NEW MARKET DESIGNS AND THEIR EFFECT ON ECONOMIC PERFORMANCE IN EUROPEAN UNION'S NATURAL GAS MARKETS*

Nadine Haase** and Hans Bressers***

Abstract

The European gas market reform triggered new market designs which aimed to achieve competitive natural gas prices, efficiency gains, and security of gas supply. The paper analyses to what extent the effects of regulation-for-competition on economic performance in the form of natural gas prices, network tariffs, efficiency gains, and investments in gas infrastructure can be empirically studied in a European wide comparative analysis. We demonstrate that conceptual and data constraints hinder the verification of the impact of regulation-for-competition on those performance indicators. Natural gas prices remain oil-indexed and new investment projects are in practice exempted from competition measures. Assuming that a positive impact is a matter of fact is thus premature. A hold-up problem (where industry is reluctant to invest due to regulatory uncertainty and a lack of incentives) is difficult to quantify empirically. However, the industry's strong opposition to ownership unbundling coupled with the popularity of exemptions from third party access while still allowing long-term contracts does indicate that the general argument in favour of a hold-up problem has empirical relevance.

Keywords: Regulatory reform, public utilities, natural gas markets, investments

1. Introduction

Ten years after the introduction of European gas market reform, consumers, politicians and industry are asking to be shown the benefits of the reform. In the course of the ongoing evaluation and enforcement phase, impact assessments are evolving to analyse the economic outcomes (exemplary ECORYS Nederland BV 2006; European Commission 2007b; European Commission 2007e)[1]. Yet it is clear that the progress of the European gas reform, as well as its effects, have fallen behind expectations. In 2005, the European Commission

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** Corresponding author, Centre for Clean Technology and Environmental Policy, University of Twente, the Netherlands. Email: nadine.haase@web.de
*** Centre for Clean Technology and Environmental Policy. E-mail: j.t.a.bressers@utwente.nl
[1] In 2006, the Dutch regulator commissioned an evaluation of energy sector liberalisation to display the cost and benefits of the national gas reform. The introduction of the "Gaswet" (gas liberalisation law) caused administrative costs of 13.6 million Euros in 2002. A comparison of costs with or without the Gaswet is not possible (ECORYS Nederland BV 2006: 68).

had already reported severe malfunctions such as market concentration, lack of liquidity in the gas market and insufficient market integration and harmonisation (2005: 271). Although research on utility reforms in general and natural gas in particular is flourishing, cross-national comprehensive studies empirically analysing the correlation between regulation-for-competition and economic performance in gas markets are lacking. Nevertheless, opponents of the reform attribute malfunctions in the sector to the introduction of competition, whereas proponents claim the unfavourable economic performance occurred because the reform has not been far reaching enough. The authors take a step back from this heated political debate and offer a scientific perspective on the matter. In the paper it is addressed to what extent the effects of regulation-for-competition on economic performance (in the form of natural gas prices, network tariffs, efficiency gains, and investments) can be empirically studied in a European wide comparative analysis. The conclusion is straightforward: A verification of whether the European Union's gas reform reached its reform goals - affordable prices, efficiency gains and security of gas supply[2] - while keeping up positivist academic standards appears to be an insurmountable obstacle. The paper outlines the conceptual and practical obstacles of analysing the correlation between regulation-for-competition and economic performance in European gas markets.

2. Regulation and economic performance – a literature review

"In economic theory, ownership and the degree of competition are both important factors in determining output levels, costs of production and prices. More formally, the capital market and the product market determine the level of allocative and productive efficiency. Therefore, privatization, competition and more effective state regulation of monopoly activities should lead to improved economic performance." (Zhang 2002: 3) In theory, the structure-conduct performance paradigm (scp paradigm) is straight forward, but in practice this piece of economic wisdom is heavily contested. After a world wide wave of privatization, liberalization and sector reforms the scientific analysis of the variable triangle consisting of competition, privatization (ownership) and regulation and its effect on economic performance received a lot of attention and resulted in numerous empirical studies. A positivist strand of literature searches for correlation between these variables by conducting econometric analyses which are single or multi-equation models conducting cross-country analysis. Steiner elaborates on the advantage of this type of analysis by criticising the state of literature examining the effects of electricity liberalisation: "It is difficult to draw general policy conclusions from existing empirical work that focuses rather on far-reaching reforms in a single market or other country-specific anecdotal discussion of regulatory change because neither type of study separates the effect of regulatory reform from country-specific features" (2001: 145). Instead, she proposes a comparable cross-country study on the basis of panel data. A regression analysis enables the exploitation of cross-national and time series dimensions, whereby country specific features can be controlled for. The following paragraph surveys the main results that econometric research has recently brought about to test the structure-conduct-performance paradigm.

[2] Security of supply is often reduced to a buzzword or a black-box concept. Here it is defined "as the guarantee that all the gas volumes, demanded by non-interruptible (firm or protected) customers, will be available at a reasonable price." (Luciani 2004)

The empirical studies analyse network based industries such as aviation, telecom, gas, electricity, railways, postal services and water. In the group of utility industry studies, sector studies examining the telecommunication and electricity sector are prevalent. The literature covers member countries of the Organisation of Economic Co-operation and Development, developing countries and regions like Latin America or Eastern Europe. To the best of our knowledge, the literature search did not reveal any study on natural gas markets, which systematically explore the causal relationship between ownership, market concentration, regulation and their effect on economic performance in the form of a cross-national comparative econometric analysis. Despite the knowledge that the European electricity and gas markets differ in many ways, the sectors are the most comparable among the utility industries and the two share significant common features. Both markets are in the energy field, network based, characterised by high sunk costs and have been liberalised shortly one after the other. Major distinctions stem from different supply structures, and applied technologies. In contrast to electricity, gas can on the one hand be stored more economically, but on the other hand different gas qualities demand complex technological solutions to allow gas transport across Europe. Due to the lack of research on natural gas in this field and some common features of electricity and natural gas sectors, we choose to refer mainly to electricity markets in our analysis.

Zhang et. al. demonstrate in their literature review that the surveyed empirical results show no clear evidence as to whether privately owned, competitive markets are more efficient than publicly owned monopolized markets (2002). Vickers and Yarrow attribute contradicting effects of privatisation on performance in earlier research days to the focus on ownership (1988). Therefore, recent research advocates to incorporate several factors summarised under the variables privatisation, competition and regulation to explain the effect on economic performance (Zhang, Parker et al. 2002). In practice, the bulk of studies do not include all three variables but often concentrate on one or two independent variables, be it privatization and competition or privatization and regulation. A number of empirical works associated competition with lower costs, lower prices, and higher productive efficiency (Kwoka 1996; Kleit and Terrell 2001; Martin and Vansteenkiste 2001). Zhang et. al. reached the same conclusion when assessing the effects of privatization, competition, and regulation on the performance of the electricity generation industry in 51 developing countries through the period 1985-2000. Competition positively effects service penetration, capacity expansion, labour efficiency and prices to industrial users. According to Zhang, privatization and regulation on their own do not lead to obvious gains in economic performance. Consequently the introduction of competition is key to achieving positive effects such as higher efficiency and productivity (Zhang, Parker et al. 2002). Another two articles apply a complex research design analysing the impact of regulation, industry structure and privatization performance in the electricity supply industry of OECD countries (Steiner 2001; Hattori and Tsutsui 2004). Although the two studies are very similar in terms of scope and methodology, the results concerning the impact of regulatory reforms in electricity supply industry on end-user gas prices are partially contradictory[3]. Steiner and Hattori/Tsutsui use the identical sample of OECD countries for the period 1987-1999, applying the same basic framework for model specifica-

[3] Steiner admits price data is not available for the generation market but only for the retail market. Instead, she uses an artifice claiming "generation prices are assumed to be a mean-shifted version of retail prices". (Steiner 2001: 166)

tion and estimation. The main difference is that Hattori and Tsutsui offer results for random and fixed effects, whereas Steiner only takes into account random effect models (Nagayama 2007). Steiner's time frame covers only the years from 1986 to 1996 and Hattori and Tsutsui attribute some of the differences in results to the 3 year time difference. Both extracted the price data from Energy Prices and Taxes published by the International Energy Agency. However, the way variables are operatonalised differ. For instance Hattory and Tsutui consider that the unbundling of transmission system operators are only fulfilled when legal unbundling is in place, whereas Steiner regards account unbundling as sufficient (2004: 825). Hattori and Tsutsui findings suggest that the existence of wholesale pool markets do positively correlate with lower prices, whereas Steiner observes the contrary. Both observe a negative correlation between the introduction of third party access and lower electricity retail prices, but differ with regard to the statistical significance of this observation. In Hattori and Tsutsui's analysis third-party access is statistically significantly, whereas Steiner concludes it is statistically insignificant. The comparison illustrates how crucial the exact operationalization is with regard to its effects on statistical significance. Furthermore, the brief review suggests more research is needed beyond 2000 to draw more solid conclusions on the correlation between specific regulatory instruments and its empirical effect on electricity prices. In the following sections we will continue our literature review by portraying the operationalization of the variables of regulation and economic performance in econometric studies and refer to their results. Moreover, we will display how those variables have been operationalised to analyse the effects of the gas sector reform on economic performance.

3. Regulatory variables and the use of regulatory indices in econometric models

Early econometric models analysing the impact of regulation on the performance of industries have appeared in simple designs. The regulation variable was reduced to a dummy variable indicating whether an independent regulator was present or not (Wallsten 2001; Zhang, Parker et al. 2002; Stern 2007). While the research agenda was progressing, more complex operationalisations were applied (Gutierrez 2003; Stern 2003; Cubbin and Stern 2006; Edwards and Waverman 2006). The new indices consisted of between 4 to 12 indicators. When applied to developing countries, the regulation variable is interpreted as a measure of policy credibility. Here, the independence of the jurisdiction and the overall stability of the political system in ensuring the property rights of foreign investors is at the forefront, whereas the institutional endowment and independence of regulatory authorities is addressed in studies focusing on developed countries (Bergara, Henisz et al. 1997). According to Stern, studies analysing the telecommunication and electricity sectors generally confirm that regulation does have a significant positive impact on infrastructural industries (Stern 2007: 162). Moreover, the impact of regulation is more accurately estimated if an index of regulatory characteristics.

The studies referred to above only take the formal dimension of regulation into consideration. Indices describe the *de jure* regulation or the properties of regulators. Currently, the actual implementation practices, or the regulatory quality, are not analysed, but research trends are moving in this direction (Stern 2007). Oxera Consulting offers an example of a wider interpretation of regulation. In their report commissioned by the United Kingdom's (UK) Department for Trade and Industry, Oxera measured the competition in electricity and gas markets across the European Union (EU) and G7 countries. Using an

applied index, the consulting company assessed not only the *de jure* regulatory instruments but also the *de facto* institutional arrangements in the form of contract characteristics, industry structure and customer behaviour. Further, indicators have been grouped along the various parts of the value chain (upstream, wholesale, downstream, network-related activities) which allows one to assess the degree of competition at different market levels (Oxera 2003). The Oxera study serves as a good starting point and source of inspiration for developing a more complex index to assess regulatory performance. However, due to Oxera's focus on general competition, its appropriateness to operationalise regulation-for-competition is limited. For assessing regulatory regimes in the natural gas sector we draw on an earlier study produced jointly with the Oxford Institute for Energy Studies in which we analysed the degree of convergence towards best-practice regulation (Haase 2008)[4]. This study focused on the formal aspects of regulatory regimes[5]. To capture different dimensions of regulatory regimes, the assessment distinguishes between regulatory functions and regulatory competencies. Regulatory functions along the gas value chain account for the applied regulatory instruments, whereas regulatory competencies describe the competencies and institutional endowment of the national regulatory authorities.

4. Economic performance

Performance indicators such as natural gas price and investment are usually in the centre of public attention. Efficiency gains are less prominent in politically-driven evaluations; they are to a larger extent the subject of academic interest. The obvious reason for divergent popularity of performance indicators is related to the nature of those indicators. For example, changes of gas prices are clearly visible on the energy bill of voting consumers. Underinvestment sooner or later translates into dysfunctions of the system in the form of 'blackouts' (negative externalities). Efficiency appears less tangible in the public perception.

The European Union set ambitious targets in terms of economic performance to be accomplished by the European gas reform. Natural gas prices and network tariffs were expected to be lowered and become cost-reflective. European companies involved in the transport of natural gas were supposed to increase their efficiency due to a reduction in their operating costs. Furthermore, the European Commission aims to fulfil its public service obligation to secure the natural gas supply of the European Union by stimulating investments. According to the public regulation approach (Cox 1999; Genoud and Finger 2004), markets are organised by a combination of two objectives: first order economic regulation predominantly addressing the structure, conduct and economic performance (e.g. price development) and second order political and social regulation, predominantly addressing the politically defined performance (e.g. security of gas supply). Thereafter, investments can be perceived as general economic performance indicators or more specifically as a public service obligation performance indicator.

[4] In addition, the study takes into account the impact of the legal provisions for the gas reform and energy policy objectives on the evolution of European gas market regulation.

[5] Regulatory regimes are defined as the bundle of institutional arrangements triggered by the liberalisation process in the context of European gas reform.

4.1 Efficiency

The field of economics contains efficiency as a central idea as a means by which it can ultimately strive to improve social welfare. In the literature there is a difference distinguished between productive and allocative efficiency. Productive efficiency is achieved when goods are produced in the least costly manner. Allocative efficiency is realised in the case where resources are allocated so as to maximise the welfare of a society. Efficiency can be conceptualised in various ways. Labour productivity is a prominent indicator for efficiency in the research on privatisation (Megginson and Netter 2001). Efficiency can also be perceived as whether incentive regulation in the form of price cap regulation is in place or not. Price cap regulation employs an efficiency factor to stimulate the reduction the operating costs of the distribution or transmission operators by regulating the prices of their network tariffs. Turvey sets out conceptual clarifications on how to perceive efficiency in the electricity sector and outlines methodological improvements to conduct short-run and long-run network efficiency comparisons for electricity distribution (2006). Steiner elaborated on the conceptualisation of efficiency for the electricity supply industry discussing possible proxies such as labour productivity (output per unit input), capital or total factor productivity (2001). Moreover, she adds utilisation rate and distance of actual reserve margins of capacities from "optimal" reserve margins to account for efficiency.[6] Some indicators were for several reasons not feasible and had to be rejected upfront. The ones she included, utilization rate and optimal reserve margin, are proxies imperfectly representing efficiency. On the basis of her data, Steiner observes a positive correlation between unbundling and the utilisation rate. However, the impact of regulation on the reserve margins remains indefinite, because the operationalization of the indicator did not account for the starting position of individual countries and its relative increase overtime. (Steiner 2001: 167, 173)

The supply industry and production of natural gas are not subject to European liberalisation policy. Therefore, indicators related to the performance of the supply industry are not of core interest when verifying the effect of regulation-for-competition on the efficiency of the regulated transport companies. In this context, the utilization rate (which is understood as used transport capacity) qualifies as a potential indicator for efficiency. In the literature, one study measures efficiency in the natural gas market by analysing company's productivity. Lee et. al. compare the performance of 28 natural gas transport utilities in eight developed countries between 1987 and 1995. The article presents a method that enables the comparison of profits, price differentials and productivity of transmission utilities and integrated utilities. The authors point out that productivity is determined by various factors such as utility size, customer density, regulatory environment etc. They observe that utility size and pipeline utilization are statistically significant. Productivity differences are largely attributed to the so-called utility dummy which functions as an umbrella variable for various utility-specific and country-specific factors (Lee, Park et al. 1999). In short, productivity in natural gas transport utilities[7] can be measured, but whether for instance the company organisation is more responsible for efficiency in-

[6] The utilisation is calculated as energy production divided by total average capacity. The optimal reserve margin is generated on the basis of a benchmarking procedure and the reserve margin is calculated as the difference between capacity and peak demand, divided by peak demand. (Steiner 2001: 164)

[7] The sample consists of two subgroups, transmission utilities and integrated utilities.

creases than is regulation, has not been controlled for. Consequently, a differential analysis would be necessary to verify the effect of regulation-for-competition on efficiency in the gas transport sector.

Another example of research on the efficiency of the natural gas sector has been de Joode's attempt to estimate the impact of two new infrastructure projects with different institutional arrangements on efficiency performance of the capacity market. In its research design, regulation is initially perceived as an intervening variable, but occurs within the interpretation of results on the performance side as well. In the context of the UK-Dutch case, de Joode points to the application of price cap regulation by the UK regulator Ofgem which imposed an overall efficiency factor of 2% on the natural gas transport companies. In his conclusion, he implies a direct benefit for the consumers stemming from the application of the incentive regulation without any further specification or measurement. Although his reasoning is logical, in doing so, de Joode runs the risk of making a circular argument. (De Joode 2007)

4.2 Natural gas prices

Assessing the impact of regulation on natural gas prices has two main obstacles: one being that it is conceptual in nature and the other that it is not reinforced by a sufficient number of cases and has the corresponding problems of data availability. A conceptual problem arises due to the fact that natural gas prices are not based on gas to gas competition. Instead, natural gas prices are still linked to the oil price. Moreover, a general clarification concerning natural gas prices should be stated upfront. In the media it is often referred to >the< gas price, which certainly is a simplification of the complexity of natural gas prices. There are numerous gas prices generated on different markets and market levels. On the national level, Phillip Wright shows how the UK market is differentiated into separate but connected markets such as the domestic consumer market, over-the-counter and on-the-day commodity trade, which leads to the generation of different gas prices (Wright 2006). As a result of contract pluralism, gas prices are most commonly distinguished between export, import and spot market prices or with respect to the consumer group (industrial and consumer prices). Historically, Western European price formulation in the natural gas sector is predominantly based on the concept of 'market value principles'. These principles "may be summarised as suggesting that gas should be priced either: so as to be at or near parity with crude oil, or so as to be competitive with the final consumer's alternative non-gas fuels, or so as to reflect historic costs of gas production" (International Energy Agency cited after Stern 2007: 1). Consequently, gas price formula within European contracts contain an oil indexation as well as several other factors reflecting production and transportation costs or the companies profit margin.[8] To sum up, the composition of these formulas and the weighting of factors do differ substantially across different market levels. Data on natural gas prices for which the influence of the oil price development is subtracted out of the equation are to the knowledge of the authors not available. Although we do not have so-called 'oil price-adjusted' gas prices at our disposal for conducting an econometric analysis, the energy sector investigations by Directorate-General for Competition (DG COMP) demonstrate the evidence of the link to

[8] Austvik gives a brief and clear introduction into price formulation, contract clauses and effects of liberalisation on prices. Additionally, he explains different schemes of price regulation. (1997; 2003)

oil product prices (European Commission 2007e: 101-105). "From an analysis of more than 500 contracts covering more than 400 Bcm of gas supplies to the EU countries for the calendar year 2004, DG COMP found that two products – light fuel oil and gasoil, and heavy fuel oil – accounted for nearly 75 percent of price indexation." (Stern 2007: 6). Apart from end-user gas prices and spot market prices, European gas prices are still not entirely transparent.

Robinson analysed the question of whether European gas prices have converged by testing for beta convergence[9] on the basis of end-user gas prices without taxes for industry in six countries between 1978 and 2004. His sample is based upon Finland, France, Ireland, the Netherlands, Spain, and the UK. The other nine old member states could not be included due to a lack of data: "complete data on gas prices for the period under investigation was unavailable for Luxembourg, Belgium, Austria, Denmark, Germany, Italy, Portugal ,and Sweden" (Robinson 2007: 2348). It remains unclear why Greece has not been included. He vividly summarizes the results for the six countries under examination: "Eyeballing the data series suggests that national prices were quite widely spread during the early 1980s, began to fall and converge after 1985 but started to rise and diverge after 1999."[10] (Robinson 2007: 2348) Robinson partially attributes the contradictory observations to the three different methodologies applied. Regardless of methodological considerations, all approaches reject the expectation that end-user prices fall with the introduction of EU gas liberalisation. Given the limited scope and quality of this article, the result has to be treated with caution.

Accompanying the 3rd Energy Package, the European Commission conducted an impact assessment, analysing the impact that certain regulatory instruments in the electricity and gas markets have on performance indicators. In this context, the European Commission attempts to empirically prove the impact of ownership unbundling on natural gas prices. The report concedes that electricity and gas prices "may not automatically decrease because of ownership unbundling" (European Commission 2007b: 37), and are instead determined by several factors. Nevertheless, the analysis fails in providing a convincing reasoning as to what extent regulation accounts for gas price changes. With regard to electricity prices, the European Commission identifies a correlation between ownership unbundling and decreasing industrial and household prices. The Commission applies a methodology which does not compare actual price levels but cumulative and aggregated price changes. Changes in the electricity price were reduced by 3% for industrial costumers in member states with ownership unbundling, whereas the Commission observed a move up to 6 % in countries with integrated transmission system operators (TSO). Percent changes of equivalent household prices appear even more divergent. Ownership unbundling at the distribution level is supposed to result in a 6% increase, while in member states with integrated transmission systems the operators account for approximately a

[9] Robinson concisely explains: "To put it intuitively, a variable β-converges if countries with low original values of the respective variable – in this case gas prices – experience more rapid growth rates in this variable than the other countries in the same sample." (Robinson 2007: 2349) For a more detailed explanation of beta convergence see Haase (2008).

[10] The data is retrieved from the Economic and Social Data Services collected under the supervision of the International Energy Association. The Robinson text is ambiguous whether household end-user prices are included. For instance, he refers to household and industry gas prices in Figure 1 in his text, but in the text itself he explicitly states the data is based on industry prices.

30% increase. According to the report written under the lead of Directorate-General for Energy and Transport (DG TREN) "it is not possible to carry out the same comparison for gas prices" (European Commission 2007b: 38). The Commission's conclusion builds mainly on the argument, that for most of the examination time an insufficient number of cases with ownership unbundling were available. We agree with this appraisal, but consider the conceptual reservation even more relevant. In fact, controlling for the influence of one decisive factor within a complex formula has not been solved.

Our next example as well advocates a long examination period, before a correlation between liberalisation and price development can be judged. Waddams analyses the effect of liberalising UK retail energy markets on consumers. She points out that retail energy prices were falling during the period from 1990 to 2002. Back then, the British government in place attributed this success to their introduction of supplier choice and the removal of price controls. Waddams expresses her doubt that this trend would still hold, when basic conditions in the market or market structure are changed. Rising oil prices and market concentration on the retail level exercised in the form of the "'joint formation' among these suppliers" might induce reversed effects (Waddams Price 2005: 142). More generally, Waddams concludes in 2005, that whether or not a regulated monopoly is less favourable than introducing competition in retail markets "depends crucially on the competitiveness of the market which emerges from the process, relative to the effectiveness of regulation of the monopoly supplier" (2005: 132). Recent experience in the UK gas market shows that rising oil and gas wholesale prices feed through and increase consumer prices. In this context, the British consumer organization Energywatch released some figures during their campaign critiquing rising energy prices: "Since 2003, British Gas customers have seen their bills go up by 76.7% for gas (from £370 to £653) and by 74.3% for electricity (from £237 to £413). Customers taking both fuels from Britain's biggest energy supplier have seen their bills go from £567 to £1049 over the same period" (energywatch 2008, 18 January)[11].

4.3 Tariffs

In general, tariffs could serve as indicators to analyse the impact of regulation-for-competition on economic performance. Edwards & Waverman for instance choose to measure performance by analysing interconnect rates in the telecommunication sector (2006). Due to regulators both defining ex ante the tariff methodology and determining the level of tariffs by applying incentive regulation in a liberalised European market, the tariffs seem to be a part of the regulation and do not qualify as pure economic performance indicators. The conceptual demarcation between tariff and tariff regulation seems to be problematic; the variables are not fully independent from each other.[12]

[11] Adam Scorer, Director of Campaigns of the UK energy watch, indirectly accused the energy companies to apply collusive pricing strategies by saying: "Four double digit rises in four weeks won't do much to persuade consumers that this market works in their interest. Four, supposedly cut-throat, competitors have raised their prices by near identical amounts in days of each other. This is a market where companies do not worry about competition for consumers." (energywatch 2008, 1 February).

[12] The tariffs are consisting of several elements. In some countries, the costs that are subject to regulatory approval and/or incentive regulation are not more than 10-15% (Haase 2008). The rest are mainly capital cost related and operational cost which are to a large extend externally determined (fuel costs, electricity, data transfer etc.). Moreover, historical evolutions of tariff levels might need to be taken into account (rela-

After the introduction of liberalisation the availability and quality of comparable tariffs across Europe has improved. For the last couple of years it has been possible to survey the tariff development by company or nation-wide average tariffs. Earlier research showed that data on tariffs for the EU 12 is often only available from 2002 onwards (Haase 2008). Caution should be used when comparing national average tariffs due to the lack of standardized definitions[13]. Some countries are very transparent and have documented their tariff development well (e.g. ECORYS Nederland BV 2006). The most comprehensive and publicly available collection of comparable tariff data are at present the benchmarking reports of the European Commission and tariff surveys of studies conducted by Arthur D. Little (e.g. 2007). To conclude, due to conceptual objections combined with insufficient data before and after the liberalisation, tariffs do not qualify to be included in an empirical test.

4.4 So far so good?

So far, the review of economic literature has shown that gas market regulation and its empirical effect on performance indicators like efficiency, natural gas prices and tariffs, has been hardly subjected to research. On the basis of the existing literature a correlation between the two variables cannot be verified. Moreover, we have demonstrated the obstacles to conducting such an econometric analysis. A historical comparison of gas transport utilities' productivity in the EU 15 fails in the attempt to investigate the productivity of transport services within integrated utilities. The introduction of incentive regulations which employ efficiency factors certainly has a cost-reducing effect on the performance of natural gas transport. Nonetheless, the regulatory instrument determines by definition the performance in terms of efficiency. Consequently, the efficiency factor as a dependent variable is dependent on the performance variable. Data on natural gas prices is not available for an EU-15 cross national comparison. Natural gas prices are influenced by the oil indexation of supply contracts and to a great extent influenced by oil prices. The influence of regulation can not be clearly extracted from other factors driving the gas prices. And finally, tariffs data is insufficiently available to allow a meaningful comparison.

5. Impact of the regulation-for-competition on investments in the EU

Concerns about the security of gas supplies have moved up the political agenda due to the huge cumulative need for investments in gas in the EU-15 countries, coupled with the fear of energy blackouts. According to the World Energy Investment Outlook, the total gas sector investment needed in OECD Europe, projected over the period 2001-2030, amounts to $465 billion, or almost $16 billion per year (2003: 266). In considering alternative and reference scenarios, the estimated cumulative gas investments in EU-15 countries between 2001-2030 amounted to: distribution $85-95 billion, transmission $50-75 billion, storage $10-15 billion, liquefied natural gas (LNG) re-gasification $15-20 billion (International Energy Agency 2003: 271). The Californian crisis has shown that "sustained periods of shortages caused by under investment or adverse hydrological condi-

tive tariff development versus actual tariff level). Steiner discussed this problem in the context of comparing the development of the actual and optimal reserve margin.

[13] Even if selected company tariffs serve as proxies for a national average tariff the problem of diverging definitions of tariffs is not solved.

tions may mean that market clearing prices can remain at high levels for lengthy periods and can produce politically unsustainable final prices to voting consumers" (Newbery 2001: 91). Both opponents and proponents of European gas market liberalisation are questioning whether the current regulatory regimes in European energy markets will ensure sufficient investment.

Proponents argue in line with the structure-conduct-performance paradigm, and claim that liberalised markets reduce monopoly rents and that consumer demand will ensure the necessary infrastructure is in place in a timely manner. For them, the measures are not sufficiently far-reaching: insufficient regulatory competencies and practice, combined with market power, runs the risk of not delivering the benefits of liberalisation. In contrast, opponents argue that liberalised markets do not provide enough incentives to ensure a sufficient level of investments. As a result, this line of argument suggests, underinvestment might result in a failure to meet the security of supply obligations that the regulatory authorities are supposed to ensure. According to this view, the current regulatory regimes have too few incentives to encourage investment. Instead, some advocate using the power of the market in times of worldwide demand-side competition[14] (General Energy Council of the Netherlands 2005; Helm 2005: 11). "The argument that long-term contracting supported by massively capitalised, vertically integrated national champions is the only way forward to ensure security of supply is difficult to refute in the absence of convincing alternative models" (Newbery 2001: 11). Both viewpoints hold some truth and generate relevant questions which need to be addressed. Nevertheless, the politicisation of discussions on the security of gas supply is not always helpful in finding solutions. Hence, there is a need for academic consideration and evaluation of the matter in hand since this promises a more balanced and systematic insight.

5.1 Literature on investment in energy markets

Historically, over-investment and excess capacity in energy markets was considered to be a serious concern before the privatisation and liberalisation of energy markets. In the 1980s and 1990s, the New Public Management movement criticised public ownership for not being appropriate for delivering adequate efficiency and the capital liquidity needed to finance large-scale investments. Nowadays, theories relating to underinvestment in liberalised markets are fashionable, and question whether competition-based approaches are appropriate for network-based industries with high sunk costs. In this context, economists have argued whether over- or under- investment is the more harmful for social welfare. Helm and Thompson (1991) suggested that, in general, the social costs of underinvestment are higher than those of overinvestment. In the more recent literature this view seems to be widely accepted (von Hirschhausen, Bechers et al. 2004). Accordingly, overinvestment should be the preferable strategy. Risk aversion on both the consumer and the company side is a common argument for a less-liberal market design. The central justifi-

[14] The reasoning is that a concentration on the supply side requires a similar concentration on the demand side in order to be able to compete with other strong buyers from other regions and to negotiate favourable supply contracts with the large gas producers such as Gazprom.

cation for this proposition stems from the apparent consumers' willingness to pay for security of supply.[15]

Addressing the impact of regulation-for-competition on investment, the recent academic debate on liberalising energy and other utilities can be divided into at least two camps. One applies econometric modelling, trying to analyse correlations between regulatory variables and investment by conducting 'large-n' empirical analysis. The other set of economic studies concentrates mainly on the electricity sector and tends to be theory-driven. Unlike the first set of studies, the latter refers to empirical developments in the form of case studies or illustrations that provide limited evidence, but are not designed as empirical tests.

In the econometric studies, the impact of regulation variables on investment is indirectly researched by using, for instance, the generation capacity installed in electricity markets as a proxy for investment decisions. A cross-national study analysing 38 countries, including countries with developing and OECD backgrounds, concluded that "well defined and credible political institutions are positively and significantly correlated with global electricity generation capacity" (Bergara, Henisz et al. 1997: 11). Cubbin and Stern (2006) reached the same conclusion after analysing 28 developing countries using data covering the period between 1980 and 2001.

The predominantly qualitative studies consider the likely impact of specific regulatory instruments, such as incentive regulations, on investment in the energy sector (Burns and Riechmann 2004; von Hirschhausen, Bechers et al. 2004; Cowan 2006). The strength of these studies lies in the micro-level explanatory power of firm behaviour. These analyses implicitly presuppose rational choice, from whence macro-economic phenomena become complex aggregates of individual decisions[16]. Drawing on spot- market pricing theory, Neuhoff and de Vries (2004) stress the importance of long-term contracts between electricity generators and retail companies in changing the incentives for investing in electricity generation capacity. Keller and Wilde (2004) emphasise the need of locational tariff price signals and multilateral coordination mechanisms to provide incentives and the necessary conditions.[17] Both these articles conclude that, under the current regime for electricity regulation, incentives are insufficient to ensure long-term investments in the electricity sector. Burns and Riechmann (2004) adopt a more integrative stance when advocating that the success of incentive-based regulation depends on how the parameters of the specific regulatory regime are defined. Across Europe, incentive-based regulation of gas markets has only been introduced in a few countries. Incentive regulation is still in its infancy outside the UK and the United States. The analysis of specific forms of incentive regulation, such as price caps, rate of return and yardstick regulation, and their possible impacts on business behaviour in terms of investment should provide useful insights, and lead to improvements and the fine-tuning of the regulatory incentive schemes beyond the electricity sector (Jamasb and Politt 2007). The bottom line is that scholars are far from convinced that the current liberal market design in the electricity sector is able to balance

[15] The willingness to pay for security of supply certainly has its limits and might ultimately result in a change in the energy mix. One should also note that this proposition dates back to periods of comparatively low energy prices.

[16] The links between the mirco-, meso- and macro- levels are not explicitly explained or elaborated upon.

[17] The authors elaborate on the interdependence of transmission and generation. From this, incentives for investing in the grid will affect incentives for investing in generation capacity. (Keller and Wild 2004)

the uncertainty which market liberalisation induces. Although the qualitative reasoning put forward is reasonable, the literature requires empirical tests to allow generalisations to be made. With the current state of the literature, no definite answer is provided.

5.2 Is there empirical evidence of a hold-up problem in the European gas markets?

In electricity and natural gas research, the occurrence or danger of underinvestment in a liberalised energy market is predominantly interpreted as a hold-up problem (von Hirschhausen, Bechers et al. 2004). An insufficient level of regulatory stability may result in the holding back of investments, meaning that investments are delayed or even never made. Investment distortions may arise due to the lack of certainty stemming from vertical disintegration and decreasing contract periods. According to Williamson (1985), industries with long asset lives and a high proportion of sunk costs need to reduce risk through either vertical integration or by concluding long term (supply) contracts along the value chain. In reality, once an investment is sunk, the company is tied to the market and reliant on it for returns on their investment. Uncertainty can arise from the regulator's decision, after the investment has been made, to renegotiate prices or expropriate parts of the vertically integrated company. Industry sees the possible compulsion to unbundle ownership, enforced by European provisions, as an act of expropriation[18]. In interpreting the hold-up problem, regulators structurally face a lack of policy credibility. Spanjer (2006: 5) concisely summarised the situation "the essence is that a typical regulator is not able to credibly commit ex post to a regulatory rule, making the rule incredible ex ante". Experience suggests that regulatory rules are erratically or periodically subjected to change. An example of erratic change is the introduction of ownership unbundling, even if long forewarned and well prepared. On the other hand, pricing regulations are reviewed and determined every 3-5 years and this is a typical example of a periodic change that influences the pricing structure and profitability of the company since, on the supply side, it is contractually bound by longer-term arrangements. Therefore, price regulation has the potential to negatively affect the returns on investments and hence the asset value of the company, raising fear of a "stranded asset" (Helm and Jenkinson 2001). To sum up, the lack of political credibility translates into uncertainty over the returns on an investment, and this increases the likelihood of declining investments, delaying investments or altering the timing of an investment decision through opportunistic behaviour. In the context of investing in gas transmission and distribution networks, opportunistic behaviour could result in an incumbent operator being inclined not to invest, or postponing such a decision, in case this led to competitors being given market access through the increased transport capacity[19]. Moreover, natural gas companies seek to reduce uncertainty by opposing ownership unbundling and applying for Third Party Exemptions for new invest-

[18] The Commission's line of legal argumentation is briefly summarised in a DG COMP's Newsletter (Lowe, Pucinskaite et al. 2007).

[19] In general, an economic agent or organisation is seen as behaving opportunistically if it quickly adapts to the opportunity structure, and votes for its own advantage. Opportunistic behaviour might even imply unlegal behaviour. Burns and Riechmann (2004: 216-217) show that companies are responsive to opportunities provided by incentive regulation schemes and adjust the timing of their investments in line with regulatory cycles. The latter is called the periodicity effect and discussed in the context of incentive regulations applied to the electricity sector.

ment projects. These exemptions prevent competitors profiting from their investment and, at the same time, allow long-term booking of capacity.

The authors have not been able to find any published study which analyses whether the European Union faces hold-up problems in practice. Ideally, such a study would compare the optimum investment level with the actual investments in the natural gas sector to empirically substantiate the occurrence or not of hold-up problems. Adopting a different line, Spanjer (2006) proposed a purely theoretical approach for evaluating whether a hold-up problem is likely in gas markets under the current European provisions. In a first step, he deduced seven criteria, relevant to the occurrence of a hold-up problem, which effect policy credibility. These criteria cover the presence of sunk investments, rapid demand growth, rate of capital depreciation, degree of technological development, private ownership of the company, investors profits and the regulator's discount factors. The last of these reflect the extent do to which the regulator values future benefits over present-day gains. He concludes that the majority of these seven, theoretically-deduced, criteria would induce a low policy credibility, suggesting the likelihood of a hold-up problem. The evaluation of the criteria and their effect on policy credibility is purely argumentative, there are no empirical references to the actual situation in European gas markets. This procedure seems to have three significant shortcomings. Firstly, Spanjer puts forward a schematic argument when comparing the number of criteria which seem to be in favour of encouraging a hold-up problem with the number against. The reasoning used assumes all criteria have equal impacts on policy credibility. On the contrary, we would argue, for example, that a low rate of technological development in the natural gas sector would be far less important than a huge demand increase which would create interdependency between regulator and industry. Secondly, he does not take the exemption regime of the European Union into account. Thirdly, the argument lacks empirical substance. Rather than concentrating on the theoretical impact of policy credibility, we would suggest examining how contract durations develop, including mirroring the actual regulatory practice with regard to exemptions from third party access (TPA) for investments, and assessing the investments in the European gas markets before and after liberalisation. These three features might be responsible to foreclose an empirical test of the hold-up thesis in the context of European reform.

5.3 Contract duration

Although the duration of contracts plays a crucial role in shaping the industry's investment incentives, little light has been shone on the details of natural gas supply contracts. Both the industry and governments classify such information as sensitive, whether this be for commercial reasons or for security-of-supply concerns. It could be argued that full transparency with respect to the current and future demand and supply situations, and accompanying trading terms, would create an information asymmetry between producing and consuming countries. Neumann and von Hirschhausen shed some light on the contract landscape by reviewing 317 worldwide long-term natural gas contracts, of which 132 were signed in Europe between 1963 and 2005. Especially in the European context, the authors faced considerable obstacles in obtaining data[20]: "there seems to be no better secret kept in European trade than which company is supplying natural gas under which

[20] Open source literature was complemented by expert interviews.

conditions" (Neumann and von Hirschhausen 2005: 10). According to Neumann and von Hirschausen, contract durations decreased significantly as natural gas markets became more competitive. Experiences of US gas market liberalisation suggest that the average contract duration shortens after the ending of a monopoly, to a period ranging from 8 to 15 years. Furthermore, long durations seem to promote the willingness to accept higher volumes in contracts. In the same publication, Neumann and von Hirschhausen observed that asset-specific investments make the difference: "Contracts that have been signed in combination with exploration of new resources or building of new infrastructure are on average seven years longer in duration in Europe and [more generally by] almost three years for all contracts [than those in America]"(Neumann and von Hirschhausen 2005). At least in the European context, this finding might be related to the practice of TPA exemptions in the EU. As we will show in the next section, virtually all major new investments can avoid granting TPA. Accordingly, for all supply contracts related to new LNG or pipeline projects a quasi-monopolistic situation has been created. In this environment, it is only natural that European contracts are, on average, longer.

5.4 European TPA exemption practice and the impact of unbundling on investment

A conceptual problem arises when trying to analyse the effect of European regulation-for-competition on investment due to the introduction of exemptions in Article 22 of the second Gas Directive: how to measure the impact of competition on investments when the related competition measures do not apply to new investment projects? In this section we will first summarise the exemption provisions and then demonstrate the significance of exemptions by analysing EU exemption practice. Following this, we will reflect on the European Commission's claim that ownership unbundling, as part of the regulatory regime, has an empirically verifiable positive effect on investments and consider whether this assertion is justified.

Since 2004, any undertaking which is planning new major infrastructure or the substantial upgrading of existing infrastructure can apply for TPA exemptions. Article 22 of the second Gas Directive allows third parties to be excluded from access to transmission and distribution systems, interconnectors, LNG facilities, storage and upstream pipeline networks. The Directive distinguishes between full and partial exemptions (European Commission 2003). In the case of a full exemption, the owner of the infrastructure has full rights over its full capacity. Consequently, there is no need for public tariffs or dispute settlement procedures. The regulatory authorities cannot intervene either *ex ante* or *ex post*. When infrastructure projects are partially exempted, the owner is obliged to offer a certain capacity to other market players. The available capacity is most commonly allocated using an open season procedure or an auction mechanism, and the regulator has to approve the method of allocation. As with a full exemption, the regulator acquires no far-reaching regulatory powers (European Commission 2004). Exemptions are subject to a two-stage decision-making process during which the designated national regulatory authority assesses the company's request and formulates conditions on which a reasoned decision is based. In the second step, the Commission reviews the decision of the national authority and decides whether to give the exemption final approval.[21] Decisions are made

[21] In the case of an interconnector pipeline, the national regulatory authorities of the countries linked by the pipeline are involved. Should the national authorities and the Commission come to conflicting decisions, Articles 3 and 7 of Decision 1999/468/EC shall apply (Article 22, Point 4).

on the basis of criteria formulated within the Directive and supplemented by an explanatory note.

Box 1: Criteria for granting an exemption based on Art. 22, Directive 2003/55/EC

(a) the investment must enhance competition in gas supply and enhance security of supply;
(b) the level of risk attached to the investment is such that the investment would not take place unless an exemption is granted;
(c) the infrastructure must be owned by a natural or legal person which is separate, at least in terms of its legal form, from the system operators in whose systems that interconnector will be built;
(d) charges are levied on users of that infrastructure;
(f) the exemption is not to the detriment of competition or the effective functioning of the internal gas market, or the efficient functioning of the regulated system to which the infrastructure is connected.

Source: European Commission (2004)

In general, the granting of exemptions is an indication that the policy objective of security of gas supply has been prioritised over a purist application of regulation-for-competition. Nevertheless, such a norm-based interpretation has limited supporting evidence, unless it can be substantiated by analysing exemption practice in the EU between 2004 and 2007. For this purpose, we compiled a list of all infrastructural projects that were granted exemptions (see Table 1).

Table 1: Exemptions granted under Article 22 of Gas Directive 2003/55/EC

Receipt of notification	Project name	Country and national authority	Activity exempted	Investment volume	Duration
8.11.2007	Nabucco Gas Pipeline	Austria, E-control (the Austrian regulator)	Interconnector	Approx. € 5 billion	(unknown)
23.07.2007	Eemshaven LNG terminal	The Netherlands, Ministry of Economics Affairs	LNG Terminal	€800 million	(unknown)
18.7.2007	LionGas Terminal	The Netherlands, Ministry of Economics Affairs	LNG Terminal	€650 million*	(unknown)
04.05.2007	Grain LNG Terminal (phase 1+2)	United Kingdom, The Gas and Electricity Market Authority (Ofgem)	LNG Terminal	€485 million	20/25/20 years for the three phases
23.2.2007	Poseidon Pipeline	Greece, Ministry of Economic Affairs	Interconnector	€350 million	25 years
23.11.2006	Gate Terminal Rotterdam	The Netherlands, Ministry of Econom-	LNG Terminal	€800 million	20 years (25 years requested, but

		ics Affairs			amended by Dutch regulator)
15.4.2005	Brindisi LNG Terminal	Italy, Ministry of Productive Activities	LNG Terminal	€390 million	20 years**, partially for 80% of new capacity
12.4.2005	Bacton-Balgzand Pipeline (BBL)	United Kingdom and Netherlands, Ofgem and the Dutch Ministry of Economics Affairs	Interconnector	€500 million	10 or 15 years, depending on the proportion of the capacity considered
3.2.2005	Milford Haven Dragon	United Kingdom, Ofgem	LNG Terminal	£250 million (€336 million)***	25 years
1.12.2004	South Hook LNG, Milford Haven	United Kingdom, Ofgem	LNG Terminal	€1067 million	25 years
1.12.2004	Isle of Grain LNG Terminal (phase 1)	United Kingdom, Ofgem	LNG Terminal (phase 1)	Included in above	as above
3.12.2004	North Adriatic LNG Terminal	Italy, Ministry of Productive Activities	TPA	€835 million	80% TPA exemption for 25 years (20% TPA)

(*) Authors' estimation. Official investment figure not published.
(**) Based on the length of the contracts
(***) Based on January 2008 exchange rate

Sources: European Regulators' Group for Electricity and Gas (2007, September), European Commission Website >http://ec.europa.eu/energy/gas/infrastructure/exemptions_en.htm<, and various project websites.

In 2007, the European Regulators Group for Electricity and Gas (ERGEG) presented an overview of projects which had applied for an exemption under Article 22. ERGEG listed ten LNG projects of which eight have been approved and two are pending (Extension to the Isle of Grain phase 3 and OLT Offshore Livorno). Out of four interconnector projects, three have been granted exemptions from third party access. At the beginning of 2008, three decisions concerning onshore extensions belonging to the North European Gas Pipeline were pending. In other words, between 2004 and 2007, 11 new infrastructure projects have received exemptions based on Article 22. These add up to a total investment of approximately €11.2 billion Euros. Except for the BBL interconnector, exemptions were granted for 20-25 years. Depending on the capacity allocation mechanism, the impact on the potential market competition and liquidity is considerable. When a TPA exemption is granted, the facility owners might negotiate and share out the primary capacity rights. With secondary capacity rights, the use-it-or-lose-it principle applies. Some of these projects allocate their primary capacity using an open season procedure, a special

form of auction.[22] Capacity allocation practice varies among the investment projects.[23] The Italian projects have tended to allocate their capacity through negotiations; whereas the British projects, such as South Hook LNG, Dragon LNG and the BBL interconnector, use either an auction for long term reservations or an open season mechanism (European Regulators' Group for Electricity and Gas 2007, September). What we observe is that recent infrastructure projects to bring new tradable gas to the European markets exclude third party access and so potentially enable vertical foreclosure to thrive. Vertical foreclosure is here understood to be obstacles to competition that arise from the vertical integration of companies active in the supply and network business. Nevertheless, the European Commission was able to draw positive conclusions from its energy sector inquiry:

> *"Traditionally LNG has been imported by national incumbents who also own LNG terminals, which has not permitted the potential [of] imports to increase downstream competition to be realised. Recent trends, however, point to more capacity going to new entrants and to producers themselves. This is likely to have a positive impact on fostering downstream competition unless such effects are frustrated by access, LNG storage or emission rules with negative effects on competition, or by anti-competitive behaviour."* (European Commission 2007a, January 10: 282)

The unfavourable rules, which might result in suboptimal competition, are not specified, and solutions to prevent a negative impact are not addressed in this context. Creating conditions in which new entrants come into play is necessary but certainly not sufficient to ensure downstream competition in the market. To reach a judgement as to whether competition will develop, it would be useful to make public the allocation of capacity in these new investment companies across Europe. It seems that the European Commission advocates competition along the complete value chain, rather than competition within and across all parts of the value chain.

To sum up, all the formal requests for exemption so far evaluated have received approval. The European Commission does not keep records of companies that make informal enquiries about exemptions but then fail to formally apply (whether due to negative feedback or any other reason). Therefore, it is not possible to compare the number of informal

[22] Some projects deviate from the norm by exercising an open season procedure on a voluntary basis, or by not conforming with the obligation to allocate capacity using an open season procedure at all (European Regulators' Group for Electricity and Gas 2007, September)

[23] LNG companies criticise the use-it-or-lose-it (UIOLI) principle because it shifts the risks to the LNG company while offering free-riding potential to opportunistic market players. In general, an LNG company needs to provide greater re-gasification capacity than LNG cargo capacity to ensure the gas flow is maintained. The need to run an LNG terminal in combination with a re-gasification facility with asymmetric capacity results in often not being able to use the whole capacity through prior booking. If this market situation is genuinely structural, and a use-it-or-lose-it regime is employed, then other market players could specialise in buying capacity in the secondary market at rock-bottom prices without sharing any of the risks. Moreover, the danger of cross-subsidising free-riders might lead other market players to refrain from signing long-term take-or-pay contracts. This line of reasoning, advanced by LNG businesses, argues that the application of UIOLI principles in effect decreases the competitiveness of Europe as an LNG destination. In times of a worldwide demand-side competition for LNG cargos, the EU runs the risk that the United States or Asia could offer a better investor-oriented market environment and thus succeed in becoming market makers. For further information see the NERA Economic Consulting Report on third party access to LNG Terminals (2006, 10 November)

and formal requests with the number of approved requests. Measuring the impact of regulation-for-competition on investment is thus problematic in terms of the dependent variable because, in practice, third party access is not granted to new investment projects. In other words, the policy objective of achieving security-of-supply is prioritised over a purist application of regulation-for-competition.

6. Conclusion

Econometric research has brought about numerous comparative studies on utility reforms across the world and has explored the explanatory power of the structure-conduct-performance paradigm. The literature review revealed that the effect of regulation-for-competition on economic performance is not straight forward and it is hard to control for single factors in complex multi-factor equations. However, a misinterpretation of causes and effects might lead to the wrong policy recommendations and as a result decrease policy credibility and social welfare. After all, the following is a common conclusion of these econometric models: to achieve favourable economic performance within a liberal market organization, competition has to be put in place in conjunction with privatisation and credible regulation. Whereas the assessment of regulatory regimes in European gas markets has been carried out, their correlation to economic performance indicators appears to be more challenging. The effect of single regulatory instruments like third party access or unbundling has not been subject to substantial research and even then the results are contradictory. More research in this regard is necessary, before a conclusion can be reached. Discussion on the factors determining natural gas prices has directed the attention back to the basic conditions of the scp paradigm. The oil price indexation of natural gas prices demonstrates the importance of basic conditions in shaping economic performance in natural gas markets. In the energy sector, some basic conditions such as a country's resource base, oil price development, access capacity and the degree of worldwide demand side competition do profoundly influence gas prices and security of supply. Changes of those basic conditions therefore need to be given systematic attention and control in econometric research equations and qualitative analyses alike.

The literature review additionally revealed that systematic analyses of the effect of regulation-for-competition on investment do not exist. In our attempt to empirically substantiate the claimed hold-up problem in European gas markets, three findings emerged. Firstly, as Neumann and von Hirschhausen show, the duration of supply contracts has decreased less in the European liberalised gas market than elsewhere. Moreover, investment uncertainty related to contract duration depends on the relevant exemption practice and can therefore only be judged on a case-by-case basis. Secondly, the European Commission and its national regulatory dependants approved all 11 formal exemption requests received between 2004 and 2007 for new investment projects. These reflect a total investment of approximately €11.2 billion in infrastructure for which there is no obligation to grant third party access. Our attempt to empirically quantify the extent to which the EU is suffering from a hold-up problem did not succeed because the optimal investment level, with which we could compare the current situation, remains undefined. Nevertheless, the industry's strong opposition to ownership unbundling coupled with the popularity of exemptions allowing long-term contracts does indicate that the general argument in favour of a hold-up problem has empirical support. Thirdly, due to the way the European market was organised prior to liberalisation, investment levels in the natural gas sector in

general, and in transmission systems in particular, are not sufficiently clear to allow a systematic comparison. Investment figures tend to be misleading in the sense that they reflect ongoing developments. Consequently, the effect of regulatory regimes on investment in the gas sector as a whole cannot be scientifically verified on the basis of an EU-wide comparison.

Taking a positivist standpoint, we have demonstrated that a verification of whether or not regulation-for-competition positively correlates with favourable economic performance is not possible due to conceptual and data constraints. The liberalisation of European gas markets and related regulation has certainly had an impact on economic performance in the form of gas prices, efficiency and security of supply. We argue the current evaluations and econometric models do not convincingly measure the impact of regulation to allow a verification of the underlying theoretical assumptions of the gas reform. This might be considered bad news for those who believe a positive impact is a matter of fact.

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