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Energy Economics 23 (2001) 339–353

Energy  
Economics

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# Testing the hypothesis of collusive behavior among OPEC members<sup>☆</sup>

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## Abstract

This paper presents a test to discriminate among collusive and competitive behavior by producers of exhaustible resources. In contrast to previous studies (Griffin, 1985; Jones, 1990), which are based on *static* models, our approach is based on of the *dynamic* implications of the optimization problem faced by a *competitive* producer. We use this framework to test the hypothesis of collusive behavior within OPEC between 1983 and 1991. The existence of future markets allows us to sidestep the difficult issues related to the estimation of future prices and demand. © 2001 Elsevier Science B.V. All rights reserved.

*JEL classifications:* Q30; C12

*Keywords:* Dynamic monopolistic behavior; Oil; Euler equation

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## 1. Introduction

What was the role of OPEC in the 1980s? Were its members following the cartel's rules or were they behaving as producers maximizing their own revenues individually?

As often happens in cartels, OPEC members have incentives to produce more than the agreed quantity; moreover, since OPEC members have different amounts of reserves, preferences, and costs of production, there is tension within the cartel

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<sup>☆</sup>This paper was written before the author joined IMF. The views expressed here do not represent those of the staff of the IMF or its board.

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regarding the optimal price path. Several theoretical models have attempted to provide a framework for a country's production decisions. Griffin (1985) has sought to discriminate empirically between the *static* implications of the various theoretical models; in particular, he tested collusive behavior (where the production of each producer depends also on the OPEC production as a whole) against the hypothesis of a competitive market (where every producer maximizes its own revenues without strategic considerations). Using the same testing strategy, Jones (1990) finds that most OPEC members produce according to a 'partial market sharing'. In this paper, we propose another way of testing strategic behavior against non-strategic behavior, based on the different *dynamics* implicit in the two models.

## 2. The framework

In the first part of this theoretical section, we specify what the behavior of the producers would be in absence of a cartel; in the second part, we specify a simple alternative hypothesis where the producers follow a revenue-sharing agreement.

### 2.1. Competitive producer

Without the pressure of cooperating with OPEC, the government of an oil exporting country would face the standard problem of how to manage an exhaustible resource: i.e. choosing between current and future production. The dynamic maximization problem with discrete time is solved by a standard Euler equation:

$$U'(P_t \cdot q_{t,i}) = \frac{1 + \delta}{1 + r} E_t U'(P_{t+1} \cdot q_{t+1,i} | Z_t), \quad (1)$$

where  $U(\cdot)$  is a generic instantaneous indirect utility function that depends only on revenues in period  $t$ ;  $P_t$  is the price of crude oil at time  $t$ ;  $q_{t,i}$  is the quantity extracted and sold in period  $t$  by the producer  $i$ ;  $E_t$  is the expectation operator, conditioned at the information known at time  $t$  ( $Z_t$ );  $r$  is the real interest rate, and  $\delta$  is the discount rate. The following three assumptions are implicit in Eq. (1).<sup>1</sup>

1. The country is small; therefore,  $P_t$  and  $E_t(P_{t+1})$  are exogenous variables.
2. The costs of production are negligible; with positive costs, we should replace the term  $[P_t \cdot q_{t,i}]$  with the term  $[(P_t - c_{t,i}) \cdot q_{t,i}]$ , where  $c_{t,i}$  is the marginal cost for producer  $i$  at time  $t$ ; however, since the cost of extracting oil is small compared to the final price of oil, the hypothesis is reasonable.

<sup>1</sup>We use as equivalent the quantity produced and the quantity sold; this is a realistic assumption in the case of the OPEC producers, because it is much cheaper to keep oil underground than to extract and keep it in deposits.

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