Monopoly Power in the Oil Market and the Macroeconomy

Dr. Nicole Branger
Professor of Finance, School of Business and Economics, University of Münster, Germany

René Marian Flacke
Graduate Student, School of Business and Economics, University of Münster, Germany

Dr. Nikolai Gräber
Fixed Income Portfolio Manager, Provinzial NordWest Asset Management GmbH

This paper studies the macroeconomic consequences of oil price shocks caused by innovations in the monopoly power in the oil market. Monopoly power is interpreted as oil producers' ability to charge a markup over marginal costs. We propose a novel way to identify markup shocks based on meetings of OPEC and show the organization's unique macroeconomic consequences compared to supply and demand shocks. In particular, global real economic activity expands when oil producers' monopoly power rises. A general equilibrium model suggests that higher monopoly profits attract investments in oil producing capital, which drive down marginal costs and stimulate economic growth.

Introduction

It is well known that the oil price is driven by supply and demand shocks that have first-order implications for the world economy. In perfectly competitive markets, the forces of supply and demand result in an equilibrium price that is equal to the marginal cost of production. Recent evidence for the oil market suggests that producers charge a markup over their marginal costs (e.g., De Loecker and Eeckhout, 2017; Asker *et al.*, 2019), which is in line with the notion that oil producers possess some degree of monopoly power. This markup is positive and time-varying. Shocks to the markup charged by oil producers may therefore represent another important determinant of the oil price and potentially have different macroeconomic effects than supply and demand shocks. Identifying and understanding the responses of the macroeconomy to markup shocks is the goal of our paper.

Empirical Evidence

In order to identify the macroeconomic effects of unanticipated markup shocks in the global oil market, we develop a novel strategy that does not involve estimation of the markup itself, since this is hampered by data limitations. Rather, we exploit the fact that the oil market is dominated by the Organization of the Petroleum Exporting Countries (OPEC). OPEC regularly holds conferences to agree on future oil production quotas and publicly announces its decisions at the end of each meeting. Economically speaking, OPEC expresses its competitive policy at these meetings and exerts power in the global oil market by optimally choosing supply to maximize profits. The oil price reacts to such announcements. Oil price movements, i.e., cumulative returns, over event windows surrounding the announcements are often large in magnitude and reflect changes of the markup and marginal costs. We want to isolate the *unanticipated* changes of the monopoly power of *all* oil producers. For this reason, we measure cumulative returns and marginal cost changes such that they come as a surprise to agents. Changes of

the markup, i.e., the residual, are then fully unexpected, too. Moreover, we measure cumulative returns and marginal cost changes at the aggregate market level, which means that we capture changes of the common markup that all oil producers can charge.

Mr. René Marian Flacke, Chair of Derivatives and Financial Engineering at the Finance Center, University of Münster, Germany, responds to a question during the "Commodities Matter Everywhere" session at the J.P. Morgan Center for Commodities' 3rd Annual International Commodities Symposium in August 2019. To Flacke's right are Dr. Xiaoqing Zhou, Ph.D., Economist, Federal Reserve Bank of Dallas and Dr. Lutz Kilian, Senior Economic Policy Advisor, Federal Reserve Bank of Dallas, and the chair of the "Commodities Matter Everywhere" session. Dr. Kilian is also a member of the JPMCC's Research Council.

Our goal is to study how markup shocks affect the macroeconomy. For this purpose, we augment the workhorse structural vector autoregressive model of Kilian (2009). Our model includes global oil production, global real economic activity, the real price of oil, and cumulative returns around OPEC announcements as endogenous variables, recursively ordered. Our identification strategy can be motivated as follows. First, it is important to note that the original model of Kilian (2009) does not include any forward-looking variable and thereby assumes that agents in the economy act on present and past information only. This assumption is likely to be violated in our case because we introduce the financial market's reactions to announcements of OPEC's quota decisions as a new variable. The new production quotas are typically effective only in the future, such that the information set of agents involves some expectations that need to be accounted for. For this reason, we use the futures price when computing cumulative returns. We consider the 3-month futures traded on NYMEX because it is liquidly traded and expires after the effective dates of new production quotas. Price movements of futures over short event windows are a nearly pure measure of unanticipated shocks (Kuttner, 2001). We construct event windows of 11 trading days symmetrically surrounding OPEC announcements. We therefore capture any information leakages prior to the announcements and any comments on the meetings' outcomes and atmosphere by OPEC members after the announcements. In other words, the event windows are long enough to allow the shocks to unfold fully. However, they span almost half a month and open up the possibility for other shocks to distort the measurement. In particular, it is possible that the cumulative returns not only reflect changes in oil producers' markup but also changes in marginal costs. We address this issue by ordering cumulative returns in our model last. We therefore correct the cumulative returns and separate out contemporaneous marginal cost changes arising from supply and demand shocks.

We calculate cumulative returns around 104 OPEC announcements within the sample period from August 5, 1986 to November 30, 2016. We construct a continuous monthly time series by setting cumulative returns in months in which OPEC did not meet to zero. The scope of our measure is therefore limited. It is possible that oil producers' monopoly power also changes when OPEC is not meeting. Our approach overlooks those cases. On the upside, however, focusing on OPEC announcements allows us to pin down the underlying cause of the oil price movement and lets us identify the macroeconomic effects of markup shocks in a narrow, concrete, and conservative manner. In particular, our event study approach greatly limits the role of other events that take place in the same month and also move the oil futures price, but are not properly accounted for in the model, e.g., monetary policy shocks around Federal Open Market Committee (FOMC) meetings.
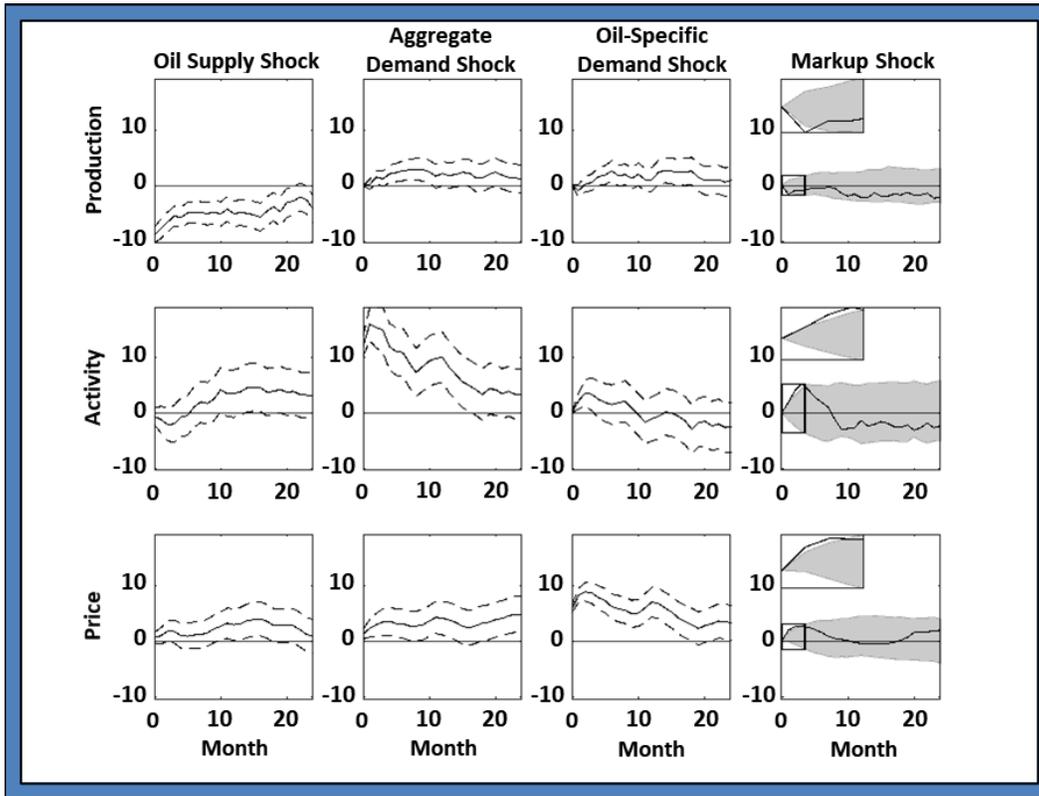
Figure 1
Markup Shocks
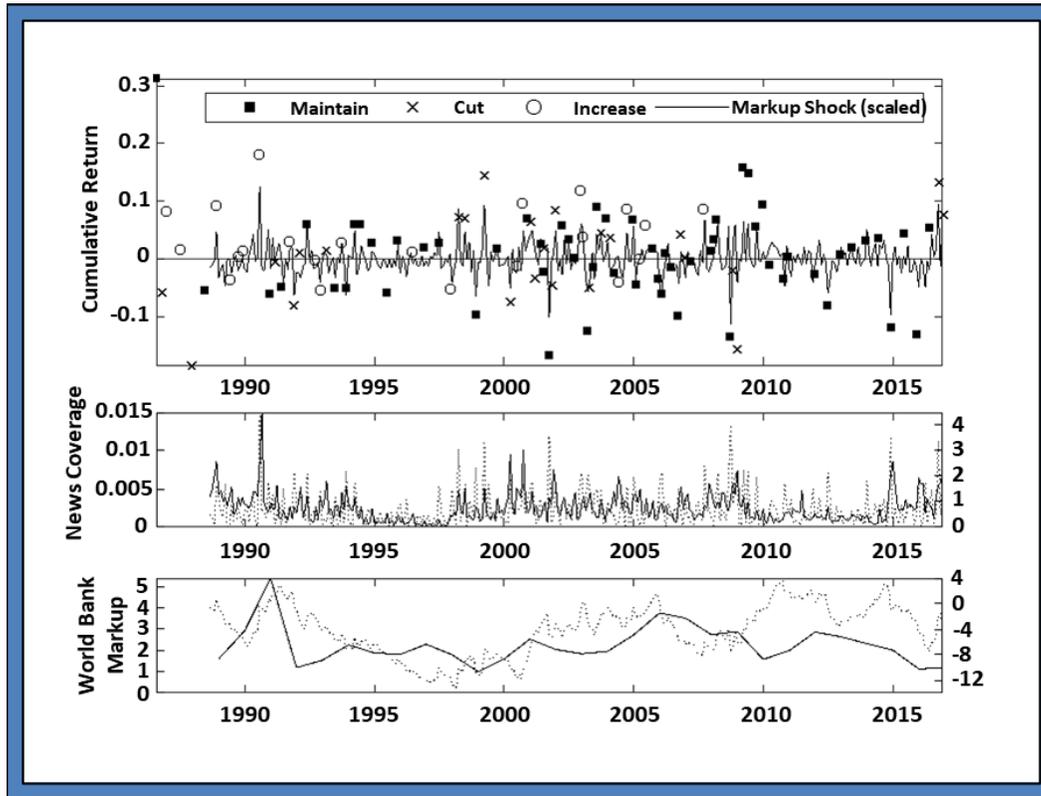
We estimate the model with ordinary least squares (OLS) and orthogonalize shocks using the Cholesky decomposition. Figure 1 plots the obtained time series of markup shocks as a solid line in the first panel. It shows that the futures price reacts to OPEC announcements over the entire sample period, even after controlling for contemporaneous changes in marginal costs. To check the plausibility of this time series, we examine two alternative measures that look at oil producers' importance and power from different perspectives. OPEC's news coverage, which is defined as the number of newspaper articles written about OPEC relative to the total number of articles (Plante, 2019), is plotted in the second panel of Figure 1 along with the absolute of markup shocks (dotted line, right axis). In line with intuition, we observe that media attention spikes when oil producers experience significant losses or gains of power, while little attention is paid when the monopoly power remains relatively constant. In the third panel of Figure 1, we compare a yearly estimate of the level of the markup in the global oil market provided by the World Bank with a cumulated version of markup shocks (dotted line, right axis). We find a positive relation between the two time series as expected. However, while our markup shocks are based on forward-looking information and are fully unanticipated, the estimated markup level of the World Bank only incorporates backward-looking information and reacts to anticipated shocks, too. Taken together, the two plausibility checks of the time series of markup shocks corroborate the view that our measure captures unanticipated innovations in the monopoly power of oil producers. We provide further evidence based on narrative records in the full version of our paper.

Figure 2
Structural Impulse Responses

Responses of global oil production, global real economic activity, and the real price of oil to one-standard deviation structural shocks are plotted as solid lines in Figure 2. The macroeconomic consequences of supply and demand shocks (first three columns) confirm previous studies (e.g., Kilian, 2009; Baumeister and Hamilton, 2019). In comparison to supply and demand shocks, markup shocks (fourth column) affect the macroeconomy in a unique way, although all shocks raise the real price of oil. Oil production sharply drops in the first month after a positive markup shock. This reaction is statistically significant at the 5% level, since it lies outside the 95% confidence interval obtained through bootstrapping pseudo event dates (shaded area). Markup shocks do not have any considerable effect on oil production afterwards. Besides, markup shocks are associated with increases in real economic activity within the first 3 months following the initial shock. This impact is at least statistically significant at the 10% level. Consequently and perhaps surprisingly, real economic activity in the world *expands* when oil producers' monopoly power rises. Furthermore, markup shocks drive up the real price of oil within the first 2 months. This effect is statistically significant at the 5% level, but starts to fade away afterwards. Thus, oil producers are indeed able to charge a higher price for some time if the monopoly power in the oil market increases – as indicated by our measure of markup shocks.

The presented empirical results are robust to using different futures contracts (1-, 2-, 4-, 6-month futures), extending the event window (21, 31, 41 trading days), and employing different proxies for real economic activity (Hamilton, 2019), as shown in the full version of our paper. Moreover, when replacing

OPEC announcements with other major events (reflecting other oil-, inventory-, stock market-, monetary policy-, or general policy-related news), we arrive at macroeconomic responses that are very different, suggesting that OPEC announcements provide unique information to agents.

Theoretical Framework

In order to understand the mechanisms that are at work when the economy is hit by a markup shock, we propose a tractable general equilibrium model that is able to replicate the empirical findings. The key ingredient of our model is the oil sector, which is modeled as being in monopolistic competition, such that oil producers can set the price in accordance with their monopoly power and charge a markup over their marginal costs. The markup is specified to be highly persistent and matches the empirical estimate of De Loecker and Eeckhout (2017). We introduce time variation in the markup in order to study the macroeconomic implications of changes in the competitive structure of the oil market. Oil producers employ oil producing capital (e.g., oil wells and rigs) in their production and sell their output to the final good sector. The final good sector produces the consumption good and cannot perfectly substitute oil with other inputs. Two additional, auxiliary sectors, the sector for patented goods and the research and development (R&D) sector, are introduced to generate sustained endogenous growth as in Kung and Schmid (2015).

We expose the economy to supply, demand, and, most importantly, markup shocks. The model confirms our empirical finding that markup shocks have distinctly different macroeconomic implications than supply and demand shocks. A positive markup shock, first and foremost, exogenously raises the price of oil. Oil as an input becomes more expensive such that the demand for and, in equilibrium, the production of oil decline. Due to the final good sector's limited ability to substitute inputs, final good production initially declines, too. As a result, economic growth decelerates for the moment. However, as a persistently heightened markup suggests higher present and prospective monopoly profits, the oil sector increases investment in oil producing capital in order to reap these profits. In the long run, a higher stock of oil producing capital implies lower marginal costs. Despite a lastingly increased markup, lower marginal costs eventually drive down the oil price below its pre-shock level. In turn, oil as an input becomes less expensive, triggering final good and oil production. Reversing and overcompensating its immediate negative effects, a markup shock eventually fuels long-term economic growth. Comparing the model-implied responses to those implied by the data, we observe that our model can replicate the sharp downturn in oil production and the surge in the price of oil following a markup shock. The reaction of economic growth is positive – as in the data – but the timing is somewhat different. While the model's response is positive only in the long run, the data shows an immediate positive effect on real economic activity.

Conclusion

Our paper makes the point that changes in the markup charged by oil producers represent another important source of oil price shocks. In the empirical part, we propose a novel way to identify markup shocks in a structural vector autoregression based on oil futures price movements around meetings of OPEC. We show that markup shocks have unique macroeconomic consequences compared to supply and demand shocks. A positive markup shock raises the real price of oil and results in a sharp decline of

global oil production in the first month after the initial shock. Most surprisingly, global real economic activity expands for a couple of months when oil producers' monopoly power rises. We explain these findings in a general equilibrium model. The model suggests that a higher markup signals higher prospective monopoly profits and triggers investment in oil producing capital. In the long run, an elevated stock of oil producing capital drives down marginal costs of oil production. Despite a lastingly heightened markup, the oil price therefore drops below its pre-shock level. This, in turn, stimulates long-term growth in the economy and explains our empirical finding of an expansion of global real economic activity.

Endnotes

Mr. Flacke presented on this topic at the JPMCC's 3rd Annual International Commodities Symposium during the "Commodities Matter Everywhere" session on August 13, 2019. The symposium, in turn, was organized by Professor Jian Yang, Ph.D., CFA, the J.P. Morgan Endowed Chair and JPMCC Research Director at the University of Colorado Denver Business School.

For further coverage of the crude oil markets, one can read past *GCARD* articles on these markets.

References

Asker, J., Collard-Wexler, A. and J. De Loecker, 2019, "(Mis)Allocation, Market Power, and Global Oil Extraction," *American Economic Review*, Vol. 109, No. 4, April, pp. 1568-1615.

Baumeister, C. and J.D. Hamilton, 2019, "Structural Interpretation of Vector Autoregressions with Incomplete Identification: Revisiting the Role of Oil Supply and Demand Shocks," *American Economic Review*, Vol. 109, No. 5, May, pp. 1873-1910.

De Loecker, J. and J. Eeckhout, 2017, "The Rise of Market Power and the Macroeconomic Implications," NBER Working Paper No. 23687, August.

Hamilton, J.D., 2019, "Measuring Global Economic Activity," *Journal of Applied Econometrics*, forthcoming.

Kilian, L., 2009, "Not All Oil Price Shocks Are Alike: Disentangling Demand and Supply Shocks in the Crude Oil Market," *American Economic Review,* Vol. 99, No. 3, June, pp. 1053-1069.

Kung, H. and L. Schmid, 2015, "Innovation, Growth, and Asset Prices," *The Journal of Finance,* Vol. 70, No. 3, June, pp. 1001-1037.

Kuttner, K.N., 2001, "Monetary Policy Surprises and Interest Rates: Evidence from the Fed Funds Futures Market," *Journal of Monetary Economics,* Vol. 47, No. 3, June, pp. 523-544.

Plante, M., 2019, "OPEC in the News," *Energy Economics,* Vol. 80(C), pp. 163-172.

Author Biographies

Dr. NICOLE BRANGER
Professor of Finance, School of Business and Economics, University of Münster, Germany

Dr. Nicole Branger is a Professor of Finance at the University of Münster. She previously held positions as Associate Professor at the University of Southern Denmark in Odense and as Assistant Professor at the Goethe University Frankfurt. She received her doctorate from the University of Karlsruhe. Her current research focuses on asset pricing, asset allocation, and

derivatives. She has published more than 30 academic articles, some of which appeared in the *Review of Financial Studies*, *Review of Finance*, *Journal of Financial and Quantitative Analysis*, and *Journal of Economic Dynamics and Control*.

RENÉ MARIAN FLACKE
Graduate Student, School of Business and Economics, University of Münster, Germany

Mr. René Marian Flacke is a fourth-year Ph.D. student in Finance at the University of Münster. Prior to his Ph.D. studies, he obtained a M.Sc. from the University of Münster, majoring in Finance and Accounting. Mr. Flacke's main research centers on the interplay of financial markets and macroeconomics. His work has been published in *Energy Economics*.

Dr. NIKOLAI GRÄBER
Fixed Income Portfolio Manager, Provinzial NordWest Asset Management GmbH

Dr. Nikolai Gräber is a fixed income portfolio manager at Provinzial NordWest Asset Management GmbH. He received his doctorate from the University of Münster in 2018. Dr. Gräber's research focuses on general equilibrium asset pricing models, analyzing the interplay of financial markets and macroeconomics. He has published in *Energy Economics*.