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THE INTEGRATION OF THE EUROPEAN NATURAL GAS MARKET[1]

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Abstract

This paper investigates the European process of creating an internal and sustainable market for natural gas. The analysis focuses on the most crucial factors that impact upon market integration (the EU gas directives, supply and demand of gas, market's competition, diversification of natural gas sources, wholesale markets, the existing regulatory framework, gas infrastructure, cross-border transmission and recent trends of the European natural gas sector). The behaviour of gas prices is considered as the focal determinant of connectivity among the member states and thus is closely examined both theoretically and empirically between economically different countries. By studying the antitrust and economic sides of the market, further liberalisation actions are being recommended in order to obtain a fully sustainable and efficient gas market. The complex analysis carried out in this paper concludes with further suggestions for fostering the overall market integration.

[1] This research contains the views of the author and does not represent the views of Gas Transmission Operator GAZ-SYSTEM

1. Introduction

The European natural gas markets are currently undergoing fundamental changes in order to create a more sustainable and secure energy sector. An integrated market is crucial in achieving higher competitiveness of the European gas sector, which will increase security of supply[2], services and efficiency[3]. In the last two decades, the European Union (EU) has introduced a number of liberalisation policies (Directive 98/30/EC, Directive 2003/55/EC, Directive 2009/73/EC (part of the Third Energy Package)[4] aimed at fostering the competition within natural gas markets and essentially generating lower prices and thereby benefiting households and firms.

Given the uniqueness of the natural gas sector it is crucial to understand the specific characteristics of the European market. The allocation of resources has rarely overlapped with the areas of its highest demand, thereby creating specific settings of the market structure for producers and customers as well as forming particular price paradigms. The behaviour of prices is crucial in market integration and will thus be a focal point of this paper. Map 1 presents a comparison of average wholesale gas prices for the second quarter of 2013.

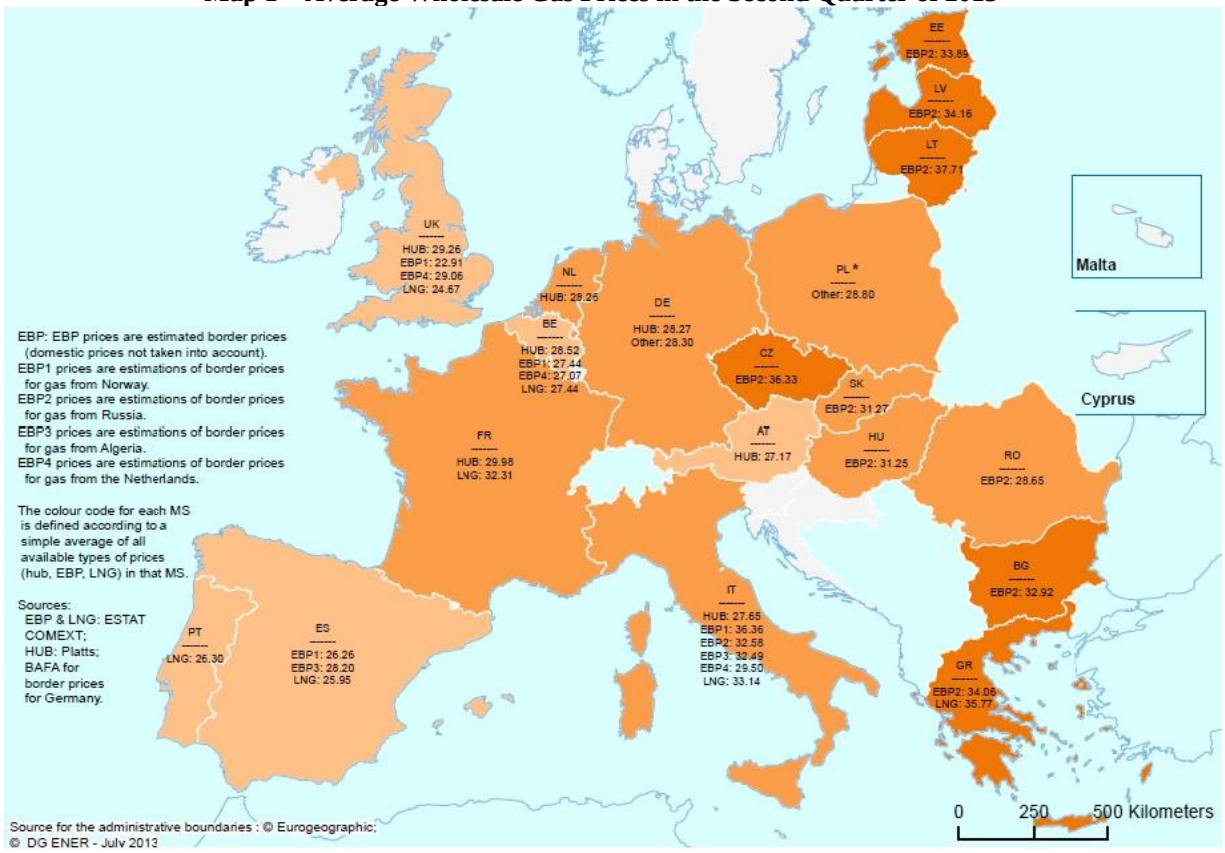
1.1. Long-term Natural Gas Contracts, Pricing Paradigms and Market's Competition

The process of integrating the European market through liberalisation combined with the evolving nature of the natural gas sector has significantly impacted commercial, economic, political and legal components of the industry.

Until the late 1990s most of the European gas supply was tied to the long-term natural gas commodity contracts between gas producers and incumbent wholesale suppliers (Dreyer et al., 2010). This system was convenient for both parties: purchasers were assured of the security of stable supply which enabled them to form long-term strategies in downstream markets and the producers sustained their demand, while obtaining continuous funds for long-term infrastructure investments.

[2] Security of supply could be interpreted in different ways. It could relate either to responsive security measures preventing from supply disruptions (as consequences of technical or political issues) or lack of long-run investment that could potentially limit transmission and import facilities from their efficient performance.
[3] The efficiency levels within the natural gas market could be understood in various ways. In the context of what effect do regulations have on market's competition, we measure efficiency in transport capacity levels.
[4] Directive 2009/73/EC is a part of the Third Energy Package, which contains a number of Electricity and Gas Proposals, that together attempt to provide a competitive and integrated energy market which will allow European consumers to choose among different suppliers, which should be granted the access to the market regardless of their size.

Map 1 – Average Wholesale Gas Prices in the Second Quarter of 2013[5]



However those market settings have been steadily changing over the last decade. The increasing significance of LNG[6], new resources of unconventional gas and rapidly emerging spot markets have diminished the attractiveness of the long-term contracts with take or pay clauses to purchasers.

The gap in natural gas prices between western European countries and eastern European still exists. It is in compliance with the economic theory regarding gas markets, which underlines lower liberalisation of the natural gas market in the East than in the West. Most research draw conclusions regarding the European market integration after focusing solely on highly liberalised western European countries, while excluding less developed and less liberalised eastern European countries. Section two thus considers both western and eastern European countries in order to correctly assess the state of market integration.

[5] Source: "Market Observatory for Energy, vol.6, iss.2", European Commission, 2013
[6] European LNG imports contributed to 20% of total gas supplies in 2011 which is almost a double amount of LNG imported to Europe in 2001.

2. Empirical Analysis[7]

The following analysis considers market as the "area within which the price of a good tends to uniformity, allowances being made for transportation costs"[8]. This definition allows for certain deviations among prices in the short-run, however due to substitutability we should observe prices being related to each other in the long-run. This is in accordance with the Law of One Price (LOP), which states that in order for the market to be efficient, prices for all the identical goods need to be the same.

However, within the European energy market the LOP does not necessarily hold[9], and therefore prices do not fully reflect the cost of natural gas (regardless of national taxes, transportation/distribution costs). This leads to a less competitive market, where consumers often lack the freedom of choice between different gas suppliers and face overvalued prices.

This study employs two sets of time series data of quarterly observations (1992 to 2012) of end use natural gas prices[10] in 9 European countries. The analysis of prices is conducted separately for industry and households. Data was originally collected by the International Energy Agency (IEA) and was obtained from the Economic and Social Data Service (ESDS) database. The prices are calculated in dollars (USD/toe)[11] using the country specific calorific value (heat content). The choice of countries for this analysis is based on data availability and the extent to which member states have adopted the EU directives. Certain members lack necessary data or choose to make it confidential therefore they need to be excluded from our research.

Cointegration feature of our price series is the most appropriate analysis for investigating market integration (Asche et al., 2000). This technique, which considers non-stationary data, examines whether prices move towards a common long-run equilibrium which therefore indicates the degree of market integration. Literature distinguishes two ways of measuring cointegration relationships, the Engle Granger test and the Johansen test. The Engle Granger test proved that, given non-stationary

[7] All the statistical tests used in this section are widely described in the literature; therefore we present only their brief description, while focusing more on the results and their interpretation.
[8] Stigler (1969)
[9] When considering the LOP it is crucial to note that the energy market varies in that respect from the traditional financial markets. Derivatives, bond and stock markets trade abstract goods for which the LOP holds; however it is not the case for energy, which belongs to commodity markets.
[10] The end-use prices: "Include transport costs to the consumer; Are prices actually paid (i.e. net of rebates); Include taxes which have to be paid by the consumer as part of the transaction and which are not refundable. This excludes value added tax (VAT) paid in many European countries by industry (including electric power stations) and commercial end-users for all goods and services (including energy). In these cases VAT is refunded to the customer, usually in the form of a tax credit. Therefore, it is not included in the prices". ESDS, (2012).Furthermore, regardless of the VAT differences among gas prices between the countries, we assume that such differences are not significant enough to impact our results.
[11] TOE = Unit representing energy generated by burning one metric ton (1000 kilograms or 2204.68 pounds), equivalent to the energy obtained from 1270 cubic meters of natural gas.

prices, running OLS is inappropriate as normal inference fails which results in strongly biased results. However, the Engle Granger test has certain drawbacks as it does not allow for testing on the parameters in the cointegration vector, diminishing the importance of the LOP. Furthermore, depending upon which price we normalise, our results may vary which lowers the significance of the test. Those issues could be overcome by using the Johansen test (Johansen and Juselius 1990) which is therefore employed in our analysis. The test is based on a Vector Error Correction Model (VECM) which combines the Vector Autoregressive system (VAR) and the error correction term. The VECM for our analysis could be represented in the following way:

$$\Delta y_t = \delta_0 + \Gamma 1 \Delta y_{t-1} + \cdots + \Gamma_{p-1} \Delta Y_{t-p+1} + \alpha\beta' y_{t-1} + \varepsilon_t$$

Where the error correction term $\beta' y_{t-1}$ represents the short-run deviations from the long-run equilibrium relationship, while the α coefficient is the speed of adjustment of y_t to the r "equilibrium errors"[12]. When applying the Johansen cointegration test to natural gas price series of the selected nine countries, we expect exactly one cointegrating relationship, given they have a long run equilibrium. A further interpretation of the cointegration tests is provided in the following subsections.

The interpretation is the following: the α coefficients presented in Table 1 allow us to distinguish which variables adjust to the long run cointegrating relationship. Large α coefficients indicate greater response of the series to deviations from long-run equilibrium, which suggests that the gap price of the series will be more stable. Accordingly, small α coefficients result in rather unresponsive behaviour of the series towards an equilibrium error, which therefore suggests that our series will reach the long-run equilibrium relatively slow. Furthermore, when gas prices are above (below) the long run relationship, negative (positive) α coefficients indicate the magnitude of the readjustment mechanism. For instance, the α coefficient for Finland (-0.23) suggests that gas prices in Finland are above the long run relationship and therefore they will decrease at a rate of 23% per period in order to regain the common long run equilibrium. Finally, α parameters are required to be significant. An insignificant α coefficient would suggest an invalid cointegrating relationship as the residual would not be able to predict changes in prices.

[12] Verbeek (2012)

Table 1 – Vector error correction representation - Industry

L1_ce1	α coeff	Std. Err of α.
lFrance	-.497**	.161
lSwitzerland	-.023	.108
lIreland	.115	.216
lSlovakia	.038	.132
lSpain	.086	.127
lPoland	-.026	.149
lUk	.695**	.223
lHungary	.005	.155
lFinland	-.231*	.118

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

Table 2 – Long run relationship between natural gas prices - Industry

β	Coeff.	Std.Error
lFrance	1	
lSwitzerland	.169	.098
lIreland	.068	.031
lSlovakia	-.368	.077
lSpain	-.405	.079
lPoland	-.116	.0779
lUk	-.339	.046
lHungary	.207	.055
lFinland	-.177	.0689

Table 1 shows that only variables for France, UK and Finland have significant α coefficients, and therefore only gas prices in these countries (within the industry sector) readjust towards the common long-run equilibrium, given changes of gas prices in other countries. Switzerland, Ireland, Slovakia, Spain, Poland and Hungary have insignificant α coefficients and therefore the speed of readjustment of gas prices within the industry sector in these countries is not significant enough to reach the common long-run equilibrium.

The interpretation Table 2 shows the long run cointegrating relations of prices (where β coefficients form the cointegrating vector). In this case, we standardise on gas prices from the French industrial sector.

In accordance with the theoretical presentation of the VECM, we provide an exemplary interpretation of how gas prices of French industry sector are cointegrated with gas prices of industrial sector from other European countries. The same logic follows gas prices for industry sector in UK and Finland. Given our results in Table 1 and Table 2, our model takes the form of the following form:

$$\Delta FR = -0.49(FR_{t-1} - 0.06IR_{t-1} - 0.36SL_{t-1} - 0.4SP_{t-1} - 0.33UK_{t-1} + 0.2HU_{t-1} - 0.17FI_{t-1} - 0.55) + \varepsilon t$$

We include only the significant β terms which suggest that prices of natural gas in France for the industrial sector are negatively cointegrated with their respective prices in Ireland, Spain, UK, Slovakia and Finland, while being positively cointegrated with prices in Hungary. Furthermore, we observe no cointegration between the prices in France and the prices in Switzerland or Poland. The α coefficient (Table 1) on the error correction term ($z_{t-1}=Y_{t-1}-\mu-\beta X_{t-1}$) is found to be negative and indeed significant. The interpretation is that when prices of natural gas (for industry sector) in France are above the long-run cointegrating relationship with their respective prices in other European countries, the negative coefficient α indicates the speed of readjustment of gas prices in France which should decrease at rate of about 49% per period in order to return to its long-run equilibrium with gas prices from other countries.

After running a similar regressions for the rest of the countries, for both sectors, industry and households[13], we find most α coefficients to be insignificant which suggests that when considering a cointegration relationship between a significant number of countries, in most cases the long-run equilibrium conditions do not influence short-run fluctuations in natural gas prices among European markets. This is in accordance with the economic theory which argues that the European market of natural gas remains not fully integrated regardless of the existence of a cointegrated relationship between the prices of different countries.

3. Discussion

The European natural gas market has developed significantly over the last two decades. However, along with the implementation of the national regulations, the overall structure and the main settings of the market have also evolved which triggered a response from major players within the sector. An increasing customer choice, international pressure for unbundling and the progressing spot prices forced gas companies to incorporate structural changes, rethink their market strategies as well as to

[13] Given the limited page limit, we present the empirical results for the industry sector. For further results regarding the results for households sector, please contact the author directly.

increase efficiency and quality of services. In order to sustain their market power, companies raised their interest in the upstream component of the gas industry as well as in the vertical and horizontal integrations, which additionally enable them to increase their economies of scope and scale. It is safe to assume that further mergers and acquisitions will take place in the following years which therefore requires stronger adjustments of the antitrust policies.

From the perspective of end users of natural gas, the most noticeable implication of market integration is observed through the behaviour of prices. This paper assumes that the relationship among natural gas prices between different economies strongly reflects the overall level of market's integration. The empirical findings confirm the existence of a cointegrating relationship between the natural gas prices of nine European countries[14]. It suggests that, while allowing for short-run fluctuations among prices of different economies, in the long-run we should expect prices reaching the same equilibrium. However, our results further reveal that the long-run equilibrium conditions do not impact the short-run variations in natural gas prices. Therefore we conclude that natural gas prices among European countries behave rather independently of each other. Their fluctuations could be largely caused by internal factors different for each economy such as growth, weather, historically established (prior to EU's regulations) market trends but also geopolitical developments and global energy trends. Nevertheless, in recent years we also observed a growing importance of the external factors such as re-establishing gas contracts and increasing diversification of supply. Both internal and external factors do significantly influence the behaviour of prices in each of the European markets, thus decreasing the effectiveness of European regulations. This is further confirmed by our analysis of prices' responsiveness towards EU's directives[15].

The evolution of pricing paradigms becomes crucial in achieving a truly integrated market. In the last few years we have witnessed a gradual shift from the long-term oil-indexed prices towards spot market prices. Currently we observe a clear division within the market. The EU encourages greater competition and therefore favours the gas-to-gas competition. On the other hand, major energy companies attempt to maintain their market share through either sustaining the pricing mechanism of the long-term take-or-pay contracts or creating informal oligopolies in the form of vertical/horizontal integrations. One could conclude that the effectiveness of the European legislatives and the extent of market power of major energy companies will be crucial in determining future trends of the gas sector. However, a crucial question remains: which market settings are better for the stability of the

[14] The number of countries selected in our analysis was the maximal number of countries which published complete data regarding natural gas prices for both households and industry end users to the International Energy Agency. Given our sample includes heterogeneous economies, developed and liberalized at different levels; we draw our conclusion in regards to the entire European Union.
[15] For further results please contact the author directly.

sector and its' future integration? Should the member states continue supporting further unbundling process and foster competition (regulation-for-competition approach (Haasen, 2009)) or should they reinstall their focus on ensuring a secure and stable gas supply through investing into long-term infrastructures which require long-term contracts (regulation-for-security-of-gas-supply approach)?

We argue that both systems have their advantages and disadvantages depending on market conditions. However, given constant market changes and thus related uncertainties, we suggest that the best possible scenario for future market integration, which ensures both competition and security of gas supply, could be achieved by combining the two price paradigms. Regarding the oil price indexation, we predict that it will progressively disappear, being driven out by the natural evolution of market's trends rather than by legislative actions. The duration of long-term contracts should reconstructed (e.g. from the currently existing 20-30 years to 10-15 years)[16] in accordance with well-constructed economic set of rules, while in extreme cases of the anti-competitive contractual settings, the terms should be renegotiated. It is crucial to continue developing short-term pipe-to-pipe (P2P) trading, while sustaining the incentives for gas producers to invest in the much needed infrastructure[17] and ensuring that the existing gas pipe-lines are fully utilised.

That being said it is important to underline the necessity of a continuous development of short-term trading. However, in order to obtain a more efficient and liquefied market, much remains to be improved. European regulations should therefore strongly focus on building new storage, transmission and LNG terminals, while developing the cross-border gas infrastructure, building new hub platforms and improving the flexibility of the existing gas network particularly through bidirectional physical flows. Thus it becomes clear that investing in new and already existing infrastructure[18] remains crucial in achieving a truly integrated market regardless of the future trends or dominating price mechanisms. Furthermore, the integration of the market should continue taking place through enforcing stronger transparency measures (regarding production, consumption and infrastructure), enhancing new investments (through simplifying regulations for new cross-border infrastructures, regulating investment planning and further diversifying European gas supply).

[16] One possible method of choosing the length of the contract, apart from private preferences of consumers and suppliers, could be the duration of installing/upgrading infrastructure segments directly related to the contractual agreement between the two parties. However due to high complexity of such investments, durations of contracts should be considered on a case-by-case basis.

[17] The need for a continuous development of existing and future infrastructure was observed during February 2012, when given sudden increase in gas demand, many Continental hubs where constrained by an insufficient capacity of gas infrastructure.

[18] GIE (2012) discusses the costs of future investments which are said to be "small with respect to commodity prices and, building on existing and partly depreciated existing infrastructure, would not hinder the deployment of other energy sources in the future, provided the appropriate regulatory regime is in place".

4. Conclusions

It should be concluded that despite multiple physical, economic, commercial and legal barriers, the integration of the European natural gas market is progressing, although at a much slower rate than anticipated. Given rather weak interactions among gas prices, one could suggest that the principal settings of the market are naturally evolving regardless of the legislative drive for changes. Within the next decade, we expect the oil-indexation to gradually disappear and the long-term contracts to be reconstructed, while also the spot prices to gain on importance, which together could potentially generate a hybrid price between the two pricing mechanisms. Future gas supply diversification is fully expected with further LNG imports and emerging production of unconventional gas.

Given the volatile nature of the market it is hard to predict the focus of future regulations will. Should we perhaps expect the Fourth Energy Package to be introduced? Considering all the aspects of the gas sector discussed in this article and the fact that the market yet remains to be fully integrated, a new European regulation will be eventually introduced, however not in the near future. At this point we are still anticipating full results of the Third Energy Package, of which the implementation progresses slower than expected. In recent years, The Council of European Energy Regulators (CEER) has developed the Gas Target Model which together with the "Bridge to 2025"[19], developed by ACER, could be considered as overarching strategies for fostering market integration and coordinating the existing set of rules for both market and network operations.

[19] "Energy Regulation – A bridge to 2025", developed by ACER is focusing on key factors, challenges and possible responses for the coming years to 2025.

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