

Estimating and Testing a Dynamic Model of OPEC and Non-OPEC

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Overview

Analyses of energy markets are important to academics, businesspeople and policymakers alike. Although there have been countless empirical studies of the world oil market, however, a satisfactory model that adequately explains historical data and accurately predicts future developments remains to be developed.

This paper estimates a dynamic model of the world oil market and tests whether OPEC countries colluded and whether non-OPEC countries behaved oligopolistically over the period 1970-2004. The model generates estimates of the shadow price of the resource with minimal functional form assumptions.

The research in this paper makes several important contributions to the existing literature. First, it takes to data the theoretical model of optimal nonrenewable resource extraction that was first examined by Hotelling (1931). Thus, unlike many previous empirical studies of the oil market, this paper uses a dynamic model of the world oil market.

Second, this paper builds upon existing empirical studies of the oil market by addressing the identification problem that arises in empirical analyses of supply and demand. Because the observed equilibrium prices and quantities are simultaneously determined in the supply-and-demand system, instrumental variables are needed to address the endogeneity problem.

The third contribution is that this paper tests for the market conduct of OPEC and non-OPEC producers. This paper also builds upon the literature on conduct parameter analysis by estimating a dynamic model.

The fourth contribution of this paper is that it estimates the shadow price of the resource. Since the shadow price of scarcity reflects the scarcity of oil and is an indicator of sustainability, the measurement of the shadow price has been the subject of much interest and previous work (Hartwick & Olewiler, 1998), and several authors have proposed that the shadow price is the best single index of trends in resource scarcity (see e.g., Brown & Field, 1978; Fisher, 1981). This paper presents a method for obtaining an estimate of the shadow price of oil over 1970-2004 with minimal functional form assumptions.

Methods

This paper estimates a dynamic model of the world oil market and tests whether OPEC countries colluded and whether non-OPEC countries behaved oligopolistically over the period 1970-2004. The model generates estimates of the shadow price of the resource with minimal functional form assumptions.

Results

Results support oligopolistic behavior among non-OPEC producers and collusion among OPEC producers except in the last 15 years. The shadow price does not rise monotonically, which is evidence for stock effects in extraction costs. The recent rise in the shadow price reflects the rising economic scarcity of oil.

Conclusions

When the data is pooled over entire time period, results support oligopolistic behavior among non-OPEC producers and collusion among OPEC producers. When separated by decade, however, results do not support collusion among OPEC in the production of oil in the last 15 years.

The result that OPEC producers have not succeeded in colluding in recent years is consistent with the studies of Marcel and Mitchell (2006) and Sperling and Gordon (2007), who argue that while OPEC producers may have succeeded in colluding when OPEC was first formed, they have failed to behave as a cartel in the past two decades in part because the state-owned companies that comprise OPEC have juggled multiple objectives, economic and otherwise, and thus have not acted so as to maximize joint profits. The results are also consistent with those of Lin (2007), who finds in her simulations of the basic Hotelling model that a monopolistic market structure better explains the world oil market than perfect competition does prior to the 1973 Arab oil embargo, but that perfect competition fares better in the years following it.

The dynamic model also generates precise estimates of the shadow price for oil. The shadow price does not rise monotonically, which is evidence for stock effects in extraction costs. The recent rise in the shadow price reflects the rising economic scarcity of oil.

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