Overview

In eastern Australia, daily auctions are used to facilitate trade of wholesale natural gas at four major physical hubs: in Victoria, Sydney, Adelaide and Brisbane. These are double auctions, meaning that participants submit bids to both buy and sell gas, so that any volume purchased by bidders from the market is supplied by other bidders. They are uniform-price auctions, where all purchases and sales occur at the same market-clearing price. The auction in each hub is cleared separately, resulting in different prices in each location.

The Australian wholesale natural gas market is far from perfectly competitive. There are three very large, vertically-integrated participants with wholesale and retail arms, as well as gas-fired power plants. Other smaller participants in the market include retailers, storage operators, electricity generators, and industrial facilities.

Despite the apparent lack of competition, it is not necessarily expected that the market price would carry a significant mark-up over marginal cost. This is because the large, vertically-integrated participants simultaneously operate on both sides of the market in each hub: on the demand side, they purchase gas on behalf of their retail customers; and on the supply side, they sell gas that they acquire from upstream producers. Therefore, on any given day these large companies could be either net buyers or net sellers, depending on how their daily retail demand (which depends largely on the weather) compares to their ability to supply gas (which depends on long-term contracts with upstream producers). On days when the firm is a net seller, it has incentive to use its market power to raise the price. On days when it is a net buyer, it has incentive to use its market power to depress the price.

Bushnell, Mansur and Saravia (2008) illustrate a similar point for US electricity markets. They use a Cournot model of market power, and show that including the firms’ contracts with retail customers in the model lowers the predicted prices, bringing them closer to observed prices. The authors explain that this occurs because pre-determined retail prices mean that companies have less to gain from using their market power to raise spot prices for wholesale electricity.

This paper investigates how close the outcomes in Australia’s wholesale natural gas market are likely to be to perfectly competitive outcomes. Under certain simplifying assumptions that retain the key features of the Australian market, I show that, in theory, the equilibrium price generated by a small number of oligopolistic bidders is the same as the price that would arise if the bidders were instead perfectly competitive. Essentially, the market power wielded by net sellers is counterbalanced by the market power of net buyers. However, the oligopolistic bidders trade smaller volumes than they would under perfect competition, and are worse off as a result. Net sellers supply a smaller volume than they would in a competitive environment, even though they could supply additional units at a marginal cost below the market price. Net buyers purchase smaller volumes from the market, supplying more of their own needs than a competitive firm would, even though their own marginal cost is above the market price.

The theoretical model also implies that, when pipelines are uncongested, the equilibrium prices at each hub differ by the cost of transporting gas between them. This is also the same result that would arise if bidders were perfectly competitive, as shown by Cremer, Gasmi and Laffont (2003). I use this result to estimate the transport costs for each pipeline in the eastern Australian gas network. The estimated transport costs are in line with those by other authors, indicating that the simple network model developed in this paper may reasonably describe the Australian wholesale natural gas market.

Research approach

I use a game-theoretic model that represents the key features of the Australian natural gas auctions, in a simplified pipeline network. To find the optimal bidding behaviour of the large firms, I utilize the Supply Function Equilibrium developed in Klemperer and Meyer (1989), Vives (2011) and Rostek and Weretka (2012). I extend the methods developed in these papers to the setting of a pipeline network with several nodes.
I start with the simplest case, which only includes the very large, vertically-integrated bidders. These bidders are assumed to be symmetric, with quadratic costs of gas supply. Gas supply only occurs at one node, and must be transported to other nodes via the pipeline network, incurring a transport cost. Bidders know how much gas their own retail customers demand at each node, but they are uncertain about the retail demand that their rival bidders face. The equilibrium bidding strategies under these simplifying assumptions yield the result that prices are equal to their competitive level, but that lower volumes are traded than in a competitive market.

To test the reasonableness of the model, I use the prediction that the prices in each node differ by transport costs to estimate the transport costs along each pipeline. I use daily data collected from the Australian Energy Market Operator (AEMO) on the volume and direction of flow along each pipeline in the network, as well as the prices in each hub. I exclude all days during which physical congestion was experienced along any of the pipelines, because on these days the price differentials between nodes should be higher than the transport costs.

My estimates indicate that the marginal cost of transporting a gigajoule of gas along a pipeline varies between $0.01 AUD and $0.96 AUD, depending on the pipeline. In general, the estimates are within the range of transport costs reported by other authors using more direct methods of measuring transport costs, including Simhauser and Nelson (2015) and ACCC (2018).

**Research insights**

The theoretical model suggests that we should not expect prices in the Australian wholesale market for natural gas to be substantially different from prices in a competitive market, despite the fact that three large producers dominate the market. This is because the market power of bidders who are sellers is offset by the market power of bidders who are buyers. However, oligopolistic bidders trade a smaller volume with each other in equilibrium than competitive bidders, leaving potential gains from trade unexploited.

The fact that the estimated transport costs are within the range of those reported by other authors lends some support to the theoretical model. However, this result cannot be used to determine whether the market is oligopolistic or competitive, because, in theory, the price outcomes in these cases are similar.

**Future research**

There are a number of small bidders operating in Australia’s wholesale gas market that are unlikely to behave the same way as the large vertically-integrated companies. My future research will incorporate these small bidders as a competitive fringe, and investigate the effects of a rule change that may increase the price-sensitivity of these bidders.

**References**


