment (ICS) during Selected Historical Episodes.

Note: Each line gives the cumulative effect of the respective shocks on the ICS.
as a drop in the ICS by 30 index points between June and October (see Figure 1). Besides the disruption of Iraqi and Kuwaiti oil production, higher demand for oil inventories in anticipation of an expansion of the conflict to oil fields in Saudi Arabia played an important role in the observed price increase (see Kilian and Murphy 2014). Consistently, Panel (b) of Figure 5 attributes the drop in U.S. consumer sentiment to other oil demand shocks such as a precautionary demand shock, for example, while negative oil supply shocks contributed to a smaller degree. When it became clear in late 1990 that Saudi Arabian oil production would not be affected, the negative cumulative effects of oil supply shocks and other oil demand shocks subsided along with a sharp decline in inventory demand and the price of crude oil (see Baumeister and Kilian 2016b).

The oil price recovery of 1999. In December of 1998, the EIA’s refiner acquisition cost of imported crude oil reached an all-time low in recent history of 9.39 dollars per barrel due to reduced oil demand during the Asian financial crisis and subsequent economic crises in emerging market economies such as Russia and Brazil, for example (see Baumeister and Kilian 2016b). While the price of oil started to recover in 1999, the ICS remained at historically high levels during 1999:1–2000:12, fluctuating between 101 and 112 index points. Kilian and Murphy (2014) show that the oil price recovery was associated with cuts in oil production, higher demand for industrial commodities including crude oil, and increased inventory demand in anticipation of tightening oil markets. Consistently, Panel (c) of Figure 5 attributes the relative stability of U.S. consumer sentiment to the combination of an increasingly negative cumulative effect of oil supply shocks, an increasingly positive effect of aggregate demand shocks, and a fading effect of other oil demand shocks, which largely offset each other during this episode.

The Venezuela Oil Strike and Iraq War. In late 2002 and early 2003, the global oil market was subject to two negative supply shocks associated with the so-called Venezuela Oil Strike and the 2003 Iraq War. While the magnitude of these supply disruptions taken together rivaled those of the 1970s (Kilian 2008), the real price of oil spiked only briefly in September of 2002 and February of 2003, as production shortfalls in Venezuela and Iraq were quickly offset by increased oil production elsewhere (see Figure 1). Moreover, less concern that the Iraq War would affect oil production in Saudi Arabia caused only a modest shift in inventory demand (see Baumeister and Kilian 2016b). In line with these results, we find an increasingly negative cumulative effect of oil supply shocks on the ICS in the second half of 2002 and only a slight effect in early 2003, while Panel (d) of Figure 5 indicates a negative cumulative effect of other oil demand shocks on the ICS during 2002 and 2003.

The oil price surge of 2003–08. Between mid-2003 and mid-2008, the EIA’s refiner acquisition cost of imported crude oil rose from 27.2 to 127.8 dollars per barrel, while the ICS fell from around 90 to 57 index points, after an initial increase to 104 index points in January of 2004 (see Figure 1). Empirical models of the global oil
market attribute the bulk of this increase in the price of oil to a series of aggregate demand shocks driven by an unexpected boom in the global economy rather than to disruptions of crude oil supply (see, e.g., Kilian 2009a, Kilian and Murphy 2014). In line with this view, Panel (e) of Figure 5 attributes the decrease in U.S. consumer sentiment over the same period to the cumulative effect of aggregate demand shocks, whereas we identify only a small and mostly positive cumulative effect of oil supply shocks on the ICS.16

The financial crisis of 2008. In the wake of the global financial crisis, the refiner acquisition cost of crude oil dropped from 127.8 to 35.6 dollars per barrel between July and December of 2008. In contrast to the preceding surge, this decrease in the price of oil was driven by a sudden reversal of expectations from an ongoing expansion to a global recession, which lowered the aggregate demand for industrial commodities including crude oil in the second half of 2008 (see Baumeister and Kilian 2016b). Following a brief recovery in September of 2008, recurring blows to consumer sentiment lowered the ICS to 55 index points in November of 2008 and 56 index points in February of 2009. The HD in Panel (f) of Figure 5 reflects the initially positive conditional comovement between the real price of oil and U.S. consumer sentiment, displaying an increasingly negative cumulative effect of aggregate demand shocks on the ICS. At the same time, we find a small positive cumulative effect of other oil demand shocks during 2008:10–2009:6, possibly due to a reduction in inventory demand in anticipation of easing oil markets.

A period of stable oil prices. When it became clear in 2009 that the global financial system was not on the brink of collapse, the demand for crude oil recovered and the price of oil stabilized around 100 dollars per barrel (see Baumeister and Kilian 2016b). The subsequent period of stable oil prices between 2010 and 2014 saw a number of smaller oil supply and demand shocks such as the first and second Libyan Civil War in 2011 and 2014, for example.17 The same period was characterized by a slight upward trend in the ICS from 72 index points in January of 2010 to 82.5 index points in June of 2014 (see Figure 1). While we refrain from attributing the entire increase in U.S. consumer sentiment to oil demand and supply shocks, Panel (g) of Figure 5 illustrates that an increasingly negative cumulative effect of other oil demand shocks was more than offset by the decreasingly negative cumulative effect of aggregate demand shocks during this episode. Moreover, the exogenous disruptions of crude oil supply associated with the Libyan Civil War are reflected in a

16. Recall from Figure 2 that the initially positive response of the ICS to a typical positive aggregate demand shock becomes statistically significantly negative after 10 months.

17. From the EIA’s Country Analysis Brief, “Libya’s oil production was disrupted for most of 2011 because of the civil war, but it recovered relatively quickly following the cessation of most hostilities. The country’s oil sector was crippled again in mid-2013 as widespread protests led to a sharp deterioration of the security environment and the closure of loading ports, oil fields, and pipelines.” Kilian and Lee (2014) estimate that the Libyan Civil War of 2011 led to an oil price increase of between 3 and 13 dollars per barrel.
sawtooth pattern of the cumulative effect of oil supply shocks, which interrupts their generally positive contribution to the ICS.

The oil price drop of 2014. Following a period of relatively stable oil prices, the refiner acquisition cost of crude oil dropped from 100 dollars per barrel in June of 2014 to 45 dollars per barrel in January of 2015, while the ICS increased from 82.5 to 98 index points over the same period (see Figure 1). Baumeister and Kilian (2016a) and Kilian (2017) find that more than half of the oil price drop between June and December of 2014 was associated with a decline in global real economic activity and increased oil production in the United States and other countries such as Canada and Russia, that was predictable as of June 2014. The rest was associated with an unexpected decline in inventory demand in July of 2014 and an unexpected weakening of the global economy in December of 2014, respectively (see Kilian 2017). Consistently, Panel (h) of Figure 5 depicts a positive cumulative effect of oil supply shocks around June of 2014, a cumulative effect of aggregate demand shocks that switches from negative to positive in December of 2014, and a decreasingly negative cumulative effect of other oil demand shocks on the ICS starting in September of 2014.

4. ROBUSTNESS CHECKS

We conduct three robustness checks, the results of which are discussed in what follows. 18

4.1 Transforming the Oil Price

First, we revisit our transformation of the real price of crude oil in terms of log deviations from the sample mean. Replacing $r_{po}$ in the vector $z_t$ by its growth rate, we find that all our main results are virtually unaffected, both qualitatively and quantitatively. This holds for the impulse response functions in Figures 2 and 3, the FEVD in Table 1, and the HD in Figure 4.

4.2 Different Lag Orders

Second, we experiment with higher and lower lag orders rather than choosing $p = 24$ discretely following the existing literature. Replicating our analysis for $p = 12$ and $p = 36$, respectively, we find that the impulse response functions in Figures 2 and 3 are qualitatively unaffected. Despite the smaller number of coefficients, however, some impulse response functions are statistically less significant for $p = 12$, suggesting that a sufficiently high lag order is necessary in order to fully capture the effects of oil supply and demand shocks.

18. The results for all three robustness checks are available from the authors on request.
4.3 Transforming Consumer Sentiment

Third, we follow the specification in Edelstein and Kilian (2009) and use the sentiment variables in growth rates rather than in levels.\(^\text{19}\) Regardless of whether we specify the real price of crude oil in terms of log deviations from the sample mean or growth rates, the impulse responses to a typical oil supply, aggregate demand, and other oil demand shock, respectively, in Figures 2 and 3 are qualitatively robust, albeit somewhat larger, when using the sentiment variables in growth rates and cumulating the responses.

5. CONCLUSION

Oil supply and demand shocks affect household disposable income available for other expenditures through gasoline and energy prices (see, e.g., Edelstein and Kilian 2009, Baumeister and Kilian 2017, Baumeister, Kilian, and Zhou 2018). Yet much of the existing literature focuses on the effect of oil price shocks on real GDP, inflation, or stock prices. Motivated by the fact that consumption accounts for two-thirds of U.S. GDP and by prior evidence that oil price shocks are transmitted also through the demand side, we investigate the effect of structural oil supply and demand shocks on U.S. consumer sentiment—a barometer of private households’ perception of current and expected future economic conditions and uncertainty.

Our findings for the University of Michigan’s ICS resonate with those for real stock returns in Kilian and Park (2009) and Güntner (2014a), for example. While disruptions of the physical supply, which raise the real price of crude oil, have a limited impact on the ICS, both aggregate demand shocks associated with the global business cycle and other oil demand shocks significantly depress consumer confidence during the subsequent years. The minor role for oil supply shocks suggests that U.S. consumers expect these shocks to be only temporary, given that reduced production in one country is quickly offset by other oil producers. On the contrary, other oil demand shocks such as a precautionary demand shock, for example, have a persistent negative effect on the ICS. In line with the results in Kilian and Park (2009), positive aggregate demand shocks cause a bout of optimism among U.S. consumers, followed by a statistically significant reduction in the ICS during the following 2 years. On the one hand, households benefit from an increase in the global demand for industrial commodities driven by global real economic activity through higher income and employment. On the other hand, the expected increase in nominal household income may be “eaten up” by higher future energy and consumer prices. We find that the latter effect dominates in the medium run.

Insights into the transmission of oil supply and demand shocks are gained by investigating the impulse response functions of the ICS’ five component indices and the

\(^{19}\) Given that inflation expectations over a horizon of 12 months are expressed in terms of the median inflation expectation in percent across households, we abstain from transforming \textit{infl}, in our robustness checks.
replies to seven more specific survey questions concerning inflation, unemployment, and interest rate expectations, vehicle and house buying conditions, and contentment with the government’s economic policy. Disruptions of the flow supply of crude oil play a limited role for the ICS, because they have only marginally significant, short-lived effects on expected inflation and perceived vehicle buying conditions, whereas they do not affect expectations about future unemployment or real household income. Aggregate demand shocks are transmitted through higher expected inflation and a substantial increase in expected unemployment after three quarters, while perceived vehicle and house buying conditions deteriorate gradually over time. Other oil demand shocks lead to pronounced increases in expected inflation and interest rates and the corresponding decreases in expected real household income, vehicle and house buying conditions in the short run, whereas unemployment expectations remain literally unaffected.

Based on these results, we conclude that different oil supply and demand shocks have diverse effects on the ICS because they are transmitted via different aspects of consumers’ perceptions and expectations. Importantly, we also find that aggregate demand and other oil demand shocks have significant influence on household satisfaction with economic policy measures “to fight inflation and unemployment.” Given that the effect of repeated oil price shocks on consumer sentiment can be sizeable, these shocks cannot be neglected by U.S. policymakers when trying to contain the economic consequences of oil price fluctuations. Our results suggest that oil supply and demand shocks might make consumers feel worse off and put part of the blame on the government.

In this study, we focus on the response of the University of Michigan’s ICS and several more detailed survey measures of consumer sentiment. While analyzing the response of U.S. personal consumption expenditures would be equally interesting, it is beyond the scope of this paper. Similarly, an analysis of the responses of business survey measures of investor sentiment to oil supply and demand shocks is left for future research.

LITERATURE CITED


SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article at the publisher’s website.