An Investigation into the Gas Trades across the Interconnector Pipeline between the UK and Belgium: Do Gas Flows Follow Price Spreads?

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ABSTRACT

Market integration between the UK and continental Europe depends largely on the bi-directional natural gas pipeline between Bacton in the UK and Zeebrugge in Belgium operated by Interconnector (UK). Physical gas trades through the Interconnector cross at least three third-party access policies while two is common in Europe since gas markets are generally physically adjacent. The use of the Interconnector is studied in order to evaluate cross-border gas competition and gas price convergence between the markets at both ends of the Interconnector pipeline. Gas flow direction changes and price responsiveness of gas trades through the Interconnector are investigated by examining flow nominations and actual physical flows for each day between 1 January 2011 and 31 December 2013 using day-ahead gas prices. The paper examines whether market anomalies may be observed. If this appears to be the case, remedies are suggested for further improvement of the regulatory regime. This analysis fits into the current transition to a fully regulated regime for the Interconnector in accordance with the European Third Energy Package.

Keywords: market integration, natural gas, price convergence
JEL-code: K23, L51, L95

1. INTRODUCTION

The paper examines the gas flow efficiency in the only bi-directional gas pipeline between the UK and continental Europe. The physical bi-directionality of the cross-channel Interconnector was rapidly valued by the market for short term trading (arbitrage) rather than for cross-border bulk gas transportation. This trading role is further intensified as gas import dependency in the UK is growing and gas demand volatility is increasing due to wind and solar generation. The pipeline is nowadays a vital connection for cross-border gas competition and gas price convergence at the adjacent virtual trading points (VTPs). Cross-border trades are considered to be economically efficient if gas flows from a lower-priced market to a higher-priced market ("Law of One Price"). If these flow patterns according to price signals are not the case, there may be barriers to trade which are typically addressed by national regulatory authorities (NRAs) for the sake of efficient market-functioning and security of supply.

Interconnector (UK) Limited (IUK) owns and operates the 235 km cross-channel pipeline running from Bacton in the UK to Zeebrugge in Belgium which became operational in October 1998. Following further enhancement projects, the Interconnector is currently able to transport 20 billion cubic meters per annum (bcm/y) in the forward mode to Belgium and 25,5 bcm/y in the reverse mode to the UK (interconnector.com). In other words, the throughput capability of the Interconnector equals a forward supply volume higher (+15%) than the domestic Belgian market and a reverse supply volume of approximately one third of the UK gas market.

There are basically two underlying markets explaining the use of the Interconnector. Firstly, the offer by operator IUK of capacity services which are bought by the shippers determines the access to the Interconnector by traders. Herein are transmission tariff rules and levels of key importance to identify the transaction costs of arbitrage. Secondly, the cross-border gas trading market determines the utilization and flow direction of the booked capacity. Obviously, the functioning of both markets and the interrelationship ultimately determine the efficiency of the Interconnector. The study of possible anomalies in gas patterns may give evidence of constraints on trading between both ends of the Interconnector: limitations in liquidity or competition in either of the two markets and/or limitations in the ability to transport between both markets. Therefore the capacity sales and the business rules of IUK are of key importance to facilitate cross-border trading and competition as well as security of supply.

IUK has entered into a regulated business since the 'Third Energy Package'(TEP) agreed in European legislation in 2009[1]. The national regulatory authorities in the UK (Ofgem) and Belgium (CREG) are nowadays in charge of regulating and supervising IUK. The regulatory framework foresees European network codes to harmonize the capacity allocation, gas flow nominations and tariff arrangements at interconnection points (IPs) across Europe. These developments will help to remove any remaining barriers for trade and reinforce the role of Interconnector in integrating gas markets in North West Europe.

This paper examines whether market anomalies may be observed from the actual use of the Interconnector. If this appears to be the case, remedies will be suggested for further improvement of the regulatory regime. Flow direction changes and price responsiveness of the gas trades through the Interconnector are investigated by examining flow nominations and actual physical flows for each day between 1 January 2011 and 31 December 2013 using day-ahead gas prices.

The paper is organized as follows. First, section 2 gives a brief overview of the regulatory context and method for the assessment. The empirical analysis starts in section 3 by addressing the gas trades between the connected gas markets. Next, section 4 examines the price convergence and section 5 the flow efficiency. Section 6 presents a broader view by benchmarking VTPs in North West Europe. Section 7 discusses the main findings and policy implications. Finally, section 8 provides conclusions.

2. REGULATORY CONTEXT AND METHOD

2.1 Access to the Interconnector

Mature VTPs[2] are generally physically connected through various cross-border interconnections able to flow gas in both directions[3]. The connection NBP and Zeebrugge Beach/ZTP is an exception since both well-developed markets are linked with an offshore pipeline in between. Moreover, the Interconnector is the only physically bi-directional link between NBP and the continental Europe since the BBL line (between the Netherlands at Julianadorp and the UK at Bacton) is currently only able to flow physically from the Netherlands to the UK. Obviously, the physical integration is very sensitive for shutdowns and planned maintenance as well as for security of supply issues.

[1] The EC Third Energy Package refers to the legislative package consisting of Directive 2009/73/EC (EC, 2009a) and Regulation (EC) No 715/2009 (EC, 2009b).

[2] A virtual trading point (VTP) is a market area for the sale, purchase and exchange for natural gas (also referred to as hubs and closely linked to the entry-exit model). The paper focuses on the British VTP National Balancing Point (NBP) and the Belgian VTP Zeebrugge Trading Platform (ZTP) together with the trading zone Zeebrugge Beach which is not notional. Following VTPs are also considered: Dutch TTF (Title Transfer Facility), both German VTPs: Gaspool and NCG (Net Connect Germany) as well as PEG Nord in Northern France.

[3] Bi-directionality is required by Regulation (EC) No 994/2010 (EC, 2010).

Access to the Interconnector[4] is not yet subject to a truly regulated third-party access (TPA) regime with regulated tariffs for access. However, initiatives are ongoing to move to a fully regulated model applicable from the 1st of October 2018.

With the target of a regulated regime in mind, IUK aligns to rules from the TEP (EC, 2009a and 2000b) but the current model is basically a negotiated TPA regime meaning that access is in the hands of a group of large shippers/suppliers on the market (in total 13, interconnector.com). The primary capacity in both directions has been allocated based on 20 year contracts which are due to expire in 2018 (1st October). Third parties have to negotiate with them to get firm capacity. Alternatives to get capacity is seeking for capacity on the secondary market or to request additional capacity from IUK offered according to principles inspired on the CMP Guidelines (Congestion Management Procedures Guidelines) (EC, 2012 and 2014). A specific consultation on the implementation of CMP was carried out by IUK on 30 April 2013 to gain feedback from the market (IUK, 2013). As a matter of fact, contractual congestion on the Interconnector reveals since all primary capacity is sold on a long term basis (until 1 October 2018) and additional demand from third parties can only be met by release already contracted capacity and by applying the congestion instruments provided by the CMP Guidelines.

2.2 Related Empirical Studies

Various studies already address the utilization ok the Interconnector and the importance of this link for market integration between the UK and continental Europe as well as for security of supply. An excellent recent empirical assessment can be found in Petrovich (2013). This study spends extensive care to appropriate price indices before demonstrating high correlation coefficients between European gas hubs. A difficult area since a significant level of gas trades is bilateral on the OTC markets (Over the Counter) and not on trading exchanges (net physical volume in Belgium: 85% OTC and 15% exchange; huberator.com). Two other empirical studies of the Oxford Institute for Energy Studies (Futyan, 2006 and Heather, 2012) helped to set the scene for this paper.

On the 1st of October 2012 the national regulatory authorities of the UK, the Netherlands and Belgium launched a call for evidence on the use of the gas interconnectors on Great Britain's border and on possible barriers to trade (Ofgem, NMa and CREG, 2012). The received feedback by the respondents has led to a joint review specifying further analysis and next steps in July 2013 (Ofgem, ACM and CREG, 2013). This joint exercise was very useful to determine next steps and to deliver recommendations focusing on the implementation of the European network codes (e.g. the Network Code on Capacity Allocation Mechanisms, 2013).

This paper aims at adding more empirical evidence and insights by i) addressing the Interconnector (IUK) from a Belgian market position in which the particularities of the Belgian market organization are taken on board (e.g. the double hub structure of Zeebrugge Beach and VTP ZTP), ii) focusing on the efficiency of flows and iii) keeping a regulatory view on addressing any barriers for trade given the fact that IUK has entered into a regulated business since the "Third Energy Package".

2.3 Double Hub Structure and Data

The introduction of the entry-exit model in Belgium on the 1st of October 2012 implemented a VTP called ZTP (Zeebrugge Trading Platform)[5] besides the Zeebrugge Beach trading place in

[4] This paper will, for convenience, use Interconnector to refer to the interconnector pipeline between Bacton and Zeebrugge and use IUK to refer to the operator (TSO, transmission system operator).

[5] In fact it is ZTP H since this is the virtual trading point for high calorific gas (H-gas). There is also a ZTP L for the separate system for low calorific gas (L-gas) which covers almost 30% of Belgian gas consumption.

the Zeebrugge area (also called ZEE which is not notional and physically within the zone composed by the Norwegian Zeepipe terminal, Interconnector UK, Zeebrugge LNG terminal)[6]. Zeebrugge Beach is an important OTC market and may be considered as the successor of the previously called Zeebrugge hub. ZTP is however the Belgian VTP and important as the balancing market for Belgium. This structure means for instance that trade from ZTP to NBP has to pay a regulated (by CREG) exit tariff on the Fluxys Belgium grid (and next a currently non-regulated fee on the Interconnector and a regulated (by Ofgem) entry tariff (reserve price) on the National Grid (National grid, 2014). Shippers solely active in Zeebrugge Beach pay a regulated annual fee (one may call it an "annual season ticket") to do physical transactions in the Zeebrugge area (Zeepipe terminal, Interconnector, Zeebrugge LNG terminal) and pay no exit tariffs. They pay for instance no exit tariff to move to the Interconnector but pay a regulated entry fee to enter ZTP as is the case at all interconnections to enter ZTP. This means that shippers in the Zeebrugge area are not yet in the notional area of Fluxys Belgium. This dual organization has immediately two direct methodological impacts for the study: i) determination of the reference price index since trades take place on the VTP ZTP as well as on Zeebrugge Beach and ii) transmission costs to deliver gas from Belgium to the UK differ whether the shipper is active on the VTP ZTP (may be considered as a balancing hub) or solely active on the Zeebrugge Beach (may be considered as a transit hub).

In order to cope with the first issue, ZTP versus Zeebrugge Beach, the paper (re-) defines the virtual trading point ZTP by incorporating Zeebrugge Beach. Hence, all the trade from Zeebrugge Beach to the UK is covered by the 'new' ZTP definition. A daily day ahead end-of-day price (daily DA EOD price) is derived from ICIS Heren (icis.com) and managed in a CREG database together with various other gas price information sources (ice.com, eex.com, powernext.com) to cover the VTPs in North West Europe. It is worthwhile to mention that the analysis of the price data demonstrated a high correlation between OTC and exchange gas prices. Furthermore the TTF DA gas prices and the ZTP DA gas prices are substitutable price indicators.

Gas trades through the Interconnector are investigated by examining flow nominations and actual physical flows for each day between 1 January 2011 and 31 December 2013 measured at the Interconnetor Zeebrugge Terminal (IZT) as published by Fluxys Belgium (gasdata.fluxys.com). There are planned annual maintenance periods which require a complete shutdown of the Interconnector. These periods were in the considered time horizon: 7 September to 22 September in 2011, 13 June to 28 June in 2012 and 12 June to 27 June in 2013. During these closed periods, price spread tend do diverge but rapidly converge again as soon as the Interconnector is again operational. The paper corrects, where needed, the analysis for these periods of planned maintenance.

2.4 Transaction Costs

The paper uses day-ahead (DA) prices primarily because the DA market is the most mature and liquid market. Hence, the gas prices are an indication of the short-term market value of gas. In the short-term (DA), the marginal cost of transportation converges to zero for shippers with an active portfolio of capacity rights on a longer basis than daily (bought on the regulated primary capacity market). This holds especially in regimes where the tariff consists basically only of a capacity fee (e.g. transmission between ZTP and TTF). Alternatively, marginal cost of transportation converges to the commodity fee in systems where the tariff consists of a capacity

[6] Zeebrugge Beach is not within the entry-exit system of Fluxys Belgium (ZTP) and allows wheeling/trading between the 'flanges' in the Zeebrugge area: Zeepipe terminal, LNG terminal and Interconnector Zeebrugge Terminal (IZT). A flat regulated fee applies for the usage of the Zeebrugge Beach and injection of gas from Zeebrugge Beach into the Interconnector does not incur a specific exit tariff in Belgium. However, to inject gas from Zeebrugge Beach into the entry-exit system of Fluxys Belgium (ZTP) incurs a regulated entry fee.

as well as a commodity fee (e.g. current tariffs applied by National Grid, see nationalgrid.com and national Grid, 2014). Day-ahead arbitrage by buying capacity on a daily basis on the secondary market seems by nature an economic inefficient practice. Collectively in a situation of no contractual congestion (without congestion rents) and a liquid secondary market for capacity (efficient price arbitrage implies also an efficient arbitrage of capacity), the marginal transportation costs tend to zero (the more transmission tariffs are defined as capacity fees - to be paid independent of usage). This assumption is further underpinned by an increasing trend of swapping trades between VTPs which allows to trade cross-border without physically capacity use. Exchanges respond on this trend by offering so-call spread products between markets. These dynamics on the gas trading side of the market have a considerable impact on price alignment on wholesale markets (VTPs) and the market for cross-border capacity.

The current IUK practice makes the situation regarding transaction costs (and price arbitrage) somewhat complex. Firstly, all the capacity rights are in the hands of a group of shippers/traders. Shippers not belonging to this group can basically only get capacity on the Interconnector if someone is willing to release and sell capacity. This buying and selling is bilaterally negotiated. The analysis of the market for Interconnector capacity and the existence of any barriers in this market, are not within the scope of this paper. The paper does not focus on mechanisms and arrangements within the current and different TPA-regimes but, instead, study market outcomes reflected in actual flow nominations, physical flows and price spread between the markets. However, it is argued that i) a fully regulated capacity model provides intrinsically a level-playing field for TPA as has been demonstrated for interconnectors elsewhere between European VTPs and ii) a path is currently paved to achieve a regulated regime by the 1st of October 2018. In the meantime, IUK is applying rules anticipating the application of the TEP. Therefore, it is important to recognize this regulatory transition in which one of the aims is to achieve a truly market integration according to rules applicable elsewhere on EU interconnectors. In this sense, it is rather a matter of harmonization in order to facilitate the market than a remedy of any barriers.

Previous discussion and, in addition, the current specific regime in the Zeebrugge area for shippers only active in Zeebrugge Beach (e.g. flat fee) together with the growing dynamics and innovations in cross-border gas trade (e.g. swapping of trades) motivate that abstraction is made of transmission costs at the outset of the study but the significance of transmission costs is evaluated in the empirical part of the paper.

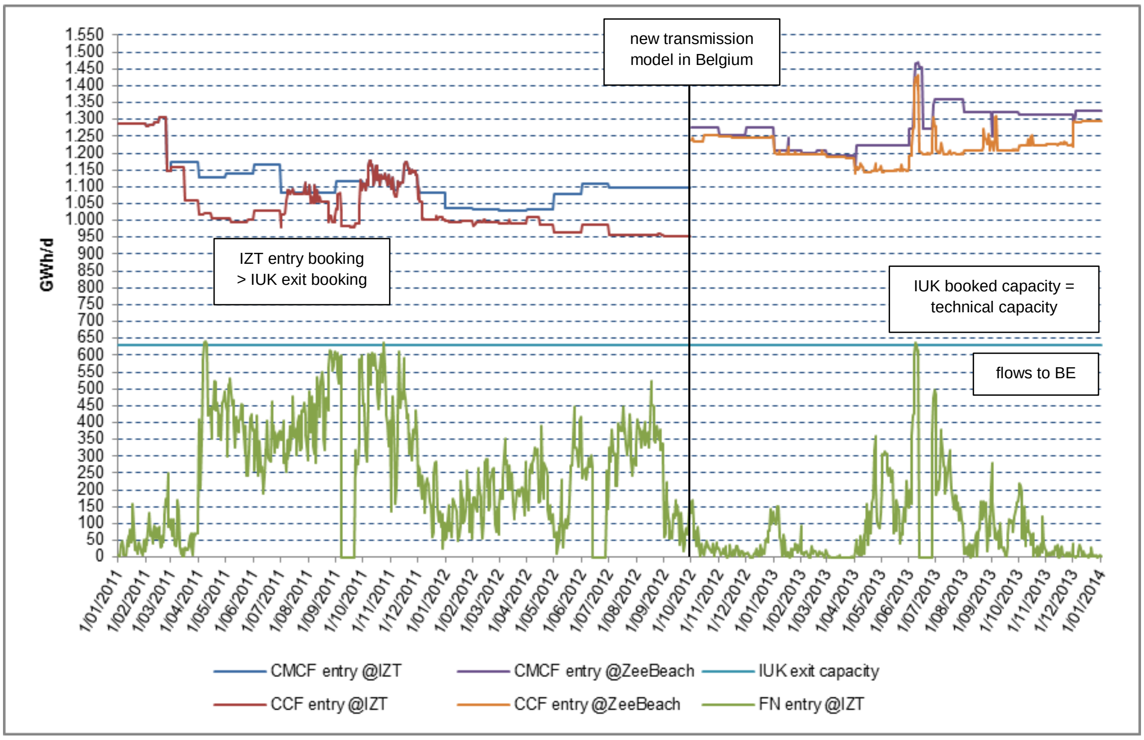
3. GAS TRADES

The Interconnector flow direction[7] as well as the transported volume result from a number trades between the markets at both ends of the pipeline. Each trader (shipper) may have several trades for physical transactions the next day and in more than one direction. The net result of the individual trades is the shipper's final flow nominations for the next day in one or the other direction. These flow nominations are constrained by the booked capacity and must match with those of the connected systems: National Grid NTS, Interconnector UK and Fluxys Belgium. The actual physical flow through the Interconnector depends on the netting of the individual final nominations of the shippers. This section examines gas trades measured at the Interconnector Zeebrugge Terminal (IZT) where the Interconnector is connected to the Belgian gas transmission network operated by Fluxys Belgium.

Figure 1 addresses the forward pattern on the Interconnector towards Belgium. The daily final flow nominations at IZT for gas trades from the UK to Belgium are presented for the period between 1 January 2011 and 31 December 2013.

[7] The physical switch of direction normally takes up to 4 hours (interconnector.com).

Figure 1: Daily Final Flow Nominations at Interconnector Zeebrugge Terminal (IZT) for ZTP Entry Belgium (GWh/day)



Source: CREG dataset derived from gasdata.fluxys.com; interconnector.com

The nominated firm entry capacity (FN entry @IZT) for physical gas trades to ZTP is strongly decreasing and knows a growing volatility and seasonality. Trades to ZTP are more and more concentrated in the summer period. The average FN entry @IZT amounts to 180 GWh/d [min: 0 GWh/d; max: 630 GWh/d] with a relative standard deviation of 95%. The average FN entry @IZT amounts in 2011 to 291 GWh/d and declines progressively to 163 GWh/d in 2012 (-44%) and 86 GWh/d in 2013 (-47%). This trend mirrors in the average nomination levels at the Interconnector exit at Zeebrugge: 46% in 2011, 26% in 2012 and 14% in 2013. Average nomination levels of volatile patterns are somewhat misleading with regard to the market needs since peak nomination of 100% are observed.

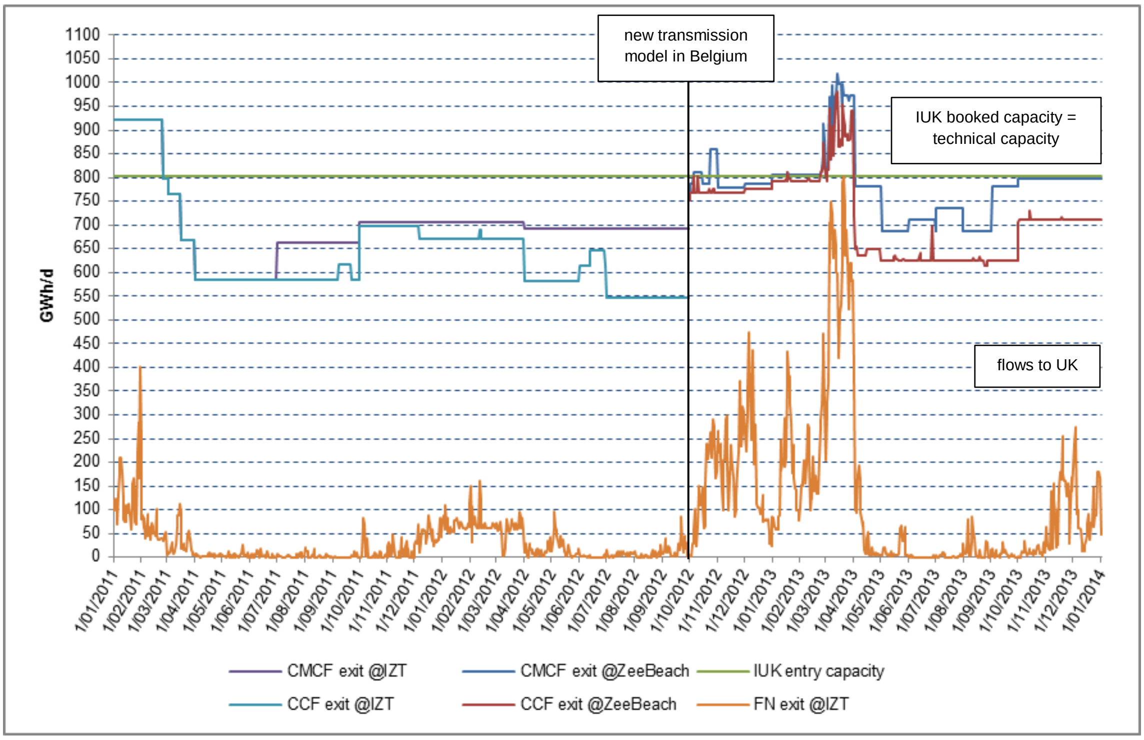
The commercial maximum firm capacity (CMCF entry @IZT) that TSO Fluxys Belgium offers for access to ZTP varies block-wise. The capacity offer was structurally modified when a full entry-exit model was introduced in Belgium on the 1st of October 2012 together with the double hub structure: Zeebrugge Beach for OTC trade in the Zeebrugge area and the notional trading point ZTP. From that moment onwards, the entry capacity at Zeebrugge Beach for access to ZTP presents a better indicator for the capacity availability since wheeling is allowed within the Zeebrugge area between ZPT (Zeepipe terminal), IZT and the LNG terminal. The offered exit capacity on the Interconnector at Zeebrugge amounts to 630,0 GWh/d, is stable over the considered period and fully booked (contractual congestion).

Figure 1 shows that the offered entry capacity at IZT by Fluxys Belgium is considerable higher than the exit capacity of the Interconnector pipeline at Zeebrugge. The calculation of technical entry capacity at IZT on the Belgian side is more dynamic because capacities are calculated from a network optimization approach including the potential of shifts of capacity from one interconnection to another. This dynamic approach allows a more flexible offer of capacity according to the specific market needs per individual interconnection point. This practice is obviously not possible on the Interconnector which consists of one pipeline and for which the capacity calculation is more straightforward and constant.

The capacity sales in Figure 1 show an important phenomenon: the booked entry capacity at the Belgian side of IZT is considerable higher than the sold exit capacity on the Interconnector. The overbooking rates varies between 1,60 and 2,10. This observation suggests important "flange trading" at IZT where traders on the Interconnector pipeline deal with downstream traders on the Belgian side of IZT. Although there is a regulatory trend to move to bundled products and hub-to-hub trade in the TEP (EC, 2009a and EC, 2009b), "flange trading" between traders is a common practice and certainly in the OTC zone of Zeebrugge Beach. However, this observation helps to understand the physical flow patterns in the Interconnector which will further discussed in section 7.

Figure 2 addresses the reverse pattern on the Interconnector towards the UK. The daily final flow nominations at IZT for gas trades from Belgium to the UK are presented for the period between 1 January 2011 and 31 December 2013.

Figure 2: Daily Final Flow Nominations at the Interconnector Zeebrugge Terminal (IZT) for ZTP exit from Belgium to UK (GWh/day)



Source: CREG dataset derived from gasdata.fluxys.com; interconnector.com

The nominated firm exit capacity (FN exit @IZT) for physical gas trades to NBP knows a significant boost since the start of the new gas year on the 1st of October 2012 when the new transmission model (full entry-exit, dual hub structure, VTP) was introduced in Belgium. Before this market reform, trades from NBP to the European continent were very low and actual only relevant during winter period. It would be myopic to explain this expansion of reverse nominations by arguing the Belgian market reform but it has undoubtedly facilitated trades. Furthermore, forward nominations were again low, as usual, in the summer period in 2013. Changed sourcing patterns in the UK intervene since the higher important dependency. Moreover, a net reverse gas flow to the UK from continental Europe was observed in 2013.

The average FN exit @IZT amounts to 67 GWh/d [min: 0 GWh/d; max: 803 GWh/d] with a relative standard deviation of 180% indicating a very high volatility (almost x2 compared to FN entry @IZT). The average FN exit @IZT amounts in 2011 to 26 GWh/d and grows progressively to 65 GWh/d in 2012 (x2,5) and 109 GWh/d in 2013 (+66%). This trend mirrors in the average nomination levels at the Interconnector entry at Zeebrugge: 3% in 2011, 8% in 2012 and 14% in 2013. As previously discussed, average nomination levels of volatile patterns are somewhat misleading with regard to the market needs. A peak nomination of 100% at IZT to NBP was observed in March 2013.

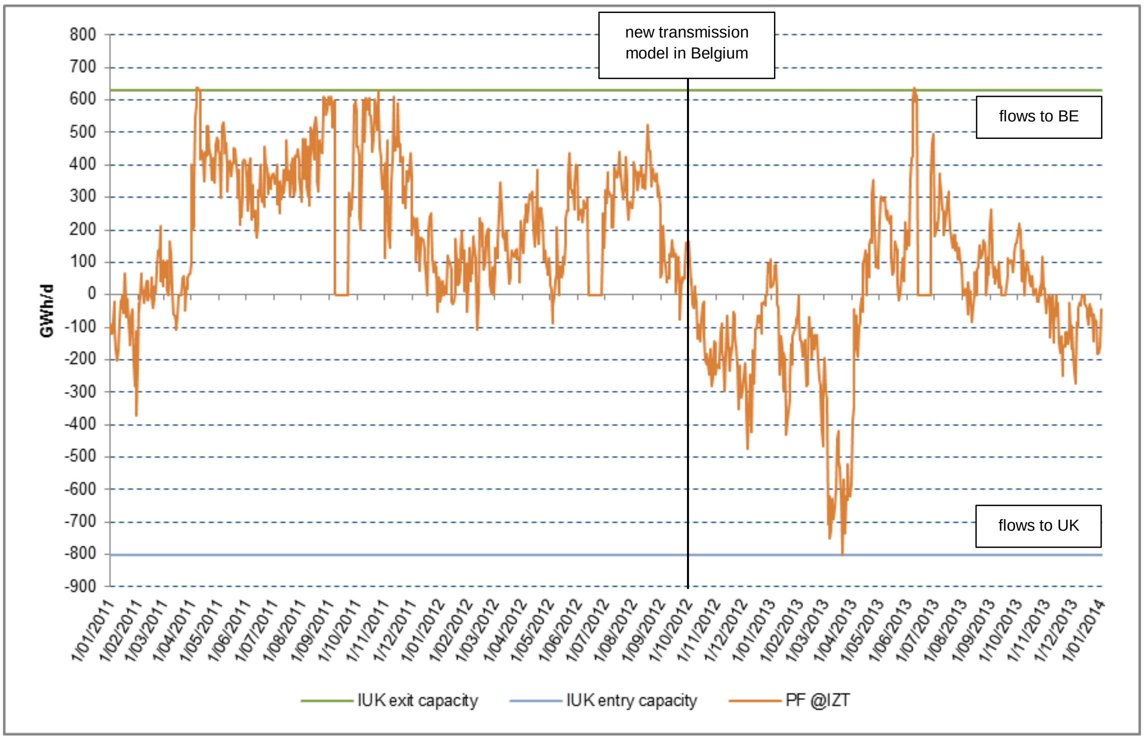
The commercial maximum firm capacity (CMCF entry @IZT) that TSO Fluxys Belgium offers for access to NBP varies block-wise (as for access to ZTP). The capacity offer was structurally modified when the new transmission model (full entry-exit, dual hub structure, VTP) was introduced in Belgium on the 1st of October 2012. From that moment onwards, the exit capacity at Zeebrugge Beach for access to IZT presents a better indicator for the capacity availability since wheeling is allowed within the Zeebrugge area between ZPT (Zeepipe terminal), IZT and the LNG terminal. The offered entry capacity on the Interconnector at Zeebrugge amounts to 803,4 GWh/d, is stable over the considered period and also fully booked (contractual congestion).

Figure 2 shows that the offered exit capacity at IZT by Fluxys Belgium is lower than the entry capacity of the Interconnector at Zeebrugge. The calculation of technical exit capacity at IZT on the Belgian side is more dynamic because capacities are calculated from a network optimization approach including the potential of shifts of capacity from one interconnection to another. This policy corresponds to the practice discussed for entry capacity. This dynamic approach allows a more flexible offer of capacity according to the specific market needs per individual interconnection point. This practice is obviously not possible on the Interconnector which consists of one pipeline and for which the capacity calculation is more straightforward and constant.

The capacity sales are very low until the Belgian market reform started on the 1st of October 2012. Fluxys Belgium offered in that period exit capacities lower than the capability of the Interconnector (room for optimization and shift of capacity). After the market reform, the offer of exit capacity converged to the capacity of the Interconnector since demand for capacity increased. Although not systematic as observed for entry capacity at IZT, overbooking is observed on the exit-side of IZT in March 2013 (overbooking rate of 1,22). This observation suggests also some “flange trading” at IZT for trades to the UK market. Figure 2 shows also the high level of flexibility of Fluxys Belgium capacity offers to accommodate market demand and to avoid contractual congestion.

The discussion of the nominations at IZT in both directions - from the UK market to continental Europe and reversely - enables to derive the net physical flows through the Interconnector. Figure 3 shows the net physical flows measured at IZT.

Figure 3: Net Physical Flows at Interconnector Zeebrugge Terminal (IZT) (GWh/day)



Source: CREG dataset derived from gasdata.fluxys.com; interconnector.com

The net physical flows (PF) from NBP to ZTP (positive values, from the UK to BE) and from ZTP to NBP (negative values, from BE to the UK) are volatile. There is a trend to growing net volumes from ZTP to NBP. The average flow from NBP to ZTP amounts to 113 GWh/d [min: -801 GWh/d; 840 GWh/d] and the relative standard deviation amounts to 220%.

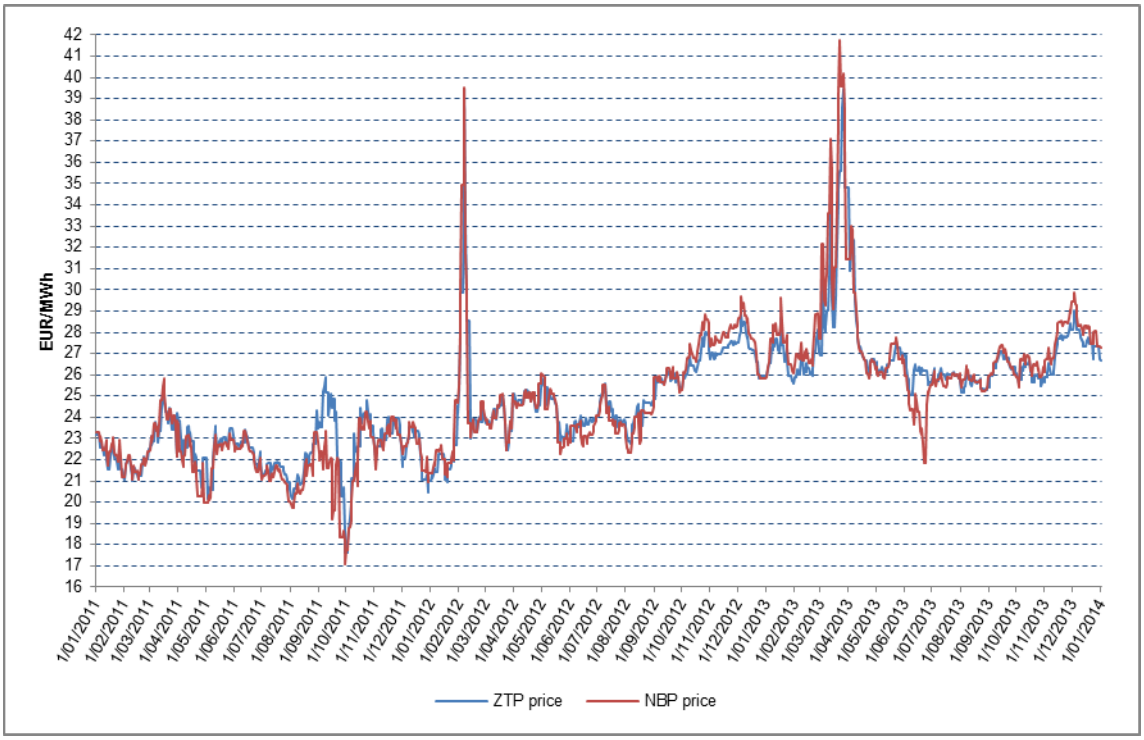
4. PRICE CONVERGENCE

Figure 4 displays ZTP DA gas price and the NBP DA gas price in EUR/MWh.

The DA gas prices in both markets, NBP and ZTP, know a strong price convergence and price signals are observed during sudden shocks. This high price convergence indicates a strong market coupling between both markets. Arbitrage from one market to the others appears to be effective.

The average DA gas price in the ZTP market amounts to 24,85 EUR/MWh [min: 17,62 EUR/MWh; max: 39,48 EUR/MWh]. The DA gas price in the NBP market is almost the same and amounts to 24,86 EUR/MWh [min: 17,09 EUR/MWh; max: 41,77 EUR/MWh]. Also the median DA gas price matches in both markets (24,54 EUR/MWh). The price volatility in the ZTP market (relative standard deviation of 10,7%) is relatively lower than in the NBP market (relative standard deviation of 12,3%). Consequently, it is not surprising that the DA gas prices in both markets are almost perfectly correlated (+0,95). The following price evolutions are observed (nominal). The gas price in the ZTP market grows from 22,45 EUR/MWh in 2011 to 25,02 EUR/MWh in 2012 and 27,09 EUR/MWh in 2013. The NBP market shows following pattern: 22,12 EUR/MWh in 2011 to 25,11 EUR/MWh in 2012 and 27,35 EUR/MWh in 2013.

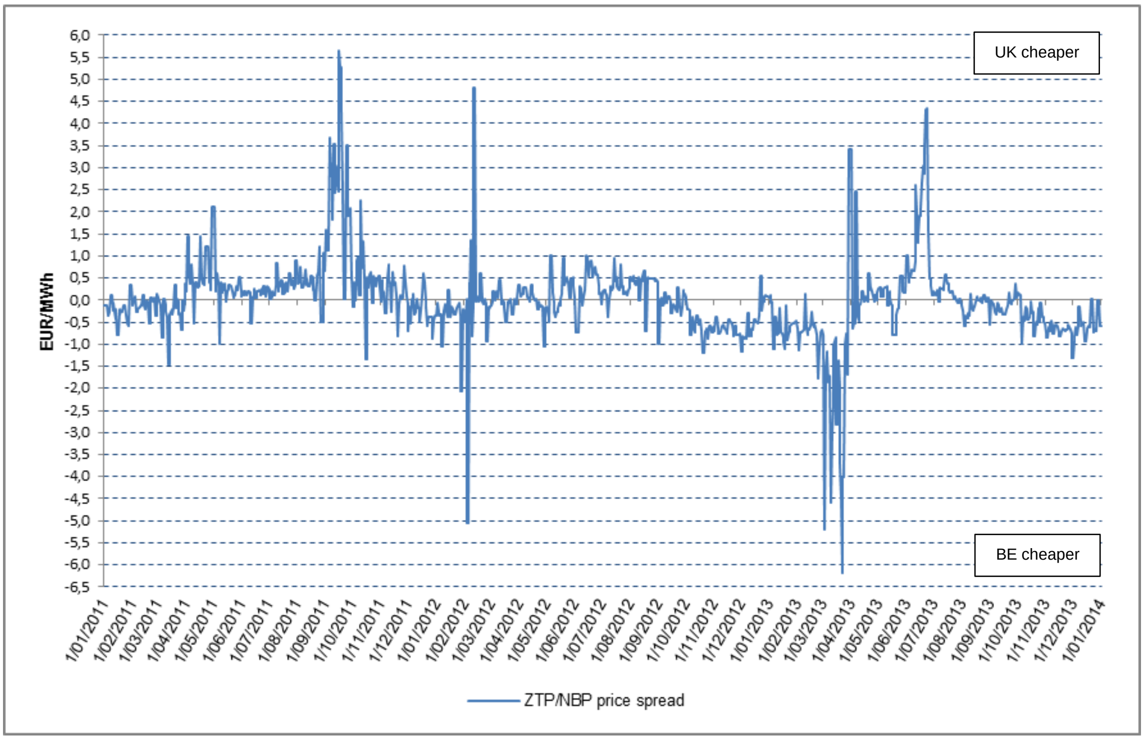
Figure 4: DA Daily Price Movements on ZTP and NBP (EUR/MWh, nominal)



Source: CREG dataset derived from icis.com

Figure 5 presents the price spread between both markets, ZTP and NBP, by taking the difference between the DA ZTP price and the DA NBP price. A positive ZTP/NBP price spread means cheaper gas at NBP while a negative ZTP/NBP price spread indicates cheaper gas at ZTP.

Figure 5: DA Daily Price Spread between ZTP and NBP (EUR/MWh, nominal)



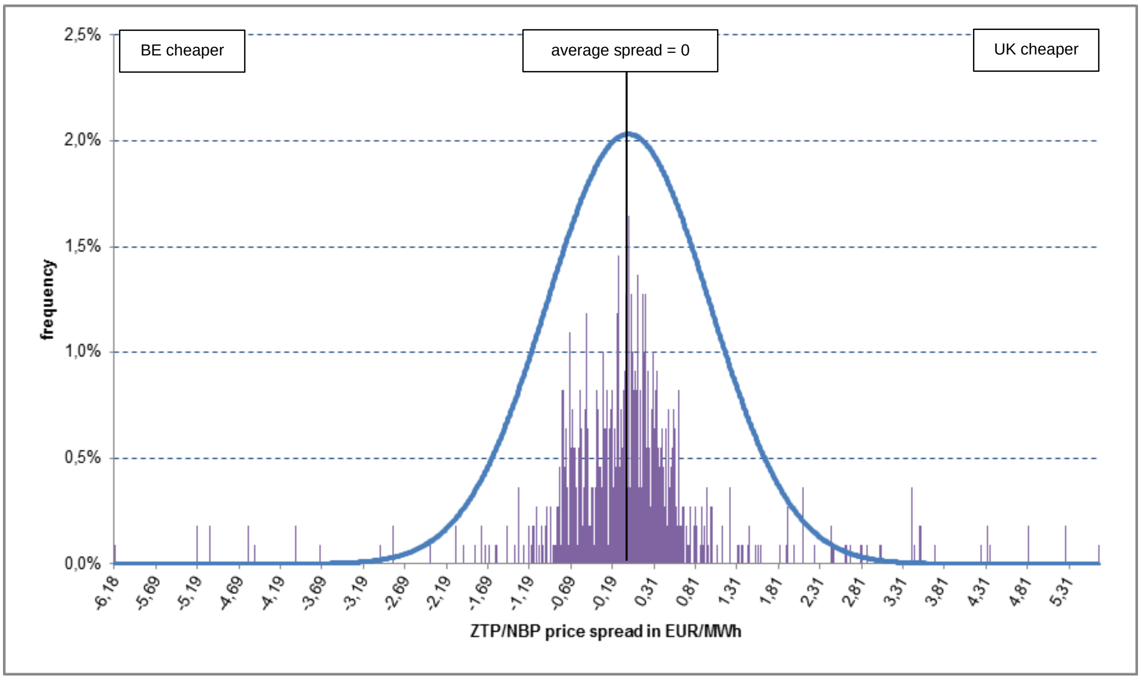
Source: CREG dataset derived from icis.com

In the considered three year period, the average ZTP DA gas price equals the average NBP gas price (average ZTP/NBP price spread = 0). The price spread is highly volatile [min: -6,18 EUR/MWh; max: 5,66 EUR/MWh] as indicated by a relative standard deviation of 0,98 EUR/MWh. The median price spread amounts to -0,02 EUR/MWh. Important price spreads are especially observed during sudden market shocks (e.g. sudden relative scarcity due to a cold wave), technical failures of the Interconnector and to a lower extent during announced maintenance periods. These sudden price spreads are important signals for supply and demand patterns. It is important to observe that both markets easily restore after price shocks and rapidly move to price convergence at levels observed before the shock. This demonstrates that the markets are able to attract liquidity or trade gas elsewhere in order to restore market equilibrium. These observations give confidence in the well-functioning of both markets.

The average ZTP/NBP price spread in 2011 amounts to 0,33 EUR/MWh. This means that gas is 0,33 EUR/MWh cheaper on NBP compared to ZTP. This situation changed and moved to more competitive ZTP prices, on average, in 2012 and 2013. The ZTP/NBP price spread in 2012 amounts to -0,09 EUR/MWh and -0,26 EUR/MWh in 2013.

Figure 6 shows the frequency distribution of the ZTP/NBP DA price spread for the period 2011-2013.

Figure 6: Frequency Distribution of the Daily DA ZTP/NBP Price Spreads in the period 2011-2013



Source: CREG dataset derived from icis.com

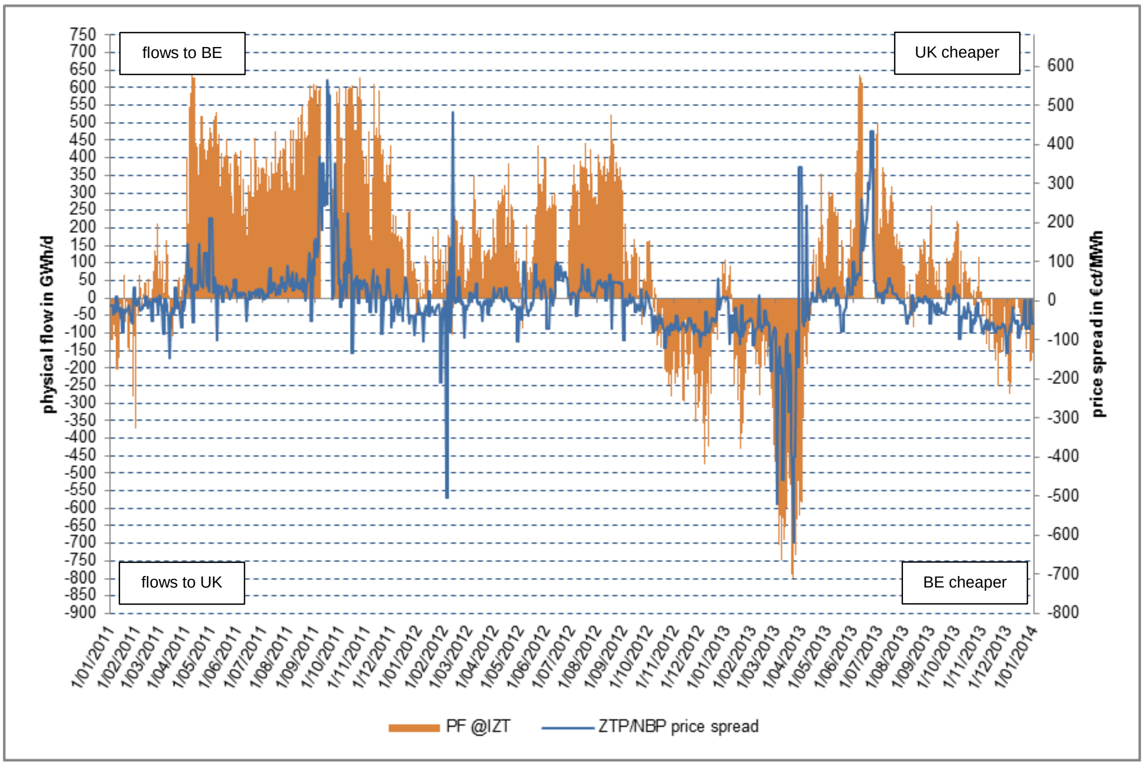
The average ZTP/NBP DA price spread in the period 2011-2013 amounts to 0 EUR/MWh and the relative standard deviation equals 0,98 EUR/MWh. High price volatility indicates a flexible price mechanism where prices rapidly adjust to market circumstances.

The probability that the ZTP/NBP price spread lies within the interval of the standard deviation [-0,98 EUR/MWh; +0,98 EUR/MWh] amounts to 88%. This is a very narrow price band and shows that transaction costs are diluted in the convergence of gas prices. Of course, the price formation in both markets is not only depending on trades across the Interconnector since various routes are used for sourcing these markets.

5. FLOW EFFICIENCY

This section confronts physical gas trades through the Interconnector (section 4) with ZTP/NBP price spreads (section 5). Gas flows are considered as economic efficient if gas flows to markets with higher gas prices in order to achieve price convergence between markets. Figure 7 displays the net physical gas flows through the Interconnector together with the ZTP/NBP price spreads.

Figure 7: Net Physical Gas Flows through the Interconnector and ZTP/NBP Price Spreads

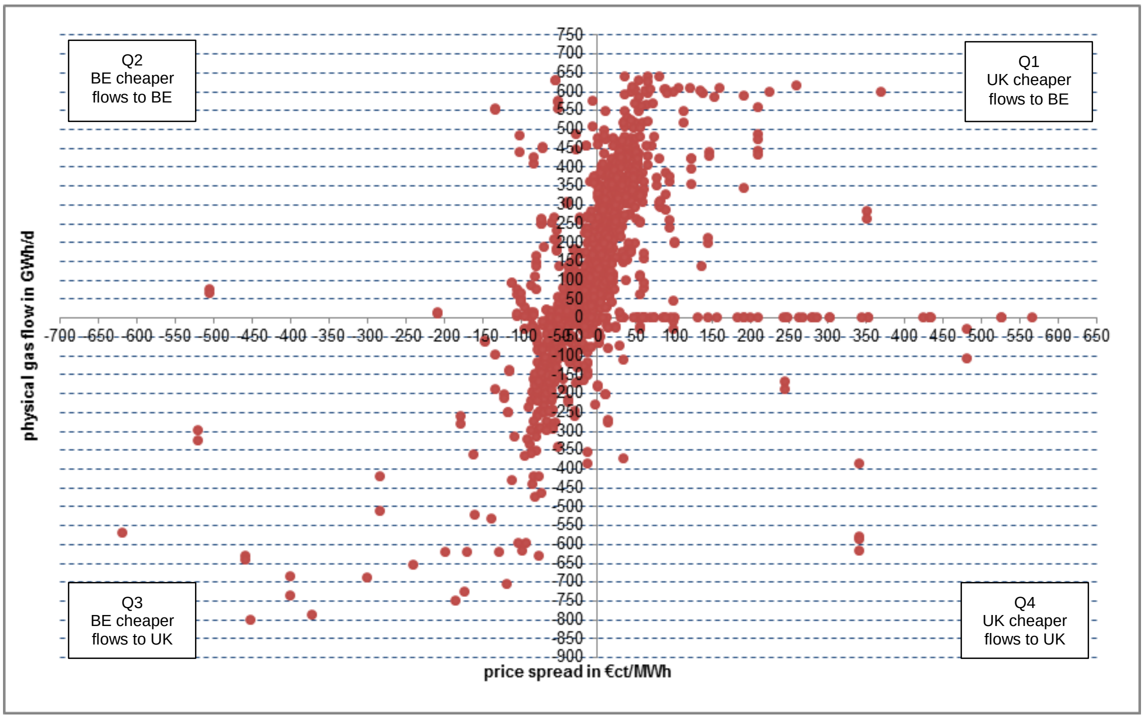


Source: CREG dataset derived from gasdata.fluxys.com, icis.com

Gas flows (PF) are economic efficient if the physical gas flows as well as the price spreads have the same sign. Cheaper gas in the UK market flows to Belgium if both signs are positive. Alternatively, cheaper gas in the Belgian market flows to the UK if both signs are negative. Daily efficient gas flows according to this principle, are observed during 71% of the time (corrected for maintenance days). This means that gas flows to the lower priced market during 29% of the cases. However, various comments should be made in order to interpret this outcome which is a rather positive outcome since i) end of day DA prices are a proxy since numerous trades generally occur during the day at different prices, ii) flows are not only “spot” flows and are also the outcome of other types of supply contracts (forward, long term, transit, directly with upstream producers, etc.), iii) spreads are rather low (and so are potential benefit margins) to compensate some lack of flexibility to easily follow price spread (e.g. crossing several regulatory regimes), etc. and as explained at the outset, abstraction has been made of any remaining transmission costs (for further discussion see section 7).

Figure 8 presents a scatter plot with quadrants of the physical gas flows and price spreads in order to better understand whether gas flows through the Interconnector are economic efficient or not.

Figure 8: Scatter Plot of the Relation between Physical Gas Flows and Price Spreads between ZTP and NBP in the period 2011-2013



Source: CREG dataset derived from gasdata.fluxys.com; icis.com

Points in the 1st and 3rd quadrant are economic efficient in the sense that flows follow the price spread. Quadrant 1 (ZTP/NBP price spread is positive and gas flows to BE) covers 45% of the days. Quadrant 3 (ZTP/NBP price spread is negative and gas flows to the UK) covers 26% of the days.

Points in the 2nd and 4th quadrant are economic inefficient in the sense that the flows do not follow the price spread. Quadrant 2 (ZTP/NBP price spread is negative and gas flows to BE) covers 26% of the days. Quadrant 4 (ZTP/NBP price spread is positive and gas flows to the UK) covers 3% of the days.

Figure 8 is corrected for maintenance days and for days without physically flows when forward flow nominations (UK to BE) are perfectly compensated by reverse flow nominations (BE to UK). The event of perfect compensation occurred during almost 7% of the calendar days in te period 2011-2013.

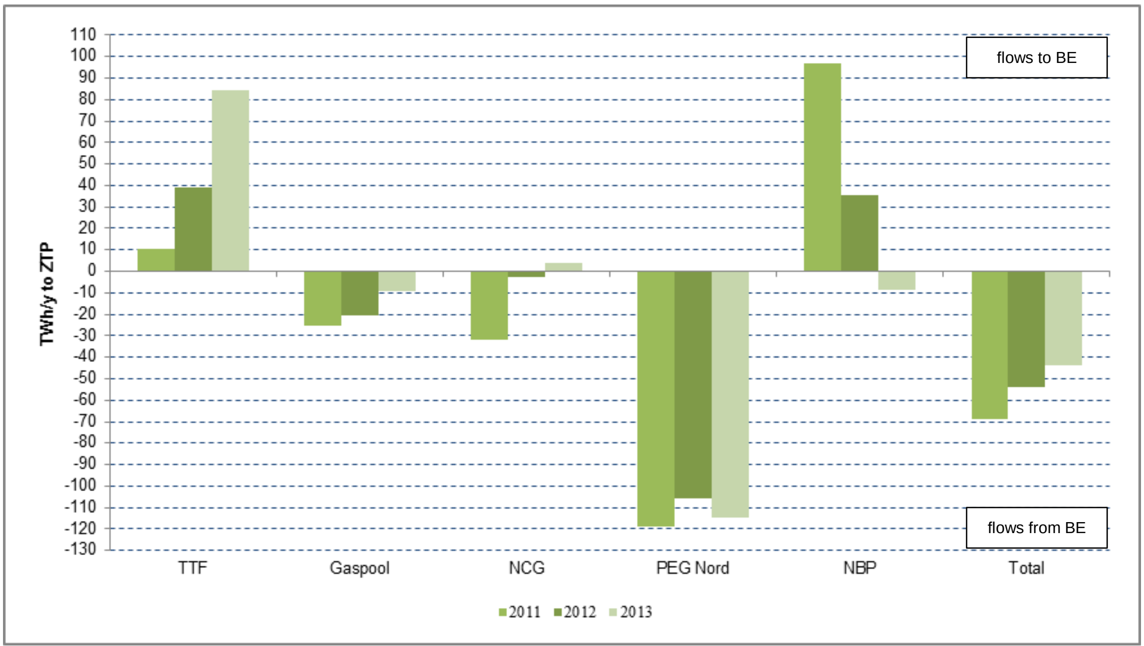
Generally, gas flows are more and more economic efficient as price spread are more significant. Obviously, price responsiveness grows as potential economic benefits/losses increase. This price responsiveness may be improved by offering more flexibility to traders and shippers (see section 7).

6. North West European market VTPs

This section enlarges the scope in order to compare the market integration and price convergence between ZTP and NBP with the other VTPs adjacent to ZTP. The other adjacent VTPs to ZTP are: the Dutch TTF, both German VTPs: Gaspool and NCG and PEG Nord in Northern France.

Figure 9 presents the netted cross-border gas transactions between ZTP and the adjacent VTPs. Positive values represent net physical gas flows to ZTP (purchases) while negative values represent net physical gas flows from ZTP (sales).

Figure 9: Netted Cross-border Transactions between ZTP and the adjacent VTPs

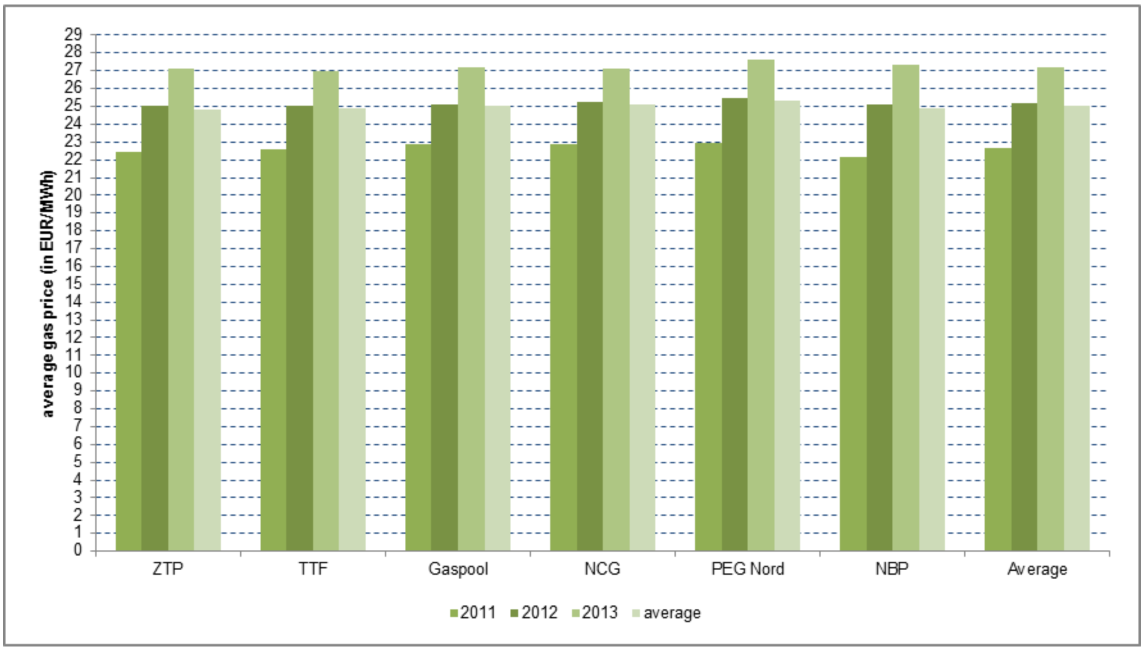


Source: CREG dataset derived from icis.com, ice.com, eex.com, powernext.com

The net physical gas flows from NBP to ZTP amounts to 96,74 TWh in 2011 and decreased drastically to reach a level of 35,60 TWh in 2012. An important change is observed in 2013 when gas trades between NBP and continental Europe resulted in a net physical gas flow from ZTP to NBP. The total volume of gas sales transactions between ZTP and the adjacent VTPs is higher than the gas purchase transactions in the adjacent VTPs for the ZTP. Cross-border net gas flows from ZTP to adjacent markets are decreasing: 68,82 TWh in 2011, 54,15 TWh in 2012 and 43,65 TWh in 2013. TTF seems to replace NBP in terms of supplying ZTP. ZTP is mainly supplied from TTF: net purchase transactions on TTF for ZTP amount to 84,57 TWh in 2013 (10,35 TWh in 2011, 39,07 TWh in 2012). The net physical gas flows from TTF represents in volume terms 65% of the Belgian gas demand in 2013 (H-gas demand: 129,8 TWh).

Figure 10 shows the price convergence patterns between the VTPs in North West Europe. The average DA gas price in the considered VTPs grows from 22,64 EUR/MWh in 2011 to 25,16 EUR/MWh and next to 27,23 EUR/MWh in 2013 (nominal). The three VTPs ZTP (24,85 EUR/MWh), NBP (24,86 EUR/MWh) and TTF (24,88 EUR/MWh) have almost exactly the same average DA gas prices. This observation indicates efficient cross-border trading leading to market integration. PEG Nord has generally the highest gas prices (average of 25,34 EUR/MWh). France currently still odorize gas as soon as gas flows into the French system. This practice is an obstacle for physical flows from France to Belgium (and also Germany).

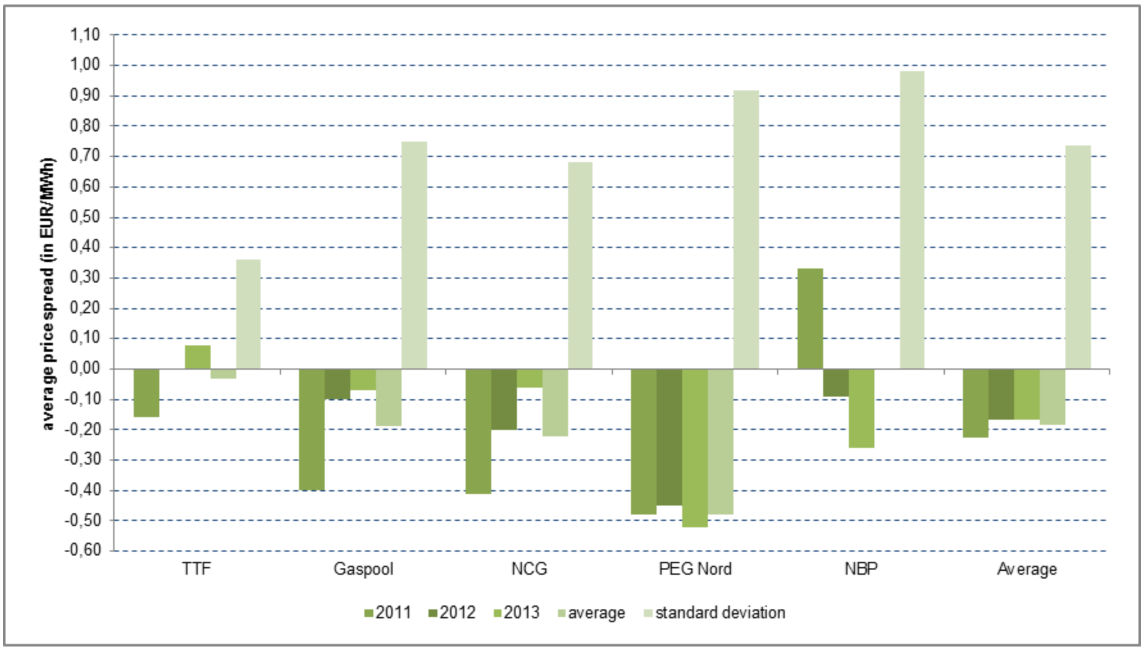
Figure 10: Price Convergence on VTPs in North West Europe



Source: CREG dataset derived from icis.com, ice.com, eex.com, powernext.com

Figure 11 shows the average price spread between ZTP and the adjacent VTPs in the period 2011-2013 (nominal).

Figure 11: Average Price Spread between VTPs in North West Europe (EUR/MWh, nominal)

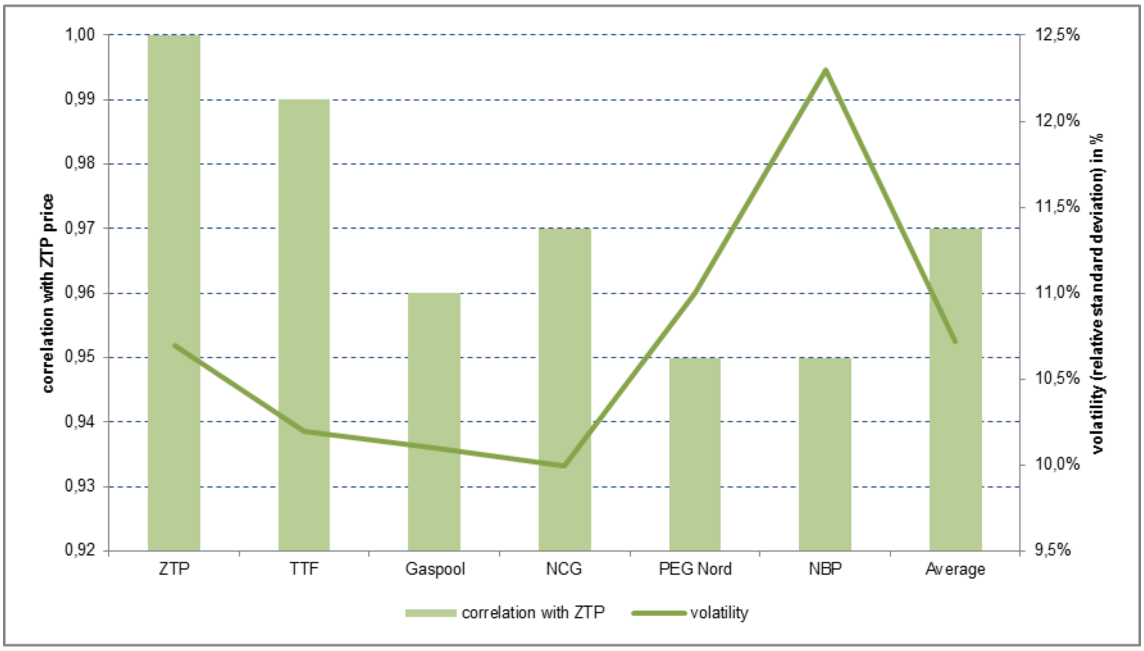


Source: CREG dataset derived from icis.com, ice.com, eex.com, powernext.com

The average DA price spread between ZTP and the adjacent VTPs amounts to -0,18 EUR/MWh in the period 2011-2013. This means that the average gas price on ZTP is 0,18 EUR/MWh lower compared to the adjacent VTPs. The price spread with TTF is the lowest (ZTP is on average 0,03 EUR/MWh cheaper). The price spread with PEG Nord is the highest (ZTP is on average 0,48 EUR/MWh cheaper).

Figure 12 presents the correlation and volatility of the DA gas prices in North West Europe.

Figure 12: DA Gas Price Correlation and Volatility in North West Europe



Source: CREG dataset derived from icis.com, ice.com, eex.com, powernext.com

Price correlation between ZTP and TTF is almost perfect (+0,99). The lowest - but still significant - correlation is measured between ZTP and NBP (+0,95) and PEG Nord (+0,95).The NBP gas price is most volatile (relative standard deviation of 12,3%). High price volatility is an important indicator for the functioning of the pricing mechanism. The better the prices adapt to fluctuations of demand and supply, the better the price signal and the higher the market confidence in the pricing mechanism.

The benchmarking shows a high level of market integration. Price convergence is not only observed between ZTP and NBP but also elsewhere in North West Europe. Prices are well correlated, and moreover, price spreads are on average very low and do even not reflect transaction costs. These observations indicate a very mature level of arbitrage and economic efficiency.

7. FINDINGS AND POLICY IMPLICATIONS

7.1 Market Integration and Price Convergence

The empirical analysis confirms a high level of market integration and price convergence between the markets at each end of the Interconnector. The analysis provides no empirical evidence for barriers to trade between both VTPs connected by the Interconnector. On the other hand, improvements in the offer of flexibility to shippers and traders could improve the price responsiveness of gas trades. There are numerous particularities in the current third-party access policies of the three involved TSOs (National Grid, IUK, Fluxys Belgium) which help to explain observed events of apparently limited price responsiveness of gas trades. Improvements in the commercial and regulatory model may provide valuable flexibility for shippers and traders and consequently lead to higher price responsiveness.

It must be recognized that the current analysis is carried out at a moment of full regulatory transition of Interconnector and that several improvements of the commercial model as well as the regulatory framework in order to facilitate competition and trade are underway. A totally new environment will appear on the 1st of October 2018 when the allocation of the primary capacity in both directions based on 20 year contracts will due to expire and a fully regulated model supervised by the British NRA (Ofgem) and the Belgian NRA (CREG) will be applicable.

7.2 Changing Regulatory Environment

The regulatory regime for Interconnector is in an important transition since the introduction of the European Third Energy Package (EC, 2009a and 2009b). Generally, there is a move from a negotiated TPA policy to a regulated TPA policy jointly supervised by the British NRA (Ofgem) and the Belgian NRA (CREG). This joint regulatory work did already achieve several (intermediate) goals in implementing the European network codes and framework guidelines. One of the recent milestones is for instance the certification of operator IUK as a full ownership unbundled TSO as is the case for National Grid and Fluxys Belgium (CREG, 2013 and Ofgem, 2013). The ongoing regulatory transition is very keen to improve rules and tariffs as much as possible in order to facilitate trade and competition.

7.3 Contractual Congestion

The primary capacity in both directions of the Interconnector has been allocated based on 20 year contracts which are due to expire in 2018 (1st October). This situation reduces the flexibility to obtain capacity for new parties since they largely depend on the capacity releases on the secondary capacity market. This situation is recognized and several initiatives are underway to improve the flexibility to get access to the Interconnector. Due to changes in the regulation, IUK is currently introducing a number of new mechanisms to allow new shippers to access capacity directly from IUK as well as through the secondary market (IUK, 2013).

7.4 Long Term Supply Contracts

It is reasonable to argue that the 20 year capacity contracts go hand in hand, to some extent, with long term supply contracts. However, Interconnector is currently especially used for short term trading. In any case, section 2 suggested important levels of “flange trading” at IZT and it is a fact that supply contracts may have various contractual delivery points. The observation that the entry booking of capacity at IZT lies much higher than the capacity of the Interconnector exit at Zeebrugge suggests important trading activities “at the flange”. These contracts moderate the price responsiveness of flows in the Interconnector and may explain to some extent flows against price spreads. These practices are likely to disappear in 2018 as bundled product at IPs becomes the standard according to the TEP (EC, 2009a and 2009b).

7.5 Marginal Transmission Costs

The marginal transmission costs for gas trades between ZTP and the adjacent VTPs (TTF, Gaspool, NCG, PEG Nord) may be assumed zero since the border tariffs consists of a capacity fee[8]. Booked transmission rights do not have a separate fee (except for gas fuel) for effective

[8] There is a fuel gas cost associated with capacity use (nominations) but these costs are relatively low and only designed for energy consumption compensation (e.g. compression) for the TSO according to the flows shipped. However, there is no split in the remuneration of the TSO within the tariff methodology between a capacity fee and a commodity fee.

use. Capacity rights on National Grid NTS consist of a capacity fee (paid whether or not gas is shipped) and an important commodity fee (paid according to the shipped gas) (National grid, 2014). Hence, physical arbitrage between ZTP and NBP faces basically a marginal cost of at least the commodity fee to be paid for the network use of National Grid.

Current tariffs on Interconnector are not yet regulated but this process is underway. IUK publishes that the average tariff per unit of existing capacity was 0,8 p/kWh/h/d[9] (equivalent to 1 p/therm) tariffs in 2012 and is subject to annual indexation (inflation) (interconnector.com). The tariff also includes a contribution to the operating costs. An evaluation of the current tariffs at IUK is beyond the scope of this paper but it is worthwhile to evaluate them in the regulatory transition process according to principles in order to facilitate competition and to achieve maximum market integration and price convergence. The more marginal transmission (transaction) costs converge to zero, the more efficient arbitrage and convergence to a "single gas price" (economic concept referred to as the "Law of One Price").

7.6 Various Zones

The dual hub structure in Belgium in which IZT lies together with the Zeepipe terminal and the Zeebrugge LNG terminal in the Zeebrugge area, so-called Zeebrugge Beach, and not yet in the Belgian VTP (ZTP) may facilitate gas trades from and to Zeebrugge Beach but may complicate trades from and to ZTP. Furthermore, in contrast with gas trades between ZTP and physically adjacent VTPs, gas trades with the UK have to cross at least one additional zone, the Interconnector. Differences in regimes, e.g. balancing rules and fees, may impact the economic rationale for arbitrage. Also these issues are currently under review in order to offer maximum flexibility to shippers and traders.

Fluxys Belgium and IUK propose to create a new cross-border entry-exit zone called ZIGMA (Zeebrugge Beach Interconnector Gas Market Area) for implementation in November 2015 (interconnector.com; fluxys.com). ZIGMA brings together the Interconnector pipeline, assets in the Zeebrugge area and Zeebrugge Beach trading place. This means that Zeebrugge Beach becomes the virtual trading point within the cross-border entry-exit zone which: i) provides sourcing possibilities from Zeebrugge Zeepipe terminal, IUK and Zeebrugge LNG terminal, ii) connects the NBP, TTF and ZTP, and iii) links into UK, Dutch and Belgian downstream market (Fluxys Belgium, 2014). ZIGMA will facilitate balancing requirements and a market-based balancing system will be introduced. This new commercial model will offer valuable flexibility for shippers and traders.

7.7 Further Study

Since physical gas flows depend on numerous factors, commercial as well as technical, it may be misleading to link flow patterns solely to price spreads and to judge economic efficiency and possible barriers to trade solely by using price spread. Moreover, the adequate price index for the analysis is always questionable and is in the best case a good proxy of the value of gas. This holds for the current study where day-ahead end-of-day gas prices are used. This means a price outcome of the day of numerous intra-day trades. Price discovery for gas trades remains an issue for further analysis.

[9] Equivalent to 0,10 EUR/kWh/h/d.

All types of gas contracts determine the gas flows and not just spot contracts. Besides long term contracts with specific take-or-pay obligations, futures contracts with predefined fixed prices and delivery points do also help to explain flow patterns which may look inefficient on the basis of day-ahead prices. Swapping of cross-border trades helps market integration and price convergence. Swapping trades is economic efficient and save on transmission but are not visible in an assessment of cross-border net gas flows.

The law of one price is, of course, a valid economic concept but assumes for instance perfect information about where to find the lowest price and that gas at different market places are perfect homogenous. Two conditions which do not necessarily always hold. There may be specific criteria which determine cross-border trade and value gas differently. Gas sourcing may be determined by security of supply rules of diversification and hedging strategies may influence sourcing. Furthermore, most markets in Europe do not produce gas or are at least net-importers largely depending on non-EU producers within a network of several routes and particularities which may impact price formation and trading patterns. A number of refinements can be achieved by integrating a broader scope in the analysis.

8. CONCLUSIONS

Physical gas trade between ZTP and NBP is different from gas trades between ZTP and the other adjacent VTPs since a separate area lies in between. Gas trades between the UK and continental Europe depend largely on the flexibility offered by IUK.

The empirical analysis confirms a high level of market integration and price convergence between the markets at each end of the Interconnector. This observation can be generalized the VTPs in North West Europe.

The analysis of market integration and price convergence, according to the applied method, does not provide evidence for barriers to trade between ZTP and NBP. It is right that the ZTP-NBP integration has several particularities which are not the case for the integration between ZTP and the other adjacent VTPs. However, ZTP-NBP integration scores comparably in a North West European benchmark.

Perfect market integration nor perfect price convergence are achieved but various reasons may explain constraints on market responsiveness. In this area, not only access to sufficient physical connectivity between markets is important. It is more often a question of flexibility for shippers and traders to get easily transmission services according to their needs and the potential to move to zero marginal transaction costs. Especially improved market flexibility and a re-thinking of transmission tariffs (e.g. the role and importance of commodity fees in addition to capacity fees which limits the convergence to zero marginal transmission costs) may help to move towards a true application of the "Law of One Price". It is well-known that the Interconnector faces contractual congestion in both directions since all technical capacity is allocated to a group of shippers (traders) based on 20 year contracts which are due to expire 2018 (1st October). Furthermore a number of initiatives are underway to reform the TPA-model applied by IUK with the target to apply a fully regulated model by the 1st of October 2018.

It has to be recognized that the Interconnector is currently in a regulatory transition in order to move to a fully regulated model supervised by the British NRA (Ofgem) as well as the Belgian NRA (CREG) in accordance with the TEP (EC, 2009a and b). The harmonizing of the regulatory standards will further contribute to the responsiveness of the market to price movements. A regular update of the market monitoring and the methodology is advocated in order to keep the right track at the benefit of the gas market functioning and security of supply.

DISCLAIMER

This working paper is written for discussion purposes. The views in this paper are solely the views of the authors and do not prejudice any decisions that CREG may take in the future or the results of any public consultation that is undertaken on these issues.

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