

# ***OPEC CARTEL BEHAVIOR: WHAT IS THEIR OBJECTIVE AND WHAT MAY HAPPEN NOW?***

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## **Overview**

The question of whether OPEC is still a cartel or can exert market power has been asked many times in the literature (Kohl 2002, Claes 2001, Alkhathlan 2014, Bremond 2012). While these sources examine OPEC's past actions and use time series to tease out Granger Causality or correlations they do not examine the range of strategic options that may be available to OPEC members. They also do not examine how changed circumstances, especially the development of shale oil and other changes that have likely increased the elasticity of the residual demand curve facing OPEC members, could change OPEC's strategic position and behavior in the future. In order to perform such analyses, one needs a theoretical model that can examine likely outcomes under alternative or counter-factual hypotheses. In this paper, we propose a very general game theoretic model that can be used to estimate the range of joint production outcomes that could rationally be enforced by cartel members. Specifically, using a famous algorithm first proposed by Abreu et al. (1990) that is based on the idea of subgame perfect equilibria of an infinitely repeated Cournot oligopoly game with perfect monitoring and public randomization, we empirically estimate the set of production levels OPEC members could enforce among themselves. These estimates provide bounds on OPEC's rational behavior when colluding among themselves, as well as bounds to their production levels when colluding with Russia. While examining historical time series can answer questions as to whether OPEC impacted prices in the past, these methods provide insight into how OPEC, or OPEC plus Russia can impact prices going forward given the marginal costs and price responses they are currently facing.

## **Method**

Methods developed by Judd et al. 2003 and Abreu & Sannikov 2014 are extended from 2 to N players and modern advances in linear programming and computation of convex hulls are utilized. The extensions allow us to compute sets of payoffs supporting subgame perfect Nash equilibria (SPNEs) in infinitely repeated Cournot oligopoly games with up to N players facing heterogeneous costs. This set exists in a N-dimensional real space.

The algorithm requires a set of payoffs of the single-period Cournot oligopoly game. To construct this, the marginal price function for crude was estimated with data from OPEC and the U.S. Energy Information Administration using an OLS linear regression on the Brent Crude Oil index. The price function was then combined with Rystad data on countries' average marginal costs of oil production to construct a set of payoffs for the single period stage game in RN space.

## **Results**

We find that payoffs from OPEC members' current levels of production (and slightly higher) fall within the sets estimated to support SPNE. However, strategies in which nations utilize their full production capacity are not supported in SPNEs. The benefits of adding Russia to the cartel are estimated. We then use the model to examine the possible consequences of an increase in the elasticity of demand facing OPEC members and Russia.

## **Conclusions**

Given the current price and cost environment, OPEC will continue to influence the price of oil. However, we show that it will do so less than it has in the past. Some, but not all, of its past influence can be won back by including Russia in the cartel. The bounds of OPECs production with and without Russia's assistance will be included.

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## References

- Abreu, Dilip, & Sannikov, Yuliy (2014) "An Algorithm for Two-Player Repeated Games with Perfect Monitoring," *Theoretical Economics*, 9(2), 313–338.
- Abreu, Dilip, Pearce, David & Stacchetti, Ennio (1990) "Toward a Theory of Discounted Repeated Games with Imperfect Monitoring," *Econometrica*, 1041–1063.
- Alkhathlan, Khalid, Gately, Dermot, & Javid, Muhammad (2014) "Analysis of Saudi Arabia's Behavior within OPEC and the World Oil Market," *Energy Policy*, 64, 209–225.
- Bremond, Vincent, Hache, Emmanuel & Mignon, Valerie (2012) "Does OPEC Still Exist as a Cartel? An Empirical Investigation," *Energy Economics*, 34(1), 125–131.
- Claes, Dag H. 2001. *The Politics of Oil-producer Cooperation*. Westview Press.
- Judd, Kenneth L, Yeltekin, Sevin, & Conklin, James (2003) "Computing Supergame Equilibria," *Econometrica*, 71(4), 1239–1254.
- Kohl, Wilfrid L. (2002) "OPEC Behavior, 1998–2001," *The Quarterly Review of Economics and Finance*, 42(2), 209–233.