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Valuation anomalies for interconnector transmission rights

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HIGHLIGHTS

- ▶ Valuation anomalies for transmission rights highlight lack of market integration.
- ▶ Exports constrained from market with ex post pricing and no hedging mechanisms.
- ▶ High start-up costs for balancing plant may deter exports from high wind regions.
- ▶ Deadband created by capacity payments based on flows versus availability.

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ABSTRACT

Whilst the acquisition of physical transmission interconnector rights between two or more electricity markets can be structured as spread options on the spot prices of electricity between connected markets, empirical evidence suggests that actual prices may be quite different. This raises issues for the valuation of transmission rights, particularly in the European context of market harmonisation, and the use of transmission rights with increasing levels of wind penetration. We examine the price differentials between the Irish and British electricity markets, where explicit transmission capacity auctions have been persistently undersubscribed and transmission rights acquired but not fully utilised. We find significant empirical indications that auction prices for transmission rights are undervalued against both arbitrage and spread option valuations. We also find significant 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 inefficiencies. These include ex-post pricing in the Irish market, intermittent wind and strategic behaviour by dominant firms.

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1. Introduction

Whilst price convergence of regional electricity markets is generally the efficient policy target, full integration may not be possible when the markets operate under separate jurisdictions. In these circumstances, wholesale trading is frequently undertaken through the acquisition of ad hoc capacity rights on designated interconnection transmission lines. Nevertheless, the benefits of increasing such interconnector capabilities and trading are well understood and include increased competition, improved security of supply, lower consumer prices and reduced reserve requirements (Cornwall, 2008; Hobbs et al., 2005; Neuhoff and Newbery, 2004; Turvey, 2006). If markets are efficient, and there is sufficient interconnector capacity available, we would expect to

see wholesale² prices between regional markets converge through arbitrage, but full price convergence between two regional markets may be limited by the size of interconnector capacity (Borenstein et al., 2000; Moselle et al., 2006; Malaguzzi Valeri, 2009). Because relative market sizes and levels of interconnection vary, regulatory and competition authorities have tended to measure market efficiency in trading between two power markets based on the prices for transmission access (interconnector) rights converging towards the price spread between the connected regions European Commission (2007).

However, a valuation principle for interconnector transmission rights is still an emerging theme in research. It is clear that the volatile and spiky properties of electricity spot prices (Bhanot, 2000; Carmona and Durrelman, 2003; Cartea and González-Pedraz, 2012; Clewlow and Strickland, 2000; Eydeland and Wolyniec, 2003; Huisman and Mahieu, 2003), together with its non-storability, explain the significant value which can be attributed to the option

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E-mail addresses: c.mcinerney@ucc.ie (C. McNerney),dbunn@london.edu (D. Bunn).¹ Tel.: +44 207 0008827.² Note that we do not address retail price convergence and so all references to prices throughout this paper are wholesale.

to trade power from a low price to a high price region, e.g. by owning the rights to access an interconnector. Bunn and Martoccia (2010) note that while real options have been used extensively for valuing investments in power generation, for gas storage facilities and for service contracts in demand side management schemes, it is on open question how well spread options can represent ex-ante transmission rights prices.

The importance of this question of valuation is significant for a number of reasons. Price convergence between regions has efficiency gains and perhaps nowhere has these been given greater emphasis than in the European Union (EU) where the creation of a single market for goods and services has included electricity markets in a series of legislations. Furthermore, the valuation of transmission rights between the electricity markets assumes increased importance as the level of intermittent renewable generation increases and as energy security issues increase the need for clear investment signals. In this study we look at interconnection between the separate electricity markets of Britain and Ireland, two regions where these issues of market rule harmonisation, wind penetration and energy security have particular prominence. Research is clear that explicit transmission capacity auctions increase transaction costs and may create a barrier to trade (De Vries, 2001; Turvey, 2006), and so in the EU, the “Target Model” is full integration of the markets, to be implemented by 2014. In a fully price coupled market, power exchanges would schedule power flows between regions based on the bids and offers on both exchanges to find a joint market clearing position and interconnector owners would be compensated based on these power flows. While a “flow-based” model of market coupling is the European ideal, given the practical challenges of integrating market systems and inadequate interconnector infrastructure, it is likely that explicit auctions for interconnector capacity will continue for some time. Ireland has been granted derogation from this “Target Model” until 2016 (SEM, 2012). Since it is important to distinguish between Direct Current (DC) and Alternating Current (AC) interconnectors, it should be noted that the Moyle interconnector between Ireland and Great Britain is a DC interconnector and does not therefore suffer some of the loop flows issues that are more common in the meshed power systems in continental Europe.

Transmission rights to trade power on the Moyle interconnector between Ireland³ and Britain⁴ are acquired explicitly ahead of time and so have option-like characteristics as they convey the right but not the obligation to trade the spread between the two markets. The central hypotheses tested in this paper is whether transmission access rights on the Moyle interconnector exhibit arbitrage or option-like characteristics and whether transmission auction prices are undervalued vis-à-vis their option value. A further question is to what extent power flows in the direction of efficient price arbitrage, and if not, what is the welfare loss to electricity consumers as result?

Market data for the Irish Single Electricity Market (SEM) and British Electricity Trading Transmission Arrangements (BETTA) spot electricity markets and transmission access rights across the Moyle Interconnector which links the two markets are analysed to test these hypotheses. There is support for the hypotheses that the monthly auction price of transmission rights are undervalued compared to their arbitrage and to their option values. There is also evidence that power flows against the efficient arbitrage direction result in significant welfare loss. Based on our initial finding, a survey of a group of experts with an interest in trading power across the Moyle interconnector was conducted to inform these apparent pricing inefficiencies for transmission rights. Survey results indicate

Table 1
Transmission access costs in (£/MW month).

| Access month | Auction date | Monthly auction data | | | |
|--------------|-----------------|----------------------|---------|-----------------|---------|
| | | Export capacity | | Import capacity | |
| | | £/MW month | MW sold | £/MW month | MW sold |
| Nov | 2007 25/10/2007 | £500 | 5 | £5156 | 50 |
| Dec | 2007 23/11/2007 | £2095 | 45 | £0 | 0 |
| Jan | 2008 19/12/2007 | £502 | 10 | £2013 | 20 |
| Feb | 2008 25/01/2008 | £0 | 0 | £2013 | 20 |
| Mar | 2008 22/02/2008 | £0 | 0 | £501 | 40 |
| Apr | 2008 26/03/2008 | £0 | 0 | £662 | 130 |
| May | 2008 25/04/2008 | £0 | 0 | £502 | 130 |
| June | 2008 23/05/2008 | £0 | 0 | £502 | 100 |
| Jul | 2008 25/06/2008 | £0 | 0 | £0 | 0 |
| Aug | 2008 25/07/2008 | £0 | 0 | £0 | 0 |
| Sep | 2008 26/08/2008 | £0 | 0 | £0 | 0 |
| Oct | 2008 25/09/2008 | £702 | 75 | £0 | 0 |
| Nov | 2008 24/10/2008 | £1458 | 80 | £0 | 0 |
| Dec | 2008 24/11/2008 | £1100 | 80 | £388 | 100 |
| Jan | 2009 22/12/2008 | £1529 | 40 | £200 | 180 |
| Feb | 2009 26/01/2009 | £750 | 80 | £300 | 230 |
| Mar | 2009 23/02/2009 | £450 | 80 | £353 | 285 |
| Apr | 2009 25/03/2009 | £450 | 80 | £800 | 190 |
| May | 2009 24/04/2009 | £0 | 0 | £820 | 195 |
| June | 2009 22/05/2009 | £0 | 0 | £956 | 195 |
| Jul | 2009 24/06/2009 | £100 | 80 | £1260 | 195 |
| Aug | 2009 24/07/2009 | £0 | 0 | £2253 | 195 |
| Sep | 2009 24/08/2009 | £0 | 0 | £2402 | 195 |
| Oct | 2009 24/09/2009 | £0 | 0 | £1000 | 60 |
| Nov | 2009 23/10/2009 | £0 | 0 | £1800 | 100 |
| Dec | 2009 24/11/2009 | £0 | 0 | £2083 | 100 |
| Jan | 2010 21/12/2009 | –£744 | 80 | £2300 | 100 |
| Feb | 2010 25/01/2010 | –£744 | 80 | £2350 | 100 |
| Mar | 2010 22/02/2010 | –£744 | 80 | £2449 | 100 |
| Apr | 2010 24/03/2010 | –£744 | 80 | £2423 | 110 |
| May | 2010 23/04/2010 | £0 | 0 | £2640 | 110 |
| June | 2010 24/05/2010 | –£756 | 80 | £2985 | 110 |
| Jul | 2010 24/06/2010 | –£818 | 80 | £3686 | 110 |
| Aug | 2010 23/07/2010 | –£818 | 80 | £3455 | 110 |
| Sep | 2010 24/08/2010 | £0 | £0 | £3333 | 110 |

Table 2
Arbitrage profits explaining actual transmission costs—imports.

| Independent variables | R-squared (%) | Coefficient | T-Stat | p-value |
|-----------------------------------|---------------|-------------|---------|----------|
| <i>Ex ante prices (2007–2010)</i> | 24.93 | 0.18274 | 3.25979 | 0.00264 |
| <i>SMP+4 prices (2007–2010)</i> | 26.24 | 0.18311 | 3.37367 | 0.001955 |

Table 3
Arbitrage profits explaining actual transmission costs—exports.

| Independent variables | R-squared (%) | Coefficient | T-Stat | p-value |
|-----------------------------------|---------------|-------------|---------|---------|
| <i>Ex ante prices (2007–2010)</i> | 6.76 | 0.03987 | 1.52311 | 0.13755 |
| <i>SMP+4 prices (2007–2010)</i> | 5.47 | 0.03756 | 1.36106 | 0.18300 |

that unharmonised market rules, including ex-post pricing in the SEM, intermittent wind, and the long term hedging strategies of electricity suppliers undermine the arbitrage and option valuations.

This paper makes a number of contributions; first, if transmission rights are not well represented by arbitrage or options valuations, these valuation anomalies may be indicative of underlying structural market misalignment. It may also provide evidence of strategic behaviour by dominant firms or market distortions caused by high levels of wind penetration. In a market with ex post pricing and no derivatives contracts (as in the Irish SEM), the valuation of

³ Ireland in this context is defined to include both the Republic of Ireland and Northern Ireland.

⁴ Britain in the context of the electricity market is defined to include England, Scotland and Wales and excludes Northern Ireland.

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