

IRREVERSIBLE TIME COMMITMENTS FOR LNG TRADE: CONSTRAINTS ON SPATIAL MARKET INTEGRATION

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Overview

Trade of liquefied natural gas (LNG) requires specially built LNG carriers to complete the long haul carriage from production regions such as Qatar and Nigeria to consumption regions such as Japan or Europe. Such long haul trade necessitates a time commitment as the product has to spend some time “in transit” before reaching its destination. It is natural that such commitments factor into decisions on trade. If the commitment is irreversible, i.e., if entering into a sales deal to one destination means that deals to other destinations are foregone, a timing option is present in trade decisions. In this case a perpetual export licence will take the form of a contingent claim similar to an American call option. The underlying “asset” of this claim is the cross market price spread, or some payoff function thereof, and the exercise price is the direct transportation cost. Contrary to a conventional American call option, a perpetual export licence does not vanish after being exercised. The option becomes operational again after the “ship has come back to port” whereby a new commitment can be made. We define this as a recurrent American call option.

This paper introduces recurrent American call options, and shows how such a claim can be used to represent the value of a perpetual export licence when trade involves irreversible time commitments. We define the claim and its valuation process. In application to trade, we show how the value of such a trade licence depends amongst others on the degree of market integration between the home and destination market, and the shipping-time technological constraint. We also show that when the option value is added to the direct transportation cost, the full transportation cost becomes endogenous to the cross-market price spread, the terms of trade. This has important implications for spatial market integration.

Trade implications are put in context of LNG trade. The literature on LNG trade has shown only weak evidence that trade is able to link regional natural gas markets (Neumann, 2012; Li et al, 2014, Oglend et al, 2016). Despite considerable regional price spreads, technological and regulatory constraints in transportation has limited arbitraging (Yegrov and Dehnavi, 2012; Oglend et al, 2016). Transportation costs in LNG has been shown to be positively correlated with price spreads (Oglend et al, 2016). This paper offers a framework to interpret the current limits of LNG trade to integrate markets, including the observed positive correlation between costs of transportation and price spreads. LNG trade can generate considerable economic benefits, and trade policies are widely discussed (i.e. Nera, 2012). It is important in this discussion to be aware of the hard technological constraints currently present in the market, and how these constraints impact the relationship between markets.

Methods

The paper is primarily concerned with the theoretical implications of irreversibility in transportation commitments. We define a trade licence option and proceed to investigate its valuation process under optimal shipping decisions. We then explore theoretically the comparative statics of the licence value. We continue by exploring the effects of timing considerations in transportation decisions on cross market price spread dynamics. The analysis is put in context of recent literature on LNG trade and market conditions, as well as policy discussions on LNG trade liberalization and expansion.

Results

The value of a perpetual trade licence with irreversible time commitments is shown to depend positively on cross-market price volatility and negatively on existing degree of market integration. A high degree of market integration reduces the persistence of arbitrage opportunities in the trade and so reduces the value of a trade licence. As expected, shipping-time negatively affects the trade licence value.

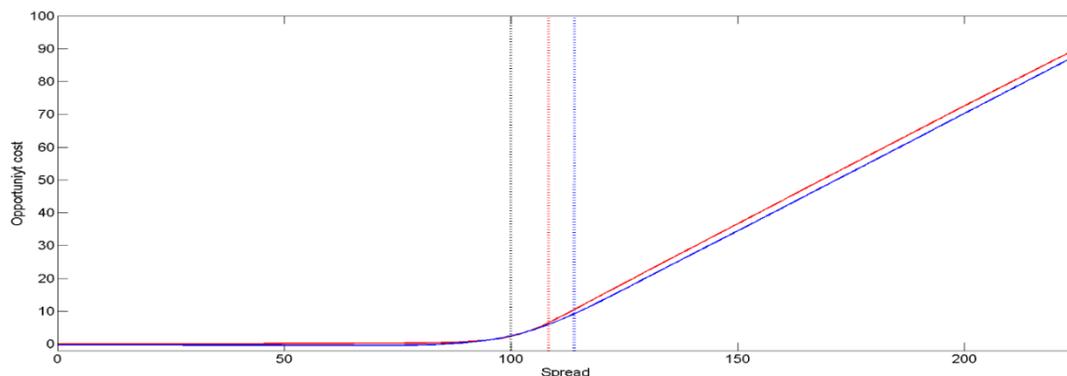


Figure 1. Unit opportunity cost (option value) of trade commitment as function of the terms of trade under low spread volatility (red line) and high spread volatility (blue). Black vertical line shows the direct transportation cost (100). Red and blue vertical lines show the threshold spread above which a trade commitment occurs.

The option value present in the trade licence leads to a full economic transportation cost that includes the direct transportation cost as well as the opportunity cost of committing to trade. When accounting for the opportunity cost, trade does not necessarily occur when the price spread exceeds the direct transportation cost. Figure 1 illustrates this. Here the opportunity cost of a trade commitment is plotted as a function of the price spread. The black vertical line shows the direct transportation cost (100 in this example). The red and blue vertical lines show threshold prices above which a trade commitment is made. This highlights that when transportation is time consuming, comparing the spread to the direct transportation cost is not sufficient to determine whether arbitrage is present in the market.

The full transportation cost depends on the direct transportation cost plus the opportunity cost due to exercising the option. As seen in figure 1, the opportunity cost is positively related to the cross-market price spread (foreign minus domestic natural gas price). This creates an endogenous economic transportation cost. The positive correlation reduces the rate of cross-market price convergence. Our results show how irreversible time commitments create barriers to market integration. Empirically this will appear as a persistent arbitrage opportunity when compared to the direct transportation cost. This provides a theoretical backing of the empirical findings in Yegrov and Dehnavi (2012) and Oglend et al (2016), which show that lack of arbitraging in LNG trade is due to constraints and not inefficiencies. If there is a market for transportation capacity (as is the case for LNG freight), freight rates will directly reflect this opportunity cost.

Conclusions

Our paper provides a theoretical justification of previous literature on LNG trade that shows limited cross-market natural gas price convergence and limited arbitrage opportunities despite large price spreads. In our model, irreversible time commitments in trade creates a timing option on trade commitments that introduces an opportunity cost to trade that is positively correlated to the price spread itself. Because the opportunity cost of committing to trade increases as the terms of trade improves, the degree of market integration is reduced. This highlights an important barrier for LNG in creating a fully globally integrated market for natural gas.

References

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