



## OPEC's kinked demand curve

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### ABSTRACT

Asymmetric effects of oil prices on the macroeconomy imply multiple equilibrium prices for OPEC. I estimate world demand for crude oil, non-OPEC supply, and the effects of changes in price on world GDP using quarterly data covering 1973 to 2010. If OPEC's marginal cost is \$20/bbl in 2014:III, and its discount rate is zero, estimated equilibrium prices are \$44–88/bbl. Multiple equilibria incent OPEC to tolerate unstable prices, which, because of the asymmetry, lower world GDP. Both policies that increase responsiveness to price and policies that lower net demand to OPEC narrow and lower the range of equilibrium prices, but the former are more effective at doing so. OPEC responds to changes in the discount rate in the opposite way from competitive producers, so policies that secure oil-related property rights in OPEC countries and other policies that lower OPEC's discount rate narrow and lower the range of equilibrium prices. Monetary policy is more effective at accelerating or slowing macroeconomic activity the larger is OPEC's market share.

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### 1. Introduction

The price of crude oil has been less stable, and marked by upward shocks, and world economic growth has been slower, since the Organization of Petroleum Exporting Countries first wielded its market power assertively in 1973.<sup>1</sup> Before then, major oil companies known as the “Seven Sisters”, in conjunction with the Texas Railroad Commission, stabilized price above marginal cost, using tacit collusion and secret agreements to elude the Antitrust Division of the U.S. Department of Justice.<sup>2</sup> Fig. 1 shows the log real price of West Texas Intermediate (WTI) crude oil and the real rate of growth of the world economy from 1951 to 2010.

Why have prices been unstable during the “OPEC era”? What is the effect on the macroeconomy, and what types of policy responses would stabilize and increase macroeconomic growth and employment? The main contribution of this paper is to help answer the former question. It contains estimated net demand to OPEC, including effects of oil prices on world GDP that allow for differences in responses to increases and decreases in price. Estimated asymmetric effects imply multiple equilibrium prices in the cartelized market, and the range of equilibria

represents a measure of potential instability in price. Due to the asymmetry, the greater the instability in the price of crude oil, the lower are macroeconomic growth and employment. Poor national economies are more oil-intensive than rich economies, so the effects of the asymmetry are experienced disproportionately in poor countries. (Using IEA and IMF<sup>3</sup> data, I regressed log petroleum consumption by country in 2013 on log GDP and derived a coefficient of 0.95, with a standard error of 0.02.) Policies that narrow and lower the range of equilibrium oil prices, then, raise GDP and employment, especially in poor countries. These include policies that make net demand to OPEC more price-elastic, policies that reduce net demand to OPEC, and policies that lower OPEC's rate of time preference. A corollary to the latter is that monetary policy is more effective at accelerating or retarding economic activity when OPEC has a larger market share.

The main welfare criterion used in this article is world GDP. Bloom and Canning (2007) confirm that the positive relationship between national income and life expectancy identified by Preston (1975) continues to hold. Ensor et al. (2010) find that recessions increase maternal and infant mortality in the earlier stages of a country's economic development. Pugh Yi (2011) summarizes literature and U.S. data, argues that poverty, both cyclical and structural, causes abortion, and concludes that raising employment and stabilizing the macroeconomy would reduce abortion.

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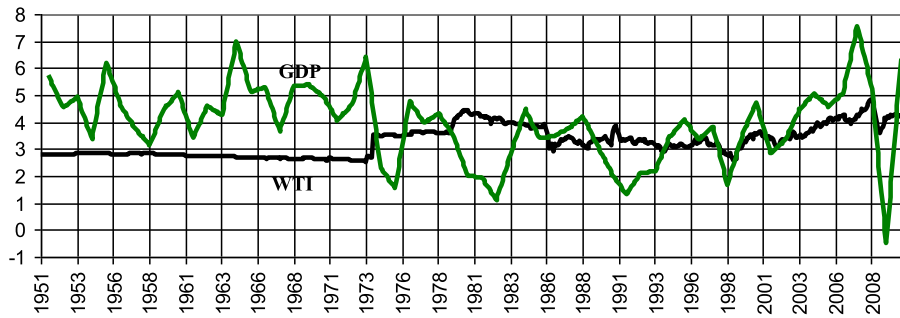
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URL: <http://appliedecon.net>.

<sup>1</sup> See Greenhouse (1987) for journalistic observations.

<sup>2</sup> See Moran (1993, pp. 159–178) for a comparison of the two cartels.

<sup>3</sup> International Energy Agency (<https://www.iea.org/>) and International Monetary Fund ([www.imf.org](http://www.imf.org)).



**Fig. 1.** Log price of WTI and annual growth rate of world GDP; 1951–2010.  
Sources: Federal Reserve Bank of Saint Louis; Angus Maddison Project; IMF.

Fig. 2 shows the real (2005\$) price of crude oil from 1973:IV to 2011:II. Worldwide recessions in my constructed data (see Section 3.3) are shown in vertical bars. Three of the five recessions were preceded by oil price shocks, and none of the oil price shocks failed to precede a recession. Far and away the two largest quarter-to-quarter price increases in the OPEC era were \$21.41 between 1973:IV and 1974:I and \$22.04 between 2008:I and 2008:II. There was a slowdown in the world economy in 1974:II, a recession beginning in 1974:III, and a recession beginning in 2008:III. The third largest increase in price during the OPEC era of \$12.63 occurred between 2007:III and 2007:IV. The large shock in 1973 preceded a long term slowdown in world economic growth, and the 2008 recession has been termed “Great”. Over two quarters, from 1978:III to 1980:I, price increased \$39.51. GDP declined at an annual rate of more than 8% from 1980:I to 1980:II and 0.7% the following quarter.

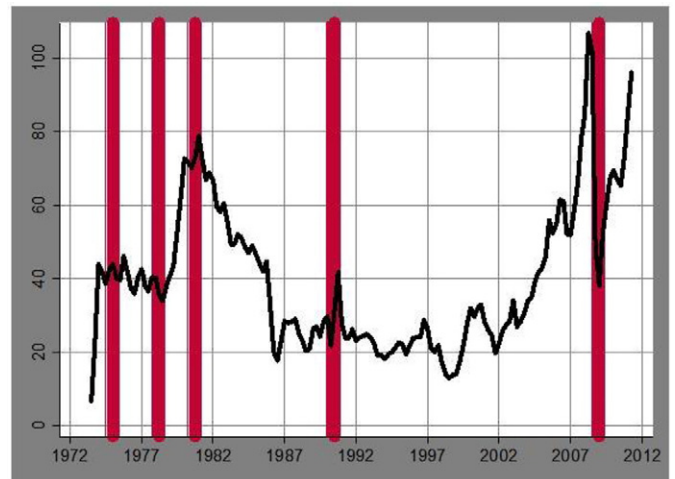
The price of oil may change in response to a macroeconomic shock or to a shock to production of oil. One might argue that instability in price occurs because OPEC is not consistently effective at counteracting the impacts of such shocks on price. OPEC has been described as “clumsy”,<sup>4</sup> but I argue that 1) asymmetric effects of price on GDP incite OPEC to allow shocks to cause price to fluctuate more than it would with symmetry, and I observe that 2) the asymmetry causes fluctuations in price to reduce GDP over time, a bad combination for the world economy. In the dataset used here, the impact of changes in the price of crude oil on the macroeconomy is negative, but the correlation between price and world GDP is positive (0.24), and is significant at the 99% level. Variation in price originates more in shocks to GDP than in shocks to production of oil. Variation in price originating in shocks to production of oil is countercyclic, destabilizes the consumption (of all goods) of consumers (excepting those with countercyclic incomes), and makes the incomes of producers of oil, including OPEC, less procyclic. Variation in price originating in shocks to GDP is procyclic, smooths the consumption of most consumers, and makes the incomes of producers more procyclic. Since variation in price originates mainly in variation in GDP, unstable oil prices overall tend to smooth the consumption of consumers and make the incomes of producers of oil more procyclic.

However, if OPEC production changes, as when war or civil conflict causes production in an OPEC country to fall, the resulting “oil price shock” will slow the macroeconomy, covariation will be inverse, and profits to OPEC, and other sellers of oil, will be countercyclic. OPEC can use such countercyclic profits to hedge the systematic risk to world GDP caused by the shock to price. In Section 4.4.3, I estimate demand to be inelastic in the short term, so, assuming increasing marginal cost, an increase (decrease) in price will raise (lower) revenue, lower (raise) cost, and lower (raise) world GDP. The countercyclic profits can be securitized in advance in a (set of) financial instrument(s) that commands a risk premium in financial markets. The premium obtains because such instruments can be used to smooth out undesirable

fluctuations in consumption associated with the macroeconomic instability caused by the changes in price. Teitenberg (2007, p. 202) explains that periods of high oil prices may leave developing nations short of foreign exchange. There is no economic risk more systematic than that to the world economy, and OPEC can sell insurance against that risk inasmuch as it results from changes in production. As noted, variation in price overall is consumption-smoothing, and causes procyclic variation in the incomes of producers of oil, including OPEC, but policies, such as trading strategic stocks of crude oil, capable of mitigating variation in price originating in changes in production will not only raise GDP over time, but also smooth the consumption of consumers, and make the incomes of producers of oil more procyclic.

Because of multiple equilibria leading OPEC to accept shocks to price originating both beyond and within the cartel, and because of countercyclic profits associated with shocks to production of oil, OPEC may find variation in price more profitable than stable prices. The multiple equilibria result from asymmetry in the effects of changes in oil prices on the macroeconomy. The asymmetry also implies that instability in the price of oil lowers economic growth and employment over time, and I proceed here on the assumption that this loss in GDP is greater than any net benefits of consumption-smoothing, though preference may be given to policies that mitigate volatility in price originating in shocks to production, rather than in shocks to GDP.

I review literature in Section 2. I describe method, model, and data in Section 3. I present and discuss estimates of world demand for and non-OPEC supply of crude oil, and the effects of crude oil prices on world GDP, in Section 4. The discussion includes estimated ranges of equilibrium prices and elasticities. I conclude, discuss policy implications, and mention further research in Section 5, and I cover more detailed aspects of the econometrics in the appendix.



**Fig. 2.** Real (2005\$) price of crude oil from 1973:IV to 2011:II.

<sup>4</sup> See Adelman (2004).

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