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Regulatory Reform on the European Gas Market

Does it make a Difference?

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Abstract

The structure of the European gas market has been the subject of extensive discussion during the last decade resulting in two EU directives. A key concept in this discussion is the mandatory break up of vertically integrated gas companies, also known as unbundling. This master thesis examines several of the regulatory measures introduced in the 2003 and 2009 gas directives. A theoretical model with the aim to predict the effects of the regulatory measures is devised. This model defines the price level as the dependent variable and several of the regulatory measures as explanatory variables. With a fixed effects panel regression the model is tested. Data on the European gas market is gathered from Eurostat, the European Commission and OECD. None of the regulatory measures could be determined to have a significant effect on gas prices. The main explanatory variable was found to be the price of oil lagged on year, reaffirming a close link between the gas and oil markets.

Keywords: European gas market, unbundling, gas directive, third energy package, quantitative method

Word count: 13 827

Contents

Abbreviations and key concepts

VIU – Vertically Integrated Utility. A company that holds assets in production/import, transmission and distribution branches of the gas industry.

Transmission – The part of the gas industry that transports gas from production/import facilities to distributional networks and industrial consumers.

Transmission networks – Networks of high capacity gas pipelines connecting production and distributional networks.

TSO – Transmission Network Operator.

Distribution – The part of the gas industry that delivers gas to domestic customers.

Distribution networks – The networks connecting domestic customers to transmission networks.

DSO – Distribution Network Operator.

Unbundling – The process of breaking up Vertically Integrated Utilities.

Ownership Unbundling – The process of dividing up Vertically Integrated Utilities into several companies with different owners.

Legal Unbundling – The process of dividing Vertically Integrated Utilities into several separate legal entities.

Account Unbundling – The process of separating accounting in a Vertically Integrated Utilities to differentiate between production/import, transmission and distributional operations.

Gas contracts – A contract between a seller and a buyer stipulating the future terms on which gas can be bought, often gas prices are indexed to oil.

1. Introduction and aim

1.1. *Problems of energy dependency and how to solve it*

A constant and reliable supply of energy is crucial for the existence of every society, whether it be historic or present. For contemporary Europe a few sources constitute the bulk of the energy supply. Almost a quarter of Europe's gross energy consumption comes from natural gas, rendering it the second most used energy source after oil.[1]

Natural gas is mainly used by power generation (31 %), households (mainly heating, 26 %) and by industry (21 %). Through these markets the price of gas directly affects private consumers. Add to this the fact that a very large share, 41 %, of EU gas imports originates from Russia[2] and it is obvious that this policy area attracts the concern of the EU institutions.

EU must respond to the reality of an energy market with high dependency of a few powerful exporters abroad. The response have traditionally been to try to increase market forces on the energy market by creating legislation that aims to lessen the influence of powerful energy companies. The idea is that if there are more companies competing in the market, disruptions in the energy supply will be less likely and their individual ability to dictate price diminishes. The dangers with large actors have been made obvious by the repeated disruptions of gas trade between Ukraine, being a transit country for further deliveries of gas to EU, and Russia during the last decade. Given the fact that gas is widely used for domestic heating the effects of a large-scale gas disruption would be severe, especially if it would take place during the winter months.

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[1] European Commission (2009a), *Europe's Energy Position: markets and supply*, Brussels, page 12.

[2] European Commission (2009a), page 21

1.2. *Natural monopolies and liberalization*

Modern understanding of economy underlines the importance of competition in order to increase efficiency of production, whether it is food, cars or energy. Increased efficiency can be translated as lower prices for consumers. The opposite of competition is monopoly and it is not difficult to se why, for example, car prices would be higher if there were only one manufacturer.

To claim that competition is good for consumers, and over all resource allocation, is not controversial. However, in certain markets there are severe problems when trying to establish competition. Markets that are network based, such as electricity and gas have some specific problems. It is not practically or theoretically optimal to allow several competing companies to build parallel networks to deliver their goods to consumers. When the capital costs are large, such as building a new gas pipeline network, and economies of scale are big a natural monopoly will be established.

A definition of where natural monopolies will occur are provided by William Bamoul:

"An industry in which multiform production is more costly than production by a monopoly"[3]

However, there has been criticism towards the idea of natural monopolies. DiLorenzo argues that natural monopolies are a mere product of government interference in the market by giving monopoly rights to certain companies.[4]

Independent of the view one might take on natural monopolies it is undoubtedly so that the European gas market is dominated by either monopolies or oligopolies. The path chosen to deal with such is traditionally by laws governing competition between

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[3] Baumol, J. William, (1977) "On the Proper Cost Tests for Natural Monopoly in a Multiproduct Industry", *The American Economic Review*, Vol. 67 No. 5, pages 809-822, page 810.

[4] DiLorenzo, J. Thomas, (1996) "The Myth of Natural Monopoly" *The Review of Austrian Economics,* Vol. 9 No.9 (1996), pages 43-58

companies. In the case of large networks industries unbundling of companies is one of many tools that have been used, and will continue to be the focus point for this thesis.

1.3. *Price system, mechanisms and elasticity*

Goods are traded in a variety of different ways, and prices are set depending on the type of market, type of goods and in some cases depending on government involvement. Different price mechanisms are adapted to different types of goods and the specific requirements they might have.

As an example, rare and unique products, such as art, are often traded with an auction type price mechanism to ensure maximum profit for the seller. Food in grocery stores is an example of where prices are posted and the buyer has no way of negotiating prices. The mechanism at play here are rather the competition between different stores and the long-term effect this might have on prices when consumers select the cheapest one. Common between most free market price mechanisms is that they mediate information on supply and demand between producers and consumers, and aids both groups on how to allocate their resources, which by definition is always considered scarce, to reach optimum use.

In a non-market system, as was common in many communist countries, price mechanisms on nearly all goods were replaced with detailed planning which tried to substitute the information mediated by prices. This type of pricing is still practiced for goods that are of extreme importance and where politics have decided that price should not be the limiting factors for individuals to obtain the goods, such as healthcare in single payer systems. The problem with such pricing is that the prices do not relay information about the demand for the goods; it is often argued that this might lead to sub-optimal resource allocation in the society. In reality all countries have a mixed price system where prices for some goods are set according to fully liberalized principles, where other goods are subject to regulation.

The price of a product is also influenced by the price elasticity of demand When consumers of different products allocate their resources towards the buying of different goods a small increase or decrease in price can produce large effects in the quantity bought. Luxury goods, such as vacations and cars, and goods that have many close substitutes, such as different brands of candy, are often price elastic. This means that when the price of the product increases, it can be expected that the demand fall dramatically. By contrast goods that are necessities, such as petrol or as in the case of this thesis, gas for heating, which have few close substitutes are expected to be price inelastic. When price increases consumers still have to buy the same or nearly the same quantities due to the high need of the product. For the producer of products that are inelastic this means that an increase in price can give an increase in revenue.

When combining a market dominance of gas monopoly and the notion of gas as an inelastic good it becomes clear why the gas company, public or private, to great financial pain for the consumers, could exploit such a position.

When discussing gas and price mechanisms two main forms are considered in this thesis. The more market oriented form of gas hubs where gas is traded in a variety of different ways, mainly spot prices but also futures. And long term contracts where gas prices are linked to oil prices.

1.4. *EU response – Unbundling of energy companies*

To increase competition in the energy market the institutions of EU have prompted the breakdown of big energy companies. Especially companies that own assets through the entire chain, such as generation assets, transmission networks and distribution networks, have attracted the interest of legislators. Such companies are called Vertical Integrated Utilities or Undertakings (VIU). Sometimes these VIU's are publically owned and considered a safeguard for the nation with regards to securing energy supply. The process of breaking down these companies are known as unbundling. It is

not difficult to see that such a process might runt into problems if the national that a publically owned VIU is beneficial for the country.

Development of the unbundling principle has emerged over time and three directives stands out as important for this study. These are the gas directives of 1998[5], 2003[6] and 2009[7]. According to article 54 of the 2009 directive Member States shall comply with the directive by 3 March 2011.

The exact criterion of unbundling companies is to a large degree technical but in general it can be said that if a company owns assets in several stages of energy generation and distribution this company must de divided into smaller parts, i.e. unbundling. Some Member States have opted for an unbundling process where the legal ownership is divided, giving companies the possibility to own assets through trusts, and other have decided to go for full ownership unbundling where no connections are allowed between the different actors in the energy system. Prior to the 2009 gas directive, known as the third energy package, several less strict types of unbundling were allowed, for example accounting unbundling. With the new directive only full ownership unbundling or legal unbundling are allowed.

The third energy package ones again changes the EU energy market and the time for a new revision of the impact of the legislation has come. Additional questions arise when considering the fact that it is now almost ten years since accession of ten Eastern European countries, whom several have a Soviet heritage. Their unique ties towards Russia regarding energy put EU legislation at new tests. Hence a thorough analysis and

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[5] European Parliament and Council Directive 1998/30/EC concerning common rules for the internal market in natural gas.

[6] European Parliament and Council Directive 2003/55/EC concerning common rules for the internal market in natural gas and repealing Directive 1998/30/EC

[7] European Parliament and Council Directive 2009/73/EC concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC

evaluation of the legislation and presumed variations between East and West is key order to create an effective single market for energy in EU.

1.5. *Aim*

As described by the previous segment, the last decade have seen the introduction of several regulatory measures on the European gas market, especially the principle of unbundling VIU's. These measures are expected to have changed the price mechanisms of gas. The aim of this thesis is thus to analyse these regulatory measures and evaluate their success, while taking into account the presumed regional variations between former East and West Europe. A theoretical model of gas price formation will be constructed and used to predict the effect of the regulatory measures on gas price. The model will be tested through a quantitative method using gas prices as the dependent variable.

2. Previous research

2.1. *How gas prices are set*

It is important to realise that the price of gas is not subject to the same mechanism in all European countries. During recent years, mainly from 2008 and onwards, a new development towards a more market based price mechanism has accelerated but old style gas contracts are still common in for example Germany.

Stern & Rogers[8] argues that the market is in a development towards more hub-based gas pricing in the countries of continental Europe. This means that gas contracts, traditionally closely linked to the price of oil, is now giving way to gas traded in hubs where spot prices prevail. The implication of this is that gas prices reflect the supply and demand of gas, rather than of oil, as is the case with contracts linked to oil price.

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[8] Stern, Jonathan, Rogers, Howard, (2011) *The Transition to Hub-Based Gas Pricing in Continental Europe,* The Oxford Institute for Energy Studies, Oxford.

Due to the relative small number of sellers and buyers at the European gas concerns regarding price manipulation have been voiced. Stern & Rogers means that these concerns are justified and argues that the European Commission's strive to liberalise the market have reduced security of demand for the sellers, which could spur price manipulation.[9] These concerns do not exist, or at least are much less worrying, in price models where gas is traded in contracts indexed to oil price.

2.2. *External aspects of gas price*

As mentioned earlier the small number of actors on the supply side of gas raises concerns with regards to their market influence. These concerns are even bigger when considering the fact that one of the biggest actors, Gazprom, is a state-owned company from Russia. Many countries in Eastern Europe, especially the Baltic States, rely heavily on Gazprom exports.

Solanko & Sutela [10] shows in their article that these concerns are well grounded additional concerns regarding the availability of gas should also be considered. At the current growth in Russian gas extraction and domestic demand there will be exports in the future, but if any of these two changes there might be a scarcity of supply. Due to the principles of supply and demand scarcity of supply will likely increase energy prices for EU. Combined with the more market based price setting mechanism discussed in the previous section this will inevitably lead to scenario where gas prices are affected by Russian policy change.

The influence of Gazprom is felt even more on the political level. As discussed by Umbach[11], the strong position of Gazprom and the Russian governments willingness to use energy exports as a foreign policy tool constitutes a threat that EU needs to

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[9] Stern & Rogers, (2011) page 15

[10] Solanko, Laura, Sutela, Pekka, (2009) "Too Much or Too Little Russian Gas to Europe?" *Eurasian Geography and Economics Volume 50, Number 1 January – February 2009,* pages 58 -74

[11] Umbach, Frank., (2010) "Global energy security and the implications for the EU" *Energy Policy* 38: 1229 – 1240

consider. This illustrates the mixed price system discussed in section 1.3 where full market liberalization nor full price regulation is in play, but rather a mix between the two. As many Eastern European countries rely heavily on Russian gas exports it cannot be ruled out that price hikes can be used as a mean of political influence. If Russia decides to use either price increases or, as in the case with Ukraine, simply stopping the gas exports this will affect prices through scarcity of supply at the earlier mentioned gas hubs.

The conclusion from this discussion is that even though gas trade moves away from long term contracts based on oil prices towards the more market based price mechanism of gas hubs, political influence from Russia is still a important factor to consider when discussing gas price. However, it is important to remember that dependency goes both ways, EU is dependent on gas from Russia, but Russia is also dependent on the income of those exports. If prices were to be increased too much incentives to cut energy usage in EU would lower the energy need to a level where Russia loses export revenue. No matter what price setting mechanism is in play, there is no way around the fact that a large portion of gas comes from one supplier and that this grants them certain powers and weaknesses.

2.3. *Unbundling and competition policy – similar but different*

It is important to note that although competition policy and unbundling policy are similar in some aspects (both try to increase competition in the market) they are not equivalents. Rather, unbundling could be looked at as a special case of competition policy. While it is true that fierce competition policy might lead to ownership unbundling, as in UK for example [12] , the logic behind legal unbundling is less intertwined with competition policy. Consider a scenario where several private companies own power plants, distribution grids and supply networks and compete on an open market. According to the principles of unbundling this would not be preferable

[12] Künneke, Rolf, Fens, Theo, (2006) "Ownership unbundling in electricity distribution: The case of The Netherlands" *Energy Policy,* Volume 35(2007), pages 1920-1930, page 1929

due to the upstream-downstream integration of such companies. Even competition might be good they would still have to be owned by separate legal entities (legal unbundling) or sold off to constitute separate companies with separate owners (ownership unbundling).

2.4. *The effect of unbundling on the price of gas and electricity*

To measure the effect of unbundling on energy prices it is important to distinguish between the many forms of unbundling. According to theory, stringent unbundling, such as ownership unbundling, should be more successful at creating efficient markets than other, less strict, forms of unbundling.

Pollitt[13] has examined the effect of different types in his 2007 article. The findings show a correlation between ownership unbundling and the creation of a more competitive market. Although it is important to remember that the causality and timing is uncertain. Econometric evidence is discussed but several problems exist. As mentioned there is a problem with causality when using price data. This is due to the fact that it is not certain whether markets that are already liberal are easier to unbundle, and vice versa. Problems with identifying the specific effect of ownership unbundling with regards to the many other reforms made during the examined period are also present. An example of this is that ownership unbundling correlates with privatisation and while retail markets have appeared over the same time span. Pollitt also notes that the process of ownership unbundling is more common in electricity markets than in gas markets.

As for the econometric evidence Ernst & Young have published an extensive report on the subject.[14] In this report they do find a significant correlation between the existence of a separate transmission operator (i.e. unbundling) and lower gas prices for industrial

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[13] Pollitt, Michael, (2008) "The arguments for and against ownership unbundling of energy transmission networks", *Energy Policy*, Volume 36, Issue 2, February 2008, Pages 704-713

[14] Ernst & Young, (2006) *Final Report: Department of Trade and Industry Research project on "The Case for Liberalization",* Ernst & Young LLP, London

consumers. The effect on prices is found to be about 15 %. The amount of data in report is very large and covers many different types of price series over different times, although Eurostat supplies the bulk of the data. Though no data is newer than 2005, some data stretches all the way back to 1985 but a majority of time series begin in the 1990's. However, Pollitt notes that the direction of causality is unclear.

The European Commission have also done econometric studies[15] on the subject of unbundling and concluded that in the electricity market there is correlation between ownership unbundling and lower prices. A similar analysis is done on the gas market but the relationship between ownership unbundling and gas prices is not significant. However, it is found that a general market opening, i.e. allowing private companies, is negatively correlated with gas prices, but it cannot be confirmed that the market structure, i.e. the dismantling of VIU's, is responsible for this.[16]

It seems that there are major problems with an econometric analysis of the effect of liberalisation. As already mentioned direction of causality continues to be an issue, and added to this the problems with keeping track of the effects of several simultaneous policy changes, such as opening a market to private companies and unbundling simultaneously. There is also a problem with measuring of energy prices when trying to determine the effect of unbundling. If the prices increase over the examined period due to other reasons, such as increased costs further upstream, this might mask the effect of unbundling. To counter this problem Ernst & Young calculated a spark spread. This is a done by subtracting the price of the intermediate goods, in this case gas for electricity generation, from the price of electricity. The study found a negative trend when plotting spark spreads from 1996 to 2005, indicating a market where the marginal revenue on electricity generated from gas is decreasing. Decreasing marginal

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[15] European Commission, (2005) *Market Opening in Network Industries Part II: Sectoral Analyses,* Brussels.

[16] European Commission, (2005) page 238

revenues in this case indicates a move towards a market with more competition.[17] negative aspect of using spark spreads is that they can only be calculated for industrial customers, and thus omits the aspects unique to domestic customers.

2.5. *Institutional explanations of different types of unbundling*

To analyse the different outcomes of unbundling processes in European countries it is important to consider factors such as institutional heritage, geography and market size. The gas transmission networks of Eastern Europe was constructed during the Soviet era and according to Boussena & Locatelli this still determines the trade patterns of gas in many of these countries. [18]As an example of this it can be mentioned that Gazprom's market share in the former soviet Baltic States is 100 %. Bouzarovski shows in his study that even though many of the countries in Central and Eastern Europe started out as rather similar, most notably with their Soviet heritage of large centrally planned energy systems, differences have emerged over time. These differences can, according to Bouzarovski, be explained with the different geographical conditions and size. As an example of this he compares Poland, which is a large market, with the Baltic States. The possibility of competition in electric generation in a market as small as the Baltics (population size range from 1-3 million) is vastly different from Poland with a population of about 38 million.[19] It is plausible that it is more complicated to implement unbundling in a market where the gas system built to accommodate the needs and trade patterns of the old Eastern block.

An example from The Netherlands confirms the importance of institutional prerequisites. Künneke and Fens shows how ownership unbundling was a way for the Dutch government to keep hold of the electrical networks while selling out production

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[17] Ernst & Young, (2006) page 45

[18] Boussena, S., Locatelli C., (2013) "Energy institutional and organisational changes in EU and Russia: Revisiting gas relation" *Energy Policy*, Volume 55, April 2013, Pages 180–189 page 181

[19] Bouzarovski, Stefan, (2009) "East-Central Europe's changing energy landscapes: a place for geography" *Area Vol 41 no. 4 pages 452-463,* University of Birmingham, page 460

and supply. While it was obvious to the politicians that with the 2003 directive[20] energy markets the previous structure where generation, distribution and supply were all under the same public company was not a viable option for the future. Instead, ownership unbundling was seen as a way of keeping networks in public hands while selling out generation and supply, which was not considered as crucial, and still complying with the directive.[21] While this holds true for The Netherlands, different institutional setup and public debate in United Kingdom meant that the ownership unbundling of the electricity market was not met with the same arguments. In UK, generation, distribution and supply are all seen as commodities and hence should follow the same rules for competition as other commodities. This was manifested in the voluntarily ownership unbundling that took place in UK prior to the 2003 directive. According to Künneke & Fens the firms were already in a state where they were treating all three aspects of the electricity market as commodities, and hence the rules laid down in the directive was not seen as controversial.[22]

The British example of voluntarily ownership unbundling follows the findings of Knill & Lenschow in their 1998 study.[23] They argue that when new legislation confirms national arrangements the required adaptations are low or non-existent and the legislation can be expected to be quite effective. On the other hand, if adaptation pressure is high and the legislation at hand fits poorly with national arrangements the expected effectiveness of the legislation is low. National institutions are likely to persist even in a high-pressure environment, depending on how well established these institutions are.

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[20] Directive 2003/55/EC of the European Parliament and of the Council of 26 June 2003 concerning common rules for the internal market in natural gas and repealing Directive 98/30/EC

[21] Künneke & Fens, (2006) page 1929-1930.

[22] Künneke & Fens, (2006) page 1929

[23] Knill, Christoph, Lenschow, Andrea, (1998) "Coping with Europe: the impact of British and German administrations on the implementation of the EU environmental policy", *Journal of European Public Policy,* Vol. 5 no. 4, 595-614.

Although Knill & Lenschows findings are on the subject of EU environmental is fruitful to extrapolate these findings to the field of energy policy, and in particular unbundling. As shown by Künneke & Fens the British system fits quite well with the principles of ownership unbundling, and as they showed, spontaneous unbundling took place prior to the 2003 directive. In this case the legislation from EU merely confirmed arrangements that already existed. In the case of The Netherlands the Dutch government twisted the unbundling legislation to fit their ideas and norms and in such the national arrangements could persist. It seems that the notion of a publicly owned energy company in The Netherlands were so well founded that it "survived" the adaptation pressure from EU. According to Knill & Lenschows study the legislation should be less effective at liberalizing the Dutch energy market compared to the British.

2.6. *Patterns of unbundling*

Van Koten & Ortmann [24] concludes in their 2008 article depending on national preconditions, for example the existence of a publicly owned VIU, the outcome and speed of the unbundling process differs.

An example from the Netherlands shows that during the process of deciding between legal and ownership unbundling several energy companies paid large sums of money to consultant companies to influence the public debate in order to promote legal rather than ownership unbundling.[25] This serves as a good example of both how VIU prefer legal unbundling and how they do influence the implementation process.

The above-described scenario could be viewed as a type of corruption. Van Koten & Ortmann tests the relationship between corruption, measured with the Corruption Perception Index (CPI) from Transparency International, and outcome of unbundling process with regards to legal or ownership unbundling.

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[24] Van Koten, Silvester, Ortmann, Andreas, (2008) "The unbundling regime for electricity utilities in the EU: A case of legislative and regulatory capture?" *Energy Economics,* 30(2008), 3128-3140

[25] Van Koten & Ortmann, (2008) page 3131

A possible pattern of unbundling would then be the extent of corruption, which is found to be significant in Van Kotens & Ortmanns article. But this relationship is different between EU-15 and the ten new member states that joined 2004 (NMS-10). The effect of CPI on unbundling type in EU-15 and NMS-10 is opposite where high corruption in EU-15 tends to lead too weaker forms of unbundling and vice versa. The conclusion Van Koten & Ortmann makes from this is that in EU-15 politicians "defend" the VIU's by going for weaker unbundling schemes. The situation for NMS-10 is more complex and it is argued that the pressure from the European Commission prior to their accession into EU many of the NMS-10 countries decided to implement unbundling types that gave the illusion of a liberal energy sector.

An alternative pattern of unbundling would be the legal origin of the country and institutions. La Porta et al.[26] argues that countries with a common-law[27] heritage have higher economic freedom and lower corruption. Extrapolating this argument a common-law origin should imply a higher occurrence of ownership unbundling. However, this theory is not proven in Van Koten & Ortmann's article where the greater degree of ownership unbundling in countries with common-law origin is not statistically significant.

2.7. *Research gaps*

Looking back at the previous research a few general observations can be mentioned.

- ☐ Correlation between privatization and unbundling on one hand and lower prices on the other is clear, but as always causality is a different question and would benefit from further research.

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[26] La Porta, Rafael, López-De-Silanes, Florenico, Pop-Elches, Cristian, Shleifer, Andrei, (2004) "Judicial Checks and Balances" *Journal of Political Economy,* Vol. 112 no. 2, pages 445-470

[27] Defined by the Oxford English Dictionary as "The unwritten law of England [. . .] which purports to be derived from ancient and universal usage, and is embodied in the older commentaries and the reports of adjudged cases." Common-law heritage refers to countries with a history of English influence on their judicial systems, such as Ireland, Australia, Canada, United States and India.

☐ Due to many parallel processes affecting the gas market the impact of EU legislation is difficult establish.

☐ Institutional prerequisites are important with regards to unbundling and price mechanism. The effect is not always the same, as exemplified by the reversed effect of corruption between EU-15 and NMS-10 Member States.

☐ The new gas directive of 2009 with less room for vague forms of unbundling offers new opportunities for a survey on the subject.

☐ Almost ten years have passed since the 2004 enlargement and the time is thus ready for an evaluation of the legislation in the new Member States.

3. Research questions

Based on the previous sections two research questions can be asked.

☐ Has the regulatory measures taken by EU resulted in lower gas prices?

☐ Is there any regional variation in the effect of the implemented directives?

4. Theoretical model

4.1. *Two tracks leading towards a gas price*

Based on the previous research section a theoretical model that explains the price of gas can be constructed. Two parallel "tracks" are considered. First, the cost of gas is product of the real costs, i.e. extraction, transportation and distribution. Second, price mechanisms used in the trade of gas decide the final price for the consumer.

The first track is dependent on natural prerequisites such as geographical conditions, method of extraction and the distance between source and consumer. A consumer that lies close to the source could due to lower transport costs obtain gas at a lower price than a consumer far away. The second track is more dependent on the market structure of the countries that the gas are extracted in, transported through and

consumed in. An example of this is when gas is subsidised, as was the case in Soviet Union, prices was thus decoupled from the real cost of gas and clearly shows that the price is a product of costs and mechanisms. To a lesser extent this is also true for when gas is traded in contracts indexed to oil price. These prices do not reflect the cost of gas, but rather the equivalent cost of oil, and thus fails to act as a signal between producers and consumers on the true state of supply and demand in the gas market.

In the medium to long term these two tracks leading to a single gas price is somewhat interconnected. Depending on the market structure different incentives exist for the investment in new extraction and transmission facilities. An example of this is when the price is allowed to float freely, if demand rises price would rise with it and create additional pressure to extract more gas, and thus invest in more extraction capabilities. However, in the short term investment cannot be done fast enough to alter the price in any significant way. A cold shock spanning over a month or so would result in a higher demand for gas due to increased need for domestic heating, but these short time periods is not enough to construct new extraction and transmission facilities and hence price would rise.

4.2. *Laws and norms*

As was described in the previous research section it is found that differences in national laws and norms influence the implementation of gas market legislation in the Member States of the EU. It is therefor reasonable to assume that a good fit between national laws and norms and EU gas market legislation would lead to unbundling regime that implements full ownership unbundling. For countries with previously publicly owned VIU's this would mean both unbundling and privatisation.

However, the causal link between privatisation and unbundling regime is difficult to establish. Imagine a country where several VIU's exist but are privately owned. When ownership unbundling is implemented this would result in the breaking up of these

companies into smaller entities. The amount of gas traded and distributed by companies will stay the same. In another country where the VIU's might be owned publicly the same legislation would result in both higher degree of privatisation, due to the fact that the state needs to sell of parts of their VIU's, and a higher number of companies active on the market. This means that the degree of privatisation cannot be explained by the unbundling regime implemented by the Member State, although it *might* explain privatisation in countries with publically owned VIU's.

4.3. *More competition leads to new price mechanisms*

With the introduction of EU gas legislation competition is facilitated in the market. As discussed by Stern & Rogers in their 2011 paper a transition is on-going where prices move away from long term oil pegged contracts towards a prices being set in gas hubs. Their explanation connects world prices and competition in the EU context.

When gas prices are indexed to oil prices the price of gas is essentially decided by the supply and demand of oil. According to Stern & Rogers this system worked as long as gas companies were large and vertically integrated. When competition increased and the number of companies on the European market grew a new mechanism that allowed trade between companies, countries and regions within the EU was needed and resulted in a process that moved away from the old way of deciding prices.[28]

Hence a causal link between unbundling and a new price mechanism plausible. However, Stern & Rogers also mentions that the decoupling of oil and gas prices on an international level also contributed to the shift away from long term gas contracts.

4.4. *Corruption affects the implementation of legislation*

A theoretical model that sets out to explain gas prices as partly products of national implementation of gas legislation needs to consider the theories of corruption and its influence on the process. As was described in the previous research section corruption

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[28] Stern & Rogers (2011) page 37

has been found to be a significant factor, where large companies subject to legislation being implemented use their vast economic resources to both lobby towards and bribe legislators to adapt the legislation. However, the relationship between corruption and unbundling regime was inverted between EU-15 and NMS-10, where the relationship was more complex in NSM-10.

4.5. *Changing price mechanism on gas*

Stern & Rogers study found that the price of gas during the later part of the last decade began to decouple from oil prices. New price mechanisms began to emerge in the hubs where gas is traded on spot markets.[29] It is important that it is not the price level that changes with the new hub based trading scheme, although it might also happen, bur rather the price mechanisms. It is interesting that the path away from oil-linked gas contracts coincides with a period where two major legislative packages concerning the gas market have been introduced.

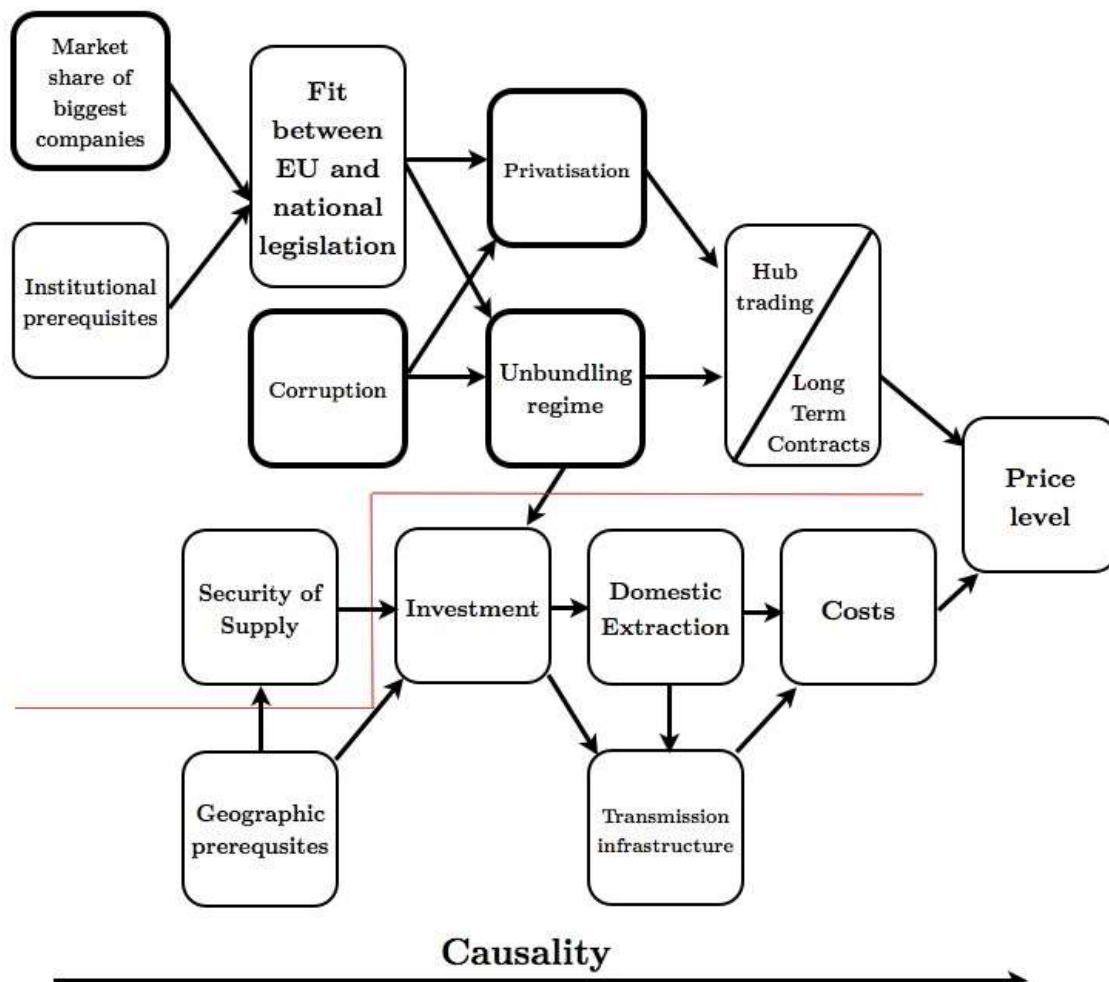## 4.6. *The relation between legislation and unbundling*

It seems obvious that the three gas directives have created a more efficient market through various means of forced unbundling, whether it be ownership, legal or another form. However, as mentioned in the previous research section national institutions are not easily changed when legislation fits poorly with existing arrangements. From this it is reasonable to draw the conclusion that the same legislation has not been equally successful in all Member States.

Measuring the relation between unbundling type and prices, while still being interesting especially in the eastern parts of the union, would not give the same evaluation of the impact of EU legislation in this particular policy area. The really interesting relation is the one between the institutional prerequisites that are considered negative for ownership unbundling and prices.

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[29] Stern & Rogers (2011) page 36

4.7. *Delimitations of the theoretical model*

To construct a comprehensive model of how the price of gas is set is a huge task and is outside the scope of a study of this size. The model constructed in this section is focused on the effects of EU legislation and factors that are closely linked to market structures, such as privatisation, market share of companies and main actors. Entire policy areas that is likely to influence the price of gas, such as security of supply, foreign relations with gas exporting countries, technical standards on transmission infrastructure is not taken into account.

4.8. *Graphic presentation of the theoretical model*

Figure 1: Theoretical model

The middle line represents the divide between factors considered to be mainly a product of geography and those considered to be of a more societal character. Although some factors, such as investment in infrastructure is both a product of geography, i.e. distance to the source, and societal conditions facilitating investment.

4.9. *Hypothesis derived form the theoretical model*

According to the theoretical model gas prices should be lower if the market have been liberalized and ownership unbundling implemented, compared to a market where this is not the case. This means that the lowest prices should be found in Member States where privatization is high, ownership unbundling is implemented, market share of the main companies are low, market concentration is low and where corruption have not had the chance to influence the political processes deciding on how to govern the gas market.

5. Method and operationalization

5.1. *Delimitations*

This section on methodology has its starting point in the theoretical model presented in the previous section. The graphic representation of the model shows many causal links and provides for a large number of possible variables to be examined. To examine all those factors and causal links would constitute a huge task, hence a series of delimitations will be made to keep the thesis within a reasonable size while covering the central parts of the theoretical model.

Due to the fact that EU's efforts in streamlining the European gas market is the main focus of this thesis, most attention will be given to factors in this area. Privatisation and unbundling regime stands out as very important factors to examine. Unbundling regime is the most central part, while privatisation is also both an end goal and effect of EU gas legislation.

As previous research have shown corruption can play an important role on the market and in combination with the relative ease this can be included in a survey makes this factor both interesting and available to include in the study.

As theorized it is important to take into account the characteristics of the market, with regards to number of companies, market share etc. To do this the market share and the number of main companies will be taken into account.

The rest of the ideas and factors in the theoretical model will not be examined in this study, although they are important to keep in mind when discussing results and future research.

Although many regional variations can be discussed and tested this thesis limits the regional variation analysis to an East/West perspective. The reason behind this is that the gas infrastructure constructed prior to the fall of the iron curtain was constructed for different trade patterns than today, and that this might be an important factor influencing gas prices. In practical terms this is done by coding a variable 0 or 1 depending on if the country was a member, or descendant from a member, of the former communist block. A list of countries in the Eastern Europe group can be found in Appendix I, Table 3.

5.2. *Discussion on data sources and variables*

Every statistical analysis benefits from as much data as possible. However, in reality the data is often limited both in time and space. For this study the spatial limit, i.e. for which countries there is data, is quite comprehensive due to the fact that Eurostat compiles data for EU27, which is the geographical area of study in this thesis. However, many of the structural indicators, such as vertical integration and public ownership have geographical constraints. This is due to both lack of reporting from national authorities to Eurostat and to the fact that countries joining EU in 2004 and 2007 was not always included in Eurostat reporting. Malta and Cyprus is also excluded due to their very small size and lack of gas markets eligible for EU legislation.

As for limitations in time there are a few more issues to be dealt with. The Commission compiles reports annually that describes the state of the European gas market, these reports constitutes a key source for this thesis with regards to market indicators such as number of main companies and their cumulative market share. The monitoring of the European gas market began with the 2003 directive; hence data on these indicators are only available from 2003 and onwards. Due to a one-year time lag for complied reports on the EU energy market, data is only availably until 2010 (the 2011 report, released in late 2012, containing information about the gas market until 2010). This means that the study will examine the processes over a maximum seven-year time span. This time span stretches from the introduction of the 2003 directive, which introduced the ideas of unbundling, to one year after the 2009 directive. Although a longer time span would be ideal, this period represents a time where evidence of unbundling, and the effects thereof, should be clearer than ever and thus makes this study possible.

Apart from Eurostat and the European Commission the Organization for Economic Co-Operation and Development (OECD) constitutes the third main statistical source for this thesis. The OECD data of interest for this study is the Indicators of Product Market Regulation (PMR) database and information on market structure, vertical integration and public ownership are collected form here.

However, the drawback with OECD data is that is only exists for the period 2003-2007 and it does not cover the entire EU27. But it still provides a complement to the data compiled by the Commission and will thus be used in the statistical analysis.

For a complete list of explanatory variables and their missing values se Appendix I, Table 1.

5.3. *Measuring gas prices*

The price of gas can be measured in a variety of ways. First off, price for industrial and domestic consumers differs due to the extra cost of distributional networks for domestic

consumers. On top of this any national taxes is added. Due to distributional being one of the focus areas for unbundling the price for domestic consumers are more important for this study than the industrial price.

Eurostat reports gas price data in Euro per Gigajoule (€/Gj)[30] without taxes, which enables price comparisons across countries. In the theoretical model the domestic price on gas without any taxes will be considered the dependent variable.

To compare prices over time is more complicated. Inflation is an important part but it is far from the only thing that affects price levels over time. New extraction technologies, growing demand from emerging economies, the shale gas boom in the USA and an increased market for gas transports by sea all effect prices over time. To examine if this has any influence over the relationships in the model a price difference can be calculated for each country/year combination. This is done by taking the price in one country during one year and subtract the average price of EU27 in that year. This will produce a new variable containing the price difference between a country's price level and a mean where a negative number indicates a price that is lower than the mean, and vice versa.

The positive properties of such a variable is that it can distinguish a trend in a country to lower its prices compared to a mean even though prices rise in absolute terms across the entire EU27. The negative aspects is that it cannot capture the effects of a lowering of prices across the entire EU27 as a result of legislative measures due to its inherent properties of only comparing countries. The price difference variable will be tested as a dependent variable as a complement to the absolute price statistics mentioned earlier.

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[30] Gigajoule is a measurement of energy; a Joule is equivalent to a power of one watt during one second. A Gigajoule is, after rounding, equivalent to 278 kWh (kilowatt hours). This is the energy needed to power a 60 W light bulb for 193 days.

5.4. *Measuring privatization*

A market with high degree of privatization would according to theory indicate a market that is more oriented towards market economy principles. In the case of the gas market where combined ownership in VIU's is frowned upon by the European Commission private ownership is a must in order to create a truly ownership unbundled market. In practice this means that when a market is unbundled according to the principles laid out in the gas directives, ownership structures must change. If the market starts out with a high share of public ownership it is likely that this will change as state or other public owners sell of assets in order to break up VIU's.

This means that the degree of private ownership on the market can be a sign of implemented unbundling legislation. However, a high percentage of private ownership is not the same as an unbundled market because a private company can constitute a VIU.

Data on privatization is collected form the OECD Product Market Regulation database. Three sub-indicators are complied to make a "public ownership" index. These sub-indicators are: (1) percentage of shares in the largest import/production firm that are owned by the government, (2) percentage of shares in the largest transmission firm that are owned by the government and (3) percentage of shares in the largest distribution firm that are owned by the government. All sub-indicators are given a value of 0, 3 or 6. Where 0 is none, 3 is between 0-100 % and 6 is 100 % ownership. The sub-indicators are then weighted together with a third of the weight each and presented as an index ranging from 0 to 6.

Because a value of 6 indicates a market where the government owns 100 % of gas assets, it is expected that this variable will have a positive correlation with price level.

5.5. *Measuring market share and market concentration*

To measure the market share of the biggest companies and market concentration an arbitrary boundary of what can be considered a big company must be set. Eurostat uses the term "main company" and sets this limit to a 5 % market share. Hence, in Eurostat data the number of main companies means the number of companies holding at least 5 % of the market. This is one measurement of market concentration, but its flawed in the sense that it cannot distinguish between markets where one company holds almost the entire market, and where only one is above 5 % and numerous smaller companies hold the rest. To measure this it is important to consider the cumulative market share of all the main companies. Such a measurement would allow for a deeper analysis.

A high number of main companies and low score on cumulative market share of those main companies would, according to the theoretical model, indicate a competitive market and lower prices. Thus, market share and market concentration will be operationalized as two separate variables, one measuring the amount of companies above 5 % market share, and one measuring those companies total cumulative market share.

The variable containing information about the number of main companies should have a negative relationship, i.e. when the number of companies increases competition increases and prices fall. The variable on cumulative market share should have a positive relationship, i.e. as fewer companies hold a bigger share of the market, competition is reduced and prices increase.

The OECD database also contains information on market structure. This variable is a combined index with information on (1) what is the market share of the largest company in import/production industry, (2) what is the market share of the largest company in the transmission industry and (3) what is the market share of the largest

company in the distribution industry. These sub-indicators are given values 0, 3 or All three are then weighted together to create an index ranging from 0 to 6.

5.6. *Measuring unbundling regime*

The degree to which a country has unbundled its gas market is not a straight forward either or between ownership and legal unbundling. Often, some of the companies active on the gas market have been unbundled and some of them have not. While in the process of unbundling different regimes might have been used on different operators and where some are ownership unbundled, some are legally unbundled and some are still vertically integrated.

To counter this problem the unbundling regime applied to the largest Transmission Operator (TSO) can be used as a measurement of the unbundling regime applied and provide a label as to which unbundling regime the country has implemented. Data on the unbundling regime applied to the largest TSO can be obtained from the "Benchmark reports" published annually by the European Commission. These reports are compiled to give the reader a overview on the developments towards an integrated European gas market and list a series of relevant indicators form both gas and electricity markets.

Because unbundling aims to decrease vertical integration on a market measures of vertical integration can be used to study implementation of unbundling legislation. The Organization for Economic Co-operation and Development (OECD) compiles data on several relevant market indicators, among those a measurement of vertical integration. In the OECD data vertical integration on the gas market is reported as a ordinal variable ranging from 0 to 6 and is a weighted index between the (1) degree of separation between gas importers and the rest of the industry, (2) degree of separation between gas suppliers and the rest of the industry and (3) vertical separation between gas distribution and gas supply. Each of these sub-indicators is given the value 0, 3 or 6 where 0 is ownership separation, 3 is legal separation and 6 is integrated (or no

separation). The sub-indicators are then added together to produce an index from 0 to 6 where 0 indicates a country with a market under full ownership unbundling and 6 a market with full vertical integration. This variable is expected to have a positive relationship with the price of gas, meaning that as the vertical integration variable increases (market is more vertical integrated) the prices increase.

5.7. *Measuring corruption*

As shown in the section of previous research corruption plays an important part when discussing gas prices and especially unbundling regimes. Transparency International measures corruption with their Corruption Perception Index (CPI) annually. This index will be used as the overall measurement on corruption. The data is obtained from the Quality of Governance institute at the University of Gothenburg.[31]

The CPI is as its name hints, a measurement of the perceived corruption in a country. Due to the inherent difficulties of measuring an activity like corruption a perception index provides a good proxy to the "real" level of corruption in a country. To compare such an index over time is complicated. Perceptions might change which might skew results independent on if the real level of corruption have changes. But as the CPI is calculated as a three-year moving average and the period for this thesis is seven years sudden changes in perception on corruption, or methodological differences, between years are even out.

5.8. *Control variables*

Because this thesis does not create a comprehensive model on gas pricing it is important to control for other factors that might affect the gas price. There are a few factors that are considered important to the price level of gas.

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[31] Teorell, Jan, Nicholas Charron, Dahlberg, Stefan, Holmberg, Sören, Rothstein, Bo, Sundin, Petrus & Svensson, Richard, (2013) *The Quality of Government Dataset, version 15May13.* University of Gothenburg: The Quality of Government Institute, http://www.qog.pol.gu.se

Because gas contracts in many countries are still indexed to oil price this is important factor to consider. As a control variable oil price that is lagged one year will be used. The idea behind the lag is that it takes time for gas and oil prices to adjust.

Inflation might be one reason behind rising gas prices. However, there is a reason to believe that there are complex causal links between inflation and gas prices. One of these reasons is that energy prices are usually included in the collection of goods that is used to compute consumer price inflation. When EU compares inflation between member states the Harmonized Consumer Price Index (HCIP) is used. This variable is obtained from Eurostat and will be used as a control variable for inflation.

GDP per capita will be used to control for the different levels of economic development between countries. The variable is obtained from the Quality of Government dataset.

5.9. *Statistical method and diagnostics*

When analysing a time series cross sectional dataset[32] some statistical problems have to be dealt with. First, it is suspected that structural differences between countries are fixed over time are that this produces heterogeneity in the intercepts. A common remedy for this problem is to apply a fixed effects model. A fixed effects model will adjust for heterogeneity in the intercepts and in this case calculate a coefficient that is more reliable than that of an ordinary regression or a random effects model.

Secondly, stemming from the time series component of the data autocorrelation might be a problem. A Wooldridge[33] test for autocorrelation indicates that this is a problem by rejecting the null hypothesis of no autocorrelation in the data. To tackle this problem a lagged dependent variable is used.

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[32] Synonymous with panel data and pooled data.

[33] Drukker M. David, (2003) "Testing for serial correlation in panel-data models" *The Stata Journal,* Number 2, pages 168-177

Multicollinearity appears to be a problem for the model. With VIF values for two the variables between 20 and 30 and an average VIF substantially larger than 1 this is cause for concern[34].[35] However, the model as a whole can still be evaluated, but the effect of individual variables have to be treated with caution.

Because several of the variables are categorical variables, such as the ownership unbundling variable, and the distribution is skewed the error terms are not normally distributed, i.e. heteroskedasticity. To correct for this a robust method will be used.[36]

As always with quantitative methods the causal direction can be questioned. However, as the model tested are backed up by theory, reasonable arguments on the casual directions can be made.

5.10. *Statistical hypothesis and equation*

In order to answer the research questions a statistical hypothesis can de derived.

Market privatization is expected to have a negative relationship with price levels, i.e. coefficient is significant and negative. The cumulative market share of main entities and number of main entities are both expected to have positive relations with price level. The unbundling regime variable is expected to have a negative relationship while the OECD vertical integration variable is expected to have a positive relationship. The Corruption Perception Index is expected to have a positive relationship with price level.

All control variables are expected to have positive relationships with the price level.

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[34] Field, Andy (2009) *Discovering statistics using SPSS, Third Edition,* SAGE Publications Inc., London., page 242

[35] Se Appendix 1 table 2 for VIF values.

[36] Robust option in Stata.

Expressed in mathematical terms the model to be estimated looks like:

$$y_{i,t} = \alpha_i + \beta_1 \dots + \beta_2 \dots + h \dots_{i,t} + \beta_3 \dots + \dots + \dots + \dots + \dots + e_i + \varepsilon_{i,t}$$

Where β is a coefficient, α is the time invariant fixed effect, e is the country specific error term, i is a country and t is a year.

The null hypothesis for the second research question is as follows: The coefficients are the same for all variables even when the regressions are run on the East and West categories separately.

6. Results

6.1. *Presentation of variables – trends and observations*

This section will present the characteristics of the dependent variable, gas price, and the key independent variables: ownership unbundling, number of main entities on the gas market and their cumulative market share. A frequency distribution of the dependent variable is presented in Appendix I.

Figure 2: Gas prices in €/Gj
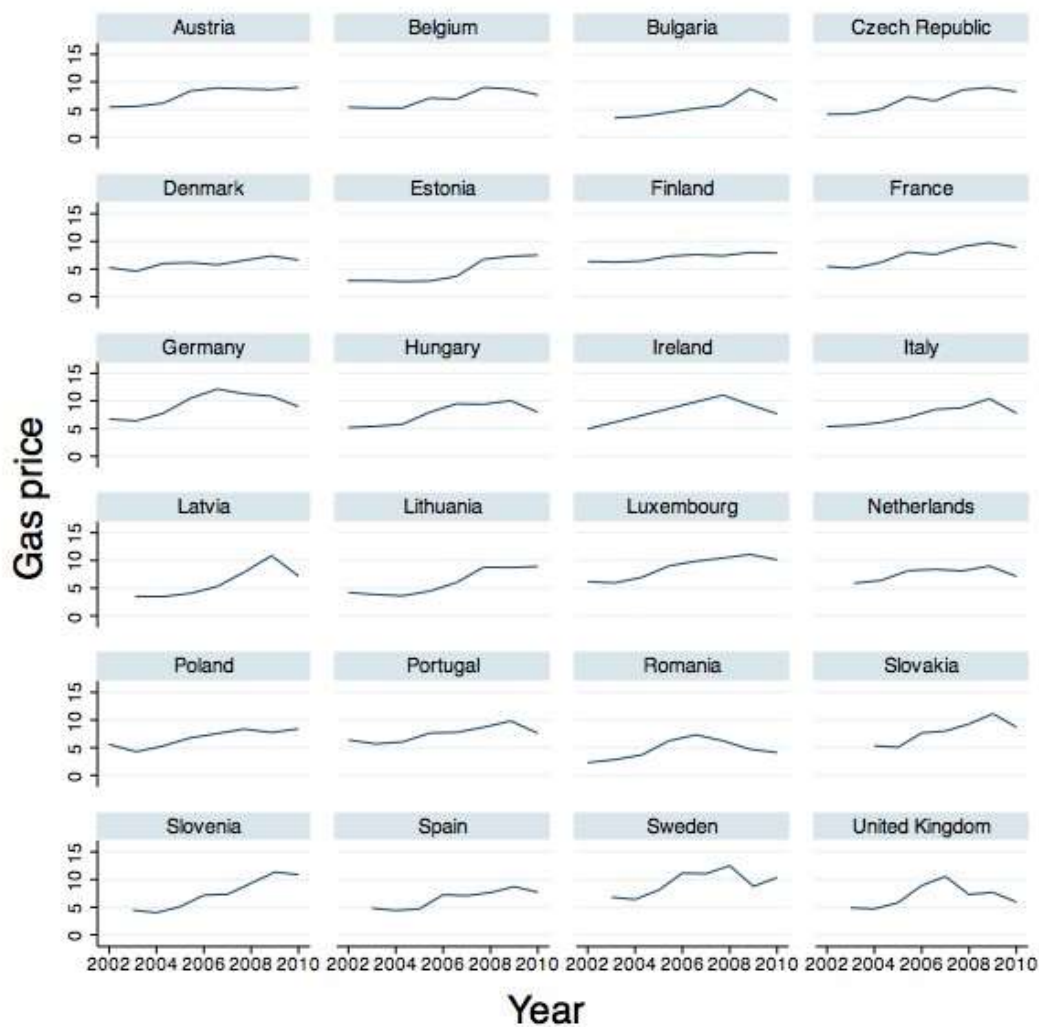
Data: Eurostat, t_nrg_price

The figure above shows the fluctuations of gas prices during the time period of this study. It clearly shows that the price have increased over time, but it is also clear that price changes have not been uniform across Europe. The figure also shows that price

hikes, such as those evident around 2007 in UK, Sweden and Germany is not present in Finland or Denmark. This strengthens the suspicion that gas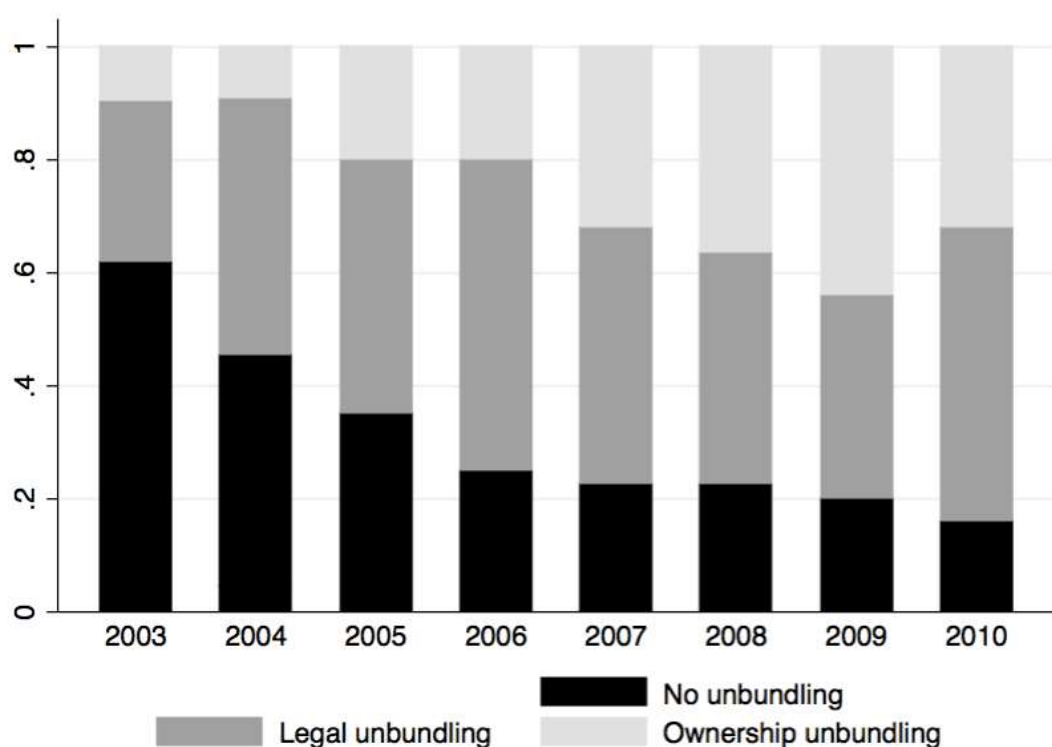 prices are determined by more than just supply and demand, and that fixed structural differences plays an important role. The fact that gas prices tend to increase over time might be explained by inflation, and thus inflation is controlled for in the statistical models.

Figure 3: Unbundling regimes implemented.

Data: European Commission, Benchmark reports, data on implemented unbundling regimes.

Figure 3 shows the percentage of each type of unbundling regime for each year of this study. The most obvious observation is that the number of countries with no unbundling regime implemented has been reduced significantly. This indicates that the directives have been implemented into national law and that an analysis of their effect on gas prices is possible. The second observation to be made is that legal unbundling is the prevailing form of unbundling implemented by the Member States. Exactly what this means is so far unclear but according what has been previously theorized in this

thesis it should have a smaller effect on gas pries than if ownership unbundling was prevailing form.

Figure 4: Mean cumulative market share of main entities.
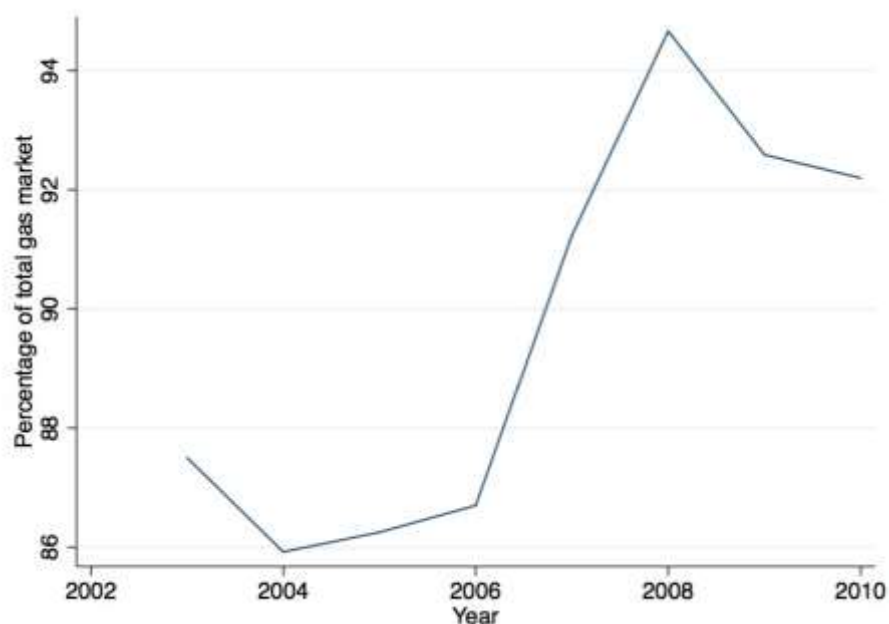
Data: Eurostat Natural Gas Market Indicators and Data in Focus reports.

Figure 5: Mean number of main entities.

Data: Eurostat Natural Gas Market Indicators and Data in Focus reports.

Figure 4 shows the mean cumulative market share of all the countries in this The trend indicates a move towards a more concentrated market where main entities are growing bigger. However, two factors needs to be considered before drawing any 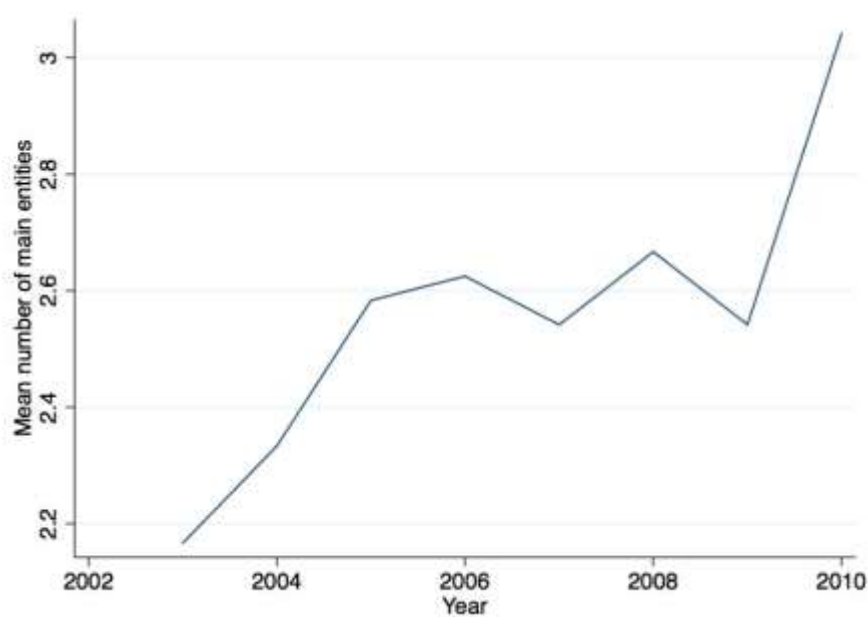conclusions. First, the increase is rather small, from a low point in 2004 at about 86 % cumulative market share, to just above 94 % in 2008. Second, the number of main entities needs to be taken into consideration. As figure 5 shows the number have been increasing, indicating a market where more companies are active. According to the theory this should have a lowering effect on prices, as competition is assumed to increase with an increasing number of companies.

6.2. *The effect of ownership unbundling on gas prices*

See Table 1 on page 38 for regression data.

A first glance on coefficients and significance levels does not look promising in the case of ownership unbundling and it is presumed effects on the gas price. However, a few interesting aspects are worth noting. Two variables in the study refer to the situation of unbundling in the member states, the OECD vertical integration variable and the ownership unbundling variable gathered from the Commission benchmark reports.

In the univariate regression the vertical integration variable has a negative impact on prices, which means that with increasing values of vertical integration prices rise. Because the variable is scaled from 0 to 6 where 0 is ownership unbundling and 6 is total vertical integration this goes in line with what would be expected.

On the other side the ownership unbundling variable gathered from the European Commission benchmark reports have a positive sign, indicating that, as ownership unbundling is implemented prices on gas increase. How can this, clearly opposite results from variables measuring essentially the same thing, be explained?

There are two explanations. The first one is that the variables collected by OECD exclude many Eastern European countries, whereas the Benchmark reports do not.

Because there is a difference in mean price between Eastern and Western countries implies that for countries with high prices, i.e. Western, prices tend to decrease as ownership unbundling is implemented, but for countries with lower prices, i.e. Eastern, there is an opposite relationship.

The second explanation is that the OECD variable includes more aspects of the gas industry, all the way from import/production to distribution and weighs them together. The data in the benchmark reports does not consist of such detailed statistics. Subsequently only data on the unbundling regime applied to TSO's are included in the variable. This might mean that the TSO's aren't the key players of the system, or not as important as thought, and that a broader measurement of unbundling is needed.

However, it is important to remember that the significance of the ownership unbundling variable is not significant when the whole model is run, and the significance of the vertical integration variable also disappears when controls are added. The data does not support any conclusion that ownership unbundling does lower prices in any significant way.

6.3. *The effect of market structure on gas prices*

The findings for the market structure variables are similar to those of ownership unbundling. The OECD variable market structure, measuring the market share of the largest company in production/import, transmission and distribution industry has a negative relationship when fitting a univariate regression with gas price. This can be explained in similar terms as for ownership unbundling, i.e. there are some countries in Europe with low gas prices and a very high market concentration.

To analyse this relationship closer regression is done separately for Western and Eastern Europe. While the coefficient decreases for Western Europe when Eastern Europe is excluded indicates that there is some truth in the above-mentioned explanation, but it is not the sole reason. Doing the regression on only Eastern European countries does not produce a statistically significant result.

Public ownership also has a negative effect on prices, meaning that as the
of shares owned by the government in the largest import/production, transmission and
distribution companies increases prices tend to drop. This cannot be attributed to the
differences between Eastern and Western Europe as mentioned on previous variables
due to the fact that Western Europe has a higher degree of public ownership in the
largest gas companies.

6.4. *Corruption, lagged dependent and control variables*

The data used in this study cannot show that corruption has any statistical significant
influence on gas prices, as was theorized. The Corruption Perception Index was not
significant in the univariate regression or full models.

As suspected the lagged dependent variable has a large effect on the dependent variable,
which is quite logical due to the inherent serial correlation prices tend to have over time.
However, when lagged oil price is included the significance disappears, possibly
pointing towards the fact that prices on gas is not determined by previous prices, but
rather previous years oil prices. The answer to this is probably to find in the fact that
large volumes of gas are still traded in contracts where the price of gas is indexed to the
price of oil.

The inflation variable is significant, indicating a relationship between gas prices and
HCIP. But as previously discussed the causal link between the two are uncertain and
the significance of inflation disappears in the full models.

6.5. *Full models*

As shown in Table 1 only the market structure and vertical integration variables have
some statistically significance when run in a model. However, when controlling for
lagged oil price also their significance disappears. Because oil and gas prices are
measured in the same unit (€/Gj) it is possible determine the effect and oil price increase
has on gas prices. Given a coefficient on 0.739 this can be interpreted as when

the price of oil increases 1 €, the price on gas increases 74 € cent. This is a quite effect and leaves little room for other factors but it does not explain 100 % of gas prices, leaving room for additional explanatory factors for future research. Concerning the high levels of multicollinearity discussed earlier it is difficult to discuss the effects of single variables in the model, but as the univariate regression between gas and oil price shows there is a substantial effect.

Reasons as to why the relationship is so strong between gas and oil prices are, as mentioned earlier, probably due to gas contracts indexed in oil prices, but also the substitutability between oil and gas in heating and electricity generation.

To test the second research question the full models are run again but individually for the East and West European groups of Member States. As before no coefficients are significant except the lagged oil price. Hence, the null hypothesis of the second question cannot be rejected.

6.6. *Alternative dependent variable and exclusion of OECD data*

As mentioned in the discussion regarding the variables collected from the OECD dataset their spatial and time limit raised concerns for this study. To test if this affects the result the same models are run without the OECD data. Still the models fail to produce any significant results except for the lagged oil price, confirming the strong relationship.

In the same manner the models are run with the alternative price variable, measuring the divergence from the EU27 mean. Again, no coefficients are statistically significant. This confirms the insignificance of the inflation control variable in the full models where absolute price were used as a dependent variable.

Table 1: Regressions

DV: Gas price, €/Gj	Univariate regressions	FE Model without controls	FE Model with controls
Explanatory variables			
Lagged dependent (t-1)	0.819***	0.700***	0.159
	(0.050)	(0.138)	(0.169)
Cum share main entities	0.061***	-0.015	-0.008
	(0.014)	(0.025)	(0.013)
Market structure	-1.181***	-0.653*	0.124
	(0.298)	(0.270)	(0.263)
Ownership Unbundling	1.019*	0.693	0.292
	(0.403)	(0.494)	(0.240)
Vertical integration	-1.150***	-0.539*	-0.287
	(0.211)	(0.255)	(0.196)
Number of main entities	0.613**	0.140	0.094
	(0.198)	(0.291)	(0.199)
Public ownership	-0.740**	-0.340	0.011
	(0.238)	(0.288)	(0.174)
Corruption	0.367	-1.113	-0.730
	(0.605)	(1.099)	(0.705)
Control variables			
GDP/capita	0.0006***		-0.00002
			(0.0002)
Lagged oil price	0.597***		0.739***
	(0.036)		(0.187)
Inflation (HCPI)	0.137***		-0.007
	(0.021)		(0.097)
Constant	-	14.528	8.074
R-square (within)	-	0.69	0.88
N (groups)	-	55 (17)	55 (17)

*p<.05 ** p<.01 ***p<.001. Standard errors within parentheses are robust. Data from OECD Product Market Regulation Database, Eurostat (t_nrg_price) and European Commission Benchmark reports on the internal market for gas.

7. Conclusion

7.1. Have the regulatory measures taken by the EU resulted in lower gas prices?

The theory behind the theoretical model was that legislation forcing the opening of markets, making them more transparent and prone to competition would lower gas prices for consumers. As is clear from the models presented in the results sections this theory cannot be supported by the data used in this study. In fact, the full statistical models hint that the oil price is still a dominant factor in determining gas prices and that regulatory conditions has very little or nothing to do with the price of gas.

A few simple explanations can be constructed as to why the regulatory efforts by EU have not managed to have a significant impact. The first explanation is that oil is simply such a good substitute that gas cannot be treated as an independent good subjected to its own price mechanism. The second explanation stresses the connection with oil through indexed contracts. This is a variation of the substitute explanation. The third explanation is that the measures taken by EU institutions to regulate the market are not enough to liberalize the market and introduce more market oriented price mechanisms. Though, the third explanation does not seem to get any support from this study due to the fact that no effect could be seen with regards to several of the important market structure variables.

To summarize the answer to the first research question: The regulatory measures taken by EU cannot be said to have lowered the price of gas.

7.2. Is there any regional variation in the effect of the implemented directives?

As was shown by Van Koten & Ortmann there was regional variation in the effect of corruption with regards to unbundling regime. This thesis tried to analyse if there was any evidence of regional variation when it comes to other regulatory measures with

regards to their effect on gas price. However, this analysis has to be done with great care due to the multicollinearity problem discussed previously where the effect of individual variables are difficult to distinguish in the full model. But as was shown, when a univariate regression was fitted the effect of ownership unbundling appeared to be different between East and Western European countries. This could also be a result of the slightly different data collected from the European Commission and OECD. But as this effect disappeared in the full models, even as they were separated into East and West categories, this indicates that the data used in this thesis does not support any significant regional variations.

7.3. *Importance of findings and link to previous research*

Considering that substantial effort has gone into the legislation regarding EU's internal energy market over the last decades is quite interesting that the statistical evidence in favour of those measures is quite weak, or non existent for the gas market. While this thesis does not intend to pull the rug from under the European Commissions feet it is clear that it is difficult to say anything for certain about the presumed positive effects of the legislation.

Worth noting is that, as explained in the previous research segment, the European Commission itself failed with finding a significant relationship between unbundling and gas prices. This study was done in 2005, just one year after the 2004 expansion and before the 2007 expansion. This thesis, while covering the enlargements during the last decade, confirms that any significant relationship still eludes the statistical tools applied.

Other studies do find a significant relationship between regulatory indicators, most notably ownership unbundling, and gas prices. These are both Pollitt's study and Ernest & Young. The reasons behind why they find a significant relationship and this thesis do not can be explained by several factors. Pollitt does his study on a different population than EU, including the USA, Australia and New Zealand. These markets

have very different initial conditions than EU and any generalization between should be done with caution. In other words, something that holds true in an American, Australian or New Zealand context might not hold true in a strictly European context. As for the Ernest & Young study their dependent variable is slightly different as they used industrial gas prices rather than domestic prices. It is not without doubt that this could have affected the result, but using industrial prices as a dependent variable fails to include the important factors of the distributional markets. The Ernest & Young study could be seen as a complement indicating substantial differences between industrial and domestic markets for gas.

7.4. *Critical evaluation of own research*

Several limiting factors weaken this study. One of the more important is data availability. As several of the variables are only available until 2007 and the study starts 2003 the time span is somewhat restricted. However this is a problem difficult to get by, the gas directive was created 2003 and that is when the interesting effects are thought to have begun. To tackle this problem data was gathered from the Benchmark reports but this data was not as precise and comprehensive as data obtained from OECD.

Variables on infrastructure could have shed light on other factors with regards to the price mechanisms of gas and their relation to regulatory measures employed by the European Commission. These variables could have included energy dependency, domestic production, geographical distance to the source and geographical constraints. Especially factors such as domestic production and energy dependency might have influenced the impact of ownership unbundling because if the number of companies increases, but the gas import is still limited to a single or very few pipelines, it might not shift the fundamental aspects that dictate gas prices.

7.5. *Further research*

As discussed previously the oil price seems to be the most important variable with regards to gas price. However, it does not account for all the variation in gas price, which opens up for further research. One of the aspects that this thesis does not take into account and that might have a significant impact on prices is the dependency on foreign energy import. If dependency is high it is plausible that this might affect prices and how EU legislation is implemented. Similarly the impact of national energy production and extraction is not analysed, and it is plausible that this has an effect.

A completely different way of analysing the relationship between regulatory reform and gas prices would be to do a case study on two countries with similar starting points but have chosen different ways of implementation. This method would have the advantage of taking very subtle national differences into account, something that a quantitative method might lack.

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Appendix I – Additional information on variables and dataset

Table 1: Missing data in dataset, period 2003-2010

Country / Variables	Price, €/Gj	Cumulative market main entities[1]	Number of main entities	OECD variables[2]	Ownership unbundling
Austria	2008			2008 - 2010	
Belgium	2003			2008 - 2010	
Bulgaria				2003 - 2010	2005 - 2008
Czech Republic				2008 - 2010	
Denmark	2008	2005, 2009 - 2010		2008 - 2010	
Estonia				2003-06, 2008-	2003
Finland				2008 - 2010	2003 - 2008
France				2008 - 2010	
Germany		2007, 2010		2008 - 2010	
Greece	2003 – 2012[3]			2008 - 2010	2003 - 2008
Hungary				2008 - 2010	
Ireland	2004 - 2007	2003		2008 - 2010	
Italy				2008 - 2010	
Latvia	2003			2003 - 2010	
Lithuania				2003 - 2010	
Luxembourg		2007 - 2010		2008 - 2010	
The Netherlands	2003	2007 - 2010	2003 - 2012[4]	2008 - 2010	
Poland				2008 - 2010	
Portugal				2008 - 2010	2003-2006
Romania		2003		2003 - 2010	2005 - 2006
Slovakia	2003			2008 - 2010	
Slovenia				2003-06, 2008-	
Spain				2008 - 2010	
Sweden		2008		2008 - 2010	
United Kingdom				2008 - 2010	
Total	230	183	214	97	177

Table 2: VIF values

Variable	VIF	1/VIF
Cum market share main entities	29.10	0.034
Market structure	21.62	0.046
Ownership Unbundling	9.01	0.110
Vertical integration	8.06	0.124
Number of main entities	4.55	0.219
Public ownership	3.85	0.259
Mean VIF	12.70	

Table 3: Countries coded as "Eastern Europe"

Country
Bulgaria Czech Republic
Estonia
Hungary Latvia
Lithuania Poland
Romania Slovakia
Slovenia
Total: 10

Figure 1: Frequency distribution of the dependent variable (€/Gj)