Valuation of Interconnector Transmission Rights – Do Auction Prices Reflect Option Values?

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Introduction

In electricity markets, the right to trade power over an interconnector by holding transmission access rights can be viewed as a spread option on the spot prices of electricity between connected markets. Furthermore, the need to trade power over interconnectors according to short-term operational factors is increasing with the proliferation of wind generation, which challenges system operators to integrate high levels of intermittent power sources. From a financial perspective, curtailment of wind due to transmission constraints results in lower returns to investors. Thus, the operation of interconnectors creates subtle financial and operational interrelations of optionality and flexibility.

Finance theory shows that volatility increases option value, Black and Scholes (1973), Margrabe (1978). Electricity cannot be stored and surges in demand create spikey and volatile prices (Bhanot, 2000; Carmona and Durrelman, 2003; Cartea and Gonzalez-Pedraz, 2012; Clewlow and Strickland, 2000; Eydeland and Wolyneic, 2003; Huisman and Mahieu, 2003). These properties explain the significant value which can be attributed to the option to trade power from a low price to a high price region by owning the rights to access an interconnector. Intermittent wind generation adds further volatility to prices, potentially increasing the value of transmission rights between markets with varying levels of wind penetration that are not perfectly correlated.

EU national governments meeting in Barcelona in 2002 agreed to a goal of interconnection levels of at least 10% of their installed production capacity by 2005. However, these goals have not been met, Platts EU Energy (2010). De Nooij (2010) suggests interconnector investment is risky, and while the European Commission has

called for more investment in interconnectors it has not been forthcoming. Further investment in interconnectors may be hampered by European Commission regulations (Regulation (EC) No 714/2009 Article 2 (2) (C)) which provide that interconnector owners can only charge interconnector users for using the interconnector when congestion exists. Congestion is defined as *"a situation in which an interconnector linking national transmission networks cannot accommodate all physical flows resulting from international trade requested by market participants, because of a lack of capacity of the interconnectors and/or the national transmission systems concerned".*

The valuation of interconnector transmission rights raises both theoretical and policy questions. While there is an emerging body of literature on the role of transmission rights in market integration (Bunn and Martoccia, 2010) and (Bunn and Zachmann 2010), the usage and pricing of interconnector transmission rights with high levels of wind penetration is not well understood. Given the level of investment needed for European countries to reach Barcelona targets on interconnection and increasing levels of wind penetration required to meet European Union 2020 targets EU (2009), the valuation of transmission access rights with higher levels of wind generation assumes increased importance.

Research indicates that explicit transmission capacity auctions act as a barrier to trade and increase transaction costs (De Vries, 2001; Turvey, 2006). While the policy goal is for an integrated European electricity market, it is likely that explicit transmission rights auctions will continue for the coming years. Despite persistent price differentials between the Irish (SEM) and British (BETTA) electricity markets, explicit transmission capacity auctions are undersubscribed, transmission rights acquired in auctions are not fully utilised and power flows appear to be against the price spread. We explore what specific factors are reducing market efficiency for transmission rights between Ireland and Britain.

Research Approach

We examine if auction prices for transmission rights are well represented by either an arbitrage or options valuation approach. We explore the approach to valuing interconnector access rights based on the methodology of Cartea and Gonzalez-Pedraz (2012) who propose the value of an interconnector is equivalent to holding a strip of European-style options (Bull Call Spreads) on the price spread between the two power markets. This approach is also consistent with the spread option methodology proposed by Hull (2003) and Rosenberg et al (2010).

We use empirical data for three years of power trading across the Moyle interconnector between Ireland and Britain to test if interconnector access prices exhibit arbitrage or option-like characteristics and to see if power flows in the efficient arbitrage direction. This approach extends earlier analysis by (Bunn and Zachmann 2010) and (Bunn and Martoccia 2010). We also explore the hypothesis that high levels of wind penetration can distort power flows and lead to suboptimal pricing of transmission capacity as wind is intermittent and difficult to predict.

Insights

We find support for the hypothesis that auction prices for transmission rights are undervalued vis-à-vis both arbitrage and option valuations. We also find power flows against the efficient price spread direction. A survey of a group of experts with an interest in trading power between Ireland and Britain inform a number of possible explanations for the apparent inefficiency. These include market misalignment due to micro-structure issues, e.g. gate closure, contract size, lack of liquidity in the market for transmission rights, risk in transmission rights trading, intermittent wind and strategic behaviour by dominant firms. Asymmetric transmission costs as well as capacity payments based on flows rather than availability may create a larger 'deadband' in transaction costs than is usual with interconnector trading.

The effect on interconnector valuation of high levels of wind penetration is not well documented in the literature. This research identifies a number of potential impacts: in a system with high level of wind penetration (such as Ireland) one might expect to see an increase in exports during windy periods (assuming the price spread favours exports). However, we find this not to be the case. The fact that capacity payments in the Irish electricity market (SEM) are paid based on flows rather than availability may deter exports during windy periods potentially creating a "deadband" which may results in suboptimal power flows. Another potential explanation highlighted in survey responses are the high costs associated with fast start plant required to balance wind: in windy periods, fast start plant cost is a high percentage of the total energy price and fast start costs are difficult to predict. Because of ex-poste pricing in SEM, generators are concerned with being "short" the market and the price volatility associated with high costs of fast start plant in windy periods adds to this risk. The challenges in accurately forecasting wind makes it more difficult to forecast prices and hence value transmission rights. There are significant price differences between ex ante and ex poste pricing in the SEM. The high penetration of wind and the inability to reliably forecast wind beyond six hours or so may explain the poor predictive power of ex ante prices for ex poste prices in SEM. Interconnector flows are scheduled based on ex post pricing using best estimates for wind output, however if the wind comes up, actual power flows may appear to be against the price spread. While we find weak empirical support for this explanation based on our survey responses, it is a concern for market participants. These findings are relevant in the context of European market harmonisation where wind curtailment will only be avoided where there is adequate interconnection investment. However, this much needed investment will only be forthcoming when market misalignments are removed and the financial risk of volatile prices associated with high levels of wind penetration are addressed.

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