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"Asian premium" or "North Atlantic discount": Does geographical diversification in oil trade always impose costs?

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ABSTRACT

We develop a Global Oil Trade Model (GOTM) to examine the ability of large crude oil exporters or importers to influence inter-regional price differentials by allocating their sales or purchases respectively among different crude oil consuming or producing regions. The model is based on the trade-offs among freight costs, qualities of the crude oils traded and the technical configurations of refineries that process the crude oil. Our reference case (based on 2012 data) minimizes the sum of freight costs and the costs of processing sub-optimal grades of crude oil at a refinery. We model a large Middle East exporter allocating its supply regionally as the leader in a Stackelberg game where all other producers and importers are price takers on the competitive fringe. We then examine the ability of a coalition of importers in Asia to make countervailing strategic purchases rather than act as a price taker. We find that large sellers can increase their revenues while diversifying their customer base by allocating volumes to more distant markets if, by doing so, they capture locational rents from more proximate buyers. Large buyers are unable to reduce their costs compared to the competitive market outcome by adopting countervailing purchase strategies but have the potential to disrupt the rent-seeking of large sellers.

1. Introduction

When market conditions are right, large suppliers can influence the supply/demand balance of crude oil and the associated regional price differentials. Similarly, a large buyer or coalition of buyers can hold prices below those in a competitive market. In a market like oil, a producer or importer can engage in regional allocations or purchases for multiple reasons. We examine the ability of a large producer and a large importer to increase revenues or lower expenditures through strategic sales or purchases that alter regional prices.

The choice of labels "Asian premium" or "North Atlantic discount" is really a discussion of the motives of the large players. One motive is diversifying customers to stabilize revenues, analogous to the risk-return tradeoff in finance. This tradeoff is implicit in the motives presented in the literature we review below. However, carrying over the conventions of finance leaves out a bigger question: can producers diversify customers *and* increase revenues or importers diversify suppliers *and* lower costs by engaging in strategic sales or purchases?

We have developed KAPSARC's Global Oil Trade Model (GOTM) to quantify the strategic opportunities for the large players to increase revenues or lower costs by making trade-offs among the origin and destination locations, accounting for sources of supply, crude qualities, and the configurations of refineries at a regional level.

Our reference case is based on the actual patterns of supply and consumption and refinery capabilities in 2012. We start from a competitive market where crude oil flows to locations so that costs are minimized and that no exporter or importer can override these market-based movements to satisfy its strategic objectives. In our alternative scenarios a large exporter or coalition of exporters allocates its supply regionally as the leader in a Stackelberg game where all other producers and importers are price takers on the competitive fringe. We then examine the ability of a large importer to engage in strategic purchases rather

Abbreviations: GOTM, Global Oil Trade Model; BOX, big oil exporter; BIM, big oil importer; NEMS, National Energy Modeling System; Mbd, thousand barrels per day; MMbd, million barrels per day; MPEC, Mathematical Program with Equilibrium Constraints.

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than act as a price taker. Lastly, we look at the consequences of having a large producer and a large consumer.

2. Background

With the oil price collapse of 1986, the OPEC administered pricing system was superseded by the use of formula prices linked to highly liquid crude oil benchmarks such as WTI, Brent and Oman/Dubai. Middle Eastern crude oil exporters adopted a market-responsive approach using formula prices based on spot and forward oil markets, making regional oil markets increasingly globally integrated. There is a growing literature around the thesis that the world oil market is "one great pool", as articulated by Adelman (1984), primarily focused on the interdependence of regional oil prices as a measure of market integration. Weiner (1991) provided one of the first empirical assessments of whether markets are globalized or regionally fragmented. His correlation and regression analyses found "a surprisingly high degree of regionalism" and speculated that the regionalization of prices "could be due to the ability of crude-oil sellers to engage in price discrimination" (Weiner, 1991, p. 107). The evidence of the literature is mixed however. For example, Sauer (1994) examined 6 key global price series for landed crude oil for the US, Japan, and Northern and Southern Europe and found that long-run co-integration relationships are relatively stable over the period examined" (July 1980 – March 1987), and hence more supportive of Adelman's original "one great pool" thesis. The different conclusions result from Weiner's data covering a period with relatively stable oil prices and small regional price fluctuations and differences that were less than what was needed to cover tanker rates and shift flows among regions, while Sauer covers a longer period with changes in oil prices that were significantly larger than tanker rates, providing opportunities for shipments to shift and profit from regional price differences.

The academic literature on inter-regional crude-oil price differentials outside these econometric assessments is relatively sparse. Nevertheless, there has been one commonly cited example of a regional crude oil price "gap". In trade journals this has often been reported as the "Asian premium" and there have been several publications by government-funded research institutions in Japan, South Korea and China. These have estimated the extent to which Asian countries pay higher prices relative to the regional European and North American markets for Middle East crude oil (Gong and Shan, 2003; Koyama, 2003; Lee, 2003). Among the reasons identified in the literature for the existence of an Asian premium, three are usually noted.

In the first category, the notion is that countries such as Saudi Arabia and other Gulf states such as Kuwait supply a relatively high level of oil exports to the US and Europe to maintain market share for political objectives, such as the presumed benefits of military and political support in the conduct of international relations. This notion implies that the "Asian premium" is effectively a "North Atlantic discount". That is, the exporters view any financial losses from their regional allocations as an insurance premium for perceived political risk coverage.

Second, it has also been argued that regulatory barriers in Asian energy markets could be one of the factors behind crude oil importers' willingness to pay higher prices than their counterparts in Europe and the US (Horsnell, 1997). If, for example, government-owned crude-oil procurement companies value perceived "security of supply" as a risk-management practice, they may be willing to pay rates at the margin which exceed those that international oil companies are willing to pay in Europe and the US. The public-choice literature on state-owned enterprises is voluminous, and there are compelling models of institutional behavior that reduce the incentives for cost-minimization (e.g., Vining and Boardman, 1992; Afonso et al., 2005). In the case of the oil industry, Hartley and Medlock (2008) show that national oil companies tend to be less efficient than privately owned companies. The common practice of regulating retail prices in the refined oil products sector in net oil-importing countries insulates importers from price signals in international markets. Regulated prices in many Asian countries thus lower the response to higher global oil prices relative to unregulated markets in the EU and the US.

A third reason often cited as the cause of the Asian premium is in opposition to the geo-political one cited above. The notion is that large crude-oil exporters can increase revenues through regional price discrimination, segmenting markets among end-users by using resale-restriction clauses in sales contracts (Soligo and Jaffe, 2000). In their illustrative monopolist price discrimination model, Soligo and Jaffe find that an optimal revenue maximizing solution for Saudi Arabia would be to charge Asian customers 3.8% to 28% more than European customers. In these models, however, implied revenue-maximizing regional price ratios are highly sensitive to the parameter values chosen. For example, Parsons and Brown (2003) postulate a coalition of Arabian Gulf OPEC members with market shares of 30% and 80% in Europe and Asia respectively. They use similar values for the European and Asian price elasticities of demand for Gulf OPEC and non-Gulf OPEC crudes and similar price elasticities of supply. They find an imputed price ratio that yields an extreme 215% premium for Asian markets, very much higher than that calculated by Soligo and Jaffe for Saudi Arabia alone. The extreme sensitivity of the results to the elasticity parameters limits the value of the numerical results.

3. Methods

A range of optimization and equilibrium models have been developed recently for natural resource markets. Examples include Egging et al. (2010), Holz et al. (2008), Boots et al. (2004), and Egging and Gabriel (2006) in natural gas markets; Haftendorn and Holz (2010) in steam coal markets; and Huppmann and Holz (2012), Aune et al. (2005), and Al-Qahtani et al. (2008b) in crude oil markets. For oil markets, Al-Qahtani et al. (2008a) provides a comprehensive survey of the literature covering both optimization and econometric models under different market structure assumptions. Using optimization methods to represent flows of crude oil and petroleum products has had a long history. For example, policy models such as NEMS (Energy Information Administration, 2013) and MARKAL (International Energy Agency, 2013) have been developed over several decades and use optimization methods to find economic equilibria. Model outputs include trade flows, market clearing prices and quantities of crude oil and refined products produced and consumed.

Unlike these models, our focus is on relative price shifts and incremental revenues due to varying regional allocations of crude-oil sales rather than absolute market prices and total revenues. The model we present here, the Global Oil Trade Model (GOTM), focuses on three basic attributes of the global crude oil trade: freight costs between supply and demand nodes, the quality of different grades of crude oil supply (as determined by its specific gravity or API), and the processing configuration of refineries in the demand nodes. We explore the relative abilities of large exporters and importers to influence inter-regional price differentials by regionally allocating their sales or purchases respectively. GOTM estimates relative crude-oil price differentials by location and the direction and volume of crude-oil trade flows with exogenously-fixed regional supply and demand volumes and transport costs.

3.1. Graphical representation of the approach

We examine the ability of large producers and consumers to alter location rents to improve revenues or lower costs. To illustrate how location rents can be garnered, we examine the consequences of a large supplier shifting some crude from Asia to North America. When the large supplier sells enough crude oil to Asia, that region does not have to purchase oil from West Africa, the next-lowest-cost supplier to Asia. Fig. 1 shows Asian demand clearing based on supplies from the Middle East as the marginal source of crude oil supply.