IDENTIFYING OIL SUPPLY NEWS SHOCKS AND THEIR EFFECTS ON THE GLOBAL OIL MARKET

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Overview

The global oil market has undergone multiple turbulence, generating either demand or supply shocks, resulting in high oil price volatility. The recent US Energy Information Administration's (EIA) projections of global oil supply matching demand through 2050 under multiple scenarios depending on the long-term availability of total recoverable resources, reflect the complexity of assessing future oil supply, as it is a multidimensional subject with multiple influencing factors. Future global oil supply is primarily impacted by the technical, economic and political viability of accessing oil resources and is also heavily influenced by geopolitical considerations. Moreover, and from a historical perspective, a new era for oil has begun, with geopolitical fractures on energy and climate becoming increasingly visible, adding to the uncertainties and risks surrounding the future global oil supply. Oil production capacity investment decisions are faced with major environmental constraints both physically and in terms of energy-transition policy commitments that aim to develop and expand low-emissions energy instead. These factors, which tend to be persistent, are likely to change agents' expectations regarding future oil supply, thus impacting both the global oil market and global economic variables. This paper uses a Max-Share approach to identify oil supply news shocks within a noncausal VAR model of standard global oil market variables. News shocks are identified in a way that explain most of the movements in real oil price driven by global oil production over a long but finite time horizon. Our findings highlight the prominent role of expectations in propagating oil supply shocks. Negative oil supply news shocks cause a gradual and persistent decline in global oil production and global economic activity and a strong and immediate increase in the most forward-looking variables, namely real oil price and global oil stocks. Finally, news about future oil supply shortfalls has substantial consequences in macroeconomic variables.

Methods

A large body of the business cycle literature establishes that the anticipated change in future productivity, that is, the news shock, constitutes an important driver of the business cycle (Beaudry and Portier, 2006; Barsky and Sims, 2011; Forni et al., 2014a; Beaudry and Portier, 2014; Kurmann and Sims, 2021, among others). Motivated by this literature, this paper aims to analyse the impact of policy decisions and company behaviour towards clean energy transitions, the agent’s view of geopolitical (in)stability and also information about new field discoveries or lack thereof in the global oil supply and thereby the global energy market and the economy. More precisely, we refer to oil supply news shocks as exogenous changes that alter the information set on which agents base their expectations of the future global oil supply. Only a few studies identify and measure the impact of oil supply news shocks. A related study by Arezki et al. (2017) focuses on capturing news shocks using a quasinatural experiment approach by exploiting the natural timing lags between giant oil and gas discoveries and the subsequent output increase. The authors argue that, although policy decisions and oil prices may influence exploration decisions, the effective timing of discoveries remains exogenous given the uncertainty that characterizes oil and gas exploration. This important contribution sheds light on the important role of the anticipated component of the oil supply shock as a source of macroeconomic fluctuations. This paper mainly differs from Arezki et al. (2017) in two perspectives. The first difference relies on the nature of the news shock. Instead of identifying oil supply news shocks at a country level concerning giant discoveries only, the focus of our study is on identifying the oil supply news shock at the global level thereby can capturing different expectations about the future oil supply. More precisely, using the four-variable VAR specification (Kilian and Murphy, 2014; Baumeister and Hamilton, 2019), we identify the oil supply news shock as a shock that explains most of the movements in the real oil price driven by global oil production over a long but finite time horizon, which has an immediate effect on forward-looking variables. This identified oil supply news shock reflects, therefore, a wider range of information on oil supply. Examples include not only large oil discoveries (Arezki et al., 2017) and climate change policy decisions, but also new production technology which takes time to translate into oil production, the political stability of oil-producing countries, or a shock related to the Organization of Petroleum Exporting Countries (OPEC) announcements (Känzig, 2021; Degasperi et al., 2021). Second, and importantly, although the direct measure of Arezki et al. (2017)’s news shock is very relevant it does

not allow us to assess the extent to which oil market and macroeconomic variable fluctuations can be attributed to the oil supply news shock, which is the precise aim of our work. We accordingly employ a different oil supply news identification strategy by exploiting the involvement of richer structures in a structural vector autoregression (SVAR) modelIn a recent contribution that is closely related to our work, Gambetti and Moretti (2017a) use a different VAR-based scheme to identify oil supply news shocks which are divided into "noise" and "true" components. Using the Kilian (2009)'s three-specification model as a benchmark, Gambetti and Moretti (2017a) show that identifying a news shock within a structural VAR model inevitably leads to a non-fundamentalness representation. The authors address the non-fundamentalness problem by using Blaschke matrices as in Forni et al. (2017b) and Forni et al. (2017a). However, this approach requires considerable restrictions which cannot be fully provided by economic theory. In this paper, we instead use a noncausal SVAR (NC-SVAR) methodology (Lanne and Saikkonen, 2013; Lanne and Luoto, 2016; Nelimarkka, 2017b,a) which has the advantage of allowing the identified shocks to be nonfundamental by construction. We show, thus, how the nonfundamental representation, due to the oil supply news shock identification, can be mapped in an NC-VAR and how impulse response functions can be derived within this model.

Results

Once the oil supply news shock has been identified using the above method, we study its effect on oil market variables within what we call the baseline model, i.e. the NC-VAR model using the four standard variables in oil market structural models, namely global oil production, global economic activity, oil stocks and the real oil price. We detect a gradual and persistent diffusion of oil supply news shocks to global oil production and global real activity and a strong and immediate effects on the most forward-looking variables, namely the real oil price and global oil stocks. In particular, the global oil stock reaction, being consistent with a reaction to an anticipated oil supply shock, gives further support to our shock identification strategy. Moreover, relying on the historical decomposition exercise we take a fresh look at the overall importance of oil supply expectation shocks in driving real oil price fluctuations in recent decades, we provide, as in Känzig (2021), evidence that an oil supply news shock seems to contribute quite significantly to the real price at particular episodes. Interestingly, the cumulative effect of the news shocks to the real oil price around the pandemic not only confirms the prevailing view that the sharp fall in oil prices over this period is entirely due to exogenous demand shocks, but also further validates our oil supply news shock identification. We investigate the oil supply news shock effects on global and US economies. Our results suggest that oil supply news shocks have substantial consequences in macroeconomic variables, leading to disruptions in both real and financial sectors.

Conclusions

We used a new empirical strategy to identify oil supply news shocks. For this purpose, we employed a model that takes into account forward-looking behaviour, to avoid the nonfundamentalness problem that can arise when using a VAR model. Up to now, the nonfundamentalness issue regarding the global oil market has been addressed either by augmenting small-scale VAR models with additional variables or latent factors, or by using external instruments or proxies to provide a more credible identification scheme. We dealt with this issue by employing noncausal VAR to model a standard global oil market and US macroeconomic variables, so as to analyse the oil supply news shock effects. Our oil supply news shock is identified by maximizing the share of oil price variance explained by global oil production. We showed, then, that nonfundamental representation is supported by the data, thus confirming noncausal VAR as an option to deal with information deficiency when identifying expectation shocks within the global oil market. We further showed that our identified oil supply news shock is anticipated by forward-looking variables before it materialises, highlighting the prominent role of expectations in propagating the shock. A negative oil supply news shock results in a gradual but significantly persistent decrease of global oil production, and global economic activity. However, the two most forward-looking variables, namely the real oil price and global oil stocks increase instantaneously and peak much earlier than the other variables. Importantly, the positive reaction of the global oil stock provides further proof of the validity of our identification strategy, as stocks should increase following an anticipated negative oil supply news shock. Moreover, using global and US macroeconomic variables, there is evidence that a news shock regarding oil supply shortfalls has macroeconomic consequences in both real and financial sectors.

References

Andersen, T.G., Bollerslev, T., Diebold, F.X., Vega, C., 2003. Micro effects of macro announcements: Real-time price discovery in foreign exchange. American Economic Review 93, 38–62.

Arezki, R., Ramey, V.A., Sheng, L., 2017. News Shocks in Open Economies: Evidence from Giant Oil Discoveries. The Quarterly Journal of Economics 132, 103–155.

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

Barsky, R.B., Sims, E.R., 2011. News shocks and business cycles. Journal of Monetary Economics 58, 273–289.

Baumeister, C., Hamilton, J.D., 2019. Structural interpretation of vector autoregressions with incomplete identification: Revisiting the role of oil supply and demand shocks. American Economic Review 109, 1873–1910.

Beaudry, P., Portier, F., 2006. Stock prices, news, and economic fluctuations. American Economic Review 96, 1293–1307.

Beaudry, P., Portier, F., 2014. News-driven business cycles: Insights and challenges. Journal of Economic Literature 52, 993–1074.

Bernanke, B.S., Kuttner, K.N., 2005. What explains the stock market's reaction to federal reserve policy? The Journal of Finance 60, 1221–1257.

Bruns, M., Lütkepohl, H., 2023. Have the Effects of Shocks to Oil Price Expectations Changed?: Evidence from Heteroskedastic Proxy Vector Autoregressions. Technical Report.

Caldara, D., Cavallo, M., Iacoviello, M., 2019. Oil price elasticities and oil price fluctuations. Journal of Monetary Economics 103, 1 – 20.

Cavaliere, G., Nielsen, H.B., Rahbek, A., 2020. Bootstrapping Noncausal Autoregressions: With Applications to Explosive Bubble Modeling. Journal of Business & Economic Statistics 38, 55–67.

Cubadda, G., Hecq, A., Voisin, E., 2023. Detecting common bubbles in multivariate mixed causal–noncausal models. Econometrics 11, 1–16.

Davis, R.A., Song, L., 2020. Noncausal vector ar processes with application to economic time series. Journal of Econometrics 216, 246 –267.

Degasperi, R., Hong, S.S., Ricco, G., 2021. Identification of Expectational Shocks in the Oil Market using OPEC Announcements. Technical Report.

Forni, M., Gambetti, L., Lippi, M., Sala, L., 2017a. Noise Bubbles. Economic Journal 127, 1940–1976.

Forni, M., Gambetti, L., Lippi, M., Sala, L., 2017b. Noisy News in Business Cycles. American Economic Journal: Macroeconomics 9, 122–152.

Forni, M., Gambetti, L., Sala, L., 2014. No news in business cycles. The Economic Journal 124, 1168–1191.

Gambetti, L., Moretti, L., 2017. News, Noise and Oil Price Swings. Research Technical Papers 12/RT/17. Central Bank of Ireland. URL: https://ideas.repec.org/p/cbi/wpaper/12-rt-17.html.

Gilchrist, S., Zakrajšek, E., 2012. Credit spreads and business cycle fluctuations. American Economic Review 102, 1692–1720.

Gourieroux, C., Jasiak, J., 2017. Noncausal vector autoregressive process: Representation, identification and semi-parametric estimation. Journal of Econometrics 200, 118 – 134.

Gourieroux, C., Jasiak, J., 2018. Misspecification of noncausal order in autoregressive processes. Journal of Econometrics 205, 226–248.

Gourieroux, C., Jasiak, J., 2022. Nonlinear forecasts and impulse responses for causal-noncausal (s)var models.

Gouriéroux, C., Zakoïan, J.M., 2017. Local explosion modelling by non-causal process.

Gürkaynak, R.S., Sack, B., Swanson, E., 2005. Do Actions Speak Louder Than Words? The Response of Asset Prices to Monetary Policy Actions and Statements. International Journal of Central Banking 1;

Kilian, L., 2009. Not all oil price shocks are alike: Disentangling demand and supply shocks in the crude oil market. The American Economic Review 99, 1053–1069.

Kilian, L., 2023. How to Construct Monthly VAR Proxies Based on Daily Futures Market Surprises. Federal Reserve Bank of Dallas Working Paper 2310. URL: https://www.dallasfed.org/research/papers/2023/wp2310.

Kilian, L., Hicks, B., 2013. Did unexpectedly strong economic growth cause the oil price shock of 2003–2008? Journal of Forecasting 32, 385–394.

Kilian, L., Lütkepohl, H., 2017. Structural Vector Autoregressive Analysis. Themes in Modern Econometrics, Cambridge University Press. doi:10.1017/9781108164818.

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

Kurmann, A., Sims, E., 2021. Revisions in Utilization-Adjusted TFP and Robust Identification of News Shocks. The Review of Economics and Statistics 103, 216–235.

Kuttner, K.N., 2001. Monetary policy surprises and interest rates: Evidence from the fed funds futures market. Journal of Monetary Economics 47, 523 – 544.

Känzig, D.R., 2021. The macroeconomic effects of oil supply news: Evidence from opec announcements. American Economic Review 111, 1092–1125.

Lanne, M., Luoto, J., 2016. Noncausal bayesian vector autoregression. Journal of Applied Econometrics 31, 1392–1406.

Lanne, M., Saikkonen, P., 2013. Noncausal vector autoregression. Econometric Theory 29, 447–481.

Mertens, K., Ravn, M.O., 2010. Measuring the impact of fiscal policy in the face of anticipation: A structural var approach*. The Economic Journal 120, 393–413.

Nelimarkka, J., 2017a. Evidence on News Shocks under Information Deficiency. MPRA Paper 80850. University Library of Munich, Germany. URL: https://ideas.repec.org/p/pra/mprapa/80850.html.

Nelimarkka, J., 2017b. The effects of government spending under anticipation: the noncausal VAR approach. MPRA Paper 81303. University Library of Munich, Germany. URL: https://ideas.repec.org/p/pra/mprapa/81303.html.

Paul, P., 2020. The time-varying effect of monetary policy on asset prices. The Review of Economics and Statistics 102, 690–704.

Ramey, V.A., 2011. Identifying Government Spending Shocks: It's all in the Timing*. The Quarterly Journal of Economics 126, 1–50.

Romer, C.D., Romer, D.H., 2004. A new measure of monetary shocks: Derivation and implications. American Economic Review 94, 1055–1084.

Sorrell, S., Speirs, J., Bentley, R., Brandt, A., Miller, R., 2009. Global oil depletion: an assessment of the evidence for near-term peak in global oil production. Technical Report. University of Sussex. London. URL: http://sro.sussex.ac.uk/id/eprint/53987/.

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