



## Price discrimination and limits to arbitrage in global LNG markets

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Not so long ago, there was a widespread conjecture that gas prices around the world would converge, with international trade in liquefied natural gas (LNG) connecting the regional markets of Asia, Europe and the US.

Indeed, since the early 2000s, LNG infrastructure investment has increased and trade has grown significantly. Contracting arrangements have become more flexible, and trade in short-term markets now makes up 25% of total LNG sales.

Yet gas prices around the world today vary widely: The average price of natural gas in 2012 was roughly US\$16/MMBtu in Japan, \$9 in European markets, but only \$3 in the US. In short, the gas market appears far from global.

For the case of the US, the reasons for price divergence are quite clear: The large-scale emergence of shale gas combined with currently very limited LNG export capability. As a result, US market developments have been largely isolated from the rest of the world.

But some industry observers argue that LNG exporters have been behaving "irrationally" by failing to engage in price arbitrage. Consider the case of Qatar, the largest LNG producer with a global market share of around 30%: For its short-term sales to the UK – rather than to Japan – some estimates suggest a forgone profit of up to \$100 million per day, and a cumulative figure in the billions.

The most immediate explanation for price divergence lies in transport costs. A simple perfectly competitive model predicts that the price differential between two regions served by an exporter is equal to the difference in transport costs – so netbacks (price minus transport cost) are the same.

The problem is that this theory cannot explain recently-observed prices. For example, gas prices have been \$10/MMBtu higher in Asia than in Northwest Europe but corresponding transport costs from the Middle East are approximately identical. Perfect competition predicts, falsely, that these two differentials should coincide.

In this paper, we suggest that regional price differentials can arise because of LNG exporters' market power. In general, profit-maximization implies that a producer equalizes marginal revenue, net of the marginal cost of production and transport costs, across any two export markets. If transport costs are identical, then short-term export quantities are such that marginal revenues for each region are equal.

The key point is simply that equalizing marginal revenue is not the same thing as equalizing price. For an exporter with market power, the “arbitrage” process stops when its marginal revenues are equalized; it is entirely possible that this optimally leaves prices across markets far apart. This basic argument holds for many different assumptions on the mode of strategic competition in LNG.

Incorporating market power can thus rationalize recent price divergences and trade flows by tracing them to differences in demand conditions. For instance, individual LNG producers may perceive lower demand elasticities in Japan – leading to higher prices – because of the nuclear power shutdown following the Fukushima accident. Also, Asian LNG buyers generally may be more concerned about “security of supply”, and have fewer substitution possibilities (e.g., to Russian pipeline gas) than European buyers.

What if the US becomes a large-scale LNG exporter? Our analysis makes clear that US and non-US prices will not necessarily converge as a result (even adjusting for transport costs). So any model of the impact of US LNG exports is likely to be incomplete if it does not take market power into account. For example, recent modelling for the US Department of Energy incorporates various general-equilibrium effects but assumes other LNG producers do not respond strategically to US market entry.

We also discuss how different features of the LNG market either limit the ability of other player, such as LNG buyers and third-party traders, to engage in arbitrage or create incentives that work against pursuing arbitrage in the first place. These include constraints on resale, limited shipping capacity, incentives arising from vertical integration and the ownership structure of the LNG supply chain, barriers to entry for third-party traders, risk-management issues, and the possibility that arbitrageurs themselves have market power.

We conclude with a preliminary discussion of the potential effects of greater price arbitrage – in the future – on LNG prices, industry profits, and social welfare.