Energy Retail Markets Comparability Study

A report for DECC

Prepared by

London Economics

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Glossary

Member State abbreviations

BE	Belgium	LU	Luxembourg
BG	Bulgaria	HU	Hungary
CZ	Czech Republic	MT	Malta
DK	Denmark	NL	Netherlands
DE	Germany	AT	Austria
EE	Estonia	PL	Poland
EL	Greece	PT	Portugal
ES	Spain	RO	Romania
FR	France	SI	Slovenia
IE	Ireland	SK	Slovakia
IT	Italy	FI	Finland
CY	Cyprus	SE	Sweden
LV	Latvia	UK	United Kingdom
LT	Lithuania		

BLS – USA Bureau of Labor Statistics

BOE – Bank of England

EIA–the USA Energy Information Administration

GB – Great Britain

GJ - Gigajoules

IEA – International Energy Agency

kWh-kilowatt hours

MWh – megawatt hours

mmBtu – million British thermal units

mcm – million cubic meters

OECD –Organisation for Economic Cooperation and Development

OLS – Ordinary Least Squares

GLS – Generalized Least Squares

Executive summary

Retail Markets Comparability Study

Objective

The objective of this study is to use publicly available data to assess the trends and position of the UK electricity and gas retail markets relative to comparable jurisdictions in terms of prices, competition and profitability.

In order to provide adequate sample sizes and a sense of trend, the study combines the latest available data with historical data, back to 1979 (for econometrics), 1984 (for prices indicators) and 2003 (for competition and profitability indicators). The key consideration for the choice of time period was data availability.

Comparator jurisdictions

The main prices analysis uses two main comparator groups: the EU 15 and Selected OECD jurisdictions.

EU 15	UK, Austria, Belgium, Denmark, France, Finland, Greece, Germany, Ireland, Italy, Portugal, Spain, Netherlands, Luxembourg and Sweden
Selected OECD **(11 jurisdictions)**	UK, USA, Canada, Japan, New Zealand, Australia, Norway, Switzerland, France, Germany and Italy

These jurisdictions were selected based on comparability, in terms of reasonably similar socio-economic, regulatory and legal environments, and on availability of data. Within the study, the jurisdictional set varies in some instances according to data availability[1].

Chosen indicators and caveats

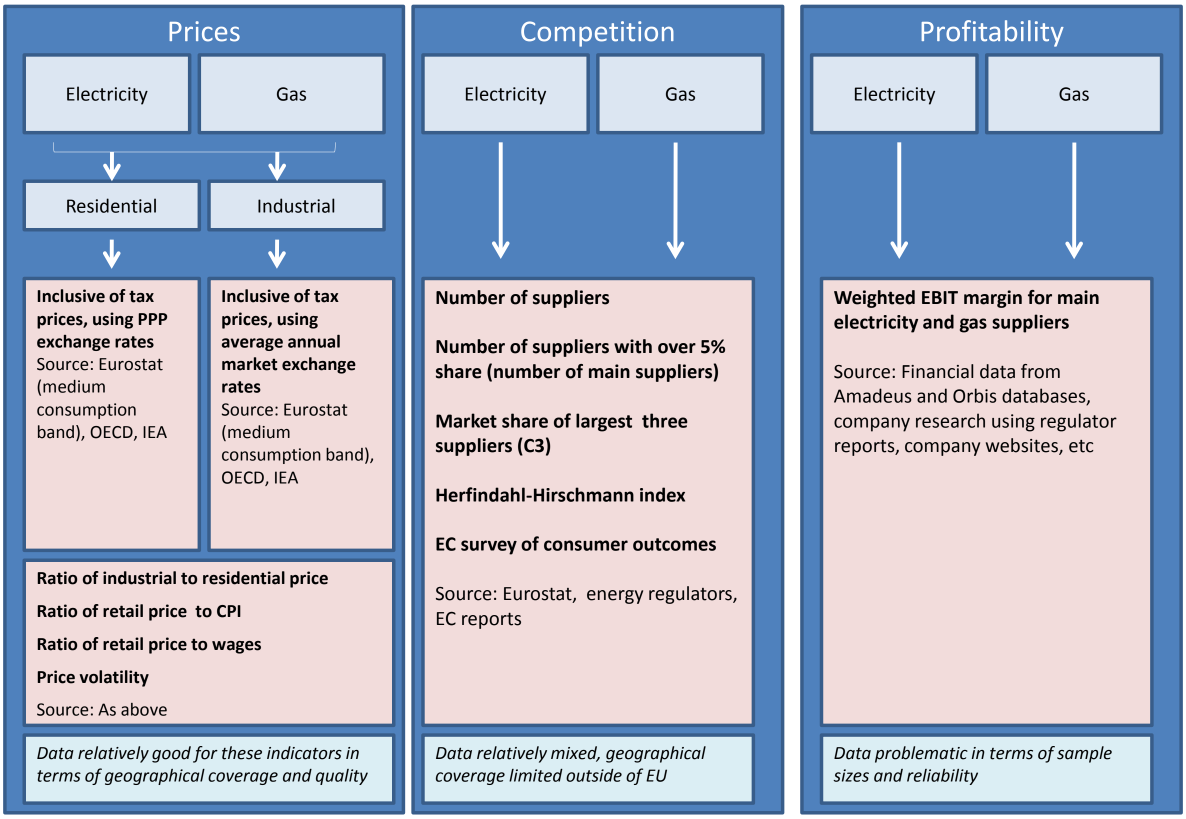
This study benchmarks the UK[2] against other jurisdictions using a range of indicators and undertakes econometric analysis of the key factors potentially accounting for the variation in prices across jurisdictions.

[1] The competition analysis mainly covers the EU 15, US States and New Zealand. The profitability analysis includes some data from each of the EU 15 and Selected OECD jurisdictions, with the exception of Japan. Some data is at the state/province/territory level.

[2] For some indicators separate results are presented for Great Britain and Northern Ireland, whereas for others only UK data was available.

The figure below describes and summarizes the three areas of analysis: prices, competition, and profitability; the types of energy prices: electricity and gas, residential and industrial; the data sources, the measures calculated and the caveats of the datasets and methods.

Figure 1



The indicators above should be interpreted in the context of the caveats presented at the bottom of each box in the figure.

Methodology

Prices

For **residential customers**, purchasing power parity (PPP) exchange rates were used to convert to a common currency price. PPPs are arguably the most relevant currency conversion method for residential customers, since they indicate the relative value of a currency in terms of purchasing consumer goods[3]. For **industrial customers**, market exchange rates were considered the most suitable conversion method. This is because businesses that are subject to international competition when selling their end products must compete based on market exchange rates. Price

[3] Purchasing Power Parities (PPPs) are currency conversion rates that convert to a common currency as well as equalising the purchasing power of different currencies. In other words, they seek to eliminate the differences in price levels between countries due to differences in currency exchange rates and in living standards.

data was generally of good quality and coverage. However, it should be noted that price rankings can vary depending on the data source[4].

After-tax prices were considered the most suitable indicators. These are the most meaningful prices for end-users and are not biased by policy decisions, such as the way that renewables support programmes are funded[5].

Competition

A number of indicators were chosen to provide a balanced snapshot of competition, while working within the data constraints. We used available data on the market share of the n largest suppliers[6] and the Herfindahl-Hirschman index (HHI). We also used data on the total number of suppliers and main suppliers, and information from an EC survey that focuses on consumer perspectives. It should be noted that the market structure and outcome variables do not directly measure the intensity of supplier competition. In addition, available market concentration data was mostly at the national level, and low concentration at a national level can mask high concentration at a regional or local level.

Profitability

The next area of analysis used accounting profit data comparisons and compared EBIT across jurisdictions. Earnings Before Interest and Tax (EBIT) allows a comparison of company profits that is less affected by differences in capital structure and tax. The chosen indicator for comparison is the weighted average EBIT margin per jurisdiction for the period 2003-2010. The indicator chosen uses the average over multiple years of data because: the relatively small sample sizes, one-off variations over time in profit due to accounting measures, and the existence of variation in business conditions across jurisdictions limits the reliability of year-to-year comparisons. The difficulties associated with isolating energy supply profits mean that data in this area is problematic[7]. In light of this, our results should only be interpreted as providing a broad indication of jurisdictional profitability.

[4] Eurostat presents a variety of different residential and industrial prices according to consumption band, whereas the IEA presents only a single price for each of residential and industrial users. We used both sources, and medium consumption bands for Eurostat data.

[5] This conclusion still holds in light of VAT because this is what users actually pay. For industrial customers, it is difficult to ascertain what the actually effective VAT rate is, as some VAT, but not all, can be claimed back.

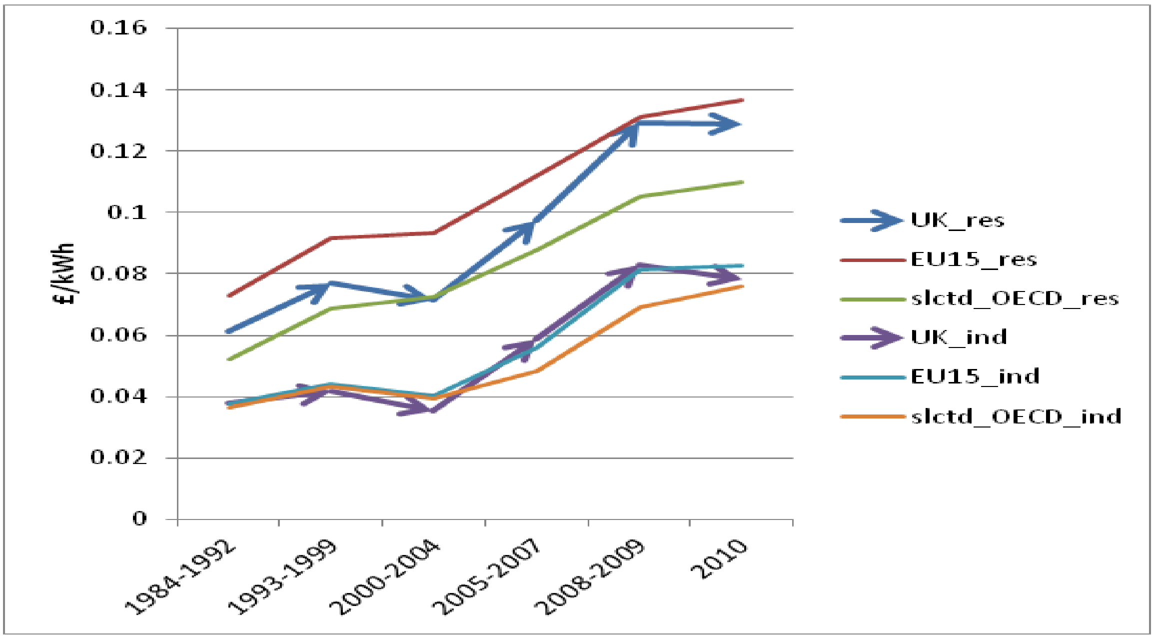
[6] We focused on the C3 measure (combined market share of 3 largest suppliers), which is considered more informative than C1 (market share of largest supplier) while having better data availability than C5.

[7] In order to achieve a reasonable sample size, some companies engaged in energy supply plus related activities were included in the sample.

Key conclusions

Prices – electricity

Figure 2: Electricity prices- Summary - EU15 & Selected OECD- Tax inclusive



Note: Australia not included due to missing data
Source: LE using data from IEA, OECD

For **residential customers**, the UK was cheaper than the EU 15 average throughout 1985-2011, but more expensive than the Selected OECD average for almost all of the period.

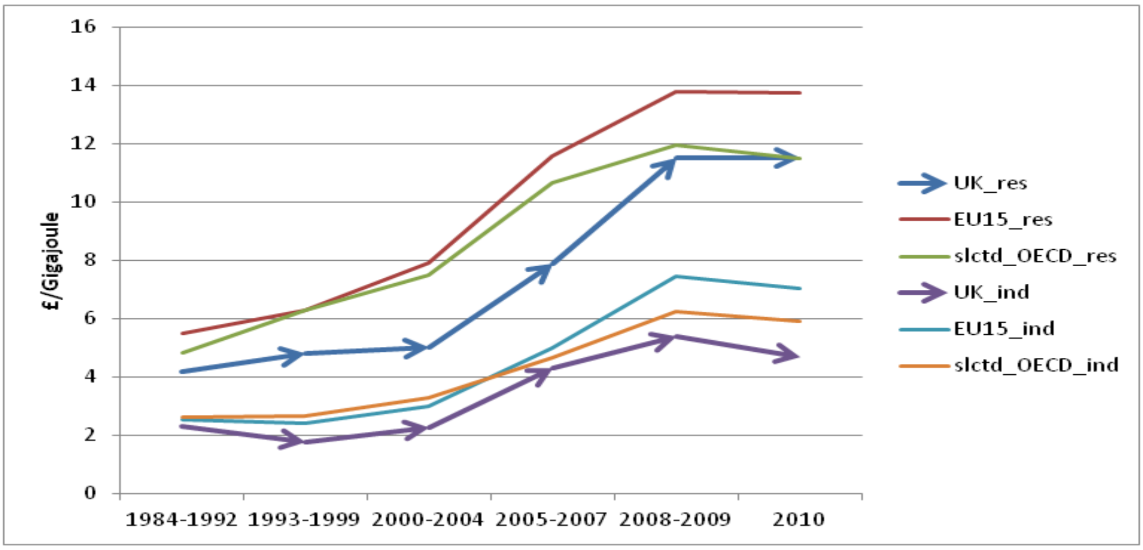
EU jurisdictions were generally more expensive than non-EU jurisdictions[8]. Italy and Germany were considerably more expensive than the UK in 2011. Both have high levels of renewables support, while Italy has a high dependence on imports. Cheaper jurisdictions were those with lower tax, greater access to cheap gas (USA and Canada), and lower levels of renewables support (Canada, Norway, Switzerland, USA), or those with high proportions of hydro and/or nuclear power (Switzerland, Norway, New Zealand, France, Canada, USA).

For **industrial customers**, the UK tracked the EU 15 average for most of 1985-2011, ending the period below the EU 15 average and above the Selected OECD average.

[8] France is a notable exception.

Prices – gas

Figure 3: Gas prices- Summary - EU15 & Selected OECD- Tax inclusive



Note: Australia not included due to missing data
Source: LE using data from IEA, OECD

For **residential customers**, the UK was considerably cheaper than the EU 15 average throughout 1985-2011 and ended the period close to the Selected OECD average.

The more expensive jurisdictions were those with higher taxation (Denmark, Sweden, Italy) and/or less favourable import conditions[9] (Spain, Italy, Japan). Cheaper countries were those with low commodity prices. The USA and Canada have been considerably cheaper than the UK since 2008. This may reflect the UK's increasing net import dependency[10], while shale gas has depressed USA commodity prices in the last 2 to 3 years.

For **industrial customers**, the UK was cheaper than the average of each comparator group throughout 1985-2011.

Competition

Overall, UK market concentration appears low relative to the comparators. It should be noted that jurisdictional samples were limited by data availability. As noted in Figure 1, the indicators do not provide a full picture of competitive intensity.

[9] For example, the need to import LNG.

[10] The UK switched from being a net exporter of gas to a net importer around 2000 and the trend for increasing net import dependency has continued since then.

Competition – electricity

The UK and Austria had more main suppliers than any other EU 15 jurisdiction in 2010, and more suppliers than the US State average and New Zealand.

Based on the same sample and the C3 measure, Great Britain was among the least concentrated jurisdictions[11]. Germany had the lowest C3 concentration of the EU 15, but has relatively localised markets[12].

On both HHI and C3, concentration in the electricity market in Great Britain in 2010 was below what would be considered “concentrated” based on indicative rule-of-thumb thresholds.

Competition – gas

The UK and Spain had more main suppliers than any other EU 15 jurisdiction in 2010. Data outside of the EU was very limited.

Based on a sample of 13 EU jurisdictions and the C3 measure, Great Britain was the 4th least concentrated market in 2007[13] and Germany was the least concentrated, although the existence of local markets means that C3 may understate market concentration in Germany. In terms of HHI, concentration in the residential gas market in Great Britain declined between 2000 and 2010, with most of the reduction coming prior to 2006. As of 2010, the market remained “concentrated” based on indicative rule-of-thumb thresholds.

Profitability

The profitability research identified 163 companies engaged in energy supply and related activities. With the exception of Japan, each of the EU 15 and Selected OECD jurisdictions was represented[14].

The weighted average EBIT margin for the Great Britain companies was 4.2% over 2003-2010, the 4th lowest of the 44 jurisdictions covered. Due to the difficulties of isolating EBIT figures that relate to energy supply only, and relatively small sample sizes per jurisdiction, these results should be treated as indicative only.

Econometric analysis

The econometric analysis suggests that commodity input prices, fuel mix (electricity), the need to import (gas) and wages explain a large amount of the variation in retail prices for both residential and industrial customers across jurisdictions and over time.

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[11] The latest comparable GB data was from 2007 for this measure. Belgium and Italy were from 2009; other countries were from 2010.

[12] The national C3 measure does not reflect market concentration at the local level. About 90% of German electricity suppliers had no customers outside their local area in 2009 according to ERGEG.

[13] The most recent year with reasonable data availability.

[14] USA states were treated individually in this analysis, as were Canadian provinces and Australian territories.

The sample comprised the EU 15 and Selected OECD jurisdictions. Average annual data were used for a range of the main variables for the period 1980-2010. For some variables, such as the competition measures, fewer years were available. Models were estimated for residential and industrial and for electricity and gas.

The table below summarises the typical impact of each explanatory variable across the regressions[15].

Explanatory variable	Typical impact on price	
	Electricity	Gas
Commodity input prices	+	+
Energy usage per capita	-	-
Wage levels (proxy for input costs)	+	+
Proportion of hydro	-	NA
Proportion of nuclear	-	NA
Proportion of renewables	+	NA
Net gas imports to consumption	NA	-

Competition variables were also considered and included in a number of the panel regression models, but in general, only a weak downward and sometimes ambiguous impact on prices was estimated. For gas prices, some regressions suggested that greater concentration (C3 measure) had a small statistically significant[16] upward effect. The weak evidence in this area may be reflective of data problems. This area could benefit from more work to create comparable and more meaningful competition data and measures.

[15] A number of regression models were explored and a variety of results obtained. Results that were ambiguous (i.e., the sign changed depending on the regression specification) are shaded in grey.

[16] The 10% significance level was used in the econometrics.

Relationship with other studies

We are not aware of any existing study which covers prices, profits, and competition across jurisdictions for both gas and electricity. Nonetheless, many more focused studies exist and are suggestive for our methodology. In general, other studies have included fuel mix (electricity) and commodity prices (electricity and gas) and other supply conditions (wages and imports) and found them to be significant explanatory factors for prices. Some of the more recent and robust studies have focused on competition in retail electricity in the US and found even controlling for fuel mix, input prices and a range of other factors, competition had a significant impact to lower price when more consumers chose their supplier. Existing studies on profitability and competition at the retail level have been less conclusive, most likely due to data challenges.

1 Introduction

1.1 Overview

This document is a study of global electricity and gas retail (end-user) prices by London Economics for the Department of Energy and Climate Change (DECC).

The study's goals are to compare UK prices with selected international comparators and to help DECC understand better the drivers and explanatory factors of end-user electricity and gas prices internationally.

To better understand retail energy prices and market functioning, the study looks in detail at prices, profits, and competition.

The study focuses on both electricity and gas, residential and industrial, retail prices.

In some cases, the comparison is based on a GB rather than a UK basis and this is based on data availability and reasonableness of comparisons, as appropriate.

The study uses a number of overall analytical approaches to achieve these aims:

1. First, for each of prices, profits, and competition, the study uses a general benchmarking approach, which compares the levels and trends of end-user energy prices, levels and trends in profits, and levels and trends in key competition metrics. This approach is largely qualitative and descriptive. The purpose of such an approach is to draw out the overall comparative picture, while recognising the difficulties involved with precise comparisons. It is also used to identify possible explanatory factors that warrant further investigation and testing later in the study using an econometric approach.
2. Next, the analysis uses some adjusted benchmarking and comparison of ratios. The adjusted comparisons are comparisons such as the ratio of energy prices to wage, CPI, etc.
3. Finally, possible explanatory factors for energy prices and profits are explored quantitatively using Ordinary Least Squares (OLS) regressions. More detailed regression models using panel data techniques are also estimated and explored.

Data used for the study has been obtained from publicly available sources, plus a survey of regulators, regulatory/energy bodies, and utilities commissions around the globe. The primary data sources for the study include the International Energy Agency (IEA), the OECD, the US Energy Information Administration (EIA), the European Commission, Ofgem and DECC, and other national regulators' websites.

1.2 Selection of countries

The study focuses on 22 countries, including the UK. They include the EU15[17], plus Norway, Switzerland, the USA, Canada, Australia, Japan, and New Zealand. Selected US States and

[17] Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, and the UK.

Canadian Provinces are included in some of the analysis and where data are available. The basis of this selection was on comparability, in terms of a reasonably similar socio-economic conditions, reasonably similar overall regulatory and legal environment and economy, and availability of data. Non-EU15 recent EU member states were not included in the sample, as their regulatory experience is not very similar to the UK. Notwithstanding this, a number of countries with somewhat different regulatory environments, such as the various States of the USA, Japan, and Canada, were included, in order to ensure a degree of variety in the sample.

1.3 Organisation of the document

The remainder of the document is organised as follows: Section 2 presents a literature review; Section 3 presents the summary background material; Section 4 presents price comparisons; Section 5 presents price volatility comparisons; Section 6 presents the price breakdowns into components; Section 7 presents the profitability comparisons; Section 8 compares competition measures; Section 9 presents the econometric synthesis; and Section 10 presents the conclusions. Additional details of background, econometrics, prices, and profits are found in the annexes.

2 Literature Review

2.1 Introduction to literature review

This section reviews the literature on electricity and gas retail market benchmarking of prices, profitability, and competition for developed countries.

In general, the total amount of research on the area of retail energy benchmarking has been limited. More often, studies are more focused on a particular area, such as whether a certain type of reform lowered prices or margins. Indeed, Joskow (2005b)[18] suggested that retail competition had not been adequately addressed in the literature, although since then some papers have been developed.

There has been generally less research into gas retail than into electricity retail. This is perhaps for a variety of reasons, such as for example, a significant number of countries do not have utility distributed gas, or less developed gas networks and systems.

A notable challenge with analysis of existing studies and the subject matter at hand is how to disentangle the retail market from the more general process of utility deregulation and restructuring, including up-stream impacts. In general, upstream, generation for electricity, and wholesale shipping for gas, have been liberalised more rapidly than retail. The upstream elements have also been liberalised more completely and, arguably, with more success. For our purposes here, we will therefore have to digress at times into some of the important studies of liberalisation on the whole, but a comprehensive review of liberalisation in general is beyond the scope of this literature review and this report.

While challenges with benchmarking studies in general should be kept in mind, naturally studies that do straightforward comparisons can be powerful when properly interpreted. For example, the case of prices in Scotland and Northern Ireland versus in England and Wales diverged after the 1990s liberalisations in England and Wales. Newbery[19] presents a figure comparing Edinburgh versus London electricity prices from 1990 to 2003. The figure shows London starts the period 10% higher, but finishes about 5-10% lower—the obvious difference being that the electricity market reforms in England and Wales predated those in Scotland.

Another aspect of the review of the research that deserves our consideration up front is the degree of independence of some studies, and the purpose of this review. While many studies may have been written with a particular viewpoint in mind about whether restructuring worked, our purpose is not necessarily to referee between such studies, but merely to consider what the studies used in terms of methods and variables and what they obtained for results.

[18] Joskow, P. (2005). Markets for Power in the United States: An Interim Assessment. AEI-Brookings Joint Center For Regulatory Studies. www.aei-brookings.org.

[19] Newbery, D., "Electricity liberalisation in Britain: the quest for a satisfactory wholesale market design," provides a good historical description of the process of liberalisation in Britain.

A final aspect of the literature review to note is that naturally there exists an extensive more general literature of the effects of competition and market structure on prices and profitability. For this study, we focus however, on retail electricity and gas market studies.

2.2 Electricity market

2.2.1 Most recent studies

Perhaps the most interesting and apparently rigorous study was recently completed by economists with the US Federal Reserve Bank, Dallas Branch (Yucell and Swadley 2011).[20] They use a dynamic panel approach and a dataset of US States. They restrict their attention to 16 states and Washington DC. They control for price caps in markets, fuel costs, switching to competition, and other factors. They find that retail market competition participation rates, price controls, a larger market, and high shares of hydro in electricity generation have tended to lower retail prices for these states. They also find that increases in natural gas and coal prices increase retail electricity rates. They find the effects of retail electricity market competition are mixed across states, but most interestingly, they find that retail competition lowers rates when consumer participation is high, but raises rates when it is low. They measure participation as the percentage of customers in the state who chose a competitive supplier. This study is important for our study in that it suggests a number of explanatory variables, including fuel mix and fuel commodity prices, as well as the potential impact of competition on lowering prices. It also shows the importance of good switching data across jurisdictions.

One of the few econometric and very recent studies on the impacts of restructuring on retail electricity prices is by Andrews (2010).[21] The study uses a panel of US States from 1967 to 2007. The study uses fixed effects and OLS estimation techniques. The dependent variables are residential, commercial, and industrial total electricity price by State. He finds that retail choice had a significant price-reducing effect. The study uses fuel mix, socio-demographic variables (e.g., population density), as well as whether the utility is in an ISO or RTO region (e.g., this generally means upstream/generation restructuring). Fuel costs for fossil fuels data are available on the unit cost of the total thermal input by state as a cost-share weighted average from EIA and this is used to control for input prices. Retail choice is measured as the percentage of the market open to competition. No measure of market concentration is used.

For the electricity markets in England and Wales, Bunn and Olivera (2008)[22] developed "a model for the dynamic strategic evolution of electricity-generating asset portfolios in response to various market interventions, and the consequent longer-term effects of such changes on market structure and prices." They used a Cournot model of the wholesale electricity market and then determined plant trading between players and the coevolution of market structure. Their

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[20] Yucel, M. and Swadley, A., "Did Residential Electricity Rates Fall After Retail Competition? A Dynamic Panel Analysis", Research Department Working Paper 1105, Dallas Federal Reserve Bank.

[21] Andrews, R., 2010. "Giving Customers a Choice: Examining the Effect of Retail Competition on the Electric Power Industry," The UCLA Undergraduate Journal of Economics.

[22] Bunn, D., and Oliveira, F. (2008), "Modeling the Impact of Market Interventions on the Strategic Evolution of Electricity Markets," Operations Research September/October 2008 56:1116-1130.

conclusions are mainly about market structure and how various changes in the structure, market rules and gaming behaviour change market outcomes, including prices and profits[23].

Fioro C. et al (2007)[24] test the impact of the Electricity Industry Reform Paradigm on consumers in the EU. This paper questions the link between privatization in electricity industry and lower prices and increased consumer satisfaction. The authors utilize micro survey data on consumer satisfaction and aggregate country data on electricity prices in the EU15 over a three-year period. Their results show that privatization does not lead to lower prices, or to increased consumer satisfaction. Analysis revealed a statistical association between public ownership and decreasing prices and higher consumer satisfaction. They also found that unbundling tends to increase prices and to lower consumer satisfaction. The data revealed that entry barriers decrease prices but consumers were not convinced. The authors conclude that some of assumptions of the Electricity Industry Reform Paradigm are too strong or over-simplified and more flexibility and realism is needed.

Blumsake, Lave, and Apt (2008)[25] used an econometric approach to study retail electricity and restructuring. They used price-cost margins as their dependent variable and firm-level data for the USA, but then consider the results for retail prices. They measure restructuring in terms of required divestiture; joining an ISO/RTO; and retail competition. They conclude, "The combination of introducing retail competition into an electric utility's operating territory and divestiture of that utility's generating assets has increased costs, but has increased prices even more. In particular, we find an average difference of 2 to 3 cents per kWh between prices and costs that is explained by restructuring rather than by increases in fuel prices". So interestingly, they find the opposite result of some of the other studies.

A study by Joskow (2008) looks back at liberalised electricity markets and distils a list of "lessons learned" from the experiences of various countries.[26] He emphasizes the need for comprehensive restructuring as opposed to a simpler model of deregulation; countries which have restructured the electricity market have been more successful in gaining the desired benefits[27]. This includes regulatory reform, privatisation of state-owned entities, vertical and horizontal restructuring [including unbundling], competitive entry and retail competition[28]. Joskow compares experience in various countries in the EU and around the world, pointing out that the ones which did not follow the comprehensive "textbook" model of restructuring experienced the greatest post-reform difficulties and failures (although that is not to say that those which undertook the textbook model encountered no problems)[29].

[23] Ibid.

[24] Fioro C.V., Florio, M., Doronzo, R., 2007. The Electricity Industry Reform Paradigm in the European Union: Testing the Impact on Consumers. Università degli Studi di Milano.

[25] Blumsack, Seth, Lester B. Lave, Jay Apt, "Electricity Prices and Costs Under Regulation and Restructuring Carnegie Mellon University, Carnegie Mellon Electricity Industry Center Working Paper CEIC-08-03 www.cmu.edu/electricity.

[26] Joskow, Paul, "Lessons Learned from Electricity Market Liberalization," The Energy Journal, Special Issue. The Future of Electricity: Papers in Honor of David Newbery, 2008, IAEE.

[27] Ibid.

[28] Ibid.

[29] Ibid.

One of the most important recent studies on restructuring is by Kwoka (2006), and similarly, Kwoka (2008)[30]. This study reviewed twelve studies on the effects on of restructuring electricity markets on costs and prices were reviewed for the American Public Power Association in 2006.[31] The author compares the studies in light of the strengths and weakness of their varying methodologies and makes various observations with respect to their conclusions[32]. He found that nine of the twelve studies concluded that restructuring resulted in cost efficiencies or retail price benefits[33]. The other three studies did not find any consumer benefits from restructuring.[34] The author noted three main areas where the studies generally lacked strength: lack of clear definition of “restructuring” and lack of accommodation for its complexity (it generally does not happen at one fixed point in time but rather is a process occurring over months or years); failure to account for administratively set prices/rates in the post-restructuring period (such prices were not a result of the new liberalised market); and failure in some instances to control for other factors affecting price[35]. Kwoka’s study is perhaps one of the more important studies in the area. While it is good in pointing out the shortcomings of previous studies, and does a good job in explaining why previous US studies have come to such different conclusions, it does not itself estimate anything new or solve the problems of past data.

Lien (2008) looked at what has worked for restructuring in an unpublished study for the US Department of Justice. During the 1990s, the US electricity markets underwent restructuring to various degrees, followed by a subsequent period of rising electricity prices in the early 2000s[36]. At that time, there was discussion of going back to the pre-reform markets because it was perceived that the market restructuring caused the price increases[37]. Lien (2008) notes that there was no clear price pattern in restructured states versus regulated states and argues that regulators should look to the “long-term development of efficient markets” when making future policy decisions instead of reacting to price increases by simply reintroducing cost of service regulation[38].

In another study in the USA, Craig and Savage (2009)[39] use a number of econometric models to study organizational and technological changes within existing generation plants. They find that plant efficiency gains presents a possible explanation of why retail prices dropped without significant changes in market structure in some US jurisdictions. Instead of new producers entering the market and existing, low-efficiency producers leaving the market, existing producers increased efficiency. Customers then reap these efficiency gains when they are able to choose between competing producers of electricity—the policy of retail choice. However, they do not sufficiently

[30] Kwoka, J. (2008) “Restructuring of the US Electric Power Sector: A Review of Recent Studies,” Review of Industrial Organization, 32, 165-196.

[31] Kwoka, J. (2006) “Restructuring the US Electric Power Sector : A Review of Recent Studies,” Prepared for the American Public Power Association.

[32] Ibid.

[33] Ibid.

[34] Ibid.

[35] Ibid.

[36] Lien, J. (2008) “Electricity Restructuring: What Has Worked, What Has Not, and What is Next,” Economic Analysis Group, Discussion Paper.

[37] Ibid.

[38] Ibid.

[39] Craig, J. and Savage S. (2009), Market Restructuring, Competition, and the Efficiency of Electricity Generation: Plant-Level Evidence from the United States 1996 to 2006. University of Colorado at Boulder Working Paper. www.colorado.edu.

determine the impacts and conclude an "investigation into whether customers actually realized lower prices for electricity as a result of restructuring (one of the major stated goals of restructuring), passing societal gains onto consumers"[40]. Naturally, including measures of market structure and retail competition functioning would be relevant.

2.2.2 Less recent electricity market studies

Harvey, McConhe, and Pope studied the impacts of market coordination on consumer electricity charges in the USA (2007)[41]. By 'coordinated' they mean ISOs and RTOs. Their study is primarily interested in the impacts of different types of wholesale market reforms. The authors use an approach which controls for fuel mix and other generation-specific factors, and use a panel of USA states. They also control for market structure, and ask the questions of how stranded costs and server-of-last resort should be treated. While overall their paper is less focused on retail benchmarking, they include an important discussion on the potential for simultaneity bias when including a total electricity sales figure as an explanatory factor. They conclude that this can impact on whether supply or demand is tight, and thus prices, and thus that the results may be sensitive to the inclusion of this variable (or its square).

Zarkinau and Whitworth (2006)[42] analyse the determinants of residential electricity prices in the competitive Electric Reliability Council of Texas (ERCOT) market. Using a panel data regression approach for the estimation period of January 1998 to October 2004, their analysis suggests that in areas open to competition electricity restructuring has not yet resulted in lower prices for the majority of residential energy consumers. The authors found that residential electricity costs for consumers at a typical consumption of 1000 kWh per month have increased at a greater rate in the areas of Texas offering retail choice than in areas of the state where retail competition has not yet been introduced. This finding is contrary to common expectations. Overall the findings suggest that there is significant divergence between prices and price relationships in the areas of Texas that have undergone restructuring and those areas which have not.

Zarkinau et al (2007)[43] employ a simple regression model to predict electricity prices for a 12-month firm price contract in the competitive regions of ERCOT based on a number of explanatory variables including market price of a 12-month strip of natural gas, load factor, ERCOT congestion zone region, date on which the price was quoted and the average market clearing price of balancing energy on the day before the price quote. 1611 generation price quotes were obtained from databases developed by two load aggregators and the price quotes covered the period from November 2001 to through to September 2005. Prices in competitive areas have tended to converge over time while greater variation was observed among the utility service areas where competition has not yet been introduced. Trends in commercial prices have closely followed trends in residential prices in the areas of Texas open to competition. For the most part, commercial electricity prices have generally increased more in the areas opened to competition

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[40] Ibid.

[41] Harvey, Scott M. , Bruce M. McConihe and Susan L. Pope (2007), Analysis of the Impact of Coordinated Electricity Markets on Consumer Electricity Charges.

[42] Zarnikau, J. and D. Whitworth (2006), "Has Electric Utility Restructuring Led to Lower Electricity Prices for Residential Consumers in Texas?" Energy Policy 34:15, pp. 2191 – 2200.

[43] Zarkinau, J., M. Fox and P. Smolen, 2007. "Trends in Prices to Commercial Energy Consumers in the Competitive Texas Electricity Market," Energy Policy 35:8, pp. 4332 – 4339.

than in the area of Texas which has not yet introduced consumer choice. The authors relate this finding to the rise in natural gas prices in this area since competition was introduced to the market.

Fagan (2006)[44] set out to determine the effect of restructuring on prices using two distinct methodologies. The first was a counterfactual model measuring the difference between actual and predicted prices and the second method was a two-stage least squares model designed to explain causality. The counterfactual model compared average retail industrial electricity prices from 2001 to 2003 with predicted prices for the same period. The second method set out to find significant determinants of the difference between predicted prices and actual prices at state level. The findings revealed that, on average, prices for industrial customers in restructured states were lower, relative to predicted prices, than prices for industrial customers in non-restructured states. The author also found that the price changes were explained primarily by high pre-restructuring prices and not whether or not a state restructured. Overall, the study found that on a consumption-weighted basis, average prices adjusted for competitive transition charges (CTC)[45] in restructured states were only marginally above predicted levels while prices in non-restructured states were significantly above predicted levels. The author concluded that the model suggested neither regulatory reform at the retail level nor at the wholesale level is a significant driver of the restructured states' superior price performance.

Using retail electricity price data, Apt (2005)[46] examines the effect of restructuring on prices paid by US industrial customers for electricity. Data was sourced from the US Energy Administration Information Annual Survey Data which includes approximately 3,300 electric utilities and 1,600 independent power producers, unregulated generation units of regulated utilities and power markets. Using the difference between the annual price change after phase-in of industrial sector competition and before it began, a regression analysis was formed using all 50 states (with the exception of Virginia and District of Columbia). The analysis showed that the variable of restructuring failed to explain price changes. Apt argues that competition has not lowered electricity prices.[47] The author found that consumer welfare has not been improved by restructuring in the electricity industry and also warns restructuring should not be extended to other states until reduced prices or at least a reduced rate of price increase can be demonstrated.

Taber, Chapman and Mount (2006)[48] examine the effectiveness of deregulation in reducing the consumer cost of electricity using a variety of measures including different customer classes and definitions of deregulation. They include average annual prices for residential, commercial, and industrial customers and total average annual electricity prices from 1990-2003. For this study, electricity suppliers were separated into privately owned utilities in

[44] Fagan, M., 2006. "Measuring and Explaining Electricity Price Changes in Restructured States," Electricity Journal 19:5, pp. 35 – 42.

[45] This is the name given to stranded costs charges in the USA. Stranded costs arise when previous rate-of-return-regulated and guaranteed capital technologies are no-longer remunerated fully under the new competitive regime.

[46] Apt., J., 2005. "Competition Has Not Lowered US Industrial Electricity Prices," Electricity Journal 18:2, pp. 52 – 61.

[47] Typically, in econometric studies, the absence of a significant explanatory coefficient should not be interpreted as the absence of an effect—merely that the effect was not found.

[48] Taber, J., Chapman, D., and Mount, T. (2006), "Examining the Effects of Deregulation on Retail Electricity Prices," Cornell University working paper.

regulated states, privately owned utilities in deregulated states and publicly owned utilities. Controlling for a number of factors which may independently affect differences in electricity prices, the analysis does not support the view that deregulation has led to lower electricity prices. Although most consumers in deregulated states experienced declines in real prices of electricity, they faced higher prices relative to customers in states that remained regulated. These results remained even after controlling for a number of determinants such as climate change, generation mix, fuel prices and NERC region.

Jamasb and Pollitt (2005)[49] studied the degree of market reforms in the EU. Their approach focuses on all main aspects of reform, including generation, separation, and retail. They then look at prices across the EU using Eurostat and IEA data. They do not conduct an analysis of countries across time or use econometrics.

In the preliminary study presented at a recent seminar, Erdogdu (2010)[50] presents results for an econometric study of the impacts of liberalisation on 'price cost margin convergence' for the power sector. His study uses a panel of country data, and includes developing and such countries as well as OECD countries. It is unclear why 'convergence' of price cost margin is preferred to some measure of price or margin, but perhaps it is because this is a measure of a 'normal' margin. The inclusion of data/countries in the data set is based on where there has been some type of reform, so arguably his model tests which type of reforms work better or worse. The study uses the dataset from IEA, and price cost margin is estimated by forming an index of the fuel/generation cost using fuel prices and generation shares from IEA. The key variable on reform is formulated as a "score variable" on a scale of 1-8. Other variables such as GDP/head and socio-demographic variables are included. He uses industrial and residential prices, too, but curiously takes the absolute value of the ratio of industrial to residential prices, and interprets this as the level of 'cross-subsidy', which could go either way (in other words, raise price to one group or another). This last element is particularly odd, as while there may have been cross subsidies in some jurisdictions at some times, lower industry prices than household prices is more generally a function of load shape, distribution charges, and cost. In total, twelve models are estimated, and there are mixed results, but notably in developed countries for residential in at least two of the models presented the 'reform' variable is significant with a negative coefficient, interpreted as indicating 'reform improves the convergence'.

Hattori and Tsutsui (2004)[51] examine the impact of regulatory reform on price in the electricity supply industry, using panel data for 19 OECD countries for the period of 1987 to 1999. The method used in this paper follows two regression equations to analyse the impact of regulatory reform on both the level of industrial price and the ratio of the industrial price to the residential price. The authors assume the country-specific effect exists and they utilise a

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[49] Jamasb, Tooraj and Michael Pollitt, Electricity Market Reform in the European Union: Review of Progress toward Liberalization and Integration MIT working paper: 05-003 March 2005.

[50] Erdogdu, Erkan, "The impact of power market reforms on convergence towards the average price-cost margin: a cross country panel data analysis", University of Cambridge EPRG Energy and Environment Seminar25thOctober 2010, 12.00W2.01, JBS, Cambridge, UK

[51] Hattori, T. and Tsutsui, M. 2004. Economic impact of regulatory reforms in the electricity supply industry: a panel data analysis for OECD countries. Energy Policy, 32, 823-832.

one-way fixed effect model and a one-way random effect model. The results of the analysis revealed that expanded retail access is likely to lower the industrial price and increase the price differential between industrial customers and household customers. Unbundling of generation and the introduction of wholesale spot market did not lower the price and may have resulted in a higher price. The analysis shows that there is no statistically significant evidence to show that unbundling leads to a lower industrial price or a lower industrial price to household price ratio. The authors suggest that a sign of enhanced competition is no longer observed. The authors also found that the introduction of a wholesale power market did not lower price and may have resulted in a higher price. Finally the study also revealed that a large share of private ownership lowers the industrial price but may not alter the price ratio between industrial and household customers. These results differ from Steiner (2001)[52].

Steiner (2001) examined the effect of regulatory reforms on the retail prices for large industrial customers of 19 OECD countries for the period 1986-1996. The dependent variable used in this study was the ratio of industrial price to residential price. Steiner also examined some reform elements separately including unbundling, power pool, TPA, and privatization. The analysis suggested that electricity market reforms generally induced a decline in the industrial price.

2.2.3 Benchmarking energy market reform

Some studies, such as Green et al (2006)[53] consider the process of benchmarking competition and reform across jurisdictions. They do not consider an econometric model or the impacts of reform on market price, margins, or other outcomes. Nonetheless, there is some comparative value in such studies.

Customer switch rate data has been used to measure competitiveness in electricity markets. The Utility Customer Switching Research Project by First Data Utilities (2006) compares customer switch rates in over 30 markets and categorizes them as: Hot, Active, Slow and Dormant[54]. The categories are defined as follows: Hot market means that over 15% of customers are switching each year; Active market means 5-15% of customers are switching each year; Slow market means 1-5% of customers are switching each year; and Dormant refers to those markets where less than 1% of customers are switching each year[55]. This study is based on the premise that customer switching rates are the direct result of successful market restructuring, as this is the best indicator that the benefits of restructuring are reaching the retail customers[56]. The UK and Australia's Victoria are the only two markets in the Hot category; South Australia, Texas, Norway, New

[52] Steiner, F. 2001. Regulation, industry structure and performance in the electricity supply industry. OECD Economics Studies. OECD.

[53] Richard Green, Arturo Lorenzoni, Yannick Perez and Michael Pollitt, "Benchmarking Electricity Liberalisation in Europe,"

[54] First Data Utilities and VaasaEMG, "World Energy Retail Market Rankings," Utility Customer Switching Research Project, Second Edition 2006, available at http://www.firstdatautilities.com/customer-switching.

[55] Ibid.

[56] Ibid.

Zealand, Netherlands, Sweden, New South Wales, and Finland are in the Active category; Flanders, New York and Denmark are in the Slow category; and the following are considered Dormant: Austria, Germany, Spain, Ireland, Portugal, Alberta, Ontario, Connecticut, Illinois, Maine, Maryland, Massachusetts, Michigan, California, New Jersey, New Hampshire, Ohio, Pennsylvania, and Rhode Island[57].

In Ireland, Forfás (2007) reported that the rate of increase in industrial electricity prices between January 2001 and January 2007 was almost twice that of EU15. Industrial electricity prices in Ireland were the second highest of the EU-25 as of January 2007; they rose from 16.7% above the EU15 average in 2006, to 18.7% above the EU15 average in January 2007. Irish industrial prices were 15.5% more expensive than those in the UK in 2007, 59.3% more expensive than Denmark and almost double those in France. Italy alone had higher industrial electricity prices than Ireland in 2007 (18.9% higher)[58]. In order to improve upon this situation, the Irish government recognized the need to improve in several areas: cost competitiveness, generation adequacy, diversify sources of supply, adequate regional capacity, improved efficiency, and long-term energy policy planning[59].

2.2.4 Studies focusing on a single jurisdiction or market

In a study of the Victoria, Australia retail market, CRA considered a number of factors.[60] Their approach, however, is not econometric and they do not have actual data. Instead, they create estimated bills based on usage patterns, known tariffs and standard charges, and other factors.

In a study, "Why did British electricity prices fall after 1998?" Joanne Evans and Richard Green (2005) considered the impacts of the reforms of the GB electricity sector, including divestiture and NETA. They use a model of supply function equilibria and compare to actual wholesale prices. Their main purpose is to attempt to consider which had a more important impact on prices, the NETA reforms or the structural reforms. Based on their model they conclude that market structure and not the NETA reforms were the primary drivers of falling prices.

Nikogosian and Veith (2012)[61] looked into the impact of the private versus public ownership of local utilities in Germany. The author uses an econometric approach and estimates the impacts on retail electricity prices. Of interest is the detail within Germany that the author uses to go into the different types of contract and reforms within Germany and the regional/local-specific effects. They're results are mixed and they conclude, somewhat surprisingly, high ownership concentration, as measured by HHI, leads to low prices. The paper does not particularly explain this result using the standard IO arguments of perhaps vertical integration or why ownership concentration should lead to lower prices, but relies on arguments loosely based on the corporate governance theory of the firm.

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[57] Ibid.

[58] Forfás (December 2007), "Electricity Benchmarking Analysis and Policy Priorities"

[59] Forfás (December 2011), "Review of Energy Competitiveness Issues and Priorities for Enterprise"

[60] CRA, (2007) "Impact of prices and profit margins on retail energy prices in Victoria," Report for the Australia energy market commission.

[61] Nikogosian, V. and Veith, T. (2012), "The Impact of Ownership on Price-Setting in Retail-Energy Markets – the German Case," Energy Policy 41, 161-172.

The New South Wales state Government conducted a recent study (2010)[62] into electricity retail prices, noting that prices in the three years to 2010 had risen 43%. They identify that the prices have two main drivers. The biggest driver is the network costs which are being driven upwards by the growth in demand for electricity, the replacement of ageing network assets, enhancement of reliability and performance standards and the escalation of operating costs. The second most significant driver of prices is the introduction and expansion of State and National government schemes to encourage the development of renewable energy sources and the reduction of greenhouse gas emissions from electricity generation.

2.2.5 Studies of mergers on retail competition

This section considers the more general literature on mergers and retail energy competition. Naturally, there have been considerable numbers of energy mergers around the world, and to cover all of them would be beyond the scope of this report. However, it is useful to consider just a few studies to cover the topic in general. One of the key aspects on such studies is that they are interested in the immediate market structure effects of the merger, and therefore the need to calculate changes in market structure over time is limited. In the case of investigation competition authorities as well, these authorities often have access to particular data on the transacting parties, which might be of limited availability to researchers in general.

Federico (2011)[63] surveyed the recent application of merger control in the European and Spanish energy sector from an economic perspective. In considering ten significant merger transactions in the energy sector, he notes that merger decisions in the energy sector have been characterised by a concern for potential horizontal unilateral competition effects[64]. He adds that a variety of non-horizontal concerns have also been considered by the competition authorities including effects flowing from the increasing use of gas for electricity generation or from limited ownership unbundling of network assets. Typical solutions have included extensive structural divestments to remove competition concerns and the author concludes that the sale of price-setting generation plants, network access, and controlling stakes in merging parties competitors. The author concludes that transactions in the energy sector give rise to a variety of complex horizontal and non-horizontal issues which need carefully designed remedy packages.

Codognet et al (2002)[65] surveyed 135 mergers and acquisitions in the EU from January 1998 to August 2003. They find no clear pattern of how mergers and acquisitions may have impacted prices or consumer markets.

[62] New South Wales State Government (2010) “NSW Electricity Network and Prices Enquiry, Final Report”.

[63] Federico, Giulio, The competition effects of energy mergers: Analysis of Europe and Spain; IESE Business School Occasional Paper Series: 2011.

[64] As opposed to vertical, and/or cooperative competitive concerns.

[65] Codognet, M., Glachant, J., Lévêque, F., and Plagnet, M. (2002). “Mergers and Acquisitions in the European Electricity Sector Cases and Patterns.”CERNA, Centre d’économie industrielle, Ecole Nationale Supérieure desMines de Paris, August, Paris.

2.3 Gas market studies

Studies of retail competition in the gas market are much less common than studies of retail electricity competition.

Jamasb et al (2008)[66] studied the impact of US regulatory reform using a Malmquist-based productivity analysis for a panel of US interstate companies. In taking productivity and convergence as performance indicators, they found that regulation has been successful, in particular during a period where overall demand was flat. Subsequently they identify two lessons for European regulators. Firstly, they point out that the US analysis shows that benchmarking of European transmission operators would be possible if data were available. Secondly, they suggest that the results indicate that market integration and competition are alternatives to the current European model.

Hawdon (2003)[67] examines some of the policy developments which affect efficiency of resource use in the gas industry and uses data envelopment analysis to measure relative performance at the individual country level. The results of their analysis included a lack of clearly defined economies of scale and an inability to detect significant dynamic processes at work in efficiency changes. However, the author does conclude that the analysis provides support for the notion that the reforms introduced in Great Britain (and intended in the rest of the EU) are associated with high levels of efficiency, high utilization of labour, and levels of underutilization of capital sufficient to support the development of competitive markets.

Dee (2011)[68] constructs variables for the sample of APEC countries. The variables are in general zero-one variables for different aspects of trade/network industry reform into an index of policy restrictiveness: Third-party access, Retail competition, Absence of entry restrictions, Unbundling of production/import, Unbundling of supply.

In general, it should be noted that many of the existing relevant studies on gas, and indeed the recent policy debate in the UK, have focused on the relationships between security of supply, commodity availability, and wholesale prices. For example, Noel (2012)[69] presents the issues of security of supply, and notes that a significant policy challenge for the UK gas policy is becoming a net importer and thus being exposed to price shocks.

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[66] Jamasb, T, M Pollitt and T Triebs 2008, 'Productivity and Efficiency of US Gas Transmission Companies: a European Regulatory Perspective', Cambridge Working Papers in Economics CWPE 0812, University of Cambridge.

[67] Hawdon, D 2003. 'Efficiency, performance and regulation of the international gas industry – a bootstrap DEA approach', *Energy Policy* 31, pp. 1167–78.

[68] Dee, P. (2011), "Chapter 2: Modelling the Benefits of Structural Reforms in APEC Economics" from The impacts and benefits of Structural Reforms in the Transport, Energy and Telecommunications Sectors, APEC no.211-SE-01.1.

[69] Noel, Pierre, "Import dependence and security of supply: the UK gas policy debate"; London 2012, the global gas challenges seminar.

2.3.1 Studies of both gas and electricity

Roques, Newbery and Nuttall (2008) examine fuel mix and correlation between electricity and gas prices[70]. They found that "high degrees of correlation between gas and electricity prices - as observed in most European markets - reduce gas plant risks and make portfolios dominated by gas plant more attractive. Long-term power purchase contracts and/or a lower cost of capital can rebalance optimal portfolios towards more diversified portfolios with larger shares of nuclear and coal plants"[71]. Although mostly about wholesale markets, the relevance of fuel mix as driver of prices is important here.

Pollitt (2012)[72] looks at a variety of prices and price comparisons for UK households, both over long time periods (comparing oil, gas, electricity, and solid fuels) and also comparing, for example, the taxes on energy (electricity and gas in particular) across the EU. He also qualitatively looks at commodity prices as drivers. He finds that the long term trends on HH prices in real terms have been either flat or downwards depending on the commodity and period chosen (both HH electricity and gas prices fall overall from circa 1982 to present), and all prices fall regardless of period when deflating by income. He concludes that ultimately commodity prices (e.g., especially oil and gas) and long-term energy policy (e.g., support of renewables) are the main drivers. For example, he cites DECC that HH electricity prices should rise by circa 33% by 2030 due to reforms and supports. With these expected to only rises in the long term, he concludes that prices will continue to rise.

In a recent paper by the European Parliament Directorate General for internal policies policy department,[73] the authors assess the opening and completion of the internal energy market through stocktaking of the current status and a critical assessment of the likely policy challenges ahead. The study undertakes a sectoral review of implementation and transposition of the 2nd energy package and discusses the 3rd energy package. It gives an assessment of the road ahead and recommends needed policy steps. They note that the level of liberalisation of European electricity and natural gas markets has increased during recent years but is not as advanced as anticipated when the 2nd energy package was adopted and the variance between states is still large.

2.3.2 Studies of competition and deregulation more generally

There are many studies of how to deregulate and liberalise. One of the challenges with studying whether retail market competition has been effective has been that there are many necessary steps and conditions, none of which are sufficient, in order to achieve effective liberalisation outcomes. Jamasb and Pollitt (2005)[74] describe their view of the required steps based on the literature: "Liberalisation generally requires implementation of one or more of the following inter-

[70] Roques, Fabien A. and Newbery, David M. and Nuttall, William J., 2008. "Fuel mix diversification incentives in liberalized electricity markets: A Mean-Variance Portfolio theory approach," Energy Economics, Elsevier, vol. 30(4), pages 1831-1849, July.

[71] Ibid.

[72] Pollitt, M. 2012. "Energy Prices: the only way is up," The Oxford and Cambridge Club, London.

[73] Altmann, M,. Schmidt, P,. Brenninkmeijer, A,. Van den Kerckhove, O,. Ruska, M,. Koljonen, T,. Korenneff, G,. Behrens, A,. Egenhofer, V,. Ronnholm, A,. Barquin, J,. and Olmos, L,. (2010) "EU Energy Markets in Gas and Electricity – State of Play of Implementation and Transportation". European Parliament Directorate General for Internal Policies, IP/A/ITRE/ST/2009-14, PE 433.459.

[74] *Op cit.*

related steps: sector restructuring, introduction of competition in wholesale generation and retail supply, incentive regulation of transmission and distribution networks, establishing an independent regulator, and privatisation (Jamasb, 2002; Joskow, 1998; Newbery, 2002a)".

Joskow (2005)[75] studied market reform in network industry in general, and includes natural gas. His study is very useful in the context of our study in that he review more generally some of the aspects of studying structural reforms in network industry. He writes: "Structural models of various types of varying levels of complexity have been used particularly extensively in analysing the effects of regulation and deregulation on prices, costs, entry and innovation in the airline, surface freight transportation, and energy sectors. In addition to the work on airlines that I have already discussed, Friedlander and Spady (1981) (on trucks and trains), Levin (1978, 1981) (on trucks and trains), MacAvoy and Pindyck (1973) (on natural gas), Hausman (1997, 1999) (on telecommunications) and many others have produced pioneering work on the effects of regulation and regulatory reform on these other sectors using structural econometric models and integrated econometric and engineering models." (pg. 179)[76] He concludes that structural models are an appropriate tool and form of investigation for studying industry reform.

Another area of literature that one should bear in mind is the area of privatisation and liberalisation. The England and Wales privatisations were combined with a process of liberalisation and Newbery (2002)[77] finds that privatisation itself delivers benefits when combined with effective regulation, competition and related policies.

2.3.3 Studies on setting regulatory rates in gas

Davis and Muehlegger[78] study retail mark-ups in US gas. Their research is mainly focused on the possible externalities of gas use versus other fuels and also on regulatory rates and mark-ups. They perform and empirical test of marginal cost pricing in the natural gas distribution market in the United States over the period from 1989 to 2008. The analysis shows a strong rejection of marginal cost pricing for all 50 states and movements away from marginal cost pricing are particularly severe in residential and commercial markets with average mark-ups of over 40%. They note that this is considerably higher than the expectations of most economists. The authors also warn that based on conservative estimates of the price elasticity of demand, these distortions impose significantly large welfare losses. Moreover, the authors conclude that the current system with low fixed fees and high per unit prices implies that there are too many natural gas customers who are each consuming too little gas. They add that policy makers should take account of pre-existing distortions due to regulated natural monopolies when considering carbon polices and other policies which are aimed at addressing externalities.

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[75] Joskow, P. (2005). "Regulation and Deregulation after 25 Years: Lessons Learned for Research in Industrial Organization," *Review of Industrial Organization* (2005) 26:169–193 Springer.

[76] This part of the paper is refuting an apparent rejection of the structural modelling approach from some economic scholars.

[77] Newbery, David, (2002). "Issues and Options for Restructuring Electricity Supply Industries." Cambridge Working Papers in Economics 0210 / CMI, Working Paper CMI EP 01, Department of Applied Economics, University of Cambridge.

[78] Davis, L,W,. and Muehlegger, E,. (2009). "Do Americans Consume Too Little Natural Gas? An Empirical Test of Marginal Cost Pricing". University of California, Berkeley, Harvard University RAND Journal of Economics, Winter 2010.

Dee (2011)[79] uses a general equilibrium model to assess the effects of a package of structural reforms focused on the introduction of competition into markets for transport and energy. APEC-wide, the projected gains are significant and almost twice as big as the gains from further liberalisation of merchandise trade. At the sectoral level, the projected output gains tend to be in the services sectors undergoing reform, and in the sectors that use their services intensively.

Silve and Saguan (2011)[80] built a simple model in which a single gas market (retail supply) company purchases gas on long term contracts from three different suppliers and supplies the entire French domestic customers' demand. With this they simulate the estimation of the price setting formula by the regulator in the context of information asymmetry and uncertainty. They then assessed the performances of the formula by building performance indicators reflecting the level of accuracy and bias of the formula as well as the frequency of the price adjustment. Their analysis shows that, even in a simple setting, the inaccuracy and bias of the formula can be significant as soon as the period and dates of the retail price adjustment with the formula are not exactly the same and/or are not matching the review periods and dates of the different long term contracts. They come to the conclusion that an imperfect formula, coupled with an unstable institutional framework will not fulfil the main functions of the tariff regulation.

Moselle (2009)[81] assessed the main effects of retail price regulation for the supply of energy (gas and electricity) to residential customer in the Netherlands. This is carried out using evidence from international experience on economic modelling and empirical data and interviews with Dutch retailers. Taking into consideration a number of potential costs and benefits of tariff regulation for residential customers, a number of key conclusions are formed from the analysis. The analysis revealed that both the direct and indirect costs of retail price regulation are very small and in the absence of effective retail price regulation the market outcome would be a system of two-tier pricing. They conclude overall that the net consumer benefit of retail price regulation has probably been positive and in an optimistic scenario it may be as significant as hundreds of millions of euro a year but in a pessimistic scenario it may be negligible.

2.4 Conclusions to the literature review

Overall, there has been a considerable amount of research on the impacts of competition in restructured energy markets. There has been much more research into the impacts of wholesale competition than retail competition, and much more research into the impacts of electricity competition than gas competition. Much of the research has focused on either individual countries or states. Focusing such a study has obvious advantages in terms of not needing to control for factors that vary across jurisdictions, but our purpose is precisely to study the conditions across jurisdiction which drive prices and profits. Some of the better studies in terms of

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[79] Dee, P., (2011) "Chapter 2: Modelling The Benefits of Structural Reforms in APEC Economics" from "The impacts and benefits of Structural Reforms in the Transport, Energy and Telecommunications Sectors". APEC no.211-SE-01.1

[80] Silve, F., and Saguan, M. (2011), "Regulating natural gas retail prices in France: the absence of a magic indexation formula and other implementation issues." Available at: http://www.city.ac.uk/__data/assets/pdf_file/0016/107512/Silve-Saguan_GasRetailPricesFrance.pdf

[81] Moselle, B,. (2009) "Assessment of the effects of Tariff Regulation on the Dutch Residential Retail Markets for Energy," The Brattle Group.

robust methodology have been done recently using data from US States and this allows for a panel analysis where some states have restructured and some have not.

Our main purpose of the literature review is to inform this study. We note that there are no studies to our knowledge that focus on retail for both gas and electricity, residential and industry, and across countries and time. Data limitations and the time costs to produce such a study are probably some of the reasons for the lack of this type of study. While no single study closely resembles the overall scope and coverage of our present study, nonetheless we believe that the aggregation of the existing literature and consideration of individual studies should inform our purposes to a significant extent.

The first main conclusion of our literature review is clear. The more recent and best studies use panel data techniques and control for commodity prices, supply conditions (fuel mix for electricity), and other such factors when studying retail market prices. Examples include Yucell and Swadley (2011) or Andrews (2010), or Taber, Chapman and Mount (2006).

In terms of electricity market studies, while the literature could not be characterised as having formed a consensus, the most recent and methodologically robust studies, such as Yucell and Swadley (2011) or Andrews (2010),[82] have found a significant and positive link between competition and lower prices in the USA. Previously studies had been somewhat more evenly divided, but a review of these studies by Kwoka (2006) found significant flaws in many of them. The result seems to be that studies and the results are sensitive to the assumptions taken and one set of assumptions might find that deregulation lowers prices and another that it has tended to raise prices.

Some of the challenges of estimating the impacts of competition on prices are in the measurement of retail competition. For example, using a variable for 'retail choice' and 'no-retail choice' has been criticised as not reflective of the reality of the continuous process of change. The main reasons for these ambiguities and sensitivities in the results have been identified in the literature to a large extent; the correcting of them has been more difficult. For example, to correct for this, in our study's econometrics section, we used a measure 0, 0.5, 1, to indicate: closed, some choice, full choice – this is probably still not going far enough to address the nature of the variable (continuous choice). The problem is that data to summarize the degree of choice is not widely available over time and across countries/states. Two studies that seemed to sufficiently address this problem by using the % of customers who had switched found positive impacts of competition (Yucell and Swadley 2011 and Andrews 2010).

We conclude that while the balance of the evidence supports a retail price-competition link, there is little evidence in the existing literature looking at profitability of retail gas and electricity in general. The existing literature which considers profits does occasionally include explanatory factors such as commodity conditions, market structure, and socio-demographic and macroeconomic variables. Of the studies we identified, only a selected few (e.g., Blumsake, Lave, and Apt (2008)[83]) used a detailed econometric approach and some measure of profitability such as

[82] Andrews, R., 2010. "Giving Customers a Choice: Examining the Effect of Retail Competition on the Electric Power Industry," The UCLA Undergraduate Journal of Economics.

[83] Blumsack, Seth, Lester B. Lave, Jay Apt, "Electricity Prices and Costs Under Regulation and Restructuring Carnegie Mellon University, Carnegie Mellon Electricity Industry Center Working Paper CEIC-08-03 www.cmu.edu/electricity.

price-cost margin, while another study with an interesting and informative approach uses price-cost margin 'convergence' as its dependent variable Erdogdu (2010).[84] One of the main problems with studying profits and margins is the measurement of marginal cost, which for retail companies and prices can be difficult. For the retail electricity or gas company, these marginal costs will depend on commodity prices, but also fuel mix (in the case of electricity) and specifics of how the gas commodity is sourced and delivered (in the case of gas). Network and distribution charges and taxes and other charges, to the extent they are variable, need to be included in such measures. Since there is often a variety of tariff structures for such charges this presents further measurement problems.

Alternative approaches using accounting profits for retail energy companies have not been found in the literature.

It is important to note that while the link between profits and market structure has not been found by LE in the literature for retail energy markets, the links between market structure and profit margins in wholesale energy markets, and in markets more generally have been found in a wide range of studies. For example, for a good review and original empirical work on market structure and wholesale electricity price-cost margins in the EU's major energy markets including the UK, see London Economics (2007)[85] or Swinand et al (2010)[86].

In terms of competition more generally, there naturally have been a number of studies, such as Jamasb and Pollitt (2005) or Joskow (2005), which have reviewed competition and reform more qualitatively in various jurisdictions. Further, other studies such as the LE study for the DG Sanco (ECME-LE Consortium 2010)[87] have looked at retail electricity prices, market structure and a range of outcomes. These studies are informative for our present purposes in that they describe many of the necessary but not sufficient conditions for energy market reform and liberalisation.

A final note for our present purposes on the literature review is that besides the identification and information on the challenges of the impact of competition and restructuring on prices, part of the purpose of our study is merely to inform the determinants of prices, and less to referee between these studies. To this extent, the studies on competition and their control variables are informative. Most econometric studies included some measure of wholesale commodity prices and import export conditions, and socio-demographic factors and found these to be significant statistical explanatory drivers of retail energy prices. Studies of US States tended to use other factors also, such as heating and cooling degree days in the year, and we did not use this as an explanatory variable. Such explanatory variables are probably particular to the US or similar markets, as electricity use for cooling in the summer can cause price spikes, but they are less important an issue for countries around the world.

[84] Erdogdu, Erkan, "The impact of power market reforms on convergence towards the average price-cost margin: a cross country panel data analysis", University of Cambridge EPRG Energy and Environment Seminar25thOctober 2010, 12.00W2.01, JBS, Cambridge, UK

[85] Structure and Performance of Six European Wholesale Electricity Markets in 2003, 2004 and 2005, Presented to DG Comp 26th February 2007.

[86] Swinand, Gregory & Scully, Derek & Ffoulkes, Stuart & Kessler, Brian, 2010. "Modelling EU Electricity Market Competition Using the Residual Supply Index," The Electricity Journal, Elsevier, vol. 23(9), pages 41-50, November.

[87] ECME-LE Consortium (2010), "The Functioning of Retail Electricity Markets in the European Union," EC DG SANCO, November, 2010.

Our final conclusion from the literature review is that retail energy prices have been linked to primary explanatory factors, such as commodity prices, economic variables, and supply conditions but the link with competition and market structure is more tenuous. The links between retail energy market profits and explanatory variables, either market structure or other economic variables have not been found.

3 Background Summary

3.1 Introduction

In this background section, an overview of the electricity and gas market in the context of the supply chain is presented. This study is about the retail prices of electricity and gas and comparisons across jurisdictions. The analytical framework for this study includes qualitative benchmarking of retail prices. In order to understand the drivers of prices differences in this qualitative benchmarking, it is important to highlight the background factors influencing prices across jurisdictions. Our study also uses an econometric approach to explaining prices, and the background study also is useful to suggest potential explanatory variables. The various elements that add up along the supply chain to make the end-user retail prices higher or lower, (depending on the cost structures, the efficiency, and the profit levels in each jurisdiction) are studied in more detail in Annex 1. It is important at the outset of this study to take note of how these elements add up to enable a robust comparison of prices across countries. The elements we focus on are fuel mix (for electricity) and commodity supply conditions. We note that the best explanatory factor of wholesale electricity costs would relate to the commodity price of the marginal generation unit. The fuel mix in general will drive prices in a variety of contexts, including when prices are based on average total cost (when cost of service regulation is in place—such as in certain parts of the US and Canada). Even when competitive wholesale markets are operating well[88], such as in Scandinavia, the fuel mix can have a large impact on prices, such as the share of hydro power in the NordPool market. However, this would require more detailed modelling of generation and demand over time during the time periods, and such detailed investigation was not possible within the constraints of our present study.

In this summary background section, a brief overview of each of the countries in our sample of 22 countries is presented. These overviews summarise as best as possible in a brief amount of space, the more detailed country-by-country reviews contained in Annex 1. We also present next a brief overview of the political and regulatory environment which affects the electricity and gas supply chains. In general, we present when the market(s) were fully opened to competition, and we define this to mean when full customer choice was allowed.

We note that a comprehensive overview of even a single country was beyond the scope of our study here.

3.2 Country-by-country reviews of energy supply-side

United Kingdom

Electricity

- From 1990 to 2009, the mix of fuels in the UK electricity generation has shifted from the majority of fuels consisting primarily of solid fuels to a majority of fuels being gases. Most

[88] And thus the marginal plant would be expected to have the biggest impact on market price.

electricity energy consumption comes from thermal (80%) followed by nuclear (13%) other renewables (6%) and hydroelectricity (1%).

- The UK[89] electricity sector was the one of the leaders of the global and UK trend towards liberalisation and privatisation of network industry that started in the 1980s under the Conservative Government. The UK electricity sector privatisation occurred in 1990.
- The GB electricity market was fully open to competition (including households) by 1998.
- All users could choose their supplier by 1999.

Gas

- Gas was privatised and commenced the liberalisation process in 1986. Initially, the vertical elements of British Gas were retained in the privatisation sale—in other words, vertical separation occurred after privatisation in 1986.
- The GB Gas market was fully open to competition (including households) by 1998.
- Customer choice was gradually introduced from the initial period. Initially, customers of 25,000 therms per annum or more could choose their supplier. In 1992, the market was opened down to consumers of fewer than 2,500 therms per annum[90].
- Passing of the 1995 Gas Act required a break-up of the gas industry into gas transportation, gas shipping, and gas supply, and prohibited the same firm from engaging in both the natural monopoly transport business and the potentially competitive shipping and supply businesses[91]. According to Saal (2002), the Gas Act therefore led to the voluntary break-up of British Gas[92].

Both electricity and gas retail

- Currently the retail market in GB is characterised by the large market share of the so-called 'Big Six' – E.ON, British Gas (BG), Scottish Power, EdF, Scottish and Southern Energy (SSE), and NPower. According to Ofgem, "with the Big Six supplying around 99 per cent of the domestic retail market and owning a large proportion of Britain's power stations, independent suppliers have found it difficult to compete to win customers, and to buy the wholesale power products that they need in the forward markets. This may also deter new firms from entering the market so reducing competition"[93].

Austria

Electricity

- Austria's electricity industry generation fleet is made up primarily of hydro power.
- Austria liberalised their electricity market ahead of the EU requirements and all customers have been able to choose their supplier since 2001[94]. However, while Austria has

[89] The process started in England and Wales. Different forms of liberalisation were chosen for each of E&W, Scotland, and Northern Ireland.

[90] Saal, David, 2002. Restructuring, Regulation, and the Liberalization of Privatized Utilities in the UK, Working Paper RP0213.

[91] Ibid.

[92] Ibid.

[93] http://www.ofgem.gov.uk/Media/PressRel/Documents1/liquidity%20feb%202012.pdf

[94] IEA, 2007, "Energy policies of IEA countries: Austria".

regulated third-party access to the grid, issues perhaps still remain with Verbund (the incumbent and largest generation, grid company, and supply company in Austria) and perceptions of/or lack of independence[95].

- The Austrian electricity market was fully open to competition (all customers) by 2001.
- Market reforms in terms of network unbundling and regulated access have been implemented in Austria via the national legislation and transposition of the Directives into national law.

Gas

- There were 28 supply companies in 2007, with the top five having the majority market share. Although full supplier choice was available since 2002, switching rates have remained low, and according to the IEA, competition weak[96].
- The Austrian gas market was fully open to competition (all customers) by 2002.
- The Austrian regulator cited weak competition, low product innovation and low switching as evidence that competition is weak and that wholesale price reductions in 2009 were not being passed on to small consumers[97].

Belgium

Electricity

- From 1990 to 2009, the mix of fuels in Belgian electricity generation has comprised mainly of nuclear sources. Gases have replaced solid fuels as the second-largest source of power generation during the period.
- The generation market is largely dominated by Electrabel (Suez). Suez's merger with GdF also combined then the next largest player, SPE, in the generation market. Electrabel also owns large stakes in the TSO and DSO, although efforts have been made to reduce Electrabel's share and make these more independent. Unbundling has been at the legal/accounting level otherwise.
- Belgium has been gradually liberalising its electricity market in accordance to the reforms required under the EU Directives. The electricity market was legally opened in 2003 in Flanders, 2004 in Brussels/Capital, and 2007 in all regions. Further national law strengthening the powers of the regulator and the national regulator were enacted in 2007 (IEA 2009)[98].

Gas

- The Belgian gas market is characterised by the large market shares of the incumbent Fluxys.

[95] IEA, 2007, "Energy policies of IEA countries: Austria".

[96] IEA, 2007, "Energy policies of IEA countries: Austria".

[97] ERGEG Progress Reports: Austria 2010.

[98] IEA, "Energy Policies of IEA Countries: Belgium", 2009.

- The Belgian gas market has been fully open since 2007.

Denmark

Electricity

- From 1990 to 2009, the mix of fuels in Danish electricity generation has consisted mostly of solid fuels.
- Denmark's wholesale electricity market, as member of NordPool, has been liberalised for some time now, and prices are set competitively.
- Customer supplier choice was available to all customers in Denmark from 2003, three years ahead of the requirements of the Directive. The right to choose a supplier was available to the largest customers well before this time, and was expanded gradually.
- Denmark's electricity market was fully liberalised by 2003.
- Overall, the regulator DERA concludes that large customers are experiencing some competition, but that competition for small and household customers is weak[99].

Gas

- All customers have the right to choose their supplier from 2004. For small customers, the combination of a lack of supply competition and the requirement to supply/be supplier of last resort means that most small customers have remained on a regulated tariff[100].
- Denmark's gas market was fully liberalised by 2004.
- Overall, the regulator DERA concludes that large customers are 'active' in switching, but that competition for small and household customers is weak[101].

Finland

Electricity

- Finland's electricity is characterized by large shares of production of electricity from renewables and nuclear power.
- Finland, as part of NordPool, has a competitive generation market, where the NordPool spot prices set the wholesale market prices.
- Finland's electricity market was fully liberalised by 1997.
- Finland has had customer choice since the Energy Market act of 1995, and full customer choice since 1998.
- Finland has fully unbundled regulated network access, and legal and accounting unbundling is required for all companies, with the larger companies required to enact functional separation (IEA 2007)[102].

[99] ERGEG National Progress Report: Denmark. 2010.

[100] IERN Country factsheets: Denmark.

[101] ERGEG National Progress Report: Denmark. 2010.

[102] IEA, Energy policies of IEA countries: Finland, 2007.

Gas

- Finland has no domestic natural gas production or storage and imports all of its gas from Russia. A single company Gasum Oy, controls the supply and pipeline, and only about 2% of the supply is for residential and small commercial users.
- The Finnish gas market competition is overall less developed and weaker than in the electricity retail market. The top three retail gas suppliers covered about 50% of the market in 2009[103].
- The Finnish gas market has not been opened to competition.

France

Electricity

- From 1990 to 2009, the mix of fuels in French electricity generation has remained fairly consistent, with Nuclear being the most prevalent fuel and capacity source by far.
- France has liberalised its electricity sector slowly relative to its neighbours and relative to the requirements of the EU.
- Opening of the retail market for the largest customers in 2000, for non-household customers occurred in 2004, while household customers could choose their supplier from 2007 (IEA 2009). Regulated third-party access and regulated grid tariffs are in place since 2004.
- Legal unbundling was required of the transmission company in 2004 and the distribution companies in 2007. EdF remains the asset owner in a separate company.
- The electricity market has been fully open to competition including households since 2007.
- France's electricity sector is still generally dominated by their former national vertically integrated incumbent Electricité de France (EdF). EdF, now vertically separated, to the extent required by the EU Directives, from its distribution and transmission grid ownership and operations, still owns the largest retail supply business in France.

Gas

- Full customer choice was available since 2007, but competition was weak to begin, according to IERN (country profiles France), and the large user market was liberalised with laws in 2003 and 2005.
- The gas market has been open to competition including households since 2007.
- The retail gas market in France is also characterised by the presence and large market share of the former incumbent national utility, Gaz de France (GdF).

Germany

Electricity

- The mix of fuels in German electricity generation has not shifted a great deal. Solid fuels comprise the largest portion, with Nuclear being second.
- German retail electricity competition was slow to develop at first, with local suppliers retaining market share within their areas. In spite of historically, and currently, having a

[103] ERGEG, EMV, Progress report to the EC: Finland: 2010.

large number of suppliers, about 90% of suppliers had no customers outside their area even by 2009, according to the regulator[104].

- The largest four generation companies, E.ON, RWE, Vattenfall, and EnBW, own and generate the vast majority of power, which raised market power concerns during the EC DG Competition's sectoral inquiry during 2007. These companies also own and operate their own transmission grids, via unbundled and separated companies.
- The German electricity market has been fully open to competition since 1998.

Gas

- Similar to the electricity market, retail liberalisation occurred early in Germany, with 100% opening by 1998.
- The pace of supplier switching in Germany's retail gas market originally picked up from a low level, and then peaked in 2006, and then slowed considerably, according to the Federal Network Authority (FNA)[105].

Greece

Electricity

- From 1990 to 2009, the mix of fuels in Greek electricity generation has comprised chiefly of solid fuels, namely coal.
- Greece's electricity market is dominated by the former national vertically integrated electric company, with over 90% of generation owned by this company, 49% of the TSO (HTSO) (the other 51% owned by the Government), and the majority of the retail and DSO segments. Full electricity market opening was envisaged for 2007, but Greece was granted derogation to the EU directives.
- The Greek electricity market was open to competition including households by 2007.

Gas

- The Greek gas industry is still developing and is dominated by the State-owned national oil and gas company subsidiary, Public Gas Company of Greece (DEPA SA). Approximately 60% of the market in terms of volume was formally liberalised in 2005, with full choice for the local monopolies owned by DEPA in 2009[106].
- The Greek gas market was fully open to competition including households by 2007.

[104] ERGEG, Federal Network Agency, Monitoring report to the EC: 2010.

[105] ERGEG, FNA, Monitoring report: Germany, 2010.

[106] IERN, ibid.

Ireland

Electricity

- From 1990 to 2009, the mix of fuels in Irish electricity generation has shifted from the majority of fuels consisting of solid fuels, both imported hard coal, and domestic peat, to a majority of fuels being gases.
- Ireland's electricity market is an interesting case study in a variety of ways, as it perhaps could be characterized by slow initial movement toward liberalisation and then rapid catch-up. Ireland's national vertically integrated incumbent, the ESB, retained the majority of generation share and retail customer shares up until mid-to-late 2007, when additional policies came into play.
- Retail competition at first was slow to emerge in the early 2000s, but has become robust. Full market opening was from 2005, but by 2007 about 30% of customers were with different suppliers[107].
- Ireland's electricity market was fully open to competition including households by 2005.

Gas

- Ireland has one of the highest switching rates in the EU.
- Ireland's gas market was open to competition including households by 2007.

Italy

Electricity

- From 1990 to 2009, the mix of fuels in the Italian electricity generation has shifted from the majority of fuels being Petroleum products to a majority of fuels being Gases.
- Electricity produced from renewable energy sources accounted for over 16.6% of gross electricity consumption in 2008. 50% of Italy's electricity comes from gas, roughly 15% from coal, more than 20% comes from renewable sources and the rest is imported. Hydroelectric energy currently plays a dominant role in contributing to the overall renewables percentage[108].
- Italy's electricity sector was liberalised in 1999.
- Italy's electricity market was fully open to competition including households by 2007.

Gas

- Italy's gas sector was liberalised in 2000.
- Italy's gas market was fully open to competition by 2003.

[107] IERN, country factsheets: Ireland, 2008.

[108] http://www.power-technology.com/features/feature76717/

Luxembourg

Electricity

- From 1990 to 2009, the total quantity of fuels in Luxembourg electricity generation has grown tremendously. The largest proportion of generation is by Gases.
- Luxembourg's electricity market was fully open to competition including households by 2007.

Gas

- The gas market in Luxembourg was also liberalised in 2007. There are no gas markets in Luxembourg for production, storage or wholesale, with total gas demand being met by German, Belgian and French gas imports[109].
- Transmission and distribution have not been unbundled, although new entrants have been admitted to the supply market[110].
- Luxembourg's gas market was fully open to competition including households by 2007.

Netherlands

Electricity

- From 1990 to 2009, the mix of fuels in the Netherlands electricity generation has remained fairly constant with increases in Gases, Nuclear and Renewables. Solid fuels and Petroleum based generation have decreased only by a small amount over that timeframe.
- While the Netherlands electricity market was liberalised in 2004, the networks remain publicly-owned[111].
- The Netherlands' electricity market was fully open to competition including small users in 2004.

Gas

- The gas production market is private, while the wholesale market is partially private and partially public[112].
- The Netherlands' gas market was fully open to competition including small users in 2004.

Norway

Electricity

- From 1992 to 2009, the fuel mix in Norway has consisted largely of Hydro power with a small amount of natural gas at the end of the period.

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109 Ibid.

110 Ibid.

111 IERN Country Factsheet Netherlands 2007.

112 Ibid.

- The electricity sector in Norway was deregulated in 1991. From 1997 to 2004, total market share for the three largest suppliers has increased in volume from 34.2 % to 43.1%[113]. In the household market alone, the market share of the three largest suppliers was 28.4% in 2004[114].

Gas

- Norway has a very large upstream gas extraction, exploration and production industry. Almost all of the gas is for export over interconnectors. Domestic and commercial gas use is almost nil in Norway.

Portugal

Electricity

- From 1990 to 2009, the mix of fuels in Portuguese electricity generation has seen the greatest increase in Renewables and also a significant increase in Gases.
- In July 2007, the Iberian Electricity Market (MIBEL) was established and replaced the former Power Purchasing Agreements model[115].
- Suppliers are free to buy and sell electricity, and consumers have the right to choose their supplier without penalty[116].
- Fully open to competition including households 2006.

Gas

- Portugal's gas market was fully open to competition including households in 2010.

Spain

Electricity

- From 1990 to 2009, the total of gross electricity generation in Spain has grown by approximately 100%. Solid fuels and Nuclear started the period with the largest shares of generation at the beginning of the period, while Gases and Renewables have grown significantly. Renewables include a significant portion of storage hydro, although this is dependent on seasonal weather conditions that vary year-to-year. More recently, subsidies for wind and solar power under the so-called 'regimen especial' or special regime have brought significant amounts of wind and solar capacity and generation online
- In 2009 renewable technologies accounted for approximately 25%of total electricity generation.[117] By 2010, renewable energy became the main source of electricity generation in Spain[118].

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[113] Ibid.

[114] Ibid.

[115] IERN Country Factsheet, Portugal 2007.

[116] Ibid.

- Spain was an early country to institute liberalization of the generation market, and institute an electricity pool pricing system.
- Full customer retail choice has been available since 2003[119].
- Fully open to competition including households 2003.

Gas

- Spain's upstream gas industry is private and liberalised.[120] The retail market has been liberalised since 2003.
- Spain's gas market was fully open to competition including households in 2003.
- Spain relies on imports for most all of its gas needs, and almost 3/4ths of these needs are met via LNG imports, with the remainder over interconnection pipelines.

Sweden

Electricity

- The vast majority of electricity generation fuels in Sweden are Renewables and Nuclear, each comprising roughly half of the total.
- Major reforms were enacted in the mid-1990s, with liberalisation in 1996. Full market liberalisation for all residential customers was allowed in 1999[121].
- Because of the hydro base, low power prices mean that Sweden tends to be an electricity intensive user country[122].
- Sweden's electricity market was fully open to competition including households in 1997.

Gas

- Sweden has a very small gas industry, with no production, very small imports, via pipeline from Denmark, no exports, and almost no storage.
- The gas industry in Sweden has been gradually opened and full supplier choice and liberalisation is available since 2007[123].
- Sweden's gas market was fully open to competition including households by 2007.

Switzerland

Electricity

- For the period 1992 to 2009, the fuel mix in Switzerland has been mainly Hydro (approx. three-fifths) with about one-quarter nuclear, and a small share for gas.

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[117] http://ec.europa.eu/energy/renewables/transparency_platform/doc/national_renewable_energy_action_plan_spain_en.pdf

[118] http://www.innovagreen.com

[119] IERN Country factsheets: Spain. 2007.

[120] IBID.

[121] Coquet, Philipe, "Opening of the Gas and Electricity Markets to Retail Competition", Cap Gemini, 2007.

[122] IEA Country profiles: Sweden, 2006.

[123] Coquet, Philipe, "Opening of the Gas and Electricity Markets to Retail Competition", Cap Gemini, 2007.

- Switzerland enacted the law on the electricity supply in 2008. The law anticipated market opening in two stages. End-users with an annual consumption of more than 100 MWh were free to choose their supplier from 1 October 2008 under the law,[124] but the EICOM website states that large user with consumption >100MWh can choose their supplier from 2009.
- The EICOM website states that small users will have full supplier choice from 2014.

Gas

- Legally, large customers are able to choose their supplier.

USA

Electricity

- The USA fuel mix is diversified but heavily reliant on coal. Petroleum products form almost none of the relative make-up.
- State level regulation is the bulk of regulation in the United States that would set rates and policies. States have Public Utility Commissions or Boards that oversee rates, quality, security of supply etc.
- In general, State-level governments have decided whether the state has restructured. Restructuring can mean a number of things, but we mean the general process of allowing supplier choice, allowing wholesale generation competition, and competition-driven prices.[125] Thus, some states still have standard vertically integrated utilities with regulated tariffs; others have full competition; others have some mix.
- US customer choice in gas retail began in the 1990s. In 1992, FERC order 636 opened third party access to the grid and pipelines, allowed choice and restructured the industry.
- Retail choice in gas, like electricity, in the US varies considerably by State. Some States allow all customers full choice, while some limit choice to traditional utility service areas or customer type of class. Customer choice has been growing.

<u>California</u>

Electricity

- In 2010, in CA, the majority of the fuel mix (53%) was Natural Gas. Hydro and Nuclear sources were each at 16%, with the remaining 15% divided between Coal, Petroleum, Wind, Wood, Geothermal and Other.
- Electricity deregulation suspended, consumer choice suspended. Restructuring activities ceased March 2010[126].
- California famously embraced deregulation in 1998 and then suspended it in 2000 when insufficient supply (due to low rainfall in hydro dominated Pacific regions, nuclear power outages and lack of commissioning new capacity in-state-combined with high demand due

[124] IEA 2007.

[125] It should be noted that some elements of the necessary conditions for liberalisation have been Federally mandated, such as allowing regulated third party access to the grid, or allowing regional transmission organisations.

[126] EIA

to hot weather and the economic boom) led to rolling blackouts and wholesale prices over $2000/MWh. Retail prices being capped by regulatory fiat while wholesale prices were set by the market led to retailers going bankrupt.

Gas

- California gas market has statewide unbundling - 100 per cent eligibility: Inactive/Limited programs.

Texas

Electricity

- The 2010 fuel mix in Texas consisted mostly of Natural Gas (46%) and Coal (37%). Nuclear and Wind comprised a significant portion (16%), while the remaining was Other Gases.
- Electricity market is deregulated and consumers have full choice. Electricity restructuring is active in this state, in that competition is continuously open, but there have been no state restructuring activities since August 2010[127].

Gas

- No unbundling.

New York

Electricity

- The 2010 fuel mix in New York consisted chiefly of 35% Natural Gas, 30% Nuclear, 19% Hydro, and 10% Coal. The remainder consisted of wind, wood, other biomass, pumped storage, and other.
- Electricity market is deregulated and consumers have choice. Electricity restructuring is active in this state but there have been no further state restructuring activities since July 2008[128].

Gas

- State-wide unbundling is active with 100 per cent eligibility for customer choice (all customers can choose their supplier)[129].

[127] EIA

[128] EIA

[129] EIA

Illinois

Electricity

- The 2010 fuel mix in Illinois consisted mainly of 47% Coal and 48% Nuclear. Beyond these two fuels, very little else is used.
- Electricity market is deregulated and consumers have choice. Electricity restructuring is active in this state but there have been no further state restructuring activities since December 2007.

Gas

- State-wide unbundling has been implementation with greater than 50% eligibility[130].

Pennsylvania

Electricity

- The 2010 fuel mix in Pennsylvania consisted primarily of Coal (48%) and Nuclear (34%) with a significant portion of Natural Gas (15%). Hydro, Wind and Other Gases comprised the remainder of the mix.
- Electricity market is deregulated and consumers have choice. Electricity restructuring is active in this state but there have been no further state restructuring activities since August 2010.

Gas

- State-wide unbundling is active with 100% eligibility.
- During the period 1995 to 2010, sources of gas production in the US have remained relatively constant in terms of mix, with US Natural Gas Processed being the largest category, and US Natural Gas Gross Withdrawals from Gas Wells the smallest contributor.

Canada

Canada

- From 1992 to 2009, the fuel mix in Canada has remained fairly constant although total generation has increased somewhat. Hydro power makes up the largest portion of the generation mix while Nuclear has been the second largest portion.
- In 2007, the majority of Canada's fuel mix consisted of Hydro (59%), while Uranium and Coal together comprised 32% of the mix. Natural gas contributed 7% of the fuel mix, while Petroleum and Other comprised 2%.

Alberta

- In 2007, the Alberta fuel mix consisted largely of Coal (74%) with 21% Natural Gas and 4% Hydro.

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[130] EIA

- Alberta enacted unbundling in the late 1990s and also has a pool-based wholesale market that was modelled much on the original England and Wales Pool.
- Wholesale competition in electricity has been introduced along with unbundling.

Ontario

- In 2007, the majority of Ontario's fuel mix consisted of Uranium (52%) with Water (22%) and Coal (18%) contributing significant amounts.
- Wholesale competition in electricity has been introduced along with unbundling.

Australia

Electricity

- Fuel use for electricity generation in Australia is focused on coal, historically and currently. In fact, coal use has formed an every larger share of the mix from about 1996 to 2006.
- Australia is a free market economy which has embraced free market principles in general and this has led to an overall approach that favours liberalisation of electricity and gas.
- Australia was one of the first countries to begin regulatory reform in the electricity sector. In 1994, New South Wales (NSW) and Victoria began the reform process. The act that deregulated the industry and unbundled former vertically integrated utilities and created the national wholesale market (NEM) was in 1998.
- Retail choice has been available since 2003, however, the details of deregulation depends on the State or Territorial Governments' regulations. Some retail choice has been available in Western Australia since 1997[131]. Within the jurisdictions that the National Electricity market (NEM) operates, retailers can sell electricity to all end-use customers down to the household level, meaning all customers are contestable[132].

Gas

- Distribution and supply have been historically integrated, but unbundling and retail competition has been variously introduced across the States.
- In Australia, the 1997 National Gas Pipelines Access Agreement (NGPAA) committed most territories to implement open access and full retail competition. There is competitive wholesale trade and a spot market for gas via the Victoria Hub since about 2002.
- Victoria enacted full retail competition in gas in 2002.

New Zealand

- From 1992 to 2009, the fuel mix in New Zealand has remained quite constant, with Hydro comprising the largest portion (approx. three-quarters) and Natural Gas comprising about a quarter of the supply. New Zealand has an extensive gas infrastructure which links its

[131] Ibid.

[132] http://www.efa.com.au

production with inland transmission and processing, as well as interconnection between the two main islands.
- New Zealand as a country has had a large and committed approach to liberalisation across most of the economy since the 1990s.

Japan

- Japan's fuel mix from 1992 to 2009 has remained relatively constant, with Nuclear and Natural Gas comprising the largest shares of supply (more than two-thirds).
- The high prices of Japan had initially led Japan to investigate liberalisation of markets along the lines of the liberalisations that were sweeping the world in the late 1990s and early 2000s. However, Japan stopped short of liberalisations along the lines of UK and EU full market opening.
- Electricity market reform at the wholesale level was being established by Government policy as early as 1995, and then also in 2000 in Japan.
- According to the IEA, end-use customers have become eligible to choose their electricity supplier in three steps: very high-voltage customers above 2 MW became eligible in March 2000; high-voltage customers above 500 kW became eligible in April 2004 and customers above 50 kW became eligible in April 2005.

3.3 Political, environmental and regulatory environment summaries

3.3.1 Overview of EU15 countries

The following tables provide an overview of the energy policy environment of the EU15 countries for the support of renewable electricity. The estimated net support expenditure per megawatt of power among the EU15 countries is presented in Table 1 below. Germany, Luxembourg and Austria are among the countries with the highest level of support expenditure per megawatt. Average support expenditure for renewable energy sources among the EU15 has been increased year-on-year from 2007-2009. Expenditure per megawatt in the UK was below average in 2007, 2008 and 2009.

Table 1: Estimated Net RES Support Expenditures 2007-2009 EU15

Country	Net Expenditure Per Megawatt (₤)		
	2007	**2008**	**2009**
Austria	4.78	4.97	5.68
Belgium	2.46	3.18	3.95
Denmark	3.40	3.59	3.44
Finland	0.07	0.09	0.10
France	0.18	0.52	0.80
Germany*	4.98	5.67	9.23
Greece	0.47	0.56	0.73
Ireland	0.40	0.40	0.99
Italy	4.86	5.97	7.36
Luxembourg	2.74	3.56	3.71
Netherlands	1.68	2.02	3.00

Portugal	1.90	2.44	3.34
Spain	2.68	5.08	11.22
Sweden	0.47	0.53	0.89
United Kingdom	2.34	2.60	3.33
Average	*2.66*	*3.28*	*4.61*

*including former GDR from 1991
Note: RES = Renewable Energy Sources.
Source: London Economics Analysis of Eurostat and European Commission Data.

Table 2 below presents a summary of the existing energy support instruments that are in place in each of the EU15 countries for renewable electricity. All EU15 countries, with the exception of Finland, Netherlands and Sweden, have feed-in tariffs in operation. Tax exemptions are also a common support instrument.

Table 2: Overview of RES-E Support Instruments EU15

	Feed-in Tariff	Premium	Quota Obligation	Investment Grants	Tax Exemptions	Fiscal Incentives
Austria	X					
Belgium	X		X	X	X	
Denmark	X					
Finland				X	X	
France	X					
Germany*	X				X	
Greece	X			X	X	
Ireland	X					
Italy	X		X			
Luxembourg	X			X		
Netherlands		X			X	X
Portugal	X					
Spain	X	X			X	
Sweden			X		X	
United Kingdom	X		X		X	

*including former GDR from 1991
Source: London Economics Analysis of European Commission Data.

Table 3 presents an overview of the main renewable heat and cooling support instruments in the EU15 which are receiving more attention from policy makers in recent years. The majority of EU15 countries operate tax exemptions and investment grants with France, Germany and Portugal alone opting to implement fiscal incentives. The UK has implemented both investment grants and tax exemptions in support of renewable heat and cooling.

Table 3: Overview of Main RES -H&C Support Instruments in EU15

	Investment Grants	Tax Exemptions	Fiscal Incentives
Austria	X	X	
Belgium	X	X	
Denmark		X	

Finland	X		
France	X	X	X
Germany*	X		X
Greece	X	X	
Ireland	X		
Italy		X	
Luxembourg	X		
Netherlands	X	X	
Portugal	X		X
Spain			
Sweden	X	X	
United Kingdom	X	X	

*including former GDR from 1991

Source: London Economics Analysis of European Commission Data.

3.3.2 Country-by-country reviews

Austria

- Target: share of energy from renewable sources in gross final energy consumption of 34% by 2020.
- Amendment to the "green electricity" act 2009 included:
  (1) Raising global subsidy funds for new renewable energy
  (2) Prolonging the guaranteed duration of feed-in tariffs for biogas and biomass
  (3)Raising funding for photovoltaic in private households
- The Federal Ministry of Economic Affairs and Labour reinstated premiums for electricity output from renewables in 2004. The Initial €225m was increased by €37 million.
- In 2004, the taxes on natural gas and mineral oil for heating purpose were increased significantly (by approximately 50%) and tax on coal was introduced[133].

Belgium

- Target: Approximately 5.2 to 5.6 % of national electricity production by offshore wind farms by 2010.
- Belgium's approach to renewable energy support includes quota obligations (obliging suppliers to supply a specific proportion of renewable energy), green certificates, investment support schemes and fiscal incentives.
- Belgium's Green Certificate system aims at giving enough incentives for a further development of renewable energy. Targets differ between the three regions of the country (Flanders, Wallonia, and Brussels) and energy policies are implemented

[133] Information on the political and regulatory environment in relation to energy for this country was obtained from the following sources:
http://www.iea.org/country/index.asp
http://www.eia.gov/countries/
http://ec.europa.eu/environment/policyreview.htm

separately, leading to differing supporting conditions and separate regional markets for green certificates. The mandatory target set is a 13% share of RES on the final consumption of energy in 2020.
- Flanders: January 2007, subsidies for the installation of solar energy in households. €3 per peak watt with a max grant of 50% of investment cost per household (40% for professional sector), with a max grant of €3,000 for solar water heating systems and €6,000 for combination systems for solar water heating and central heating. Cost of a meter is reimbursed (€235)[134].

Denmark

- Target: share of energy from renewable sources in gross final energy consumption of 30% by 2020.
- Belgium provides support for renewable energy electricity by way of a feed-in tariff or a premium so that the combination of market price and supplement ensures a fixed tariff for the producer. All subsidies are passed on to the consumer.
- Wind turbines connected to the grid from 2005 onwards are eligible for a premium of €1.3 per KWh.
- In June 2001, EU Commission approved the rules for payment of green electricity from new renewable energy plants. New wind turbines would be guaranteed a fixed settlement price of DKr 0.33 per kWh for the first 22,000 full-load hours, corresponding to approximately 10 years' production. A premium of DKr 0.10 per kWh was added to the market price. The premium was to be replaced by Green Certificates for electricity production. Electricity from biomass-based plants was then settled at a price of approximately DKr 0.60 per kWh[135].

Finland

- Target: 38% share of renewable energy on final consumption by 2020.
- The construction costs of renewable energy plants are co-financed by the government with grants of up to 40% in the case of wind.
- The "Electricity Tax Benefit" involves the government imposing a tax per KWh on all electricity suppliers which is passed on the consumer. The government refunds the tax to suppliers of renewable electricity.

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134 Information on the political and regulatory environment in relation to energy for this country was obtained from the following sources:
http://www.iea.org/country/index.asp
http://www.eia.gov/countries/
http://ec.europa.eu/environment/policyreview.htm

135 Information on the political and regulatory environment in relation to energy for this country was obtained from the following sources:
http://www.iea.org/country/index.asp
http://www.eia.gov/countries/
http://ec.europa.eu/environment/policyreview.htm

- 2007: electricity produced through wind power, small-scale hydropower (below 1 MVA), recycled fuels, biogas and forest chips are eligible for subsidies. Wind power and electricity produced with forest chips is €0.69 per kWh, recycled fuels is €0.25 per kWh and others is €0.42 per kWh.
- 2005: Teollisuuden Voima Oy (TVO) granted licence for construction of a nuclear power plant unit called Olkiluoto 3 on the island of Olkiluoto, in the municipality of Eurajoki.
- 1999: Programme to increase the use of renewable energy by 50% compared to 1995 levels and 30% by 2001 levels by 2010. Grants for renewable energy use account for 200 million Finnish marks (€33 million) and subsidies in energy taxation reach a total of 300 million marks (€50 million) annually. Installations using thermal pumps cover 4% of the planned extra capacity and both wind farms and hydropower plants each account for 3% of the target. The ministry is also expecting solar cell technology to fulfil 0.5% of the future increase[136].

France

- France is committed to an increase in the share of renewable energies to at least 23% of final energy consumption in France by 2020. The National Energy Efficiency Action Plan 2006 (NEEAP) aims to reduce GHG emissions by a factor of 4 by 2020. This includes: minimum of 9% energy savings over the period 2008-16, decreasing energy intensity by 2% per year by 2015 and by 2.5% per year by 2030.
- Feed-in tariffs were introduced in 2005 and modified in 2005 for PV, Hydro, Biomass, biogas, geothermal, offshore wind, onshore wind, and combined heat and power.
- 2007: Feed-in tariff for hydropower installations with contracts of 20 years. The tariff comprises €6.07 per kWh, together with a bonus of between €0.5 and €3.5 for small installations and a bonus of between €0 and €1.68 per kWh in winter.
- 2005: The French Senate extended eligibility for preferential EdF purchasing tariffs from wind farms of 12 MW capacity to all installations, regardless of generating capacity. Implementation of the feed-in tariffs will depend upon local planning. The main measures are demand-side management in the buildings, transportation, service and industrial sectors, and a white certificate scheme.

Germany

- Targets: share of renewable energy in end use energy consumption 18% and renewable energies in the production of electricity to a share of at least 30% by 2020.

[136] Information on the political and regulatory environment in relation to energy for this country was obtained from the following sources:
http://www.iea.org/country/index.asp
http://www.eia.gov/countries/
http://ec.europa.eu/environment/policyreview.htm

- Feed-in tariffs were first introduced in 1990 and now exist for hydro, wind, biomass, solar and geothermal. Tax credits are also provided for PVs.
- 2009: Amendment of the Renewable Energy Sources Act (EEG) provides a higher feed-in tariff for wind energy, and other measures to stimulate the development of both onshore and offshore wind power. The feed-in tariff for onshore wind farms was increased from EUR cents 8.03 to EUR cents 9.2/kilowatt-hour (kWh) for the first five years of operation, and EUR cents 5.02/kWh after that. This tariff will be decreased every year for new installations by one per cent, as opposed to the previous two per cent.

Greece

- Target: 18% share of renewable energy on the final consumption of energy in 2020.
- The renewable energy source Act 2006 stipulated feed-in tariffs for renewable energy sources such as hydro, wind biomass, solar and geothermal for 20 years.
- 2009: Special program for installing photovoltaic systems up to 10 kWp on rooftop. The guaranteed feed-in tariff of the produced energy from the photovoltaic system was 0.55 Euro/kWh for the contracts up to 2011.
- 2005: contained provisions to enable grid investments and readily approve wind farm construction and connection to the grid. The bill lists feed-in tariffs for wind farms of EUR 0.068/kWh plus Eur1.756/kW installed, which on average amount to just under EUR 0.073/kWh. Autonomous island grid-connected wind farms would receive EUR 0.0846/kWh[137].

Ireland

- Ireland has committed to achieving a share of energy from renewable sources in gross final energy consumption of 16% by 2020.
- On-shore wind is supported by a Feed in tariff of about €90/MWh and is the primary source of renewable generation in Ireland, with about 2GW of installed capacity.
- Support price structure for bioenergy, i.e., use of natural materials for the production of electricity under the government's Renewable Energy Feed in Tariff (REFIT) range from 15 cent per kilowatt hour to 8.5 cent per kilowatt hour depending on the technology deployed. The technologies supported include Anaerobic Digestion Combined Heat and Power, Biomass Combined Heat and Power and Biomass Combustion, including provision for 30% co-firing of biomass in the three peat powered stations. REFIT is designed to provide price certainty to renewable electricity generators. It has been in operation for wind and hydro power since 2006. It operates on a sliding scale, acting to ensure a guaranteed price for each unit of electricity exported to the grid by paying the difference

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[137] Information on the political and regulatory environment in relation to energy for this country was obtained from the following sources:
http://www.iea.org/country/index.asp
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http://ec.europa.eu/environment/policyreview.htm

between the wholesale price for electricity and the REFIT price. In effect, this means that as electricity prices increase, the amount paid under REFIT falls, mitigating the effect on the consumer.

- The CHP Investment Grant Programme provides non-discretionary investment grants for small-scale fossil fired CHP with a capacity greater or equal to 50kWe and less than 1MWe. Up to 30% of investment costs can be covered by the grant scheme, with certain maximum costs per kWh depending on capacity.

Italy

- Target: 17% share of renewable energy on final consumption of energy in 2020.
- The renewable energy obligation (3.05%) for suppliers increased annually by 0.75% up to 2012 and after 2012 a new annual increase will be established.
- Italy also used tradable green certificates in order to fulfil its renewable energy obligation. Each certificate corresponds to 1MWh and is released for 15 years.
- The Ministerial Decree of 19 February 2007 introduced in Italy a new version of the feed-in premium scheme applied to photovoltaic plants connected to the grid with a nominal capacity higher than 1 kW realised by individuals, registered companies, condominiums and public bodies.
- Electricity produced by thermodynamic solar plants commissioned can obtain a feed-in premium for 25 years. Up to 2012 the bonus varies from EUR 0.22 to EUR 0.28 / kWh depending on the level of integration of the plants[138].

Luxembourg

- Luxembourg has committed to achieving a share of energy from renewable sources in gross final energy consumption of 11% by 2020.
- Feed-in Tariffs for renewable energy are differentiated according to the renewable energy source and to installation capacity and are guaranteed over 15 years.
- Tariffs for wind onshore since January 2008 are set at €82.7 per MWh. For photovoltaic, this tariff is set for small PV panels (inferior or equal to 30kW) at €420 per MWh (with an annual digression rate of 3%) and for bigger panels (31kW-1000kW) at €370 per MWh.
- Investment subsidies are also made available to private companies, communes, farmers and households investing in renewable energy[139].

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138 Information on the political and regulatory environment in relation to energy for this country was obtained from the following sources:
http://www.iea.org/country/index.asp
http://www.eia.gov/countries/
http://ec.europa.eu/environment/policyreview.htm

139 Information on the political and regulatory environment in relation to energy for this country was obtained from the following sources:
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http://www.eia.gov/countries/

Netherlands

- Following the MEP renewable energy and CHP subsidy schemes, which ended in August 2006, the Dutch government decided on a new target for the reduction of CO2 emissions; 30% CO2 reduction in 2020.
- The Netherlands have committed to achieving a share of energy from renewable sources in gross final energy consumption of 14% by 2020.
- The economic recovery plan, presented in March 2009, includes substantial funds for energy efficiency improvements in (semi-)public buildings and private dwellings, as well as from offshore wind energy (contributing to the objective of 6000 megawatt capacity by 2020 compared to around 2000 megawatt in 2008)[140].
- The national climate change objectives for 2020 in some respects go beyond the Dutch targets under the EU climate and energy package and include a 30% reduction of greenhouse gas emissions compared to 1990, an average energy efficiency improvement of 2% per year, and a share of 20% renewable energy in primary energy use.

Norway

- In its March 2008 Climate Policy Agreement, Norway set itself a national target of achieving of 14 TWh/50 PJ increased use of Bioenergy by 2020. In April 2008, the Bioenergy Strategy was elaborated to meet this target.
- It should be recalled that Norway gets almost all of its electricity from hydro-power, and consumes very little gas and other fossil fuels domestically.

Portugal

- Portugal has committed to achieving a share of energy from renewable sources in gross final energy consumption of 31% by 2020.
- Portugal operated feed-in tariffs for renewable energy sources such as Hydro (€7.5 per KWh for up to 20 years), onshore and offshore wind (€7.4 per KWh for up to 15 years); Biomass solid (€11 per KWh up to 15 years), biogas (€10.2 per KWh up to 15 years); PV (€31-€45 per KWh for up to 15 years); CSP up to 10 MW (€26.3-€27.3 per KWh for up to 15 years) and Wave (€26-€7.6 KWh for up to 15 years).

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http://ec.europa.eu/environment/policyreview.htm

140 Information on the political and regulatory environment in relation to energy for this country was obtained from the following sources:
http://www.iea.org/country/index.asp
http://www.eia.gov/countries/
http://ec.europa.eu/environment/policyreview.htm

Spain

- Spain has committed to achieving a share of energy from renewable sources in gross final energy consumption of 20% by 2020.
- Feed-in Tariffs for Electricity from Renewable Energy Sources (special regime (R.E)) incorporates both fixed total prices and price premiums added to the electricity market Price. In 2007 new rules were approved curbing profits for wind generators and setting incentives for other types of renewable energy. The new rules guarantee an internal rate of return of 7 per cent to wind and hydroelectric plants that opt to sell power to distributors direct and a return of between 5 and 9 per cent if they participate in the electricity pool market.

Sweden

- Sweden has committed to achieving a share of energy from renewable sources in gross final energy consumption of 49% by 2020.
- The electricity certificate system supports renewable electricity. As the country is experiencing some difficulties in seeking to achieve its planned objective for wind power (namely 10 TWh of wind power production by 2015), the grant for local authority land use planning for wind power generation assisted the achievement of the planning objective by supporting local authority land use planning for 2007 and 2008.
- Production of renewable energy sources is increasing in Sweden. By the end of 2008 there were 1138 wind turbines in Sweden, compared to 1009 in 2007 and 817 in 2004 and there are two financial support schemes in effect to promote wind power: The Electricity Certificate and The Wind Power Pilot Project.
- Grants seek to assist the achievement of the planning objective by supporting local authority land use planning for wind power[141].

Switzerland

- The Federal Council proposes to amend the Mineral Oil Tax Act in 2007 to introduce tax incentives for clean fuels. The proposal includes a tax reduction of 40 Swiss cents per litre of petrol equivalent for natural and liquefied petroleum gas (LPG) and complete tax exemption for biogas and other fuels from renewable sources.
- On 14 March 2008, the Swiss Federal Council adopted an ordinance linked to the Energy Law, establishing a system of feed-in tariffs, applicable as of 1 January 2009. The system provides feed-in tariffs differentiated by technology, size and application. Hydropower

[141] Information on the political and regulatory environment in relation to energy for this country was obtained from the following sources:
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http://ec.europa.eu/environment/policyreview.htm

generation is capped at 50% of the fund, and wind at 30%. Solar PV is capped at 5% of the fund, although this is to increase to 10% once the average PV cost falls below CHF 0.60/kWh. The feed-in system is to be reviewed every five years, with the first review likely occurring within three years.

- In an official statement on 26 April 2005, the Swiss government proposed a national green energy target of supplying 10% of present annual power demand with renewably-generated electricity[142].

United Kingdom

- Targets: 15% share of energy and 30% of UK electricity from renewable sources in gross final energy consumption by 2020.
- Feed-in tariffs (2010) to support micro- and small-scale renewable projects.
- The Renewables Obligation (RO) is the UK's main mechanism for supporting merchant generation of renewable electricity. It was introduced in 2002 and will continue to 2027. If electric suppliers do not meet their obligation to source an increasing share of their power sales from renewable sources they must pay a penalty of £34.30 (€50.58) per MWh. The percentage of renewable power that must be supplied is 7.9% and will increase to 15.4% by 2015. Suppliers who generate renewable energy are presented with a Renewables Obligation Certificate (ROC). Each year the funds accumulated from penalties are shared among the suppliers who received ROCs.
- Emerging technologies such as wave and tidal power receive support from capital grant schemes[143].

USA

- Emergency Economic Stabilization Act of 2008:

The Act extended the PTC for wind power by one year, till the end of 2009 (in 2007 this equalled USD 2.0 cents/kilowatt hour). Small wind power gained a 30% ITC, up to $4,000 for wind turbines with capacities of 100 kilowatts or less, through to 2016.

The bill also provided a two-year PTC extension, through 2010, for electricity produced from geothermal, biomass, and solar energy facilities, as well as waste-to-energy facilities, small

142 Information on the political and regulatory environment in relation to energy for this country was obtained from the following sources:
http://www.iea.org/country/index.asp
http://www.eia.gov/countries/
http://ec.europa.eu/environment/policyreview.htm

143 Information on the political and regulatory environment in relation to energy for this country was obtained from the following sources:
http://www.iea.org/country/index.asp
http://www.eia.gov/countries/
http://ec.europa.eu/environment/policyreview.htm

hydropower facilities using irrigation water, capacity additions to existing hydropower plants, and hydropower facilities added to existing dams.

Solar energy gained an eight-year extension (through 2016) of the 30% ITC for residential and commercial solar installations, as well as the elimination of the USD 2,000 tax credit cap for residential solar electric installations. The bill created a new ITC for electricity produced by marine and hydrokinetic renewable energy systems (also called advanced water power systems) with a rated capacity of at least 150 kilowatts and placed in service by 2011.

The bill extended energy efficiency tax deductions for commercial buildings through 2013 and revived similar deductions for home improvements installed in 2009, adding a new USD 300 tax credit for energy-efficient biomass fuel stoves.

In June 2007, the US Senate Finance Committee authorized USD 3.6 billion from 2008-2011 for clean renewable energy bonds. The federal Energy Policy Act of 2005 (H.R. 6, Sec. 1335) established a 30% tax credit (up to USD 2,000) for the purchase and installation of residential solar electric and solar water heating property and a 30% tax credit (up to USD 500 per 0.5 kilowatt) for fuel cells[144].

Canada

- Ontario's Feed-in Tariff (FIT) programme, in effect as of October 2009 allows all sizes of generators, from homeowners to large developers to participate, providing a fixed tariff for electricity produced and fed into the electricity grid.

- The 14-year ecoENERGY for Renewable Power programme will invest roughly CAD1.5 billion to increase Canada's supply of clean electricity from renewable sources such as wind, biomass, low-impact hydro, geothermal, solar photovoltaic and ocean energy (wave and tidal).
- ecoENERGY for Renewable Heat is a CAD 36 million programme that runs from April 1, 2007 to March 31, 2011. It is designed to encourage the use of Renewable thermal technologies, specifically energy efficient active solar thermal equipment used for space (i.e. air) heating and cooling and water heating[145].

[144] Information on the political and regulatory environment in relation to energy for this country was obtained from the following sources:
http://www.iea.org/country/index.asp
http://www.eia.gov/countries/

[145] Information on the political and regulatory environment in relation to energy for this country was obtained from the following sources:
http://www.iea.org/country/index.asp
http://www.eia.gov/countries/

Australia

- In 2001, the Government set an objective that biofuels would contribute at least 350 million litres to the total fuel supply by 2010. The Government restated its commitment to this target in 2005 and is working with stakeholders to establish how it will be reached.
- To help ensure the federal government achieves its goal of a 20% share of renewable energy in Australia's electricity supply by 2020, the Government has introduced a national Renewable Energy Target (RET) scheme which includes a legislated target of 45,000 gigawatt-hours in 2020. The expanded measure will operate until 2030. Legislation for the expanded target was passed in August 2009 and new targets for renewable energy purchases commenced on 1 January 2010.
- The Australian Capital Territory's (ACT) feed-in tariff scheme pays households and businesses that install renewable energy generation technology AUD 0.5005/kWh generated for systems up to 10kW and AUD 0.4004 for between 10kW and 30kW to 30 June 2010. The Scheme will pay AUD 0.457/kWh for up to 30kW systems from July 1 2010 to 30 June 2011. The premium price will be set in advance each year.
- The Energy Efficient Homes Package was launched by the Australian government as part of its National Building and Jobs Plan, designed to improve the energy rating of homes and to reduce their electricity bills.
- The Home Insulation Program incorporates the Homeowner Insulation Program and the Low Emission Assistance Plan for Renters, which ran from 3 February 2009 to 31 August 2009, and is capped at AUD 2.45 billion.
- The Victorian Government has implemented an ongoing "fair" feed-in tariff for micro-generation from solar, wind, hydro and biomass up to an installed capacity of 100kW. The rate of the tariffs is a rate not less than the rate the customer pays to buy electricity from the retailer.
- The Victorian Government has also introduced a premium feed-in tariff, which began in the second half of 2009. It is available to households, community groups and small businesses with electricity consumption up to 100 MWh per year, for small-scale solar photovoltaic systems with a capacity of up to 5 kW. The scheme will run for 15 years, or when 100MW (approximately 50,000 systems) have been installed. The tariff is net and is to be set at AUD 0.60/kWh.
- South Australia's Solar Feed-in Tariff Scheme pays a premium guaranteed net tariff of AUD0.44/kWh to households and small customers who feed solar electricity into the electricity grid. The scheme will operate for 20 years and applies to households and small businesses that consume less than 160MWh of electricity per annum[146].

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[146] Information on the political and regulatory environment in relation to energy for this country was obtained from the following sources:
http://www.iea.org/country/index.asp
http://www.eia.gov/countries/

New Zealand

- New Zealand's energy policy has been committed to light-handed regulation and this country was a pioneer in electricity market liberalisation.
- New Zealand's target under the Kyoto Protocol is to limit levels of greenhouse gas emissions to 1990 levels on average during the period from 2008 to 2012. The latest projection of New Zealand's net position is below their commitment.
- New Zealand's Electricity Commission subsidised the retail purchase price of the energy saving bulbs. This project was completed in 2007.
- As of December 2010, New Zealand had an installed wind generation capacity of 539 MW. Wind power now provides enough electricity to meet the needs of 160,000 New Zealand households, or approximately 3% of the country's electricity demand. Wind farms with a further capacity of 80 MW are under construction, with approval granted or being sought for another 2,875 MW[147].

Japan

- Japan had installed hydroelectric generating capacity of 22 GW in 2008, accounting for about 8% of total capacity. The Japanese government has been promoting small hydropower projects to serve local communities through subsidies and by simplifying procedures. There are also a number of large hydropower projects under development, including the 2,350-MW Kannagawa plant due online in 2017 and the 1,200-MW Omarugawa plant online in 2011.
- As of 1 November 2009, the New Purchase System for Solar Power-Generated Electricity obligates electric utilities to purchase excess power produces from solar PV energy at specified prices. Excess electricity generated from households is to be purchased at a rate of JPY 48/kWh (in case of installing at 2011, JPY42/kWh), and that from non-household sources (e.g. schools and hospitals) at JPY 24/kWh (in case of installing at 2011, JPY40/kWh). The cost of the scheme will be covered by a monthly surcharge of approximately JPY 30 collected by electric utilities starting in April 2010. The scheme is set to run for 10 years.
- In 2009, a new subsidy scheme to encourage the installation of solar PV systems in the residential sector was offered, following from the previous scheme which ended in 2006[148].

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147 Information on the political and regulatory environment in relation to energy for this country was obtained from the following sources:
http://www.iea.org/country/index.asp
http://www.eia.gov/countries/

148 Information on the political and regulatory environment in relation to energy for this country was obtained from the following sources:
http://www.iea.org/country/index.asp
http://www.eia.gov/countries/

3.4 Summary and conclusions

There are a range of levels of regulation and deregulation, as well as environmental policy across the countries, states and jurisdictions. While naturally these factors can be drivers of prices and profits, our purpose is to have both a qualitative understanding of these factors, as well as suggestions for summary variables to include in our econometric analysis.

To date, among the EU countries, there has been a significant move towards deregulation of electricity and gas retail markets in-line with the EU Directives required full market opening (all customers can choose their supplier), but the implementation in terms of actually achieving competition have been more gradual across member states.

Regulation in the US is at state level. Electricity markets have been deregulated in all of the states in our sample with the exception of California where deregulation has been suspended. Consumer choice varies greatly from one state to another in the US but overall the trends show that consumer choice is growing. Among the other non-EU countries Australia and New Zealand were among the first to introduce electricity market liberalisation.

With the common aim of meeting their Kyoto targets, the EU15 countries have been increasing their share of energy consumption from renewable energy sources such as wind, hydro, solar, geothermal and nuclear. The average support expenditure for renewable energy sources per unit of energy among the EU15 has been increasing (see Table 1). All of the EU15 countries operate feed-in tariffs as renewable energy support mechanisms, with the exception of Finland, Netherlands and Sweden. Tax exemptions are also a common mechanism with fewer countries opting for investment grants, premiums, quota obligations, premiums and fiscal incentives.

4 Retail price comparisons

4.1 Introduction

This section presents the qualitative retail price comparisons for electricity, gas, households and industry. The primary goal is to compare qualitatively the performance of the UK retail markets against the selected comparators. The analysis is also suggestive of further more detailed empirical work using econometric methods to estimate the impacts of commodity input prices, socio-economic cost factors, and supply factors on retail prices.

4.1.1 Note on price conversion

Prices have been converted in this chapter using either the Purchasing Power Parity (PPP) method or using annual exchange rates. All exchange rates were calculated using OECD annual exchange rates[149].

Comparisons of residential prices are made using PPP as needed to convert national currencies into pounds sterling. It is our judgement that the comparison of residential retail prices is best made using a PPP basis, as PPP is the best attempt to reflect the true purchasing power parity of currencies. Purchasing power parity is a method used by the OECD by which the true consumer purchasing power of one currency can be compared to another. This is achieved by estimating the average national currency price of a basket of retail goods in each country at points in time. Our rationale for using PPP to compare consumer (household) retail energy prices is that the PPP values reflect the relative purchasing differences in the national currencies. A typically UK consumer cares little if sterling depreciates against the US Dollar (on international foreign exchange markets), if their typical basket of purchases still costs the same in pounds sterling. Naturally, such a method will have its limits, such as the tendency of different countries to have different preferences which drive the mix of their purchases (rather than prices).

Comparisons of industrial prices are based on average annual exchange rates. It is our opinion that for industrial comparisons, as the major concern of industrial users is with competitiveness impacts, that exchange rates are the relevant and best basis for converting to a common currency unit.

The main analysis uses prices are compared on nominal bases, adjusted for exchange rates. Comparisons of prices relative to CPI, which effectively is real prices, are done later in the chapter.

4.1.2 Note on weighted averages

All bar charts in this chapter contain countries/regions that have been ranked by the time weighted average of their relevant prices for each breakdown of consumption, tax status and price method. The technique employed allows greater weighting towards recent prices and less

[149] Any graphs or tables focussed on EU15 countries only will have either exchange rate prices using OECD annual exchange rates or Purchasing Power Standard prices which use the Eurostat PPS method over the similar OECD PPP method. Any graphs or tables containing both EU15 and non-EU15 countries that are using Purchasing Power Parity prices have been calculated using OECD PPP rates.

weighting the further back in time the price was. Generally, years have been combined to create sub-periods that allow the graphics to be clearer and to focus the emphasis of the study on recent years while still using as much time series data as possible. All bar charts display countries that have been ranked in this manner. For example, the last sub-period is commonly 2010, the second last is 2008-2009, the third last is 2005-2007 etc. Every sub-period going backwards in time from 2010 adds another year to that sub-period.

4.1.3 Note on country groups and comparators

All primary benchmarking undertaken has been done on two separate country groups. The first country group, whose figures are titled 'Selected OECD', contains all G7 countries plus a sample of non-EU15 OECD members. This sample group includes: UK, USA, Canada, Japan, New Zealand, Australia, Norway, Switzerland, France, Germany and Italy.

The second sample group of nations used for primary benchmarking is a group of 15 EU members whose figures are titled with 'EU15'. The countries included in this group are: UK, Austria, Belgium, Denmark, France, Finland, Greece, Germany, Ireland, Italy, Portugal, Spain, Netherlands, Luxembourg and Sweden.

These groups were selected based on our judgments of relative and relevant comparators in terms of social, economic, and energy policy, and also available data as discussed previously. The group of comparators was split both for ease of visualising the data but also to show the sensitivity of the rankings to the sample.

4.1.4 Note on data sources, energy units and consumption bands

All data used for the Selected OECD grouping figures and analysis was IEA sourced. All data for EU15 analysis was Eurostat sourced. All electricity prices are per kilo-Watt hour and all Gas prices are given per Gigajoule.

All price data sourced from the IEA is price data containing prices for users within each customer type, e.g., Residential and Industrial. Our understanding is that the IEA data are typically based on total expenditures divided by total units, which provides the equivalent of a quantity-weighted-average price across price bands. However, as previously discussed, all EU15 country analysis has been carried out using Eurostat prices. These prices are taken not to include all levels of consumers within each type, residential and industrial, but instead only medium consumption band prices were used. The size bands used for each breakdown of Electricity and Gas prices are described in Table 4 below.

Table 4: Eurostat medium consumption Band Definitions

Energy Source	User type	Eurostat size band	Annual Consumption (kWh/MWh)
Electricity	Residential	DC (medium use)	2,500-4,999kWh
Electricity	Industrial	ID (medium use)	2,000-19,999 MWh
Gas	Residential	D2 (medium use)	5,557-55,557 kWh
Gas	Industrial	I3 (medium use)	2,778-27,777 MWh

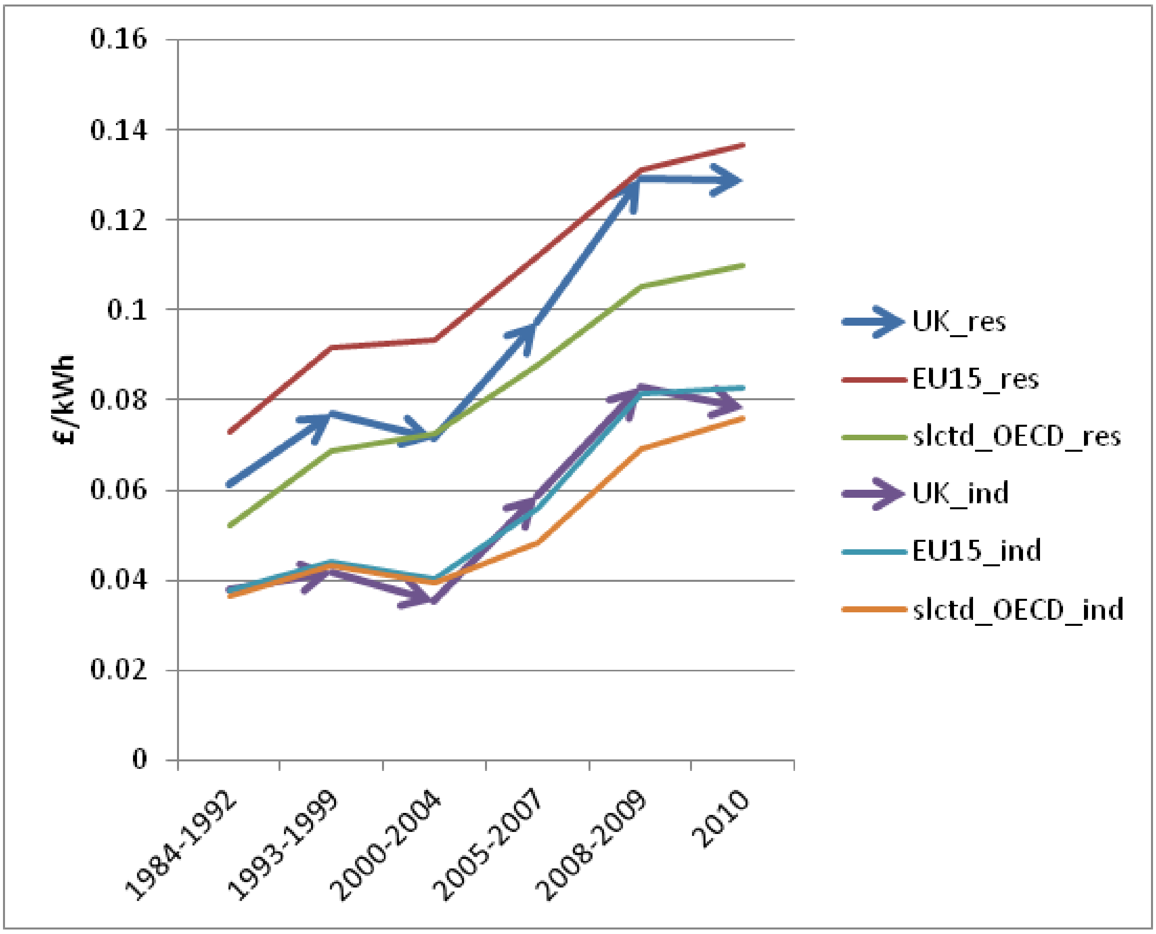
Source: Eurostat

4.2 Primary benchmarking

4.2.1 Electricity

Summary electricity price comparison

Figure 1: Summary comparison of electricity prices



Source: LE using IEA, OECD data

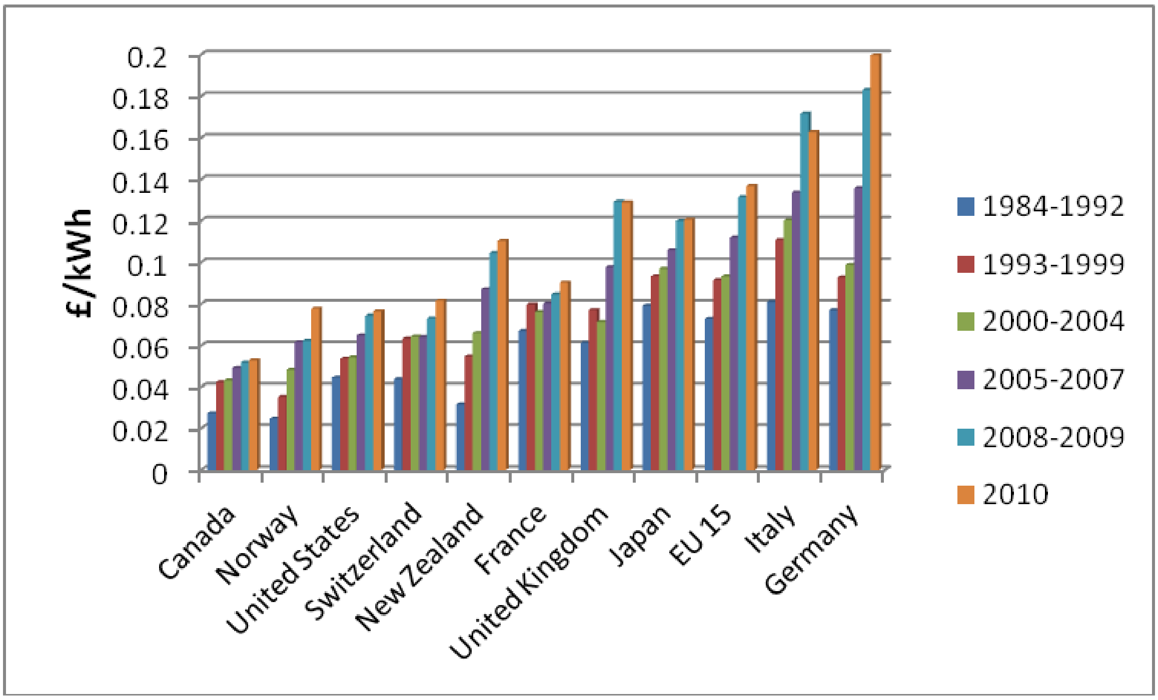
The figure above shows the overall trends in electricity end-user prices comparing the data for the UK with averages across the selected sample groups: the UK, the EU15, and the Selected OECD (slctd_OECD). The trends are shown for each of residential (_res) and industrial (_ind). As can be seen by the figure, for residential prices, the UK starts the period in the lower half of the group-comparisons. For industrial prices, the three comparators all start virtually equal. The UK prices for both residential and industrial then fall below the Selected OECD just barely at about 2000-2004, but then rise much more quickly than the comparators' averages till about 2008-09. The UK prices then fall relative to both the EU15 and Selected OECD comparators. For residential prices, UK prices end up well above the Selected OECD but significantly below the EU15, but above the midpoint of the range. For the industrial prices, the UK prices are still about in the middle and close to the average for the most recent data. Overall, there is not very much difference between the UK prices and the average prices for the industrial prices, but there is a wide range between the Selected OECD and EU15. It is interesting too that the overall difference between the residential and industrial prices seems to stay quite stable, and that all the prices are apparently tracking a similar trend mostly driven by commodity prices and in turn fuel mix. This relationship is explored later with econometric analysis.

Residential

It is useful, to consider the comparisons on a more detailed basis with individual countries.

Selected OECD

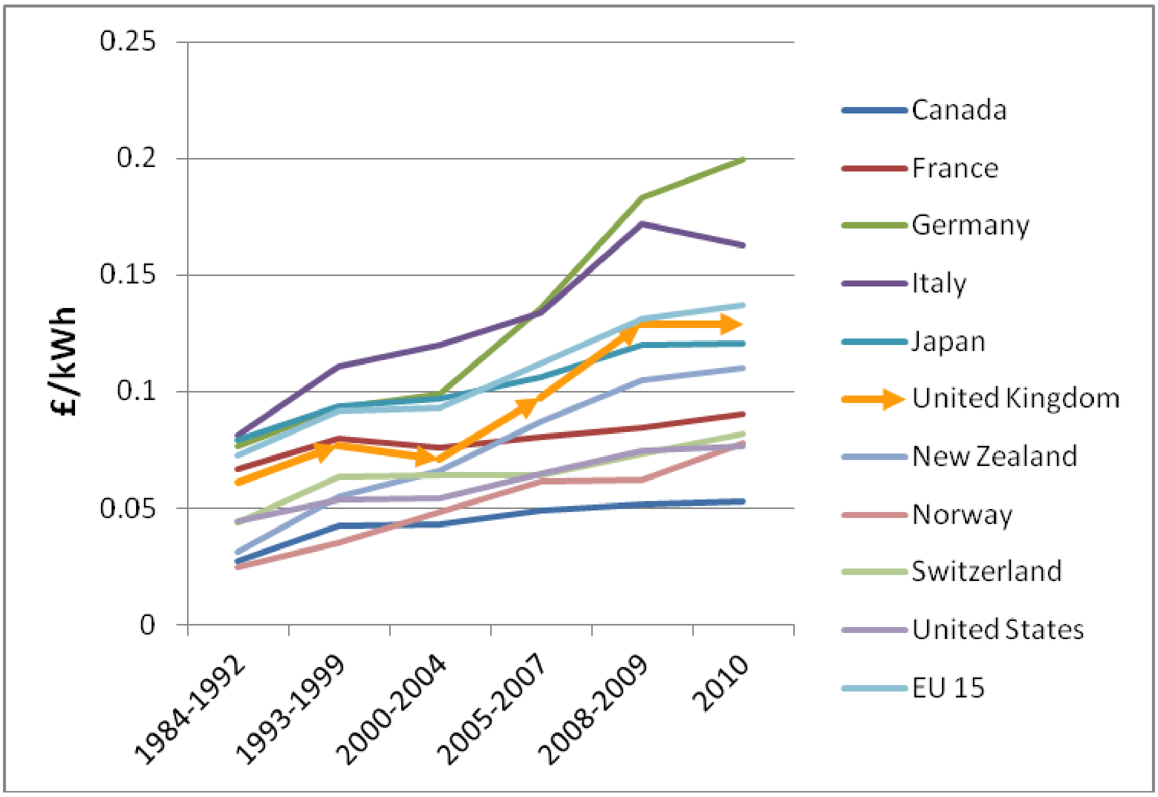
Figure 2: Electricity Prices- Residential- Selected OECD- PPP- Including all taxes- Countries ranked by average price



Note: Australia not included due to missing data
Source: LE using IEA, OECD data

Figure 2 above shows the electricity prices in sterling (PPP exchange rate conversion) of the Selected OECD member nations selected using data sourced from the IEA. When measured against the member nations of the Selected OECD grouping the United Kingdom shows price levels similar to the EU15 average. UK prices are significantly lower than those in Italy and Germany. However Canada, Norway, Switzerland and the USA display prices lower than in the UK consistently through all examined periods, this is perhaps due to the lower levels of taxation and environmental policy that is typical of the non-EU countries in question. There is an apparent pattern here; the EU countries included, except France, have higher prices, while all non-EU countries, except Japan, have lower prices. Switzerland, Norway, and New Zealand, it should be noted, have high proportions of generation from hydro power. France, Canada and the USA have high portions of power generated from nuclear and hydro, while Canada and the USA also have indigenous hydrocarbon fuel sources. Our econometric analysis, literature review and background analysis all showed these to be the major drivers of electricity prices.

Figure 3: Electricity Prices- Residential- Selected OECD - PPP- Including all taxes- Trend lines



Note: Australia not included due to missing data

Source: LE elaboration of IEA, OECD data

The chart above shows growth in UK prices that closely matches the growth profile of the EU15 average. However, the increase since 2004 has been greater than all Selected OECD nations excluding Germany. In the first period of examination the UK ranks 6th lowest in price however by 2010 the UK ranks 4th highest in price among the Selected OECD nations. In the interim period the UK surpasses France and Japan on price. Once again the trend of prices rising in the EU countries relative to the other Selected OECD nations examined shows how regulatory and environment/taxation issues appear to be driving their growth. It is also important to note that factors such as commodity prices/fuel mix are not be as favourable within the EU as in Canada, Norway or the US.

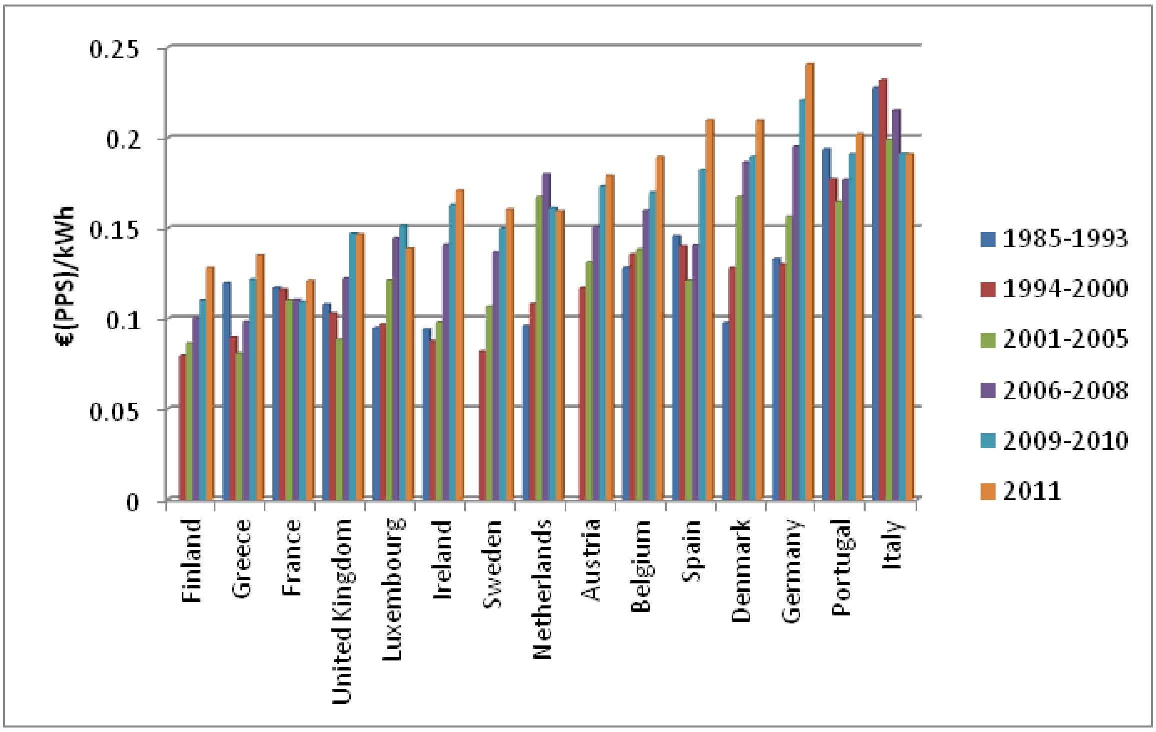
It is noteworthy to consider in more detail some of the analysis uncovered in various other sections of this report. The later section on econometric synthesis shows that commodity input prices, fuel mix, wages, and the energy intensity of the country all are significant explanatory factors and explain a large part of the variations in prices across country and within country. The background section details some of the environmental policies.

The USA, Canada, and Australia and New Zealand in general have more readily available commodities for inputs, such as gas and coal for power generation than the UK and EU countries. These countries in general have lower energy taxes and higher energy intensity of the country, both of which lower prices on average. Finally, these countries tend to have a higher percentage of either hydro or nuclear power. Norway, Switzerland and New Zealand have particularly large shares of hydro power. Canada has large shares of hydro, nuclear and indigenous fossil fuel supplies. Australia has indigenous coal and gas supplies. Japan must import much of its fossil fuels and has a significant nuclear capacity.

Italy and Germany notably have rather high prices, and large portion of this is thought to be explainable by environmental policies (Italy and Germany), grid and network, policy and charges, and in Germany's case, closing nuclear stations, while in the case of Italy, a fuel mix dependent on imported fossil fuels and also imported electricity.

EU15

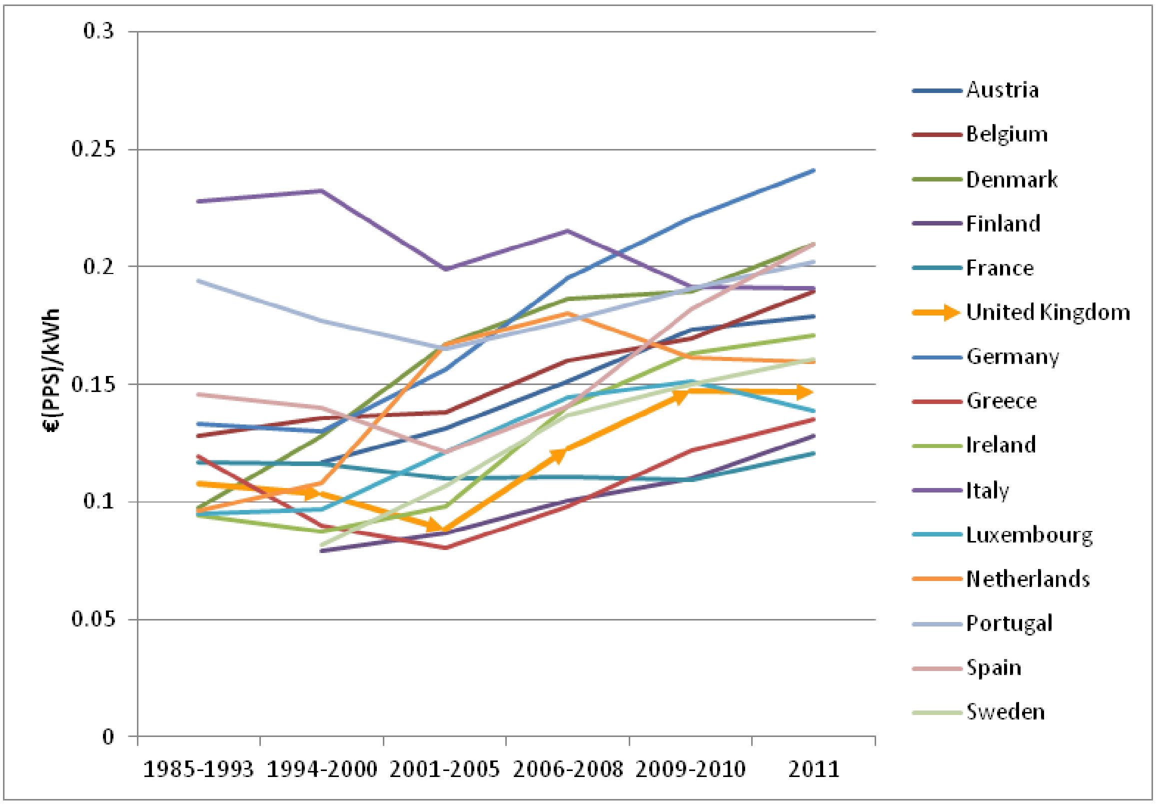
Figure 4: Electricity Prices- Residential- EU15- PPP- Including all taxes- Countries ranked by average price



Source: LE elaboration of Eurostat data

The figure above shows that total residential prices in the UK are higher than only three other EU15 states, France, Greece and Finland. Those countries exhibiting high prices may do so due to high taxation[150] policy that is tied into environmental goals. A reliance on imports and a less than favourable fuel mix may also contribute to higher prices such as in Italy.

Figure 5: Electricity Prices- Residential- EU15- PPP- Including all taxes- Trend lines



Source: LE elaboration of Eurostat data

The next figure contains trend data on electricity prices weighted by time for the EU15 member states. The UK show moderate growth relative to other nations examined. In the first period of analysis, the UK ranks as fifth lowest unit price within the EU15 and by 2010 the UK was the fourth lowest price of the 15 nations. It is also important to note that the maximum number of countries offering lower prices than the UK was no bigger than five at any stage during the evaluation. From the start of the period to the final sub-period Denmark, Netherlands and Ireland all rose above the UK price offering but in that same period France, Finland and Greece have all gone below the UK on price.

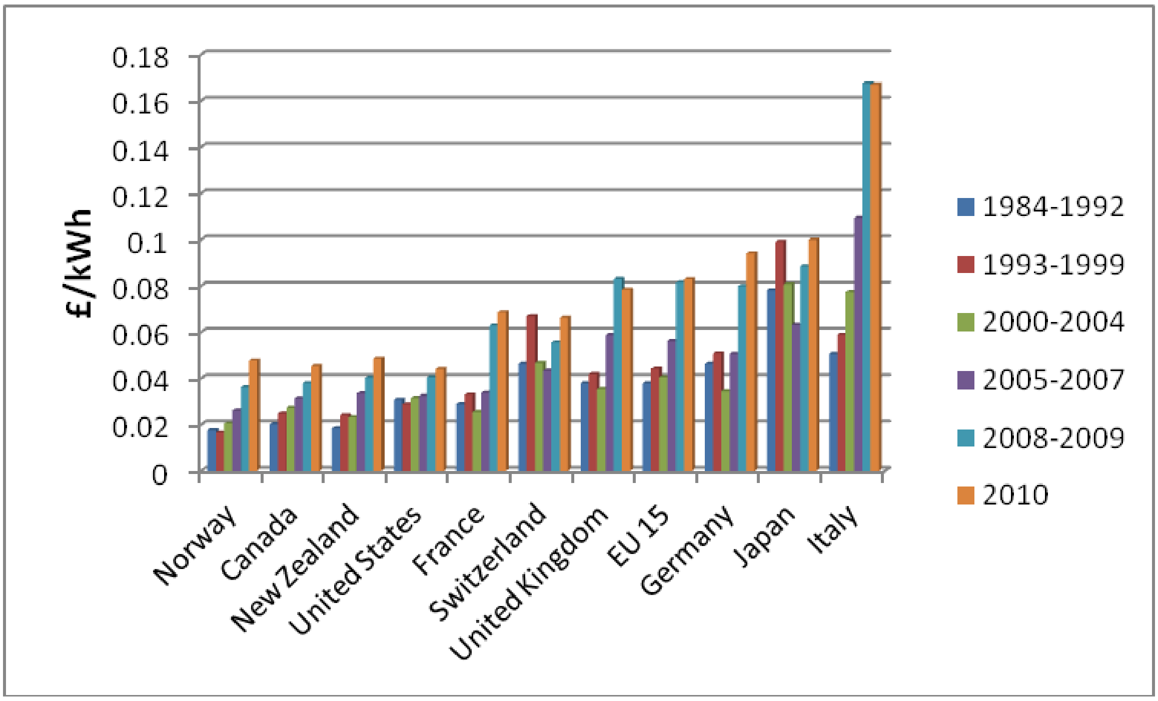
Of particular note is the trend of prices and most recent data for Germany, Denmark, and Spain (the latter two not shown in the previous graph for the Selected OECD). The major drivers here are thought to include environmental subsidies and the need to import gas/not having domestic gas.

[150] Additional analysis comparing prices with and without tax was done and is contained in the annexes.

Industrial

Selected OECD

Figure 6: Electricity Prices- Industrial- Selected OECD - XCH- Including all taxes- Countries ranked by average price

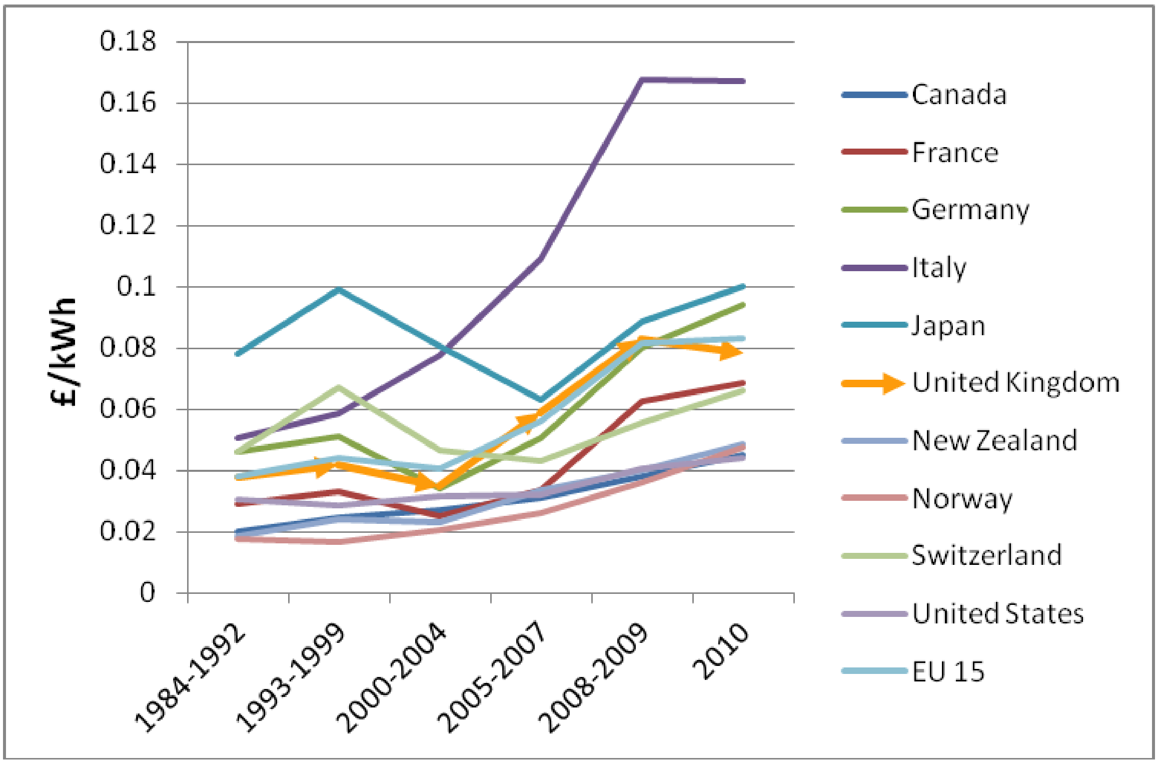


Note: Australia not included due to missing data
Source: LE using IEA, OECD data

Figure 6 shows that UK prices for industrial customers compare similarly to those for residential customers against the Selected OECD group of nations. However, the prices rank slightly lower overall in comparison to residential prices. As before France, Norway, Canada, New Zealand and the US all display lower levels of prices; similarly Germany and Italy are ranking above the UK again. The major change versus residential pricing is that levels are consistently lower than in Japan. These price levels in part reflect changing environmental policy landscapes, with the UK, Germany and Italy all displaying significant increases in the most recent sub-periods. EU prices appear to be consistently higher than prices in the non-EU countries examined. This can be attributed to both the changing environmental policy landscape and the unfavourable import levels and therefore fuel mixes of countries such as Italy. Italy also has high industrial prices relative to residential prices, and this may be due to how grid and environmental charges are shared among user groups, although we have not been able to confirm this.

The differences between the rankings for industry and residential is of particular interest. Almost all countries have industry prices much lower than residential. Italy is the notable exception. The UK is ranking below the EU15 average, and right about the middle of the group. The UK is ranking quite a bit above the USA and Canada, and Norway and New Zealand. The price of gas, the cost of capital, and the availability of sites are probably some of the main drivers for this, as industrial prices in these countries should be very close to the all-in levelised cost of building new generation (CCGT).

Figure 7: Electricity Prices- Industrial- Selected OECD - XCH- Including all taxes- Trend lines



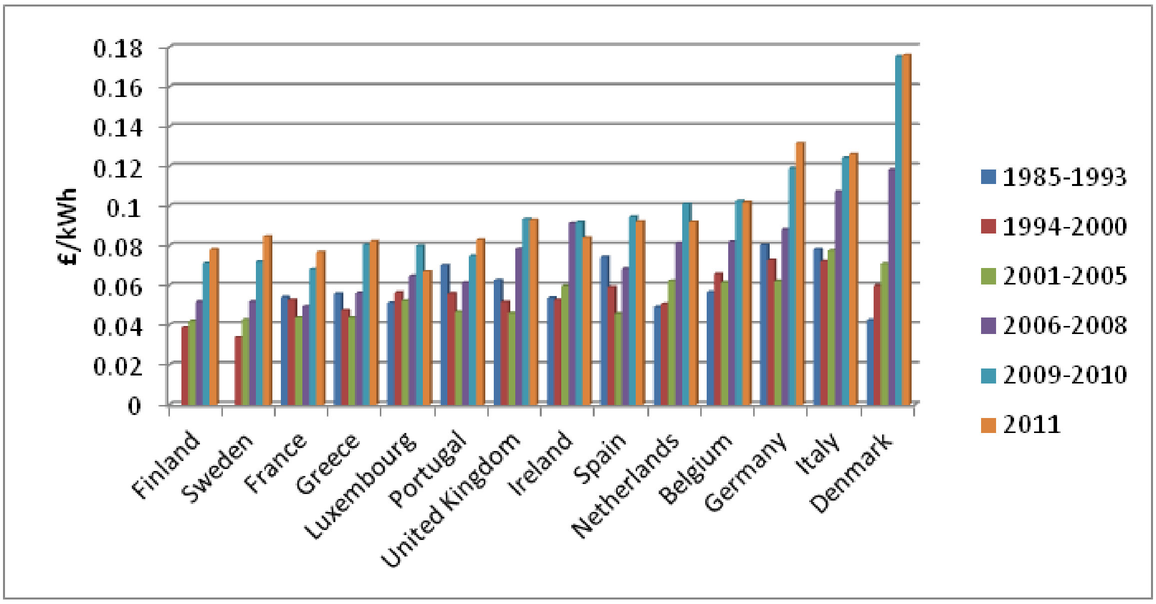
Note: Australia not included due to missing data
Source: LE, IEA, OECD data

The trend in total industrial prices, displayed in Figure 7, shows the UK to have a similar growth profile to most of the Selected OECD countries with Italy and Japan showing exceptionally different growth profiles. The UK is ranked 5th lowest price at the beginning, while ranking 4th highest by the end of the analysis period. Switzerland was the only country to change its position relative to the UK on price in this period, going below the UK during the 2005-2007 sub-periods. The trend of Norway, Canada, New Zealand and the US displaying low prices and growth profiles in relation to the other nations continues. As discussed previously this may be attributed to a combination of commodity prices and therefore fuel mix cost, environmental taxes and regulatory landscape. Again, we note that more discussion of this is found in the background and econometrics sections.

The trends for industrial prices are showing a similar picture. Of interest is how closely the trends seem to be tracking a general trend in commodity prices, with the exception of Italy. Japan seems to be tracking this trend but the fall in price in the 1993-2005 period is exaggerated.

EU15

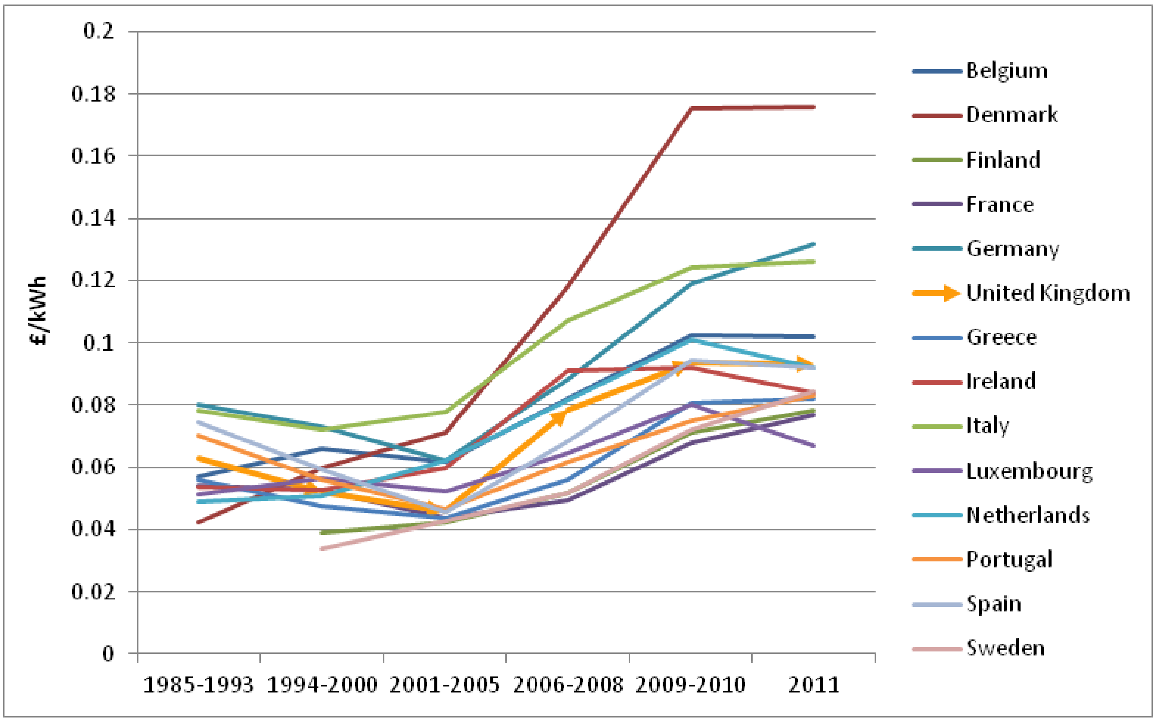
Figure 8: Electricity Prices- Industrial- EU15- XCH- Including all taxes- Countries ranked by average price



Source: LE, Eurostat data

Figure 8 shows that the UK ranks 7th lowest of the group in this subcategory when ranked by weighted average over periods between 1985 and 2011. The UK here appears to have prices that are largely in line with the average in this sample group. Only Denmark, Italy and Germany offer consistently higher prices. As already discussed this can be attributed to unfavourable weather dependant supply issues and/or high environmental taxation levels. This idea is enhanced by econometric results, presented later in the report, suggesting that fuel mix cost has explanatory power across countries for Industrial Electricity prices.

Figure 9: Electricity Prices- Industrial- EU15- XCH- Including all taxes- Trend lines



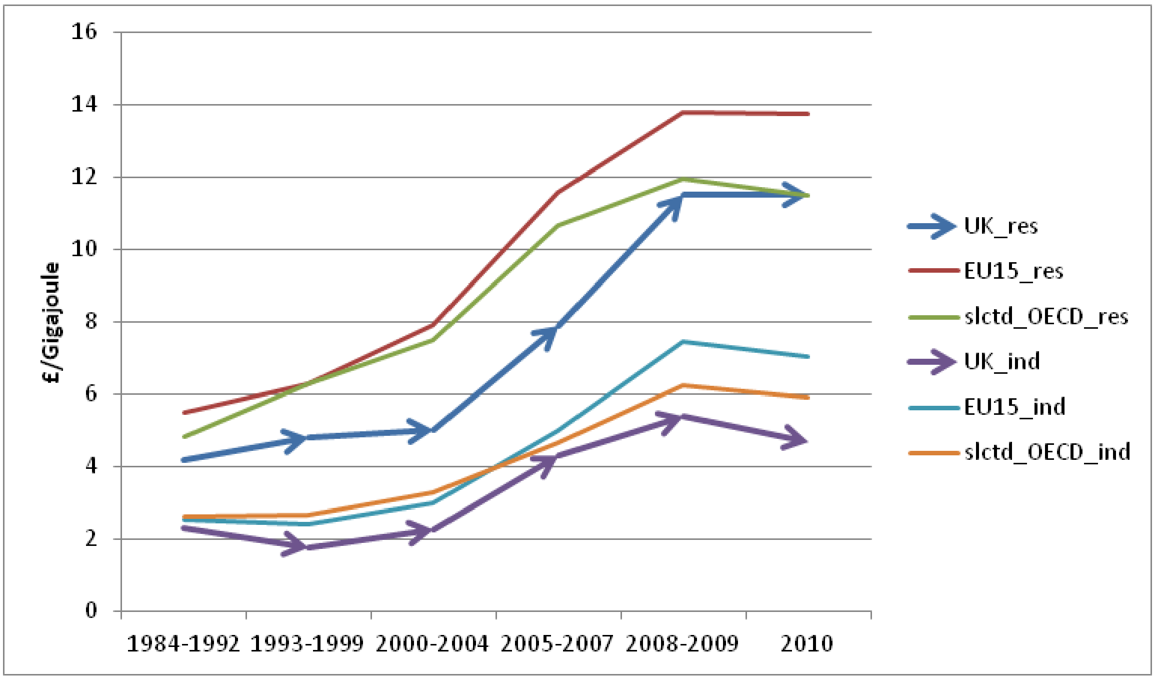
Source: LE, Eurostat data

Figure 9 shows growth trends on prices shown in Figure 8. The UK follows a similar growth profile to most of the other EU15 nations. Whilst the UK in the first sub-period ranked 5th highest price by the final sub-period the UK has maintained its rank of 5th highest price point. In line with expectations, Germany, Denmark and Italy follow a much higher growth pattern than the other EU states. The levels of industrial prices in these countries are now quite high relative to the central tendency of the sample. Belgium is the only State to have its price point rise above the UK during this period.

4.2.2 Gas

Summary gas

Figure 10: Gas prices- summary averages



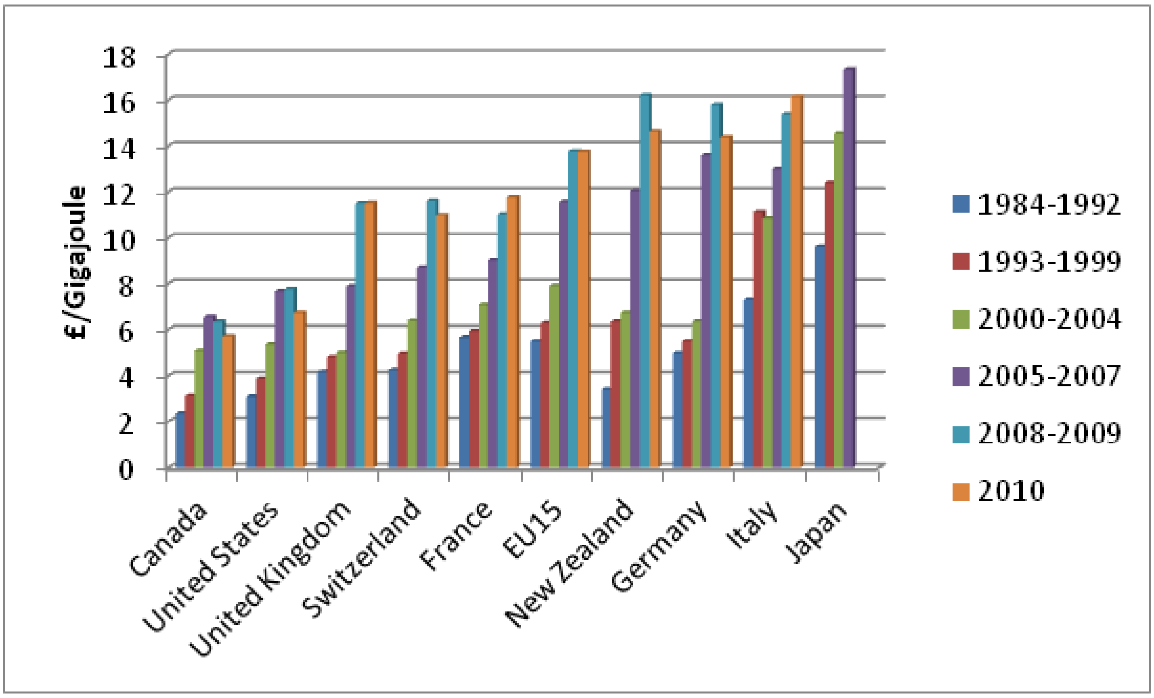
Source: LE, IEA, OECD data

The figure above shows the overall trends in gas end-user prices comparing the IEA data for the UK with averages across the selected comparator groups: the EU15 and the Selected OECD(slctd_OECD). The trends are shown for each of residential and industrial. As can be seen by the figure, the UK prices start the period as the lowest of the group comparisons for each of residential and industrial. This continues with residential prices only rising above the Selected OECD just barely by the end of the period in 2010. Residential UK gas prices rise quickly in the 2000-2009 period, but EU15 price rise almost as quickly over the same period. The Selected OECD prices start the sample period rising but then flatten by the late 2000s. The main driver of this is commodity prices in North America, which have recently been influenced by drivers such as shale gas. By 2008-09, all prices fall modestly, save the EU15. Industrial prices follow a similar trajectory to residential prices. The UK industrial prices are the lowest in the sample, and continue to be during the whole sample period, while ending up even lower relative to the selected comparators' averages by 2010. There are naturally variations within the comparator groups, and so we thus again study the country detail below.

Residential

Selected OECD

Figure 11: Gas prices- Residential- Selected OECD - PPP- Including all taxes- Countries ranked by average price



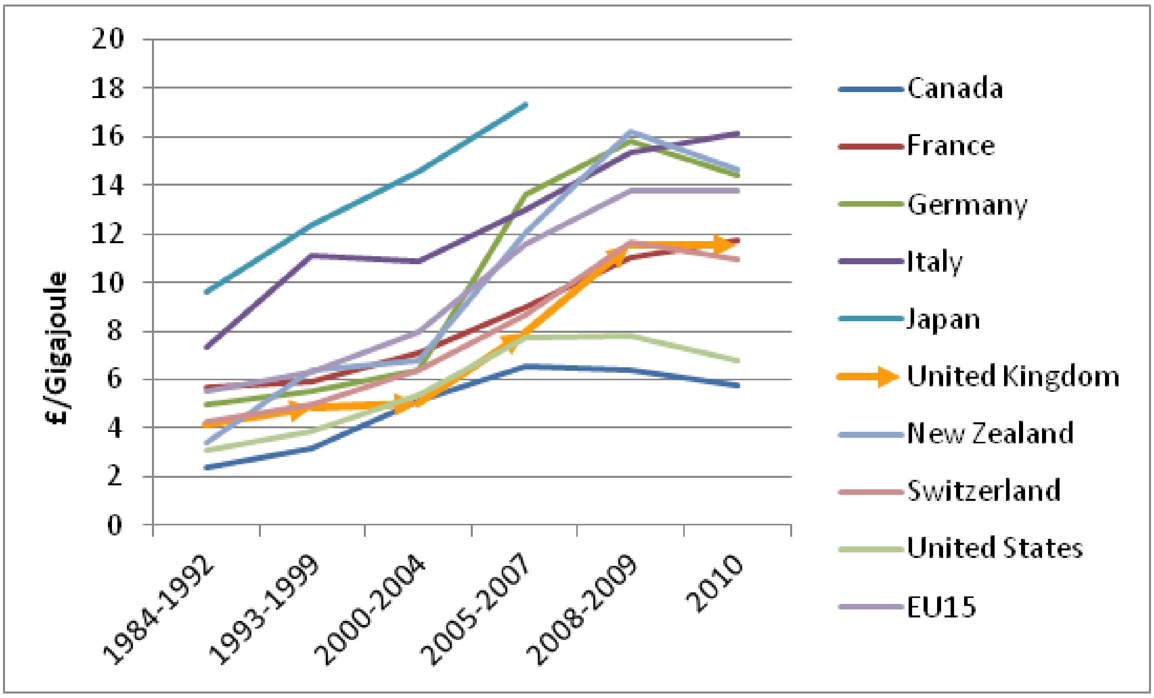
Note: Australia not included due to missing data

Source: LE, IEA, OECD, data

Figure 11 illustrates that for gas prices the UK is similar in historical profile to France and Switzerland average whilst being consistently below Germany, Japan, New Zealand and Italy on price and consistently above both Canada and the US.

The lower price levels of the US and Canada reflects differences in commodity prices, driven by vast differences in commodity supply and demand when compared to nations such as Italy and Germany. Recent discoveries of Shale Gas have pushed the price of gas down further in these countries. Commodity prices are shown through our econometric analysis to have good explanatory power when describing price differences across countries. The need to import a large percentage of consumption is also an important explanatory factor in determining gas prices.

Figure 12: Gas Prices- Residential- Selected OECD - PPP- Including all taxes- Trend lines

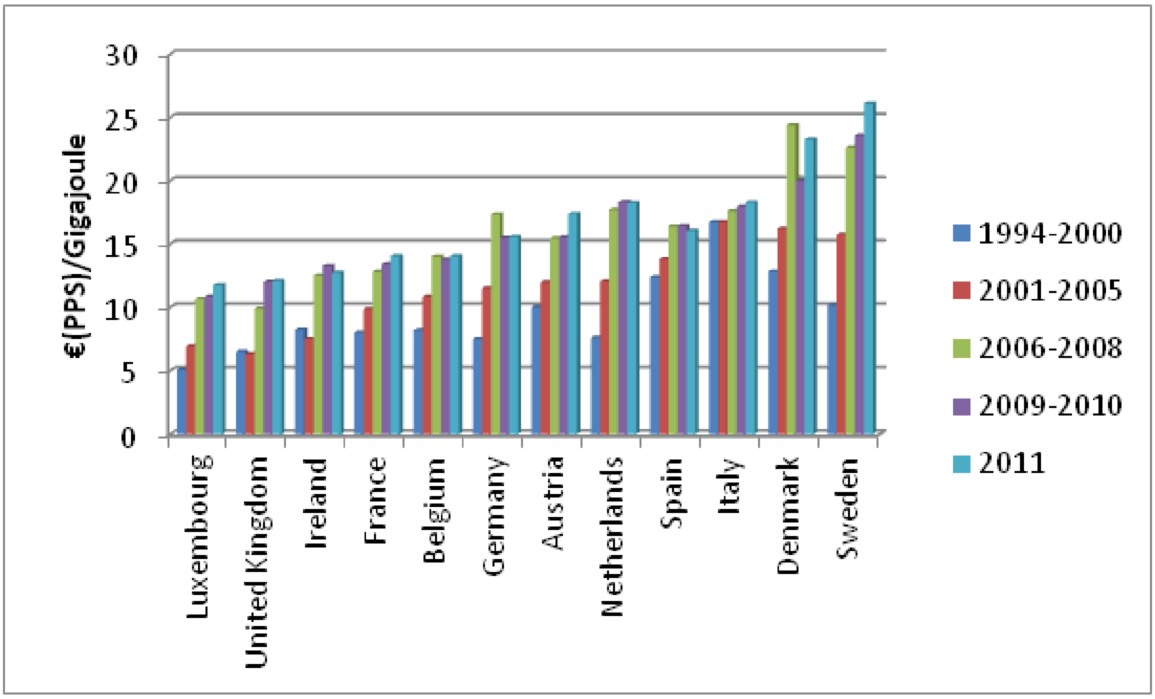


Note: Australia not included due to missing data; Norway effectively has almost no domestic gas use.
Source: LE, IEA, OECD

Figure 12 shows that in terms of prices trends and rankings over time, the UK is ranked 4th cheapest in the first sub-period and remains in that rank come the final sub-period. The trends show the North American countries to have a lower growth profile over this period in contrast to the European countries. This illustrates the points previously made about different regulatory landscapes driving prices. Commodity prices and commodity availability locally, need for LNG also dictates some of the higher prices found in EU countries, such as Italy. New Zealand is the only state whose prices have risen above the UK in this period, while France is the only state whose prices have dropped below those of the UK in the same period. This result contrasts those using Eurostat data due to the medium consumption band prices used in all EU15 analysis. The IEA sourced prices above reflect not just medium level consumers of gas but all level of residential Gas consumers.

EU15

Figure 13: Gas prices- Residential- EU15- PPP- Including all taxes- Countries ranked by average price

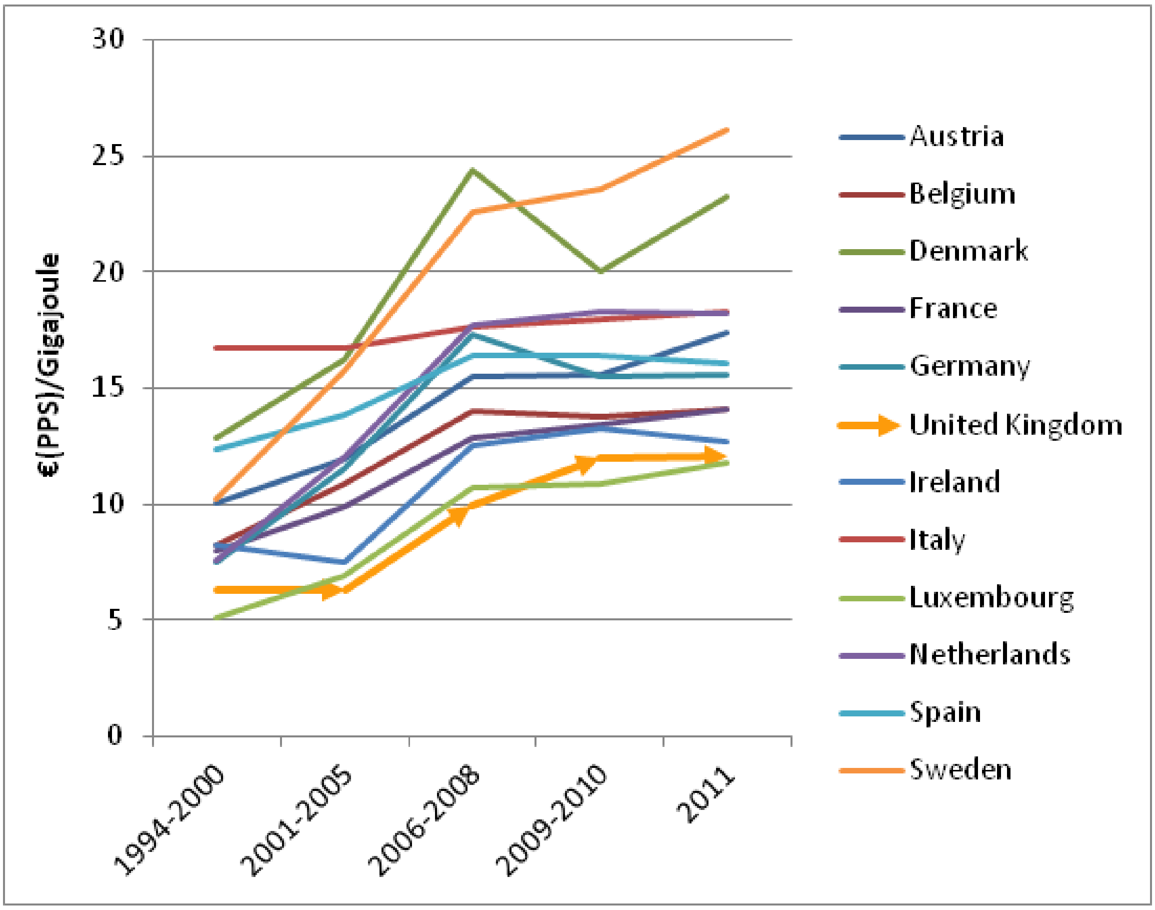


Source: LE, Eurostat data

Figure 13 shows the United Kingdom to have the second lowest price profile of the EU15 with only Luxembourg offering a lower ranking price profile. The higher priced countries in the EU15 such as Denmark, Sweden and Italy have high taxation policies that drive higher prices. These policies are consistent with environmental policy that has become a more prominent driver of prices in recent years. Unfavourable import conditions/need to import via LNG and commodity prices can also contribute to higher prices in countries like Spain and Italy.

Spain imports about 75% of its gas as LNG. In power generation, dry and hot weather can cause significantly higher electricity prices in Spain. Whether this effect also feeds into gas prices is more difficult to say, although dry weather will certainly increase the demand for gas for power generation, and hot weather will certain increase the cooling related demand for power. Nonetheless, the EU gas system is still on the whole a winter peaking system with peak gas prices occurring in the winter months.

Figure 14: Gas Prices- Residential- EU15- PPP- Including all taxes- Trend lines



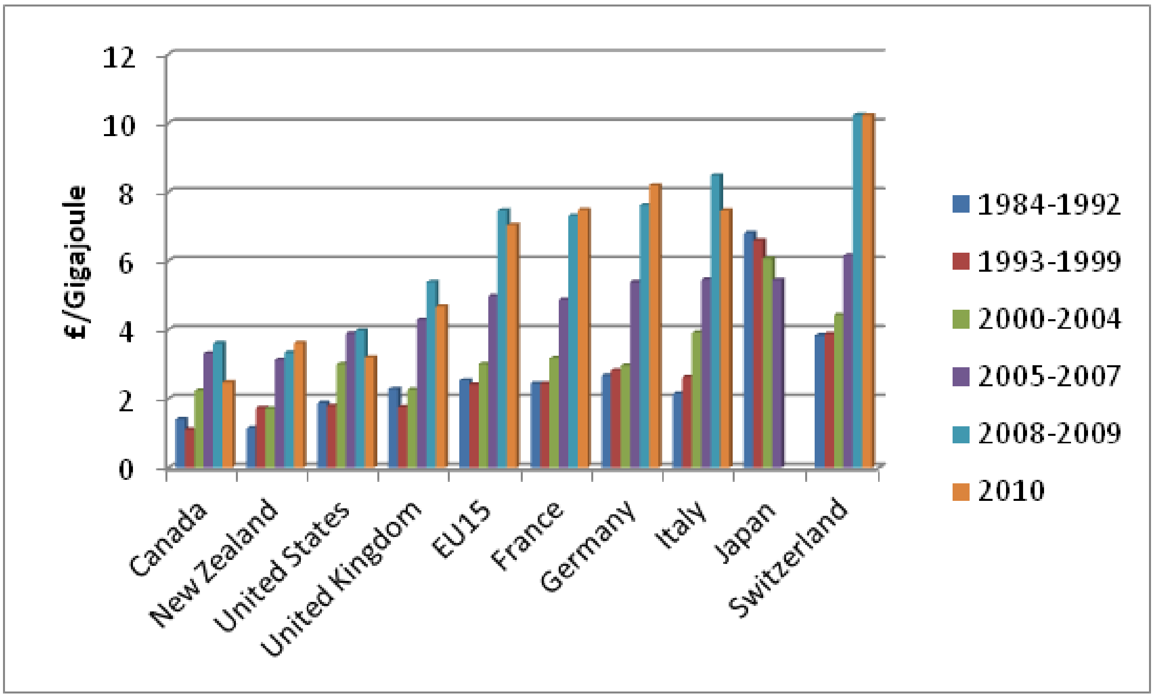
Source: LE, Eurostat data

In Figure 14, we can see the UK and Luxembourg following a similar growth pattern to other countries but still offering the lowest price levels. In the first sub-period (1994-2000) the United Kingdom is ranked 2nd lowest in price and in the final sub-period that ranking is still intact. During the middle of the sample period, circa 2000, the UK had the lowest prices. Only Luxembourg offers a lower price at any point during this period. The most significant explanatory factor for the UK's low prices is probably that the country had a large surplus of domestic gas in the late 1990s and early 2000s. In addition, the UK's successful move towards liberalisation in this period made their end-user prices more in-line with these low commodity prices.

Industrial

Selected OECD

Figure 15: Gas prices- Industrial- Selected OECD - XCH- Including all taxes- Countries ranked by average price

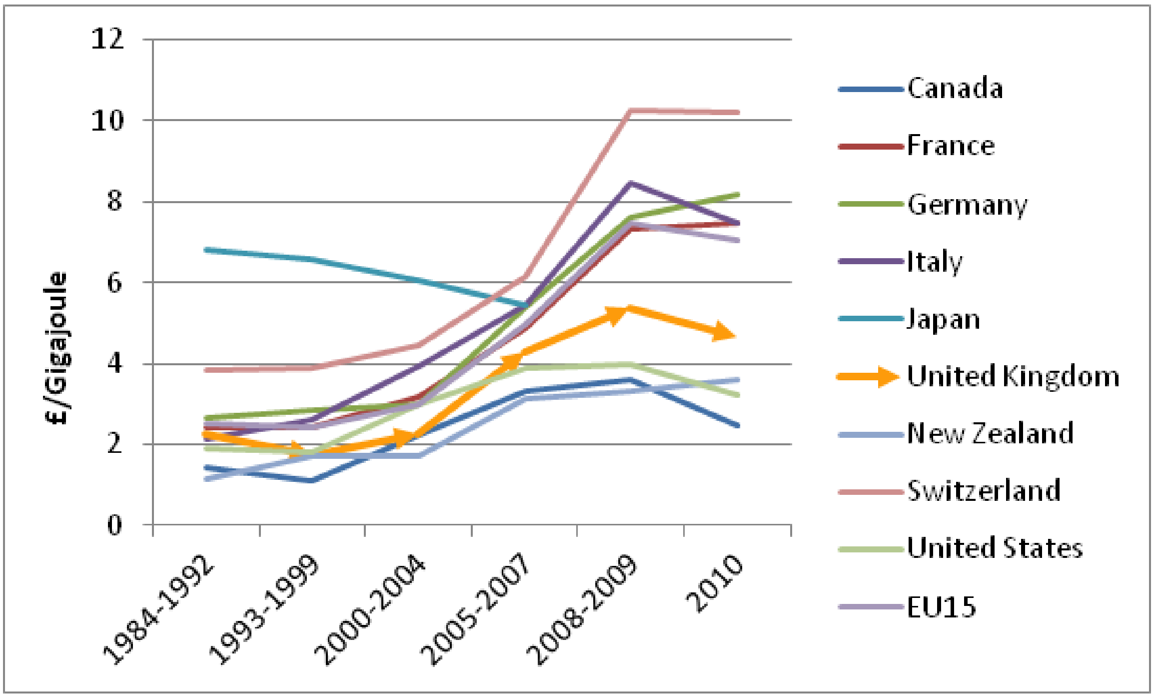


Note: Australia not included due to missing data

Source: LE, IEA, OECD data

In Figure 15 above the UK shows prices higher than both North America and countries but have lower prices than France, Germany, Italy and Japan. The UK ranks as the third-lowest price profile under this price segment. This ranking is most likely driven by the varying policies on commodity prices, sharing of grid charges between industry and consumers, and availability of domestic commodity. It is important to note that unfavourable commodity prices and local supply/need for imports may have good explanatory power when analysing the price differences, especially in a EU15 context. In addition, recent Shale Gas discoveries in North America have ensured that prices remain low in that region. These results were confirmed in our econometric analysis, for industry as well as residential prices.

Figure 16: Gas Prices- Industrial- Selected OECD - XCH- Including all taxes- Trend lines

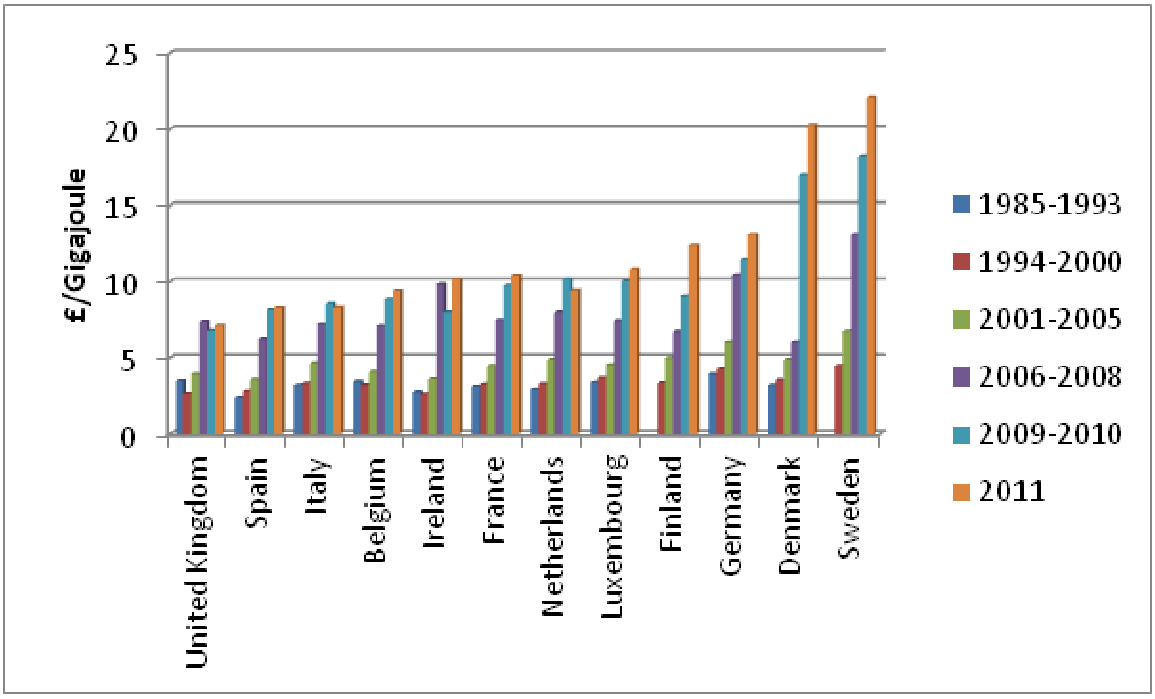


Note: Australia not included due to missing data
Source: LE, IEA, OECD data

Figure 16 contains price trends for the Selected OECD group of nations on tax inclusive Industrial gas prices. All data is IEA sourced and has been converted using annual exchange rates taken from the OECD. The trend profile of the UK is line with other Selected OECD group nations with the UK experiencing steady growth from the second sub-period that subsides in the final sub-period. The UK is ranked as 5th lowest in the first sub-period and by the final sub-period is ranked 4th lowest price above only the USA, New Zealand and Canada. It does however have a price point by the final sub-periods that are considerably below those of comparable EU15 nations. These results are in line with expectations and previous results and give further strength to the idea of commodity supply levels driving price.

EU15

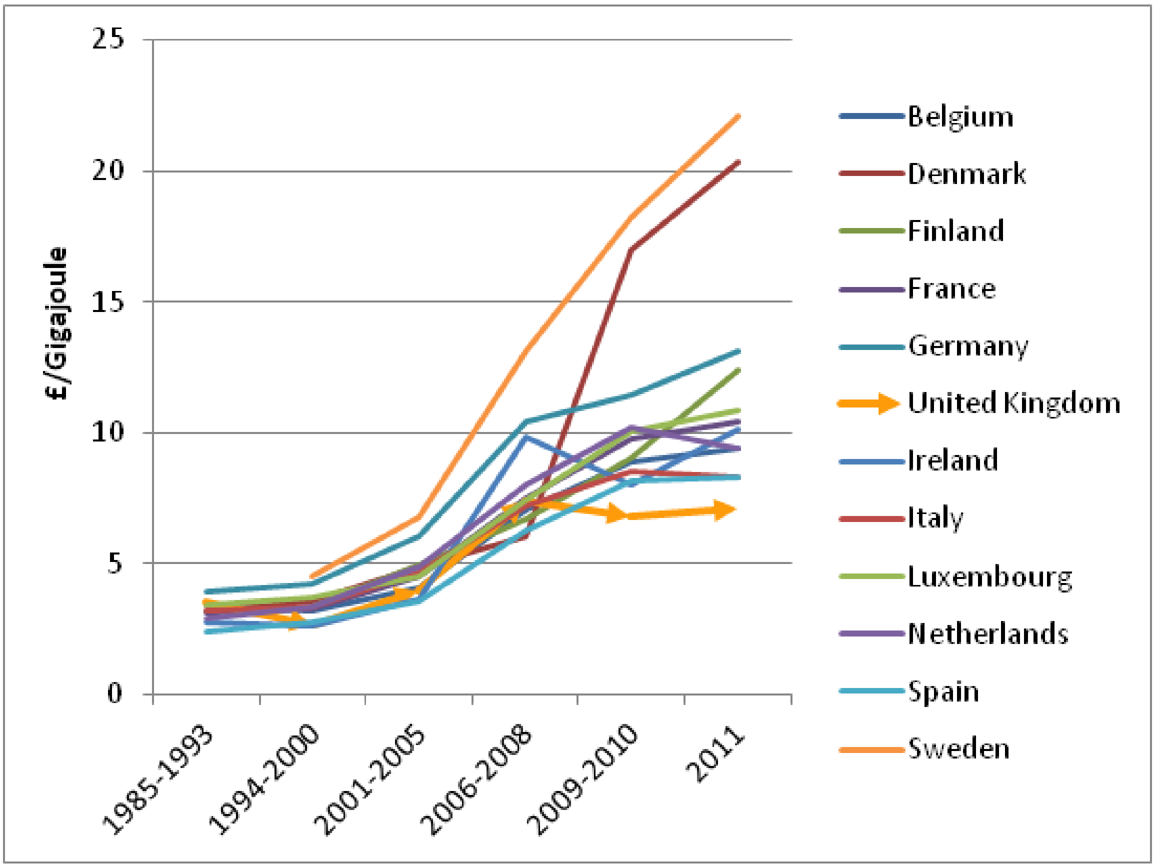
Figure 17: Gas prices- Industrial- EU15-XCH- Including all taxes- Countries ranked by average price



Source: LE, Eurostat data

Figure 17 shows Eurostat data illustrating Industrial Gas prices for EU15 countries. All prices are inclusive of tax and have been converted using OECD exchange rates. The graph shows the UK to have the lowest price profile in the group. The UK shows a price profile similar to that of all nations examined here with the exception of Finland, Germany, Denmark and Sweden. All of these nations have a high taxation level driven by environmental policies and other taxes and levies. The econometric analysis at this consumption level indicated that commodity conditions and to a lesser extent market regulation are key price drivers.

Figure 18: Gas Prices- Industrial- EU15-XCH- Including all taxes- Trend lines



Source: LE, Eurostat data

Figure 18 contains Industrial gas prices sourced from Eurostat. All prices are inclusive of tax and have been converted using OECD annual exchange rates. The UK follows a very similar growth pattern as the other EU15 countries between 1985 and 2008. However, in the last two periods the UK growth has slowed up more than the other countries sampled leaving UK ranking as the lowest price offering in 2010. Germany, Denmark and Sweden have shown continuous growth when other nations have slowed down on price growth. These diverging price patterns appear to have strengthened from 2008. This is most likely due to the changing regulatory and taxation environment as previously discussed. Taxation levels are changing as nations try different approaches to environmental policy. In addition to taxation policy, commodity supply and demand issues will also drive price differentials among the EU15 nations.

4.3 Adjusted benchmarking

4.3.1 Introduction

Residential-Industrial ratio

The Residential-industrial price ratio allows us to how these two price points interact in each state. This ratio will reflect the different margins applied to each customer group. As industrial customers are more contestable the relationship between the two can vary by regulatory environment. Residential customers also tend to consume mostly peak load energy while industrial outfits will usually target base load prices/times.

CPI-Electricity price Index ratio

CPI-price ratio simply offers the chance to view energy prices in relation to inflation. It allows us to examine the 'real' change in prices across the examined states.

Price/Average wage

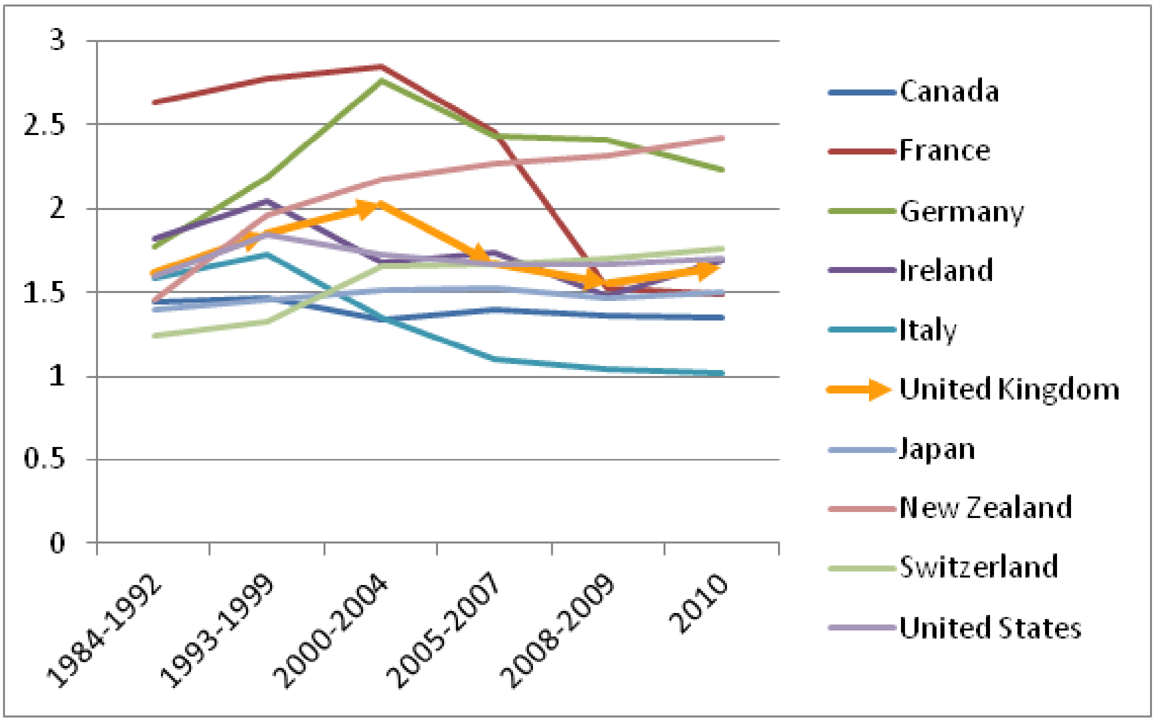
Price/average wage allows us to look at how price relates to wages across each state. Both the gross levels and relative growth are examined to see how much electricity and Gas prices are likely to move with wages and population. Any movement above and beyond wages would suggest that prices are not just determined by wider economic conditions.

The inclusion of an index for each country's ratio provides an opportunity to analyse growth in each country of this metric while ignoring relative starting levels. Relative prices levels are taken out of the examination so that relative growth can be assessed in a solo context.

4.3.2 Electricity

Residential-Industrial ratio

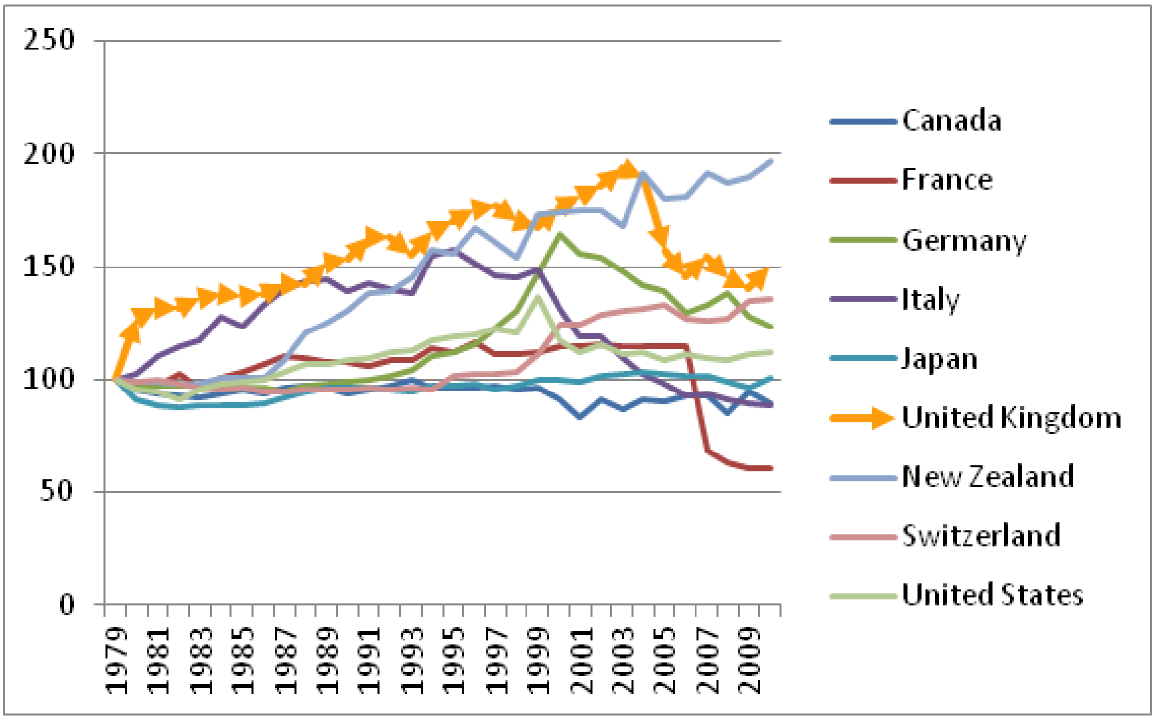
Figure 19: Electricity Prices-Residential/Industrial price ratio- Including tax- Selected OECD



Source: LE, IEA, OECD data

Figure 19 displays the ratio of residential to industrial electricity prices from 1984-2010 for a sample group of ten countries. All prices are IEA sourced and are inclusive of tax. The UK consistently ranks around the average of the sample nations. In the first sub-period they have the 4th highest ratio and by the final sub-period the UK has the 5th lowest ratio. Since 1984 the ratio of residential and industrial prices in the UK has been in between 1.5 and 2. The ratio of these prices is also affected by how costs such as transmission and distribution costs are shared by each customer type. The final issue worth noting here is that while industrial customers tend to consume base load energy, residential customers will often consume at peak times causing another price differentiating factor.

Figure 20: Electricity Prices-Residential/Industrial price Index- Including tax- Selected OECD



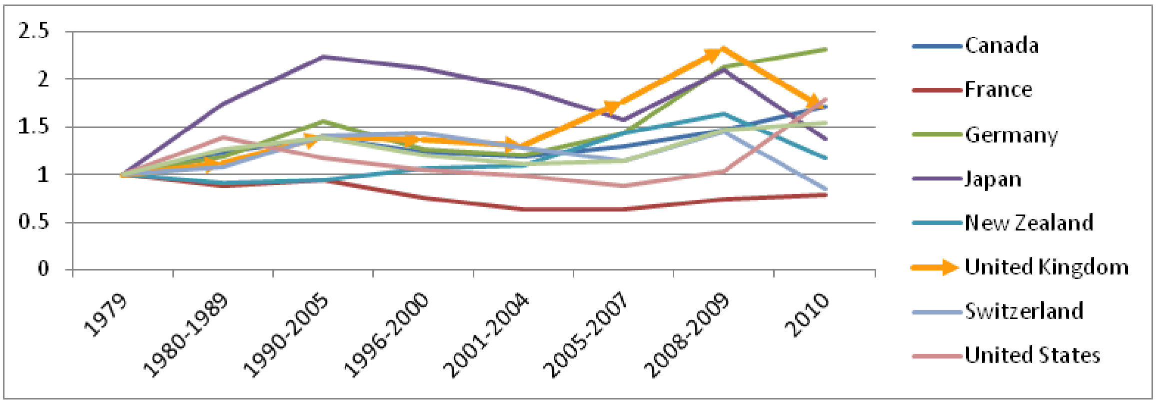
Source: IEA, OECD

Figure 20 contains country indices tracking the movement of the residential/industrial electricity price ratio in each sample nation. The graph shows that in 2003 the UK had experienced the highest amount of growth among this country group. By 2011 the UK has experienced the second largest amount of growth to the residential/industrial ratio out of the nations selected. Only New Zealand has seen this metric increase more since 1979. The United Kingdom ratio fell significantly subsequent to 2003, leading to greater consistency in the industrial and residential price.

CPI-Electricity price Index ratio

Residential

Figure 21: Electricity Prices-Residential – Residential price index/CPII- Including tax- Selected OECD

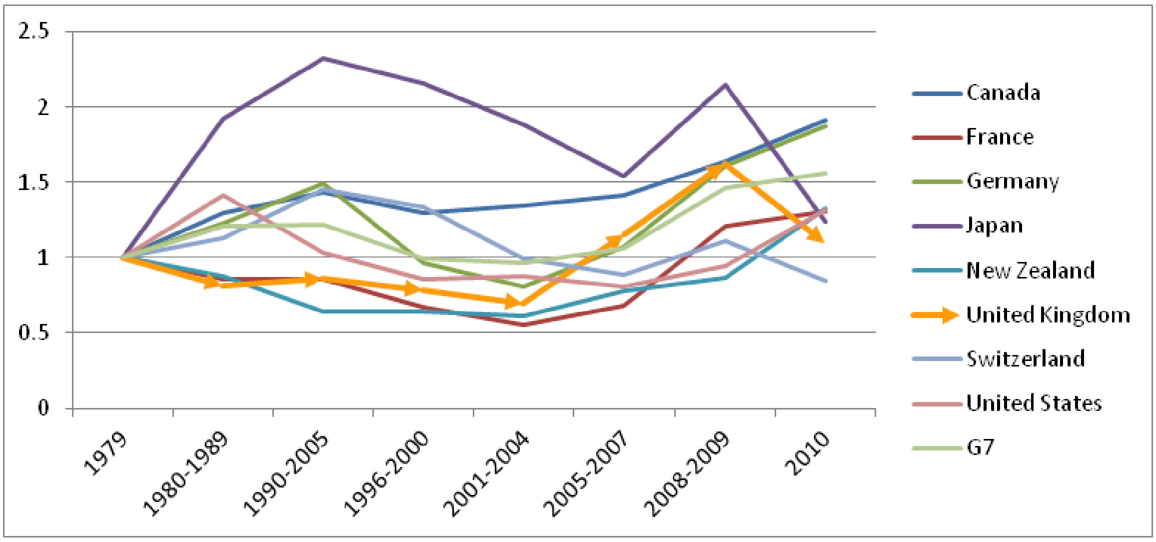


Source: IEA, OECD

Figure 21 contains the ratio of the index for residential prices to the CPII of the nation in question. The ratio seeks to show how much are residential electricity prices increasing above/under the inflation in the country. The graph shows that in the second last sub-period (2008-2008) the residential electricity price in the UK had increased over twice that of the UK CPII. With a decrease in that ratio occurring in 2010 the UK has the third highest ratio of the group since 1979 (base year) by the final sub-period. Only France and Switzerland have managed to decrease their residential price in relation to their CPII. Some of the deviations from CPI, particularly in the case of Germany and the UK, of the electricity price can be attributed with the increased amount of investment into renewables that have occurred in these states in recent years. The increased investment in this area relative to other examined states may cause prices in that area to grow faster than inflation due to the high capital costs involved.

Industrial

Figure 22: Electricity Prices-Industrial – CPII/Electricity Price Index- Including tax- Selected OECD



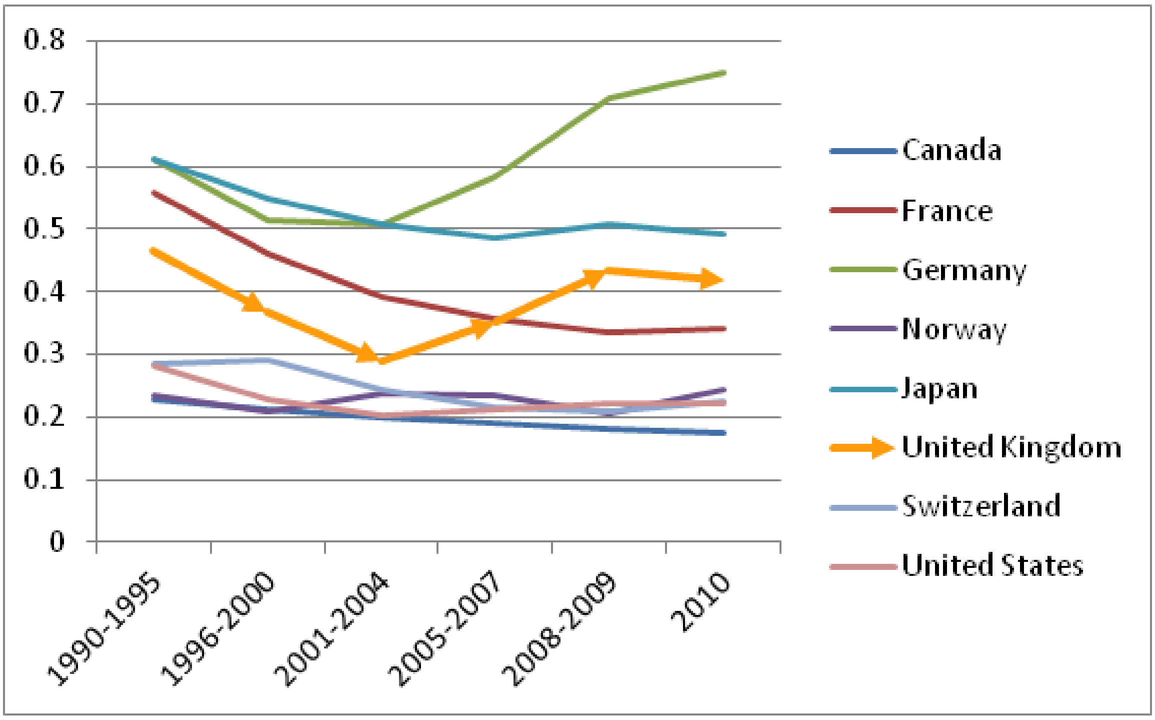
Source: IEA, OECD

Figure 22 contains the ratio of the industrial electricity price index to the CPII for each sample country. All prices are inclusive of tax. The graph shows the UK until 2004 had lowered the industrial price of electricity in relation to inflation. From 2004 the ratio moves to a point where the price of industrial electricity has grown 1.5 times more than inflation since 1979. In 2010 the relationship has levelled off again towards an equal growth level since 1979. In the final sub-period the UK ranks as the second lowest in terms of price growth over inflation.

Price/Average wage

Residential

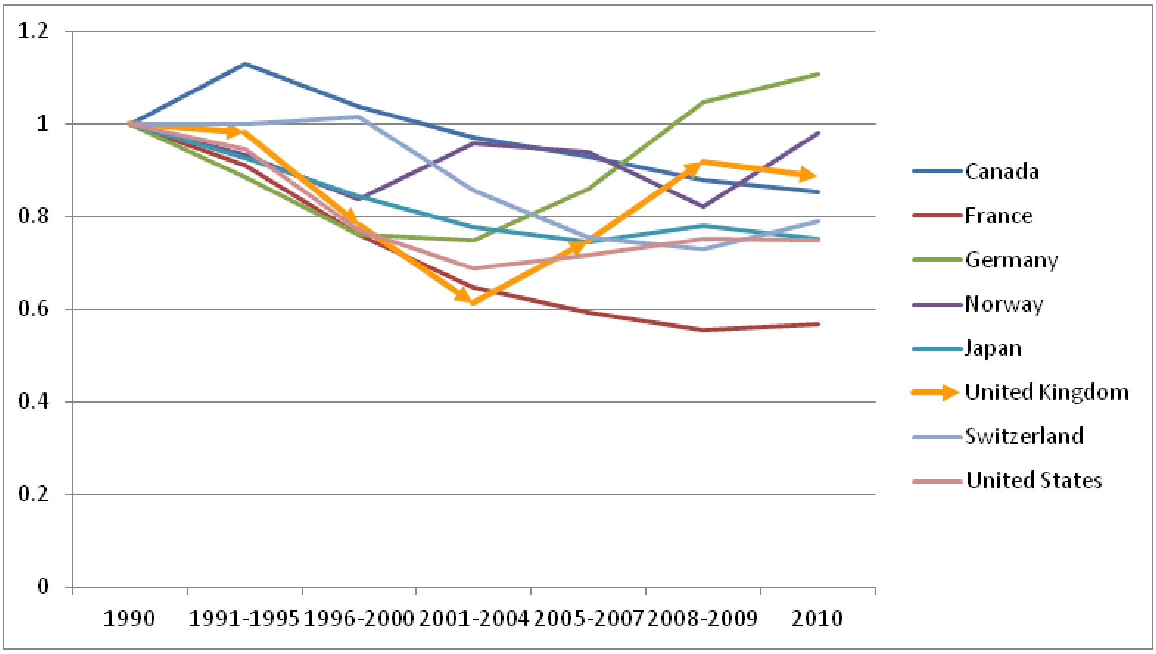
Figure 23: Electricity Prices-Residential –Price/Average wage trend lines- Including tax-Selected OECD



Source: IEA, OECD

Figure 23 shows trend lines for residential prices in terms of average wage. All prices are inclusive of tax and are IEA sourced while average wage data is OECD sourced. From 1990 until 2004 the UK price per average wage declined steadily. From 2004 until 2009 the price per average wage grew again almost back to the original position in 1990. In the final sub-period the relationship levels out and the UK is offering the 3rd highest price per average wage below only Germany and Japan in this sample.

Figure 24: Electricity Prices-Residential –Price/Average wage indices- Including tax- Selected OECD

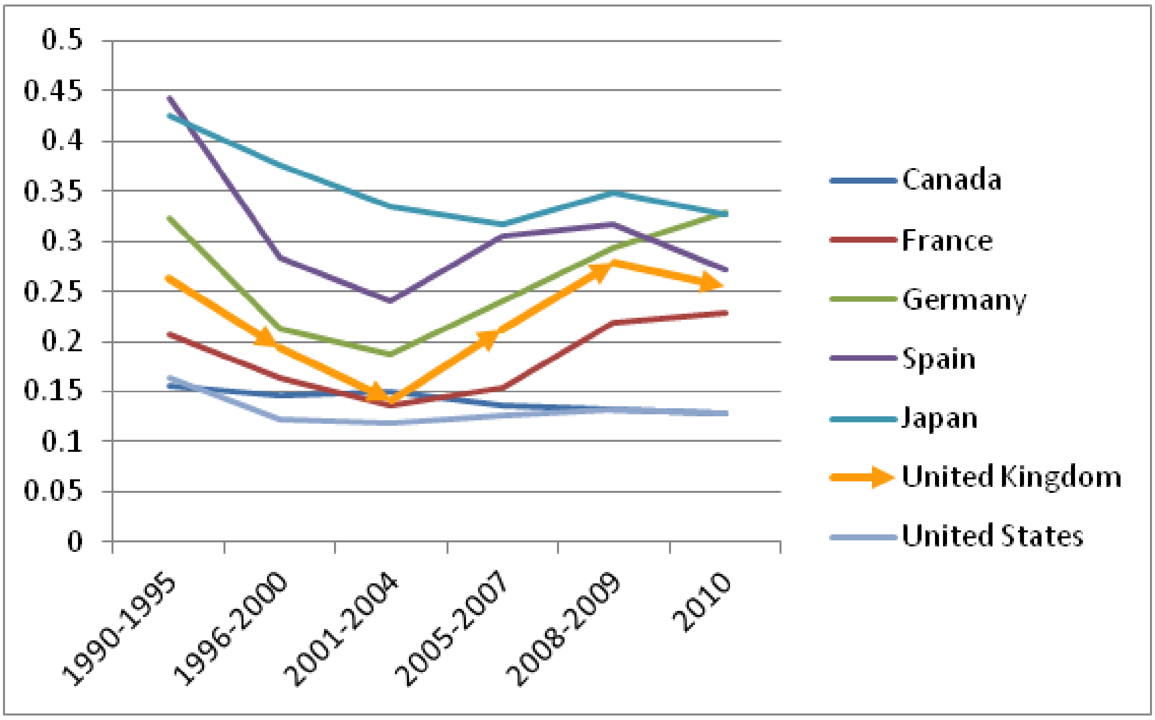


Source: IEA, OECD

Figure 24 contains ratio of indices for residential electricity prices to indices of average wage. All wage data is OECD sourced and all price data is IEA sourced. All prices are tax inclusive and all indices have a base year of 1990. Only Germany has not decreased the price/average wage ratio since 1990. All other nations have managed to lower residential electricity prices relative to average wages since 1990. By the 4th sub-period the UK has seen the biggest decrease of the price/average wage relationship. However in the final sub-period the UK has seen the third least amount of price/average wage decrease since 1990 of the eight sample nations.

Industrial

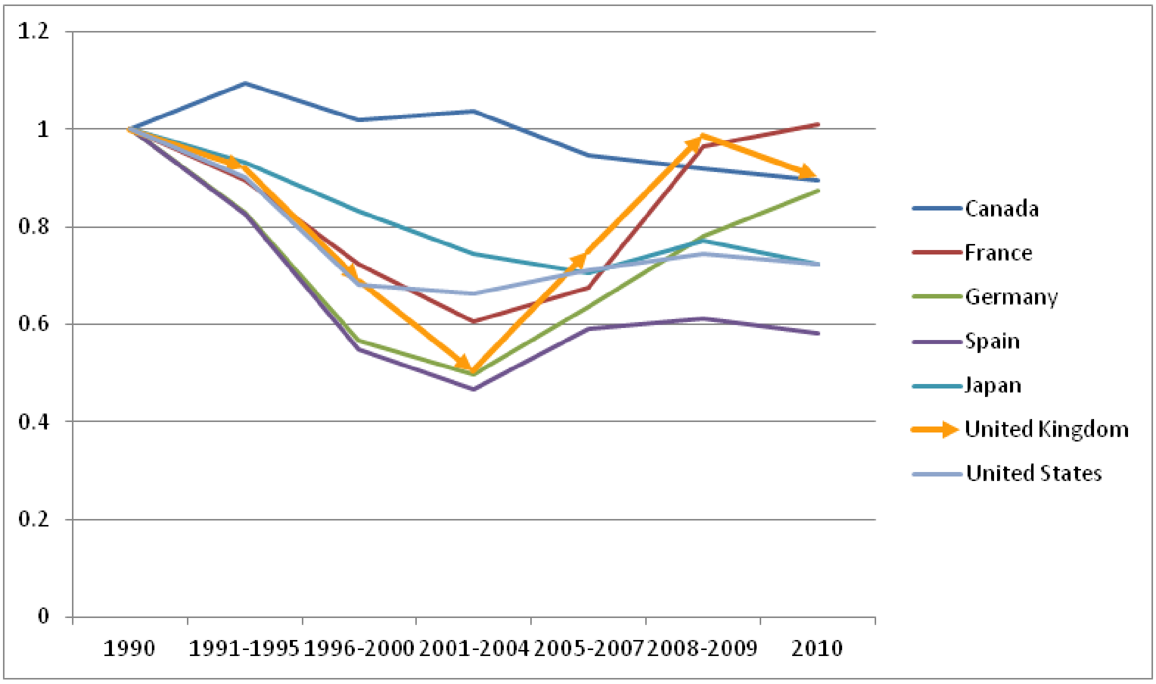
Figure 25: Electricity Prices-Industrial –Price/Average wage trend lines- Including tax-Selected OECD



Source: IEA, OECD

Figure 25 contains trend data on price/average wage ratios since 1990. All prices are IEA sourced and average wages are given by the OECD. The UK for the most part keeps a consistent ranking of median priced country through the sub-periods. The price/average wage never moves above that of Germany, Japan or Spain and only one occasion does the price/average wage of the UK move below that of Canada and equal with France (2001-2004).

Figure 26: Electricity Prices-Industrial –Price/Average wage indices- Including tax- Selected OECD



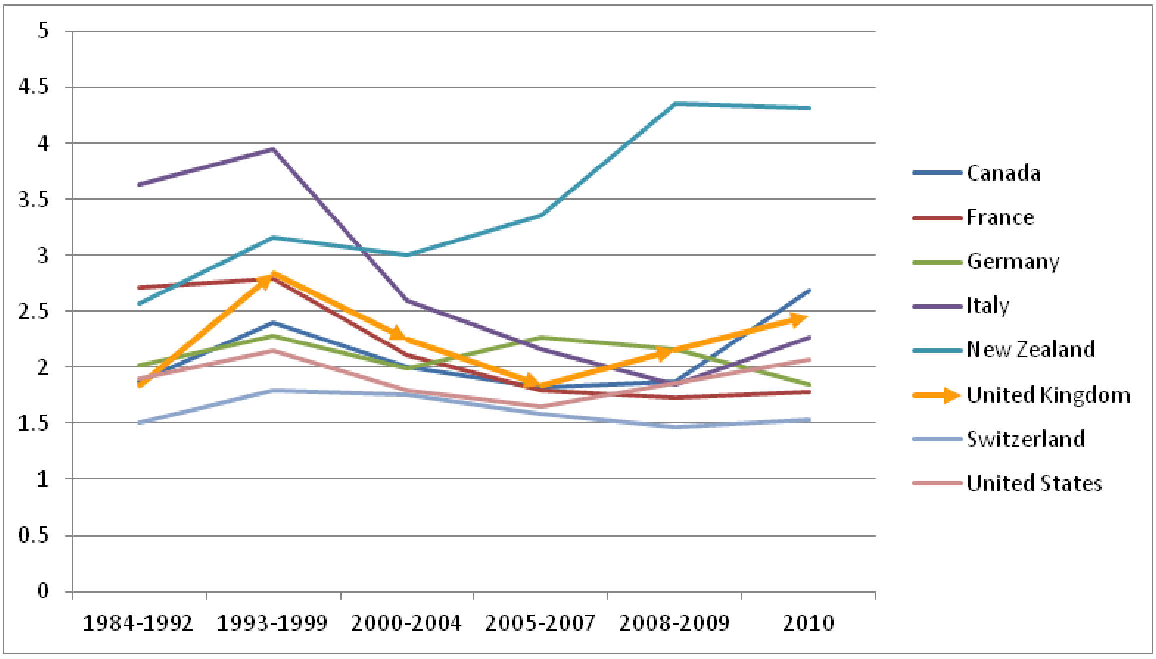
Source: IEA, OECD

Figure 26 contains the ratio of industrial electricity price indices to average wage indices. The graph shows that by 2010 only France has not decreased the industrial price of electricity in relation to average wage. With the exception of Canada the sample countries experienced a drop in price/average wage from base year 1990 until 2001. From 2001, the UK began to increase price relative to average wage more than all other countries before experiencing a decrease again from 2009 to 2010. By 2010 the UK has decreased the industrial electricity price relative to average wage by the second least since 1990 out of the sample nation group.

4.3.3 Gas

Residential-Industrial ratio

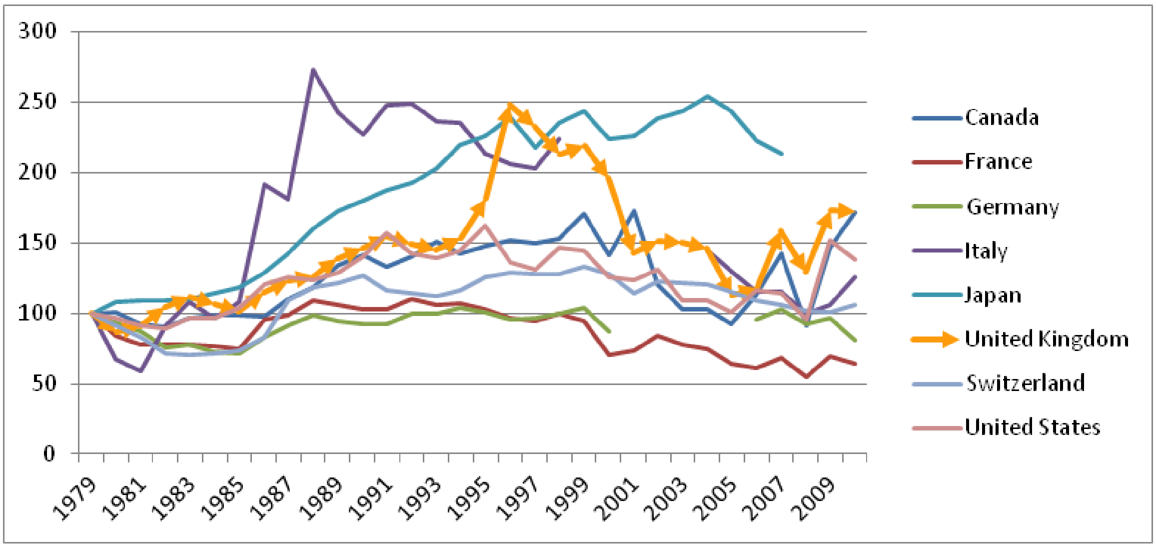
Figure 27: Gas Prices-Residential/Industrial price ratio- Including tax- Selected OECD



Source: IEA, OECD

Figure 27 displays the ratio of Residential to Industrial Gas prices. All prices are IEA sourced and are tax inclusive. The UK is ranked among the lowest price ratios in the first sub-period and by the final sub-period is ranked as the 3rd highest price ratio. Switzerland is the only country which goes as low as having residential prices only 1.5 times the industrial prices. Most other countries including the UK seem to oscillate around the ratio being 2.

Figure 28: Gas Prices-Residential/Industrial price Index- Including tax- Selected OECD



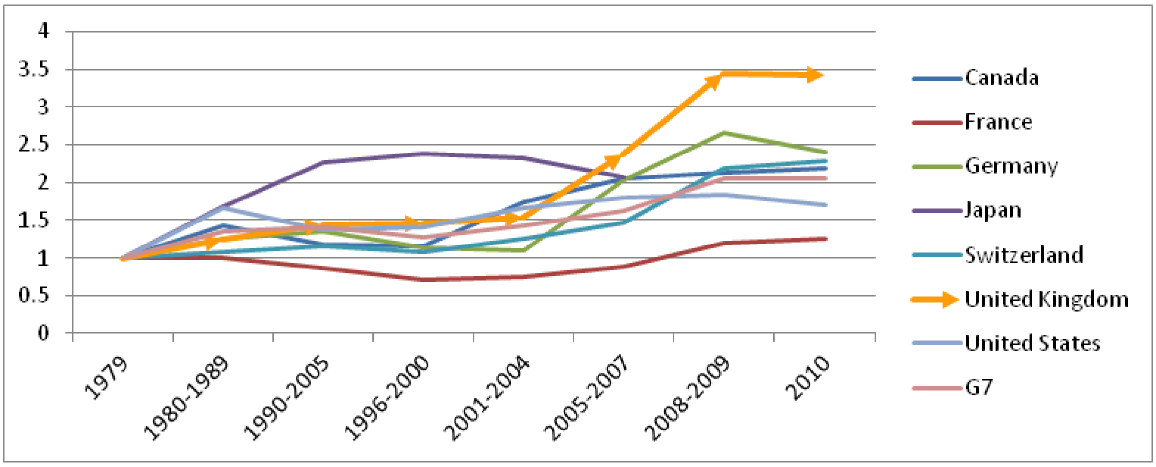
Source: IEA, OECD

Figure 28 shows indices of the residential/industrial gas price ratios. All prices are IEA sourced and are inclusive of tax. By 2010 the United Kingdom has seen the biggest increase in the residential/industrial gas price ratio of the sample nations (Japan data unavailable for 2008-2010). In 1995, the UK had a residential/industrial price ratio that was 2.5 times the value in 1979. Since then there has been a steady decrease to 2006 followed by a gradual increase to 2010. Germany and France are the only nations which have a lower residential/industrial gas price ratio in 2011 than they did at the base year (1979) showing that policy in these countries may not be as focused on the industrial markets as other nations examined.

CPI-Electricity price Index ratio

Residential

Figure 29: Gas Prices-Residential – Gas Price Index/CPII- Including tax- Selected OECD

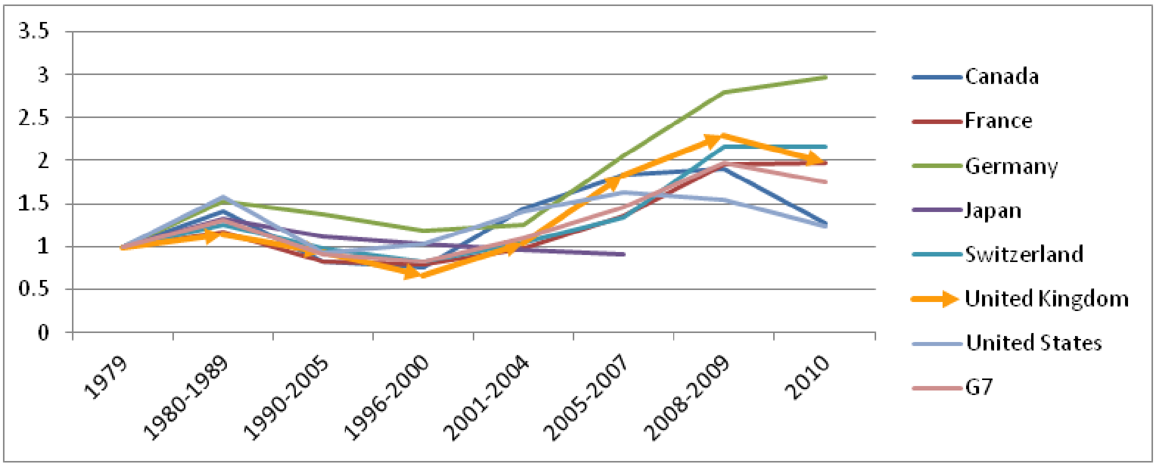


Source: LE using IEA, OECD data

Figure 29 contains a ratio of the index of the residential gas price against the Consumer Price Index. All prices are IEA sourced and inclusive of tax. Consumer price indices were given by the OECD. The graph shows that in recent periods the UK's residential gas price has been growing a lot faster relative to inflation than in the other sample countries. From 2005 the UK has been the country with the highest price growth relative to inflation of the group. While inflation has remained steady in the UK, residential gas prices have seen significant increase in recent years.

Industrial

Figure 30: Gas Prices-Industrial – Gas Price Index/CPII- Including tax- Selected OECD



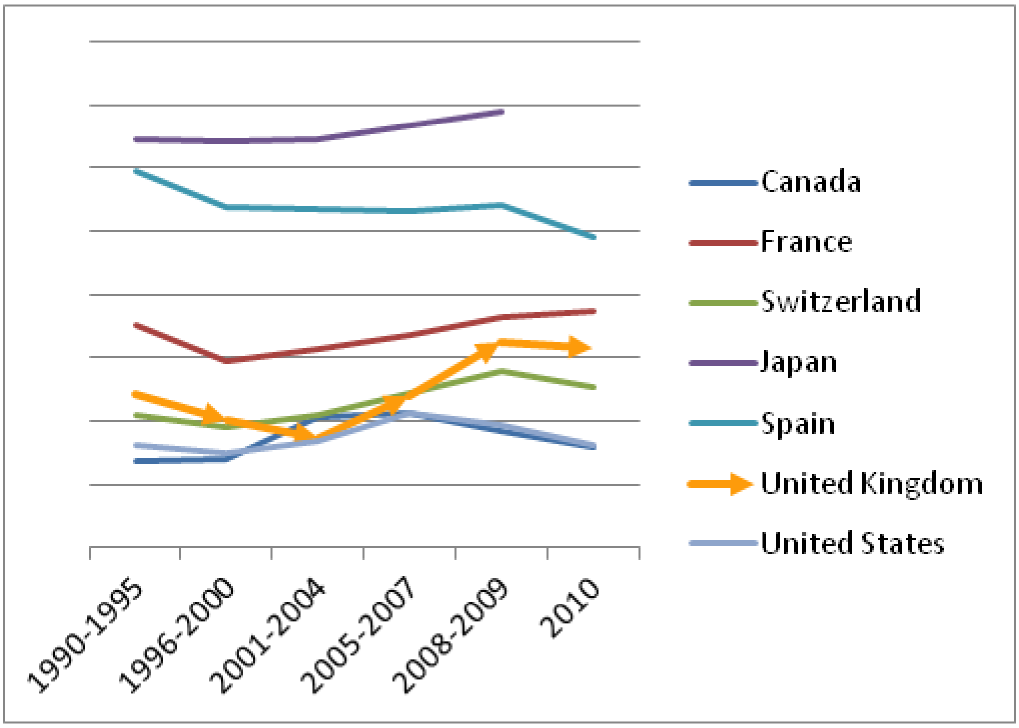
Source: IEA, OECD

Figure 30 graphs the ratio of the index of industrial gas prices to the Consumer Price Index. It seeks to explore how the industrial price has changed relative to inflation since 1979 (base year). The UK follows a similar growth pattern to most countries with the exception of Germany from 2004. The UK ranks as the median nation in increasing the industrial gas price in relation the inflation by 2010 since 1979. The growth of the industrial gas price since the base year to 2010 was twice that of inflation.

Price/Average wage

Residential

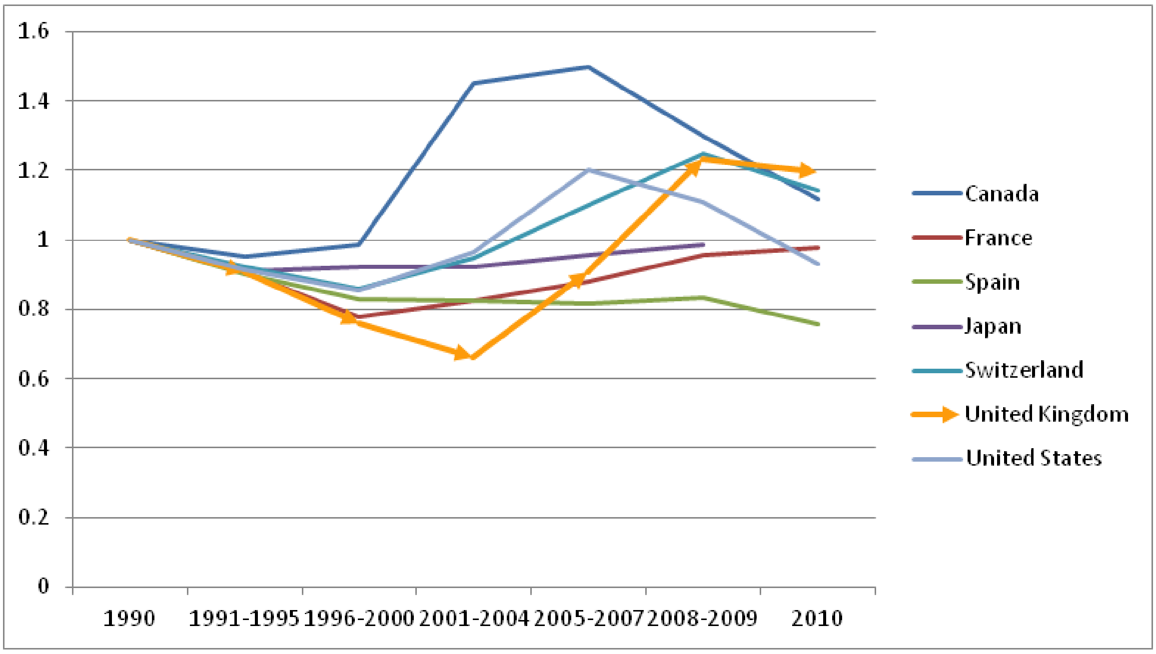
Figure 31: Gas Prices-Residential –Price/Average wage trend lines- Including tax- Selected OECD



Source: IEA, OECD

Figure 31 contains trend data on prices relative to average wage. Japan, Spain and France all have price/average wage profiles that stay consistently above that in the UK. The UK in the first and last sub-period is ranked as the median country in this sample group. In the third sub-period the UK goes below Switzerland and Canada on price/average wage only to rise above both countries again by the second last sub-period.

Figure 32: Gas Prices-Residential –Price/Average wage indices- Including tax- Selected OECD

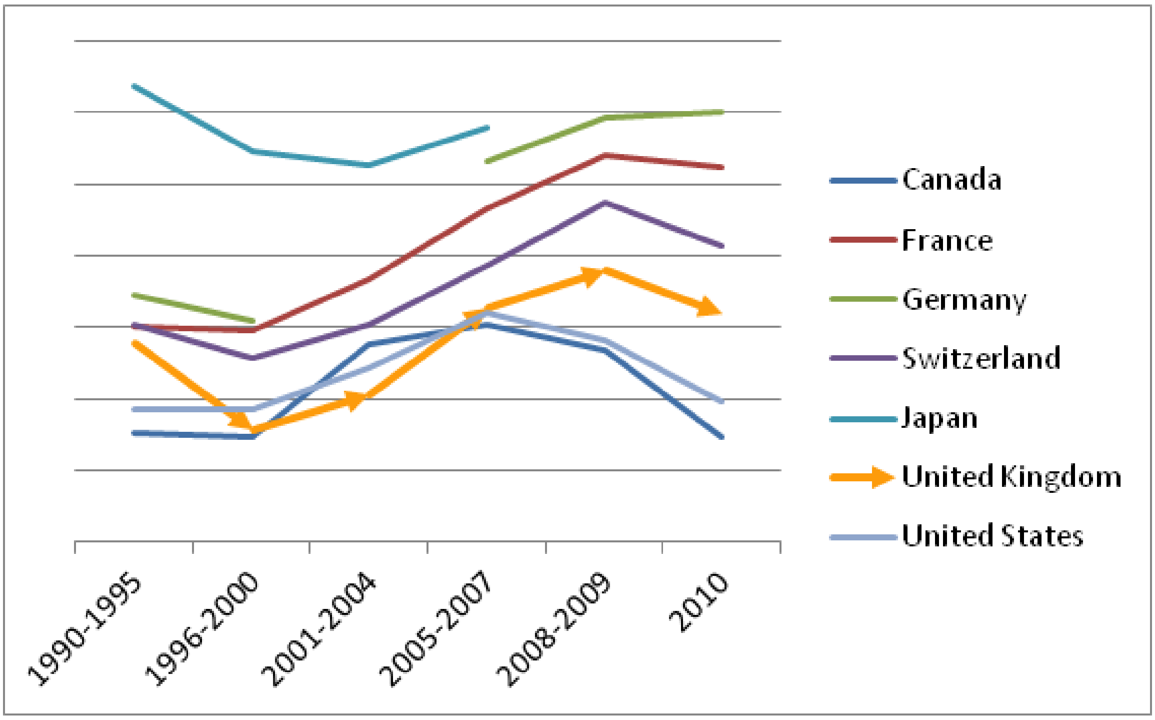


Source: IEA, OECD

Figure 32 contains ratios of residential gas price indices to average wage indices. All prices were IEA sourced and are tax inclusive while average wage data was given by the OECD. The graph shows that when 1990 is taken as the base year by 2010 the UK has experienced the most residential gas price growth in relation to average wage growth out of the sample nation group. The level of residential gas prices in relation to average wages is 1.2 times the ratio in 1990 in the UK.

Industrial

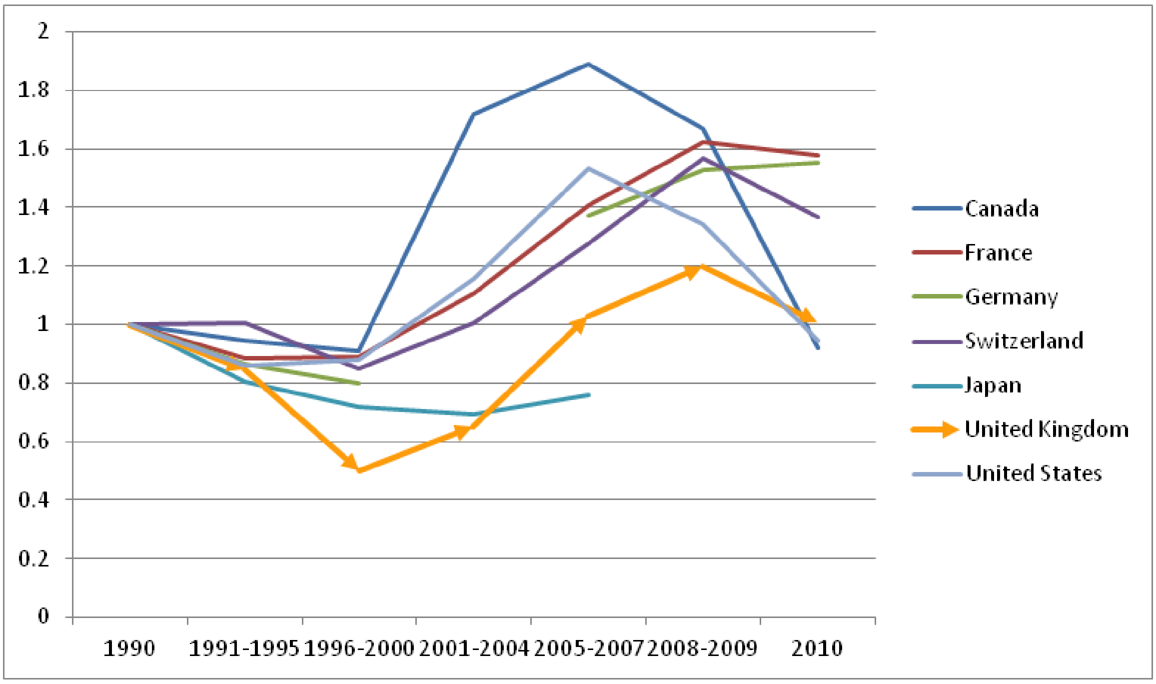
Figure 33: Gas Prices-Industrial –Price/Average wage trend lines- Including tax- Selected OECD



Source: IEA, OECD

Figure 33 contains trend data on industrial gas prices relative to average wage. Japan, Switzerland, Germany and France all have price/average wage profiles that stay consistently above that in the UK. The UK in the first and last sub-period is ranked as the third cheapest country in this sample group. In the third sub-period the UK goes below USA and Canada on price/average wage only to rise above both countries again by the second last sub-period.

Figure 34: Gas Prices-Industrial –Price/Average wage indices- Including tax- Selected OECD



Source: IEA, OECD

Figure 34 contains ratios of industrial gas price indices to average wage indices. All prices were IEA sourced and are tax inclusive while average wage data was given by the OECD. The graph shows that when 1990 is taken as the base year by 2010 the UK has experienced the third least industrial gas price growth in relation to average wage growth out of the sample nation group. The level of residential gas prices in relation to average wages in 1990 is very close to its level in 2010. The US and Canada are the only countries to have seen a reduction in this ratio since 1990.

4.4 Conclusions to the pricing comparisons

Overall the UK ranks cheaper than average in terms of price comparisons internationally for both electricity and gas. The UK tends to rank somewhat cheaper for residential customers than for industry, and cheaper for gas than for electricity.

Across the range of comparisons, UK ranks towards the top of the sample (low prices) relative to the EU15, while middle-average to above average (low prices) when compared to the Selected OECD sample of countries.

In general, the adjusted benchmarking results are not indicating anything that goes against expectations with UK prices and the results are largely consistent with the basic benchmarking.

The ratio of residential to industrial electricity prices reflects retail margin differences, differences in tax and levies, T&D charge differences between small and large users, and the cost of serving more peaky loads. If one customer group were paying a substantially lower share than the other, this might be indicated here. The ratio of residential to industrial electricity price is showing the UK is on the higher side of the ranking.

Relative to CPI and wages, the general trend has been that prices in the UK have been growing relatively more rapidly when compared to other countries. Naturally, this may be due to factors such as wages and prices growing more slowly in the UK relative to other countries, in addition to commodity supply factors. This is consistent with the recession in the UK and the notion that the BOE has been able to keep interest rate low. While this may have led to inflation that has been somewhat higher than historically, it likely also led to a greater increase in the nominal cost of fuels as sterling depreciated. However, the net result is that the rises in wages and CPI have been relatively slower in the UK than in comparators.

While it is difficult to make sweeping conclusions, we believe that the broad trends and levels of comparisons are consistent with hypotheses about the drivers of prices (which we test further in the econometric synthesis later in this study). These hypotheses are that overall, commodity prices and local conditions, including import-export levels and energy intensity and scale, impact price the most. Fuel mix, environmental and taxation policy are also very significant drivers. This all seems to be consistent in the broadest sense with the comparisons in this chapter. These factors and the qualitative analysis of this chapter, all provide a good point to start econometric analysis in order to strengthen our hypotheses.

5 Volatility

This section studies the volatility of retail electricity and gas prices across our sample of 22 countries.

We note that the volatility of the price series in a general sense can be studied by observation of the price trend graphical analysis presented in the previous section. This chapter presents a more formal analysis of price volatility. The analysis calculates the volatility over time (1990-2010) for each country based on a standard deviation of the natural log volatility definition. The time period was chosen as the most recent available, but still sufficiently long enough to have enough observations to have a statistically meaningful estimate.

We also note that it is not *a priori* clear that low volatility is good. It could be, for example, that if retail prices do not correctly reflect volatility in wholesale prices, then consumers could make inefficient investment decision in their energy using equipment/appliances, etc[151].

Included in our regression analysis was a regression of retail price volatility on wholesale commodity volatility, but the results were poor, probably because the definition of volatility we use is annual and so we only had 22 observations across country, but not across time.

It should also be noted that our data are average annual data from the IEA and so volatility in terms of wholesale prices that might be daily (e.g., NBP gas) or even hourly (e.g., APX electricity) are not relevant, although these might typically come to mind when one thinks of volatility.

5.1 Volatility definition

Before proceeding further, it is necessary to consider a more formal definition of volatility. We would like a definition that gives some measure of the dispersion of the variable, but one that is unit less. We would also note that volatility of a time-series with either trends or unit roots should be defined relative to some unit of time. We use the definition that is similar for financial calculation,[152] such as for pricing derivatives such as Black-Scholes call and put options. In this sense, we define the volatility as the standard deviation of the natural log of the price series. The time-dimension is annual, so this is the annual volatility. The formula is:

Where *T* is the number of years (time periods), *P* is the price in year t, and *p*-bar is the average of the natural log of the price series.

[151] Lower volatility induces consumers to invest less in flexible energy using capital, for example.

[152] Financial volatilities are usually based on 'returns'.

5.2 Data

The study of volatility uses the IEA data on residential and industrial end-user prices. It includes the totals with tax[153]. In general, the sample period was from 1990 to 2010, or the latest years' data available.

For most countries, the data set was not missing many values although data coverage was better for electricity markets than it was for gas markets. For industrial electricity, in 14 out of 21 countries, no more than two observations were missing. For residential electricity, 18 out of 21 countries were not missing more than two observations. For industrial gas, 12 were missing more than two observations and nine were missing more than two observations for residential gas. Countries missing more than 10 observations were Luxembourg for industrial electricity, Sweden, Portugal, Luxembourg, Denmark, Austria and Australia for industrial gas and Australia, Portugal and Sweden for residential gas.

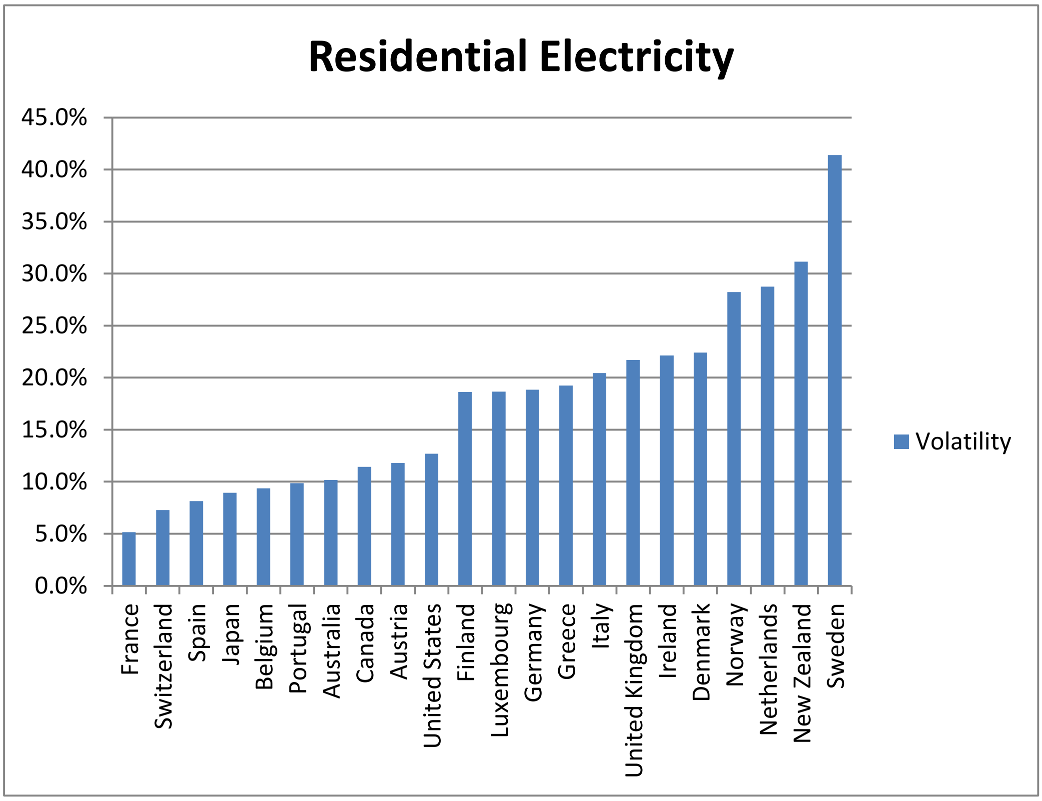
5.3 Volatility of electricity prices

The results of our volatility study for electricity are found in the figure below. The UK has the seventh highest volatility of the sample of 22 countries. France has the lowest volatility and Switzerland and Spain have the second and third lowest. Spain, it should be noted, had a history of non-cost-reflective tariffs and a 'tariff deficit' over the period. Japan had the fourth-lowest and fourth-lowest volatility levels, respectively. The country with the highest price volatility is Sweden[154]. The Nordic countries, as well as New Zealand and Spain, perhaps have high volatilities as these jurisdictions are known to be sensitive to weather conditions and hydro availability.

[153] A significant methodology change in 2007 in the Eurostat data meant that this impacted the volatility estimates and so we used only the IEA data.

[154] The IEA data for Sweden did contain missing values, and this is influencing the results here.

Figure 35:Volatility of residential electricity prices



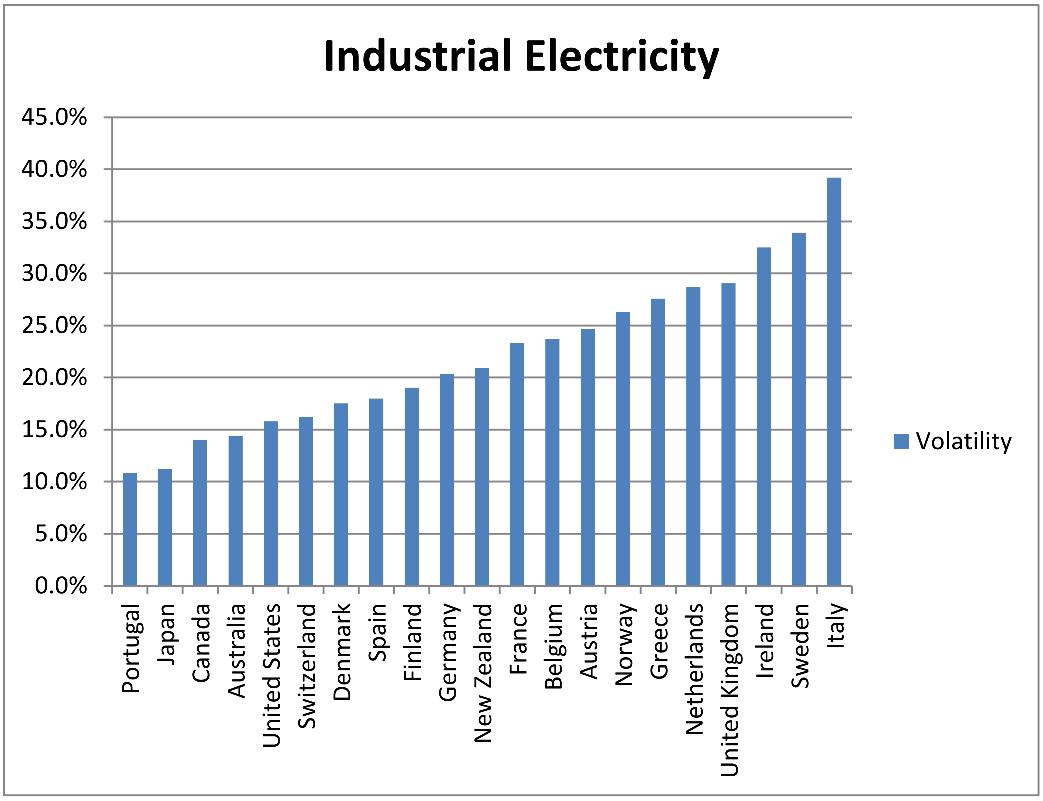
Note: Data from IEA, including tax

Source: London Economics figure

Industrial volatility estimates are found in Figure 36 overleaf. The UK has relatively high price volatility over the sample period and ranks fourth-highest out of the 21 countries[155]. Ireland, Sweden, and Italy are the highest volatilities in industrial prices. The lowest value is for Portugal and Japan has the second lowest volatility.

[155] Luxembourg was excluded due to missing values. If half or more of the values were missing the country was excluded.

Figure 36:Volatility of industrial electricity prices

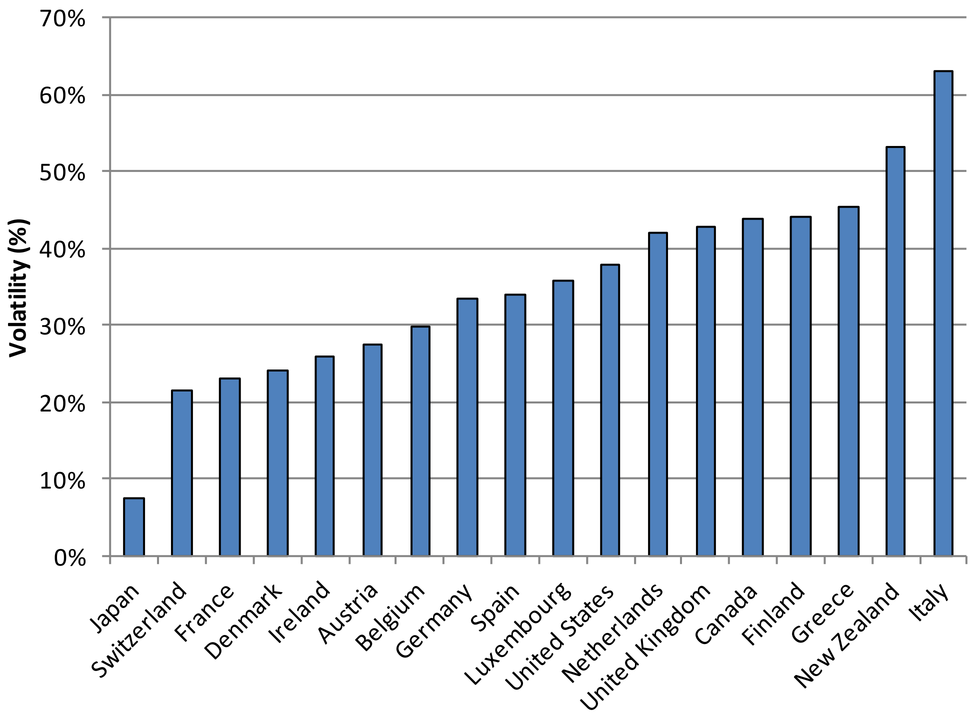


Note: Data from IEA, including tax
Source: London Economics figure

5.4 Volatility of gas prices

The results of our volatility study for residential gas are found in Figure 37 overleaf. The UK ranks sixth highest for residential gas price volatility. The average volatility level for the group is 35.3% while it is 42.8% for the UK. Italy, which had the highest industrial electricity price volatility, has the highest residential gas price volatility. New Zealand, which has the second highest residential electricity price volatility, ranks second highest for residential gas price volatility. Similar to the results for industrial and residential electricity, Japan has very low residential gas price volatility.

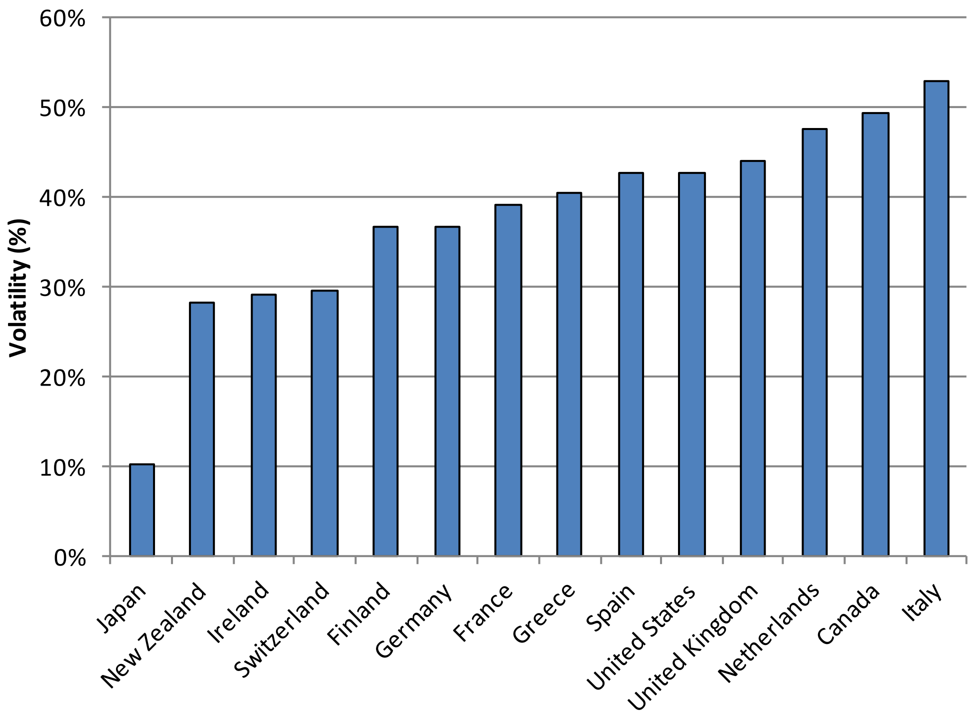
Figure 37:Volatility of residential gas prices



Note: Data from IEA, including tax
Source: London Economics figure

Finally, we present the chart for the volatilities of industrial gas in Figure 38 overleaf. The UK has the fourth highest volatility level for this category of the fourteen countries in the sample. Identical to the residential gas price rankings, Japan and Italy have the lowest and highest volatility levels for industrial gas respectively. Similar to the residential case, Japan's industrial gas price volatility level is less than half the size of the next highest volatility level. This may be reflective of long term LNG contracts being Japan's source of gas.

Figure 38:Volatility of industrial gas prices



Note: Data from IEA, including tax
Source: London Economics figure

5.5 Conclusions on price volatility

The volatility of UK electricity prices for residential users could be characterised as middle-high, ranking seventh out of 22 countries. For industrial users electricity price volatility is also relatively high, and is the fourth highest in a sample of 21 countries. The UK's gas price volatility is higher than average for both residential and industrial gas prices. For gas, the UK ranked 13th for residential users and 10th for industrial users, for the available sample.

The results are based on the IEA sample of countries and the period 1990-2010, defining volatility as the standard deviation of the natural log of price.

Volatility seems relatively similar across the UK markets. A likely explanation of this is that gas commodity price volatility has to volatility in end-user electricity and gas prices. Two factors of gas commodity in the UK are probably significant here: the switch from being a net exporter to a net importer, as well as the importance of spot market prices for competitive retail prices. It should be noted that the period 1990-2010 encompasses the period of export expansion and then a switch to a net importer for the UK after the so-called 'dash to gas' in the power sector. The impact of this on volatility and the gas price rises in the UK is probably significant. We were unable to confirm this hypothesis and others on volatility using econometrics, however, due to the small sample size. We would note that the possibility of estimating more detailed volatility figures, perhaps using quarterly data for end-user prices and more granular time-series for wholesale prices would be a potential area for further research.

6 Price breakdown

6.1 Introduction

In Chapter 4 electricity and gas retail prices were examined, both including and excluding tax. This section goes one step further, examining the breakdown of gas and electricity prices into its components with the aim of comparing the components in Great Britain with those in other countries and regions. The components of interest are:

- Commodity price;
- Supplier margin;
- Transmission, distribution and network costs; and
- Taxes and levies.

The supply margin indicates the proportion of the price going to the gas or electricity supplier (this would generally fund supplier overheads and provide a net profit).

The Council of European Energy Regulators (CEER) requests each of its members to provide information about electricity and gas prices in their annual reports[156]. The information describing the breakdown of a typical energy price into its component parts was collected from members' reports from 2005 to 2011 as well as from other sources such as regulator websites. Information from 2009 for European countries was available in Eurostat's "Electricity prices for second semester 2009" report.

In many cases, commodity price and supplier margin are aggregated and in other cases, information about taxes is not provided or transmission and distribution costs are merged with tax costs. Special cases are noted below.

6.2 Price breakdown for electricity markets

6.2.1 Price breakdown for residential electricity markets

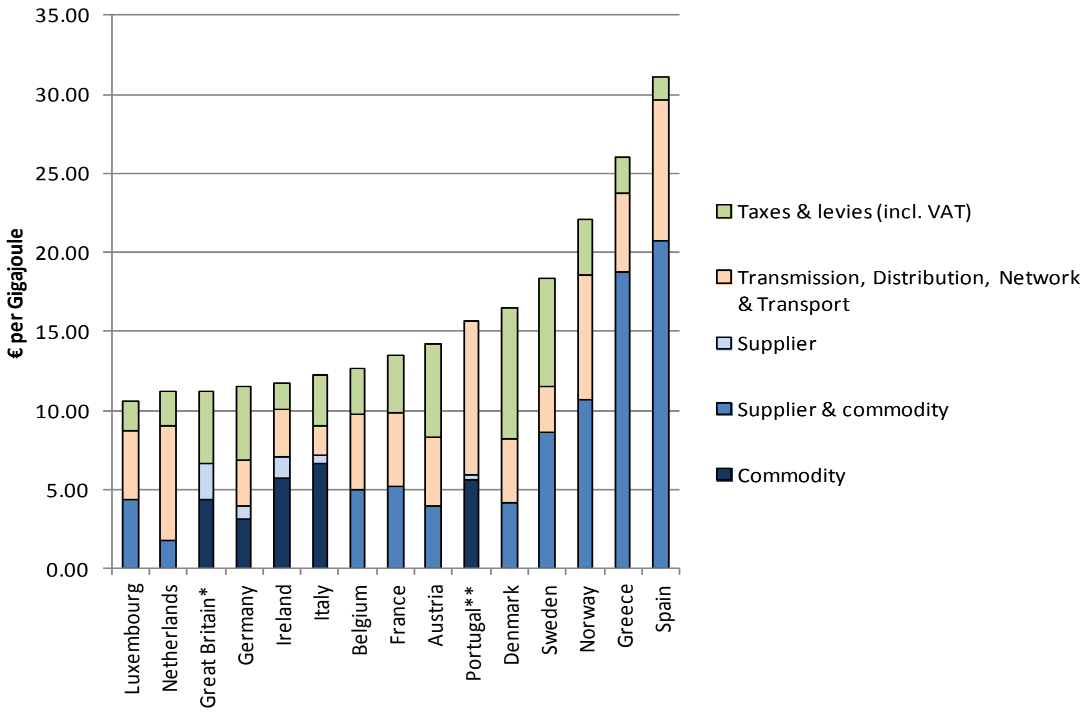
Figure 39 orders the countries by average cost. Luxembourg has the lowest average cost and Spain has the highest. Great Britain has the third lowest average cost.

In most cases, the supply margin figure was aggregated with the cost of the commodity and so any comparison of this figure is limited. When combined supply margin and commodity cost is considered, Great Britain ranks 9th lowest out of the 15 countries.

When the aggregated taxes and network costs component for Great Britain is considered and compared against the sum of taxes and network costs in other countries and regions, Great Britain has the lowest nominal combination of taxes and network costs.

[156] Available at www.energy-regulators.eu

Figure 39:Nominal breakdown of electricity prices to residential customers



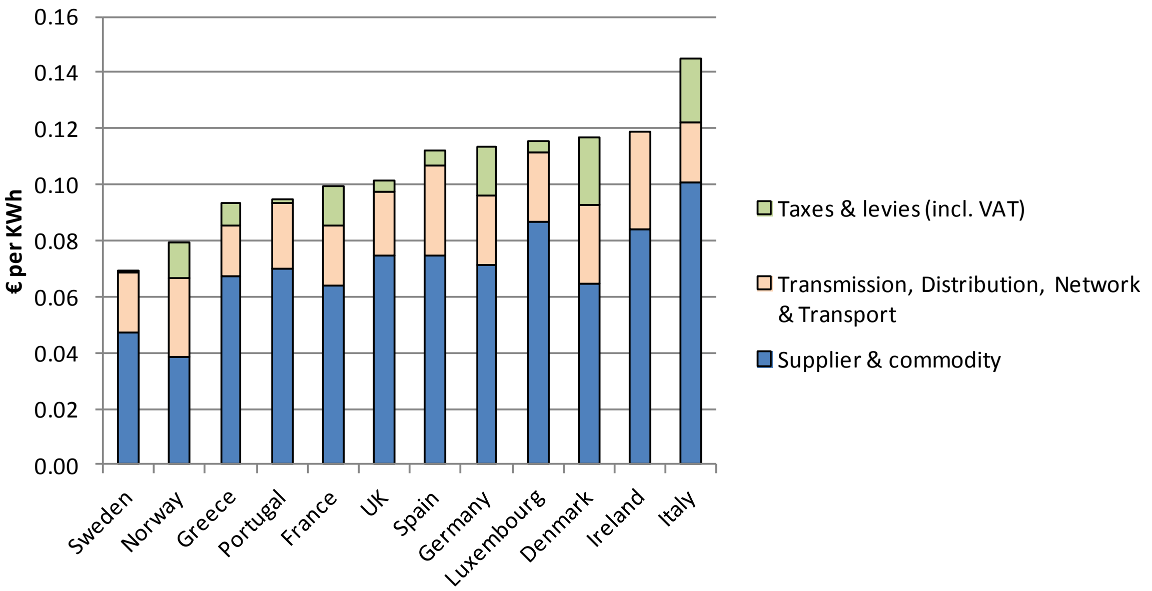
Note: Figures from 2009 for Norway, Spain and Greece, from 2010 for Netherlands, Germany, Portugal and Luxembourg and from 2011 for all others.
* The UK figures include Transmission, Distribution, Network and Transport in the Taxes and Levies section
** The percentage of Taxes and Levies was not specified in these cases
Source: London Economics analysis of price breakdown data from annual regulator reports submitted to CEER, Eurostat report and web research (price breakdown information) and Eurostat database (average costs).

6.2.2 Price breakdown for industrial electricity markets

Figure 40 shows the breakdown of electricity prices to industrial customers. Figures from Eurostat were not available for Great Britain but were available for the UK instead. When countries are ordered by total average electricity cost, the UK has the 6th lowest average cost of the 12 included countries.

Disaggregated supply margins were not found for these markets and supply margin has been merged with the commodity cost instead. The UK ranks 4th highest on this measure. However it has the 4th lowest tax and levy figure and the 5th lowest network costs.

Figure 40:Nominal breakdown of electricity prices to industrial customers



Note: Figures are for 2011 for France, 2010 for Denmark and 2009 for all others.

Source: London Economics analysis of price breakdown data from annual regulator reports submitted to CEER, Eurostat report and web research (price breakdown information) and Eurostat database (average costs).

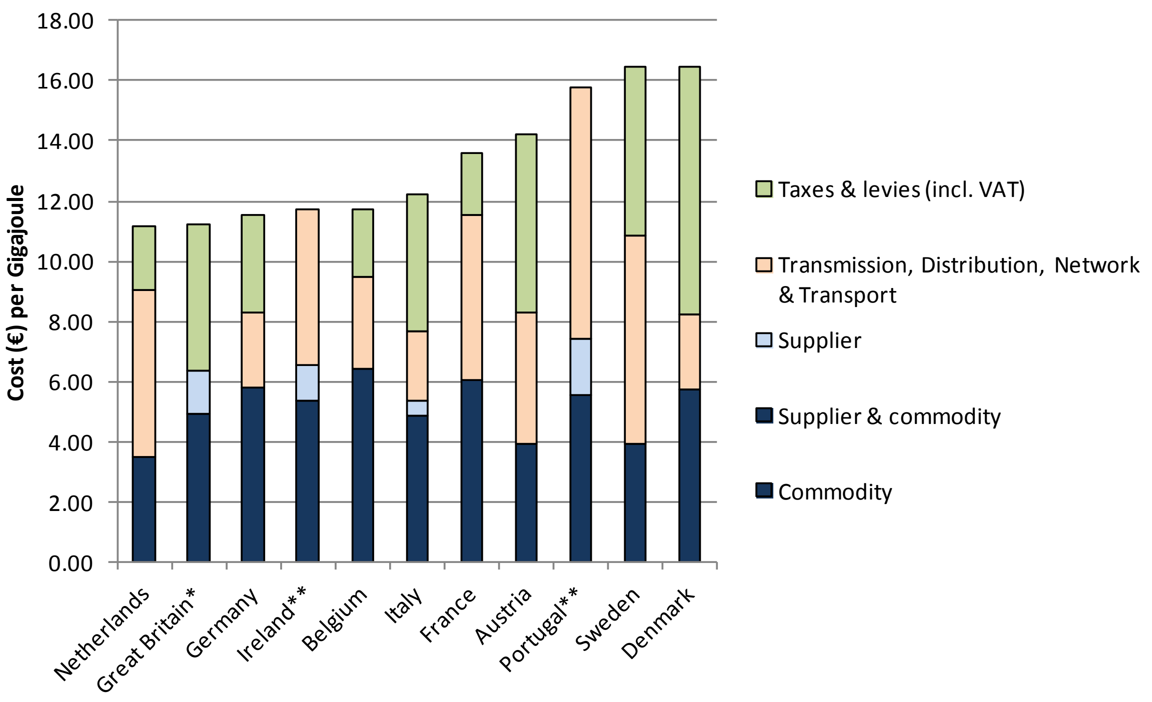
6.3 Gas

6.3.1 Price breakdown for residential gas markets

Figure 41 orders the countries by average cost and shows the breakdown of residential gas prices. Great Britain has the second lowest average cost. When the combined supply margin and commodity cost figure is calculated, Great Britain ranks 4th highest out of 11.

When the aggregated taxes and network costs component for Great Britain is considered and compared to the sum of taxes and network costs in other countries and regions, Great Britain has the lowest combination of taxes and network costs.

Figure 41:Nominal breakdown of gas prices to residential customers - 2011/2010

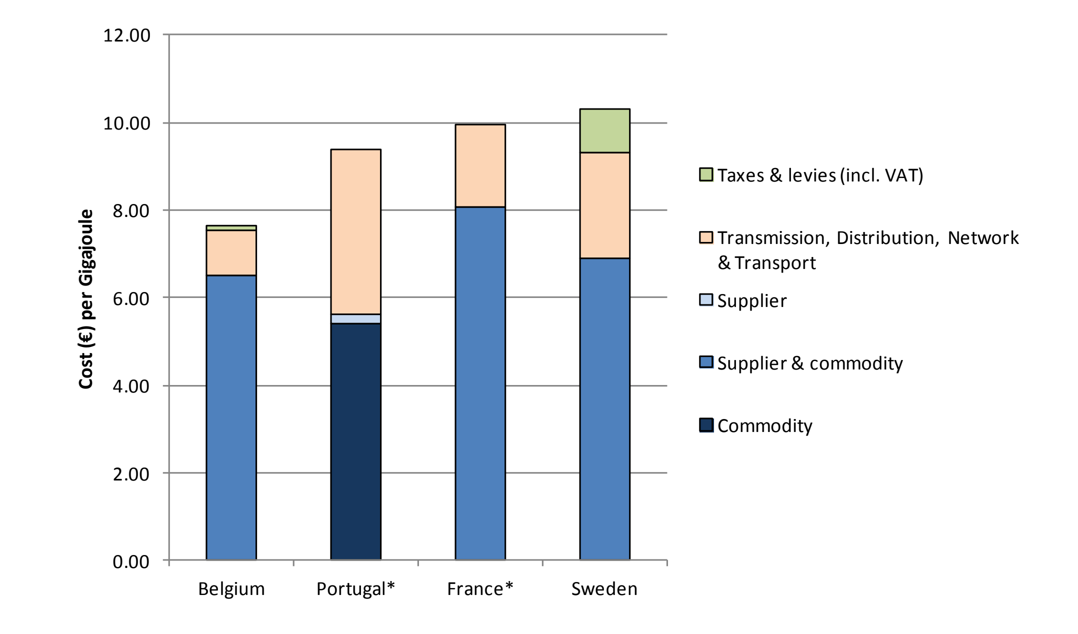


Note: Figures are for 2010 wherever figures for 2011 were not available.
* The UK figures include Transmission, Distribution, Network and Transport in the Taxes and Levies section
** The percentage of Taxes and Levies was not specified in these cases
Source: London Economics analysis of data from annual regulator reports submitted to CEER and web research (price breakdown data) and Eurostat database (average costs).

6.3.2 Price breakdown for industrial gas markets

Figure 42 shows the breakdown of electricity prices to industrial customers. The equivalent figures for Great Britain could not be found so no comparison can be made between Great Britain and the included countries. The supply margin could only be found for Portugal.

Figure 42:Nominal breakdown of gas prices to industrial customers - 2011/2010



Note: Figures are for 2010 wherever figures for 2011 were not available.
* The percentage of Taxes and Levies was not specified in these cases
Source: London Economics analysis of data from annual regulator reports submitted to CEER and web research.

6.4 Conclusion

The aim of this analysis was to examine how Great Britain[157] compares with other countries in terms of the various price components. Unfortunately, disaggregation to supply margin level was only available for a small number of countries (five countries for electricity and four for gas).

For the countries without disaggregated supply margin, the supply margin was combined with the commodity price. If we consider this combination instead, Great Britain has the 9th lowest figure out of the 15 countries for the residential electricity market and 4th highest out of 11 for residential gas. The UK has the 4th highest combination of supplier margin and commodity cost of 12 companies included for industrial electricity.

By contrast, energy prices in Great Britain have a very low tax and network cost component relative to the other countries, ranking lowest for both residential electricity and residential gas. Similarly, the industrial electricity market in the UK has the 4th lowest tax and levy figure and the 5th lowest network costs of 12 countries.

It appears that the UK's low tax and network costs are two of the main drivers behind the UK's relatively low gas and electricity prices.

[157] Great Britain for residential and UK for industrial

7 Profitability

7.1 Introduction

7.1.1 Objectives of the analysis

This section examines business profitability among energy suppliers with the aim of benchmarking profitability levels of supply companies in Great Britain against those in Europe, Canada, New Zealand, the United States and Australia. The aim was to gather profitability figures that corresponded to each of the main electricity and gas supply businesses in each country or region, and by using the figures to compute a total measure of profitability for that country or region. This profitability ratio measure could then be compared across countries to give a picture of the average level of profitability of electricity and gas supply companies in Great Britain relative to that of other countries and regions.

7.1.2 Outline of the approach

The first step in the analysis was to identify the relevant companies. Due to the international scope of the analysis, a variety of sources were used in the research. This process is described in more detail in Section 7.2.

Once the companies had been identified, the next step involved the retrieval of the corresponding profit figures for each company. Two databases (published by Bureau Van Dijk) which provide economic and financial information, Fame and Orbis, were used to source the required data. Section 7.2.2 provides more details. We retrieved a variety on profit data and, following a review of the data availability we focused on the ratio of EBIT to turnover. However, before these data could be used, clear outliers were removed from the dataset as in some cases these outliers appeared to be cause by data entry errors. The selection of the profit indicator and the data cleaning process are described in Section 7.2.3 and Section 7.2.4, respectively.

One difficulty with using reported profitability ratios of companies is that in the case of vertically integrated companies or multi-product suppliers, the published profit figure reflects the combined profits of all activities undertaken by the company and not just the profit at the supply stage. This issue is discussed in greater detail in Section 7.2.5.

In country or region profit indicator presented below is a weighted average of the company-specific figures. The approach used for the calculation of the weighted profit indicator is outlined in Section 7.2.6.

Finally, the results of the analysis are presented in Section 7.3 using graphs to benchmark profitability levels in Great Britain with those of the other countries and regions. Section 7.4 concludes the analysis.

7.2 Methodology

7.2.1 Research process for building the sample of companies

The dataset used for this analysis is based on financial information for a sample of electricity and gas supply companies across 45 countries and regions including the EU15 Member States, Norway, Switzerland, Canadian provinces, US states, Australia states and New Zealand. The main criterion for inclusion in the sample was that a company had to have a national market share of over 5% in either the residential or commercial gas or electricity markets.

In many cases, market share information was gathered using information available on regulator, consumer or company websites and, in some cases we obtained this information from the regulator directly. A question regarding the main suppliers in the gas and electricity markets was also included in the survey sent to national regulators and, in cases where we received a response from a regulator, this information was reconciled with our own desk research.

In the case of US electricity companies, market shares were calculated based on the information provided by suppliers to the US Energy Information Administration[158]. For European countries, the main sources for market share information were the annual regulatory reports produced by the national energy regulators for the Council of European Energy Regulators (CEER)[159]. For Australia, market share information was available in the Australian Competition and Consumer Commission's annual "State of the energy market" report[160]. For New Zealand, the information on gas markets was provided by the gas regulator and electricity market shares were sourced from the electricity regulator's website[161]. The main sources for information about Canadian companies were provincial regulator websites.

7.2.2 Data source

Once the sample companies had been identified, profit information was sourced from the Amadeus and Orbis databases[162].

For each company identified as a main player in the energy market, an effort was made to find the entry in the databases that corresponded as closely as possible to the supply part of the business. This was done by using sources such as annual reports and company websites as well as using figures such as total assets per employee, fixed assets and revenue per employee to determine whether the data were likely to relate to the generation or supply part of the business or both.

In some cases, it was clear which the data corresponded to the supply business. In others, particularly for vertically integrated companies, the financial figures to the supply revenue as well

[158] Based on the form EIA-861 which is filled by all US electricity marketers

[159] Available at www.energy-regulators.eu

[160] AER "State of the energy market", 2011

[161] www.ea.govt.nz

[162] Orbis is published by Bureau van Dijk and is a global database containing financial information and financial ratios at company level for companies throughout the world. Amadeus is a similar database, published by the Bureau van Dijk but provides information on European companies only. Profit information was available from 2003 to 2010.

as revenue from other sources, e.g. generation, transmission, the sale of other products. This point will be discussed further in Section 7.2.5.

7.2.3 Selection of profitability ratio

EBIT margin (Earnings before Interest and Taxes) was chosen as the most appropriate profitability indicator to analyse how business profitability of electricity and gas suppliers in Great Britain compares with that of other countries and regions with comparable market structures. EBIT margin is defined as:

EBIT margin (%) = (Earnings before interest and taxes) / Operating revenue * 100

The EBIT margin was chosen as the profit indicator because it comes closest to the economic concept of return to capital irrespective of the financial structure of the company (i.e. the measure is not affected by financial engineering in contrast to a profit figure after interest payments). The EBIT was normalised as a percentage of total turnover to be able to compare the profitability across different company sizes.

Two other profitability indicators, namely “Return on Capital Employed” (ROCE) and “Return on Equity” (ROE) were also considered.

ROCE = (Net income + Interest paid) / (Shareholder funds + Non-current liabilities) * 100

ROE = (Net income / Shareholder funds) * 100

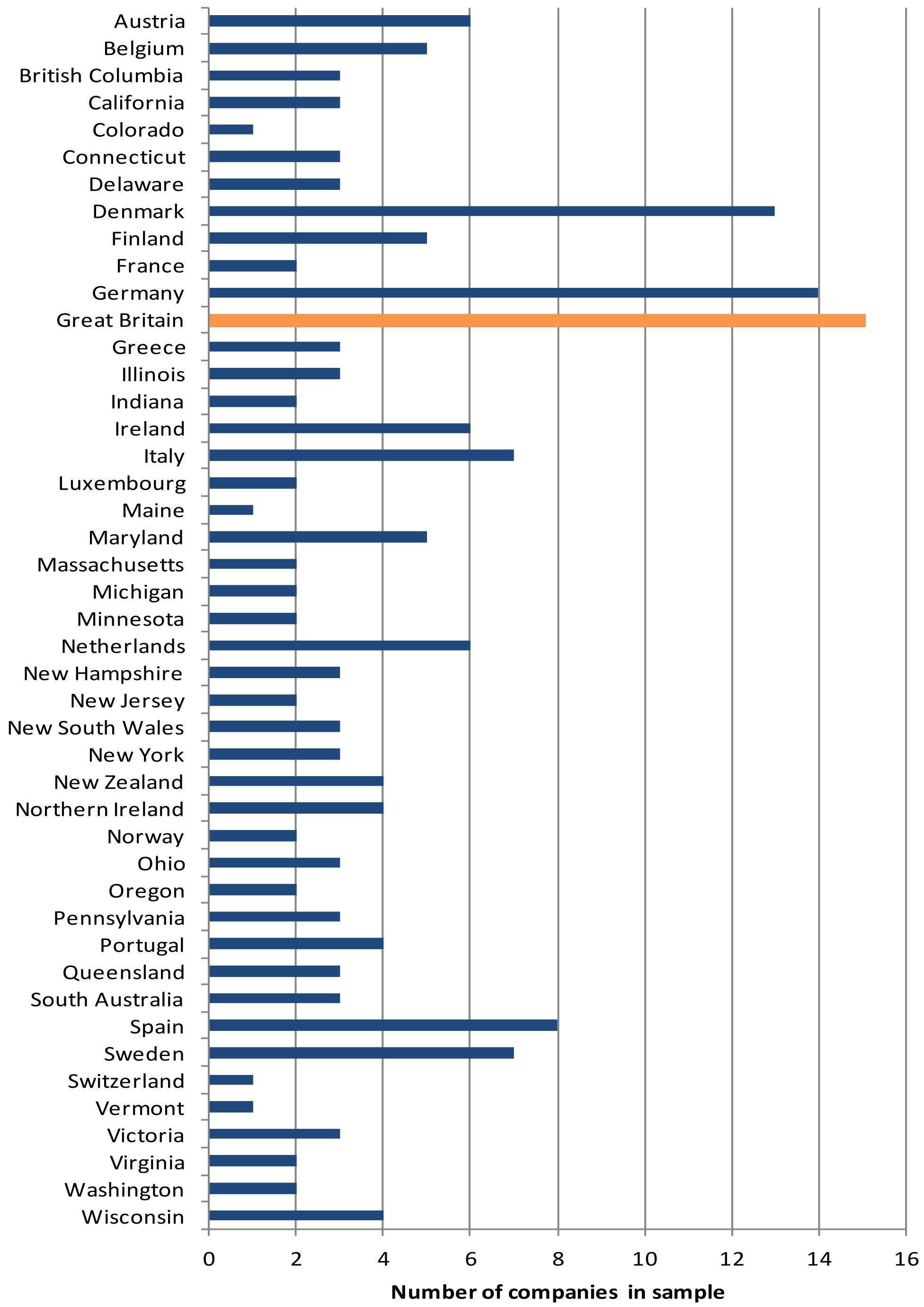
However, there were too many missing values in the Amadeus and Orbis databases for these two measures to allow a meaningful comparison across countries and regions. Furthermore, since ROCE figures ranged from -527% to 892% and ROE figures ranged from -815% to 703% for the sample companies, these were judged to be unreliable measures and so were not used.

7.2.4 Companies excluded from dataset

Our first step was identifying the main supply players in each market. After having been identified the main player in each market, some companies could not be included in the dataset due to a complete lack of data in the Amadeus and Orbis databases. Other companies had to be dropped from the dataset because some of their data points appeared to be outliers (e.g., an EBIT margin of over 25% for every year or jumps and falls larger than 50 percentage points) or because of a lack of recent data. The full list of companies included in the analysis is provided in the annex as is another table which lists the companies which were dropped from the analysis and the specific reason for exclusion.

The following figure shows the number of companies in the sample used for the analysis by country or region after excluding the companies listed in the annex. The final total number of companies in the sample is 163.

Figure 43: Number of companies in the sample per country or region



Note: The above graph does not aim to reflect concentration in each market, only to describe the composition of the London Economics dataset.

Source: London Economics desk research

7.2.5 “Pure suppliers” and “non-pure suppliers”

Because many entries in Amadeus and Orbis relate to a vertically integrated it was necessary to take account of this fact when comparing business profitability across countries and regions. Where an entry in Amadeus or Orbis appeared just to describe the revenue from supply operations only, this company was called a “pure supplier”. Where a proportion of total revenue originated from some other part the energy business (e.g., production, distribution) or from the supply of some other product(s) (e.g. broadband, oil), the company was called a “non-pure supplier”.

One approach used to establish what activities the EBIT data related to was to use sources such as the company descriptions provided by the Amadeus and Orbis databases, annual reports and consumer websites. Another approach was to consider variables such as total assets per employee, fixed assets and revenue per employee to determine whether the entry was likely to describe the generation or supply part of the business or both. For instance, one would expect a “pure supplier” to have high revenue per employee and relatively low fixed assets. By contrast, high levels of total assets or fixed assets could signal that the company owns a generation capacity and / or is involved in transmission or distribution.

In the end, it turned out that very few of the companies in the dataset could be classified as “pure suppliers” – too few to allow benchmarking between Great Britain and other countries and regions. Thus, companies that are best described as “non-pure suppliers” are also included in the analysis which follows.

7.2.6 Weighted EBIT margin across countries and regions

In order to produce a profit figure for a particular country or region, the EBITs of the companies operating in a particular region or country were weighted by operating revenue, to take of account of different sizes. As a result, the profit measure for each country or region reflects larger companies more strongly than smaller companies.

The weighting was undertaken as follows for companies (i = 1, ..., m) operating in country or region j:

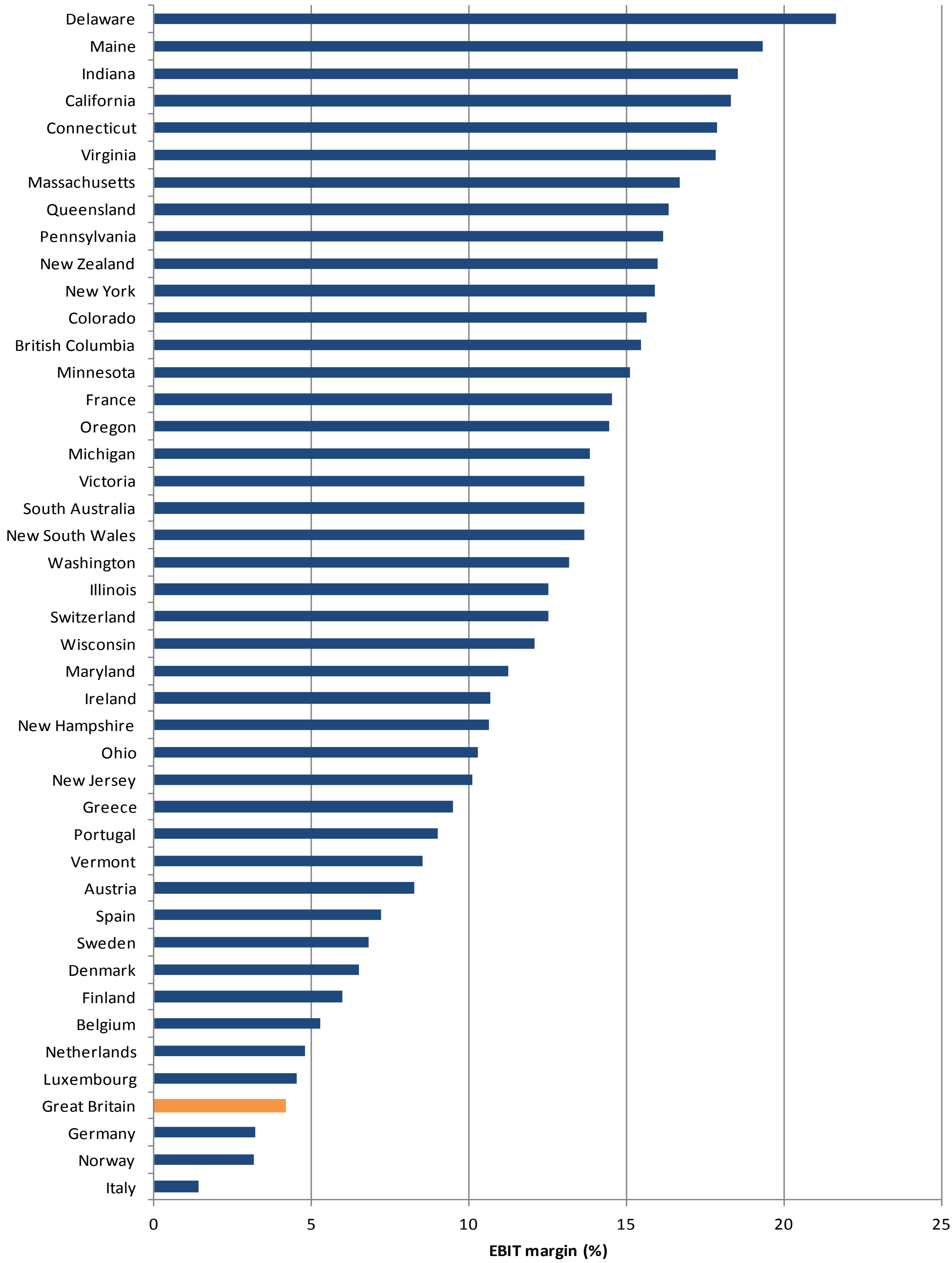
7.3 Benchmarking results

7.3.1 Average EBIT margin across time

Figure 54 below shows the weighted EBIT margin averaged over the years from 2003 to 2010 for each country or region. The number of sample companies is broken down by country in Table 5.

The weighted EBIT margin in Delaware is the highest of the group of countries and regions included. Furthermore, 11 out of the 15 countries or regions with the largest associated weighted EBIT margin are US states. By contrast, it is mostly European countries that populate the bottom of the figure with 14 out of the 15 countries or regions which have companies with the lowest EBIT margin being European countries. Great Britain has the 4th lowest EBIT margin of all of the countries and regions at 4.2% and Italy has the lowest average EBIT margin.

Figure 44: Average weighted EBIT margin 2003 – 2010 by country



Note: Companies weighted by operating revenue.
Source: London Economics analysis of Amadeus and Orbis databases

Table 5: Number of sample companies per country/region			
Country/region	No. sample companies	Country/region	No. sample companies
Austria	2	Minnesota	2
Belgium	4	Northern Ireland	4
British Columbia	3	Netherlands	6
California	3	New Hampshire	3
Colorado	1	New Jersey	2
Connecticut	3	New South Wales	3
Germany	13	New York	3
Denmark	12	New Zealand	4
Delaware	2	Norway	2
Spain	8	Ohio	3
Finland	4	Oregon	2
France	2	Portugal	4
Great Britain	12	Pennsylvania	3
Greece	1	Queensland	3
Ireland	4	Sweden	7
Italy	7	South Australia	3
Illinois	3	Switzerland	1
Indiana	2	Vermont	1
Luxembourg	2	Victoria	3
Maine	1	Virginia	2
Maryland	4	Washington	2
Massachusetts	2	Wisconsin	4
Michigan	2		

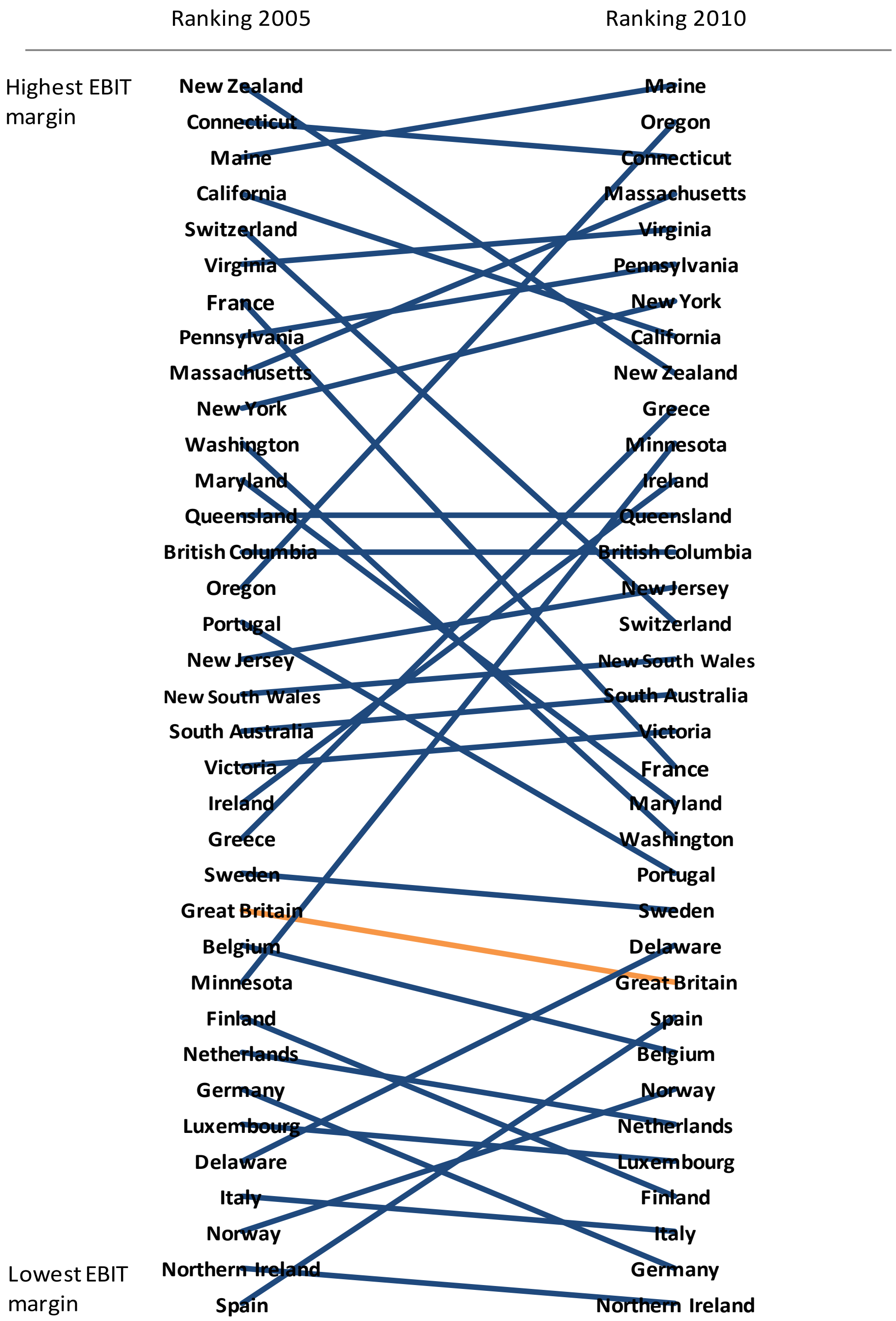
Note: This does not aim to reflect concentration in each market, only to describe the composition of the London Economics dataset.
Source: London Economics desk research

7.3.2 Changes in ranking from 2005 to 2010

In Figure 45, countries and regions were ranked in order of highest weighted EBIT margin to lowest for the years 2005 and 2010. The purpose is to explore how the profitability ratios (weighted EBIT margin) within countries and regions have changed relative to one another. Denmark, Austria, Michigan, New Hampshire, Colorado, Illinois, Indiana, Ohio, Vermont and Wisconsin were dropped from the graph as no EBIT margin figures were available for either 2005 or 2010 for the sample companies in these countries and regions.

Great Britain has the 12th lowest EBIT margin of the 35 countries and regions in 2005 and the 10th lowest in 2010. The most dramatic jumps in ranking over this time are posted by in Minnesota, Oregon, Ireland and Greece. The most dramatic falls are seen in France, Switzerland, Washington, Maryland, New Zealand and Portugal.

Figure 45: Changes in EBIT margin ranking from 2005 to 2010



Source: London Economics analysis of Amadeus and Orbis databases

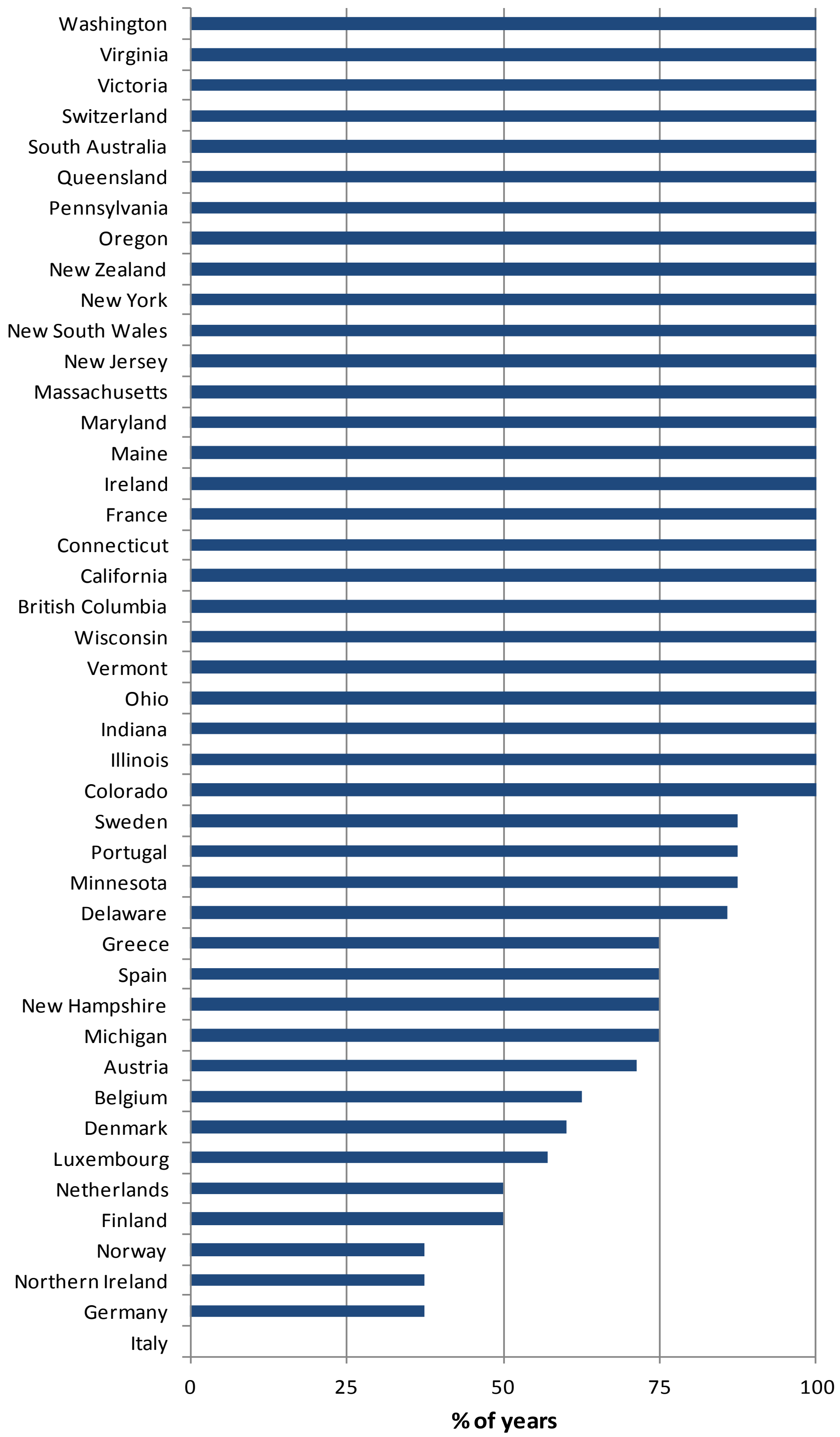
7.3.3 Benchmarking of yearly Great Britain EBIT margin

When the country-wide EBIT margin was considered in Section 7.3.1, Great Britain had the 4th lowest of 45 countries or regions. However, because this measure is averaged across years, it does not take account of trends across time.

Figure 56 below shows the percentage of years between 2003 and 2010 that the average weighted EBIT margin associated with each country or region was higher than that associated with Great Britain. As for some countries or regions, figures for one or two years are not available, the figure shows the percentage of years that each country or region is associated with a higher weighted EBIT margin than in Great Britain rather than the number of years to avoid introducing a bias from the missing values.

The most striking feature of the figure is that all of the included Canadian provinces, Australian states and the US states (except Minnesota, Delaware, New Hampshire and Michigan) are associated with a higher weighted EBIT margin figure than Great Britain for all years from 2003 to 2010. The only countries where a lower weighted EBIT margin than in Great Britain is observed over 50% of the time are Norway, Northern Ireland, Germany, and Italy which always has a lower figure.

Figure 46: Percentage of years that a country or regions was associated with a weighted EBIT margin higher than that associated with Great Britain



Source: London Economics analysis of Amadeus and Orbis databases

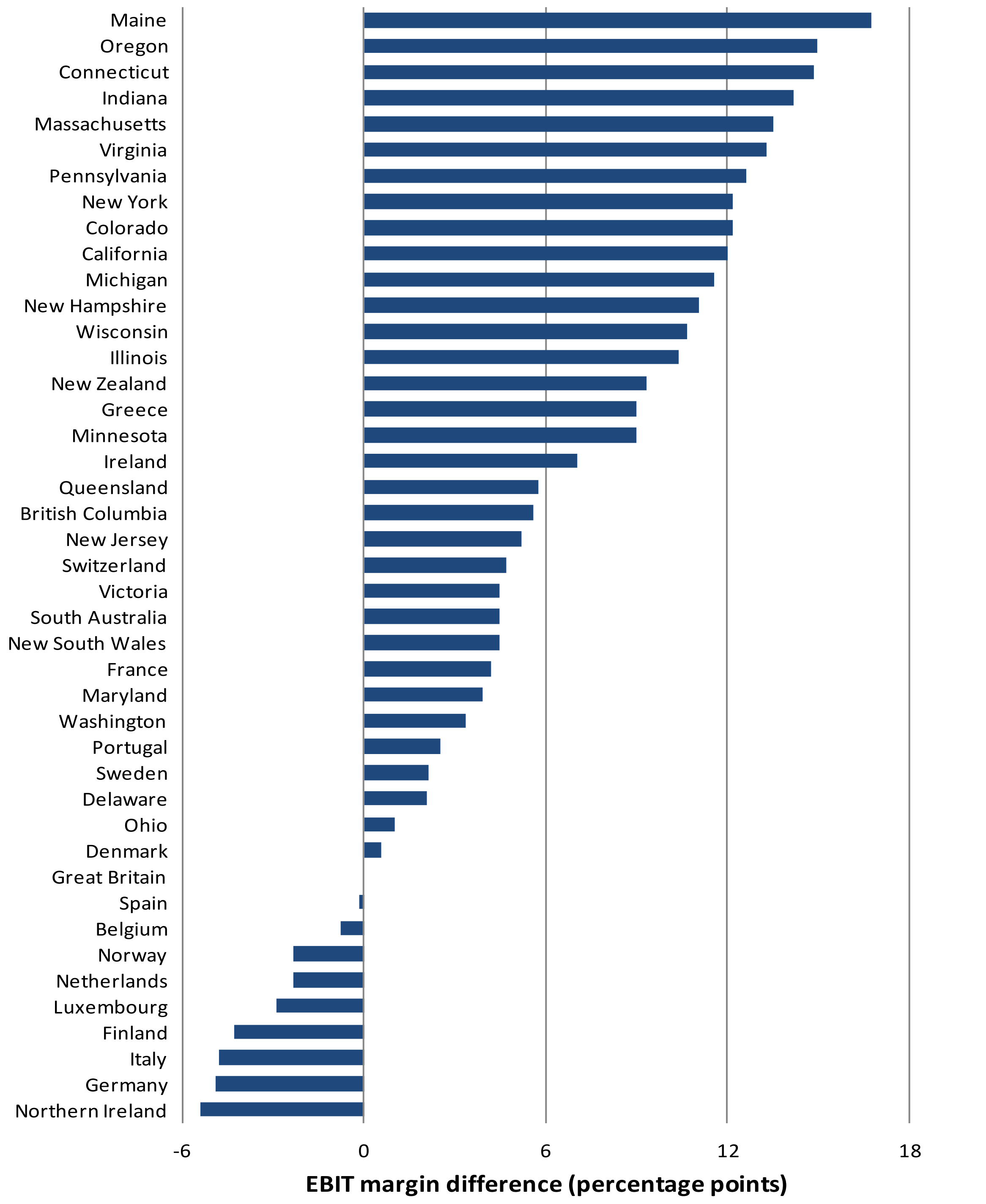
Further analysis of the yearly weighted EBIT margins can be found in the annex.

7.3.4 2010 EBIT margin comparison across countries/states

Figure 47 focuses on the most recent EBIT margin figures in the dataset. The total number of countries and regions in the figure is 43 due to missing 2010 data for two countries or regions.

Great Britain is associated with the 10th lowest weighted EBIT margin of the 43 included countries and regions in 2010. The 14 countries or regions associated with the highest EBIT margins in 2010 are all US states. However, although Delaware is the state with highest EBIT margin average from 2003 to 2010, it ranks 13th lowest of the 43 countries or regions in 2010. It is mainly European countries which have the lowest EBIT margins in 2010, a fact which is consistent with the results based on EBIT margin averaged from 2003 to 2010.

Figure 47:Difference in 2010 EBIT margin between Great Britain and other countries and regions



Source: London Economics analysis of Amadeus and Orbis databases

7.4 Conclusions of profitability analysis

The aim of this section was to benchmark energy supply profitability in companies in Great Britain against the profitability of companies operating in comparable markets across the world.

However, the analysis encountered challenges such as the difficulty in isolating profit figures that relate to energy supply activity only, and small sample sizes per country (having removed some apparently anomalous data points). Hence the data set included energy suppliers and companies with energy supply and related activities.

Overall Great Britain ranks among the countries with low EBIT margins relative to the other countries and regions included in the analysis. . Great Britain had the 4th lowest EBIT margin of all of the countries and regions at 4.2%. Further, for the weighted-average EBIT margins between 2003 and 2010 in our sample, only four countries or regions have a lower weighted EBIT margin than in Great Britain for over 50% of the years included in the analysis.

8 Competition

8.1 Introduction

The present section provides information on:

- the state of opening to competition in the electricity and natural gas supply markets;
- the level of concentration in the electricity and natural gas supply markets;
- the consumer experience in the electricity and natural gas supply markets; and
- switching by consumers.

The overall purpose of the section is to compare and benchmark concentration in electricity and natural gas supply in Great Britain to the situation prevailing in other countries or regions.

At issue is whether energy supply markets are highly concentrated which could result in end-users paying higher prices for their electricity and natural gas than justified by the combined costs of the commodity, services and taxes and levies.

However, a high concentration level does not necessarily imply low competition as markets in which only a few businesses compete could be in fact characterised by intense rivalry and competition among these businesses.

The concentration information is reviewed using a variety of measures, such as HHI, C3, C1 and the number of suppliers or number of main suppliers.

It is useful to keep in mind that the market share of the largest three suppliers is used later in this report (in the econometric analysis) as a variable that may explain differences in electricity and natural gas prices and profit margins.

8.2 Approach

At the outset of the study, we sought to gather concentration figures for all the countries/regions of interest, namely the EU15 Member States, Norway, Switzerland, the USA, Australia, Canada and Japan.

In terms of concentration information, we followed typical competition analysis and aimed to gather information on the market share of the largest supplier (i.e., C1), the market share of the n largest suppliers and the Herfindahl-Hirschman index (HHI).

The Herfindahl index is equal to the sum of the squares of the market shares of all suppliers, and thus takes into account the market shares of the companies as well as the number of suppliers in the market. It can range from zero to 10,000 where figures close to zero indicate a market with many companies each with a low market share and 10,000 indicates a market where one firm holds the entire market.

For example, when there are five suppliers in the market with a market share of 20% each, the HHI is 2000. However, if one supplier has a market share of 40% and the other four suppliers have a market share of 15% each, the HHI stands at 2500.

Competition authorities typically view a HHI figure below 1,000 is being indicative of a competitive market, a figure between 1,000 and 2,000 as showing some level of concentration and a figure above 2,000 as reflecting concentration that could be problematic. For example,

- in its merger guidelines, the OFT views: any market with a post-merger HHI exceeding 1,000 as concentrated and any market with a post-merger HHI exceeding 2,000 as highly concentrated[163]. The European Commission, in its merger guidelines, states that is unlikely to identify horizontal competition concerns in a market with a post-merger HHI below 1 000 and in a in a merger with a post-merger HHI between 1 000 and 2 000 (and a HHI increase below 250) or a merger with a post-merger HHI above 2 000 and an increase in HHI of less than 150, except where special circumstances[164].

In the U.S, markets in which the HHI is between 1000 and 1800 points are considered to be moderately concentrated, and those in which the HHI is in excess of 1800 points are considered to be concentrated. Transactions that increase the HHI by more than 100 points in concentrated markets presumptively raise antitrust concerns under the Horizontal Merger Guidelines issued by the US Department of Justice and the Federal Trade Commission[165]. The scope in terms of concentration indicators and geographical coverage of the concentration information reported below is entirely determined by data availability.

In practice it turned out that it was possible to obtain, for a number of countries but not all, information on the number of suppliers in the country/region, the market share of the largest supplier (C1), the market share of the three largest suppliers (C3) and, for a more limited number of countries/regions the HHI.

The set of countries, for which each of the three competition indicators (C1, C3 and HHI) is available, varies. This is the reason why the figures below showing the different concentration indicators differ in terms of geographical scope.

It is important to note that these indicators, which are computed at the national level, may not provide a good indication of the actual competitive conditions facing a particular consumer if the relevant market is in fact regional or even local as is the case in a number of countries such as Germany or Sweden.

The sources of the different concentration indicators presented below are listed at the beginning of sub-sections presenting the concentration figures for electricity and natural gas supply.

According to the latest EC *Report on Progress in Creating the internal Gas and Electricity Market*[166] and additional information sourced from regulators' websites among the 15 EU Member States of interest, only Greece (natural gas – residential and small scale non-residential) had not yet

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[163] OFT (2010), Merger Assessment Guidelines

[164] European Commission (2004), *Guidelines on the assessment of horizontal mergers under the Council Regulation on the control of concentrations between undertakings* (2004/C 31/03), Official Journal of the European Union, C31/5, 5 February 2004

[165] See http://www.justice.gov/atr/public/testimony/hhi.htm

[166] European Commission, Commission Staff Working Paper of 9 June 2011

achieved full market opening by 2010 (for further details see the calendar of electricity and natural gas liberalisation provided in the annex).

In fact, among the EU15 countries, Greece and Portugal were the only two Member States which did not achieve full market opening in the natural gas sector on 1st July 2007, the EC deadline for full market opening in the EU15. Portugal did so in 2010. Full electricity market opening had been achieved by all 15 Member States of interest[167].

However, full market opening to competition does not mean that all end-user electricity and natural gas prices are set freely in the market. In 2009, a majority of Member States (with Great Britain and Northern Ireland treated a separate entities) had still price regulation in place for some of the end-users (households and non-households).

Table 6: End-user price regulation in 2009

	Electricity		Natural Gas	
	Households	**Non-Households**	**Households**	**Non-Households**
YES	Denmark, France, Greece, Ireland, Italy, Northern Ireland, Portugal, Spain, Netherlands	Denmark, France, Greece, Ireland, Italy, Northern Ireland, Portugal, Netherlands	Denmark, France, Greece, Ireland, Italy, Northern Ireland, Portugal, Spain, Netherlands	Denmark, France, Greece, Ireland, Northern Ireland, Portugal, Netherlands
NO	Austria, Belgium, Finland, Germany, Great Britain, Luxembourg, Sweden	Austria, Belgium, Finland, Germany, Great Britain, Luxembourg, Spain, Sweden	Austria, Belgium, Finland, Germany, Great Britain, Luxembourg, Sweden	Austria, Belgium, Finland, Germany, Great Britain, Italy, Luxembourg, Spain, Sweden

Source: EC Report on Progress in Creating the internal Gas and Electricity Market June 2011

As will be shown in the next section, the opening to competition has not resulted in major changes in the number of major retail suppliers (i.e. suppliers with a market share of over 5% in the whole retail market) in electricity or natural gas supply.

8.3 Data sources for indicators of concentration in electricity and natural gas supply

Overall, information on concentration in electricity and natural gas supply is patchy. The key information sources used in the analysis below are:

- the *EC Report on Progress in Creating the internal Gas and Electricity Market* of June 2011 which provides the market share of the 3 largest suppliers (C3) in the whole national electricity and natural gas retail market for 2009;
- the annual reports *European Electricity market indicators* and *European natural gas indicators* produced by Eurostat. The latest publications covering the period 2003-2010 provide the number of retailers and the number of suppliers with a market share over 5%

[167] Except for the islands not connected to the grid in the case of Greece.

in the whole retail market for both electricity and natural gas. In addition, the natural gas publication provides the market share of the largest supplier (C1);

- publications and statistics available from various public authorities and regulators. These sources provide additional information for a few countries (USA, New Zealand);
- the survey of regulators undertaken as part of the present study; and
- the consumer survey undertaken as part of the study on the functioning of the electricity retail markets undertaken for EC DG Health and Consumers.

We present below the various market structure indicators together with a brief benchmarking of the UK and/or Great Britain's situation.

8.3.1 Benchmarking concentration in the electricity supply market

Key points to note

The electricity market structural indicators reported below show that:

- Among the EU15, the UK[168] has highest number of suppliers with a market share over 5% in the whole retail market, suggesting that the retail electricity market is less concentrated than in the other Member States.
- Great Britain is among the few jurisdictions covered by the study posting low concentration figures (C1 and C3) and a HHI below the threshold at which competition concerns arise.

Below, we provide information on the number of suppliers active in various jurisdictions, the market share of the largest and three largest suppliers as well as the HHI.

1. Total number of suppliers and number of suppliers with a market share over 5% in the whole retail market

In a number of EU15 Member States and in many US states, a large number of suppliers are active. In general, one does not observe through the last decade a significant decline or increase in the number of suppliers (Table 7). The very large number of suppliers is explained by the fact that, in many countries/states, many suppliers operate only in small regional areas such as city, a municipality, a county, etc.

Table 7: Total number of electricity retail suppliers to final consumers 2003-2010

Country	2003	2004	2005	2006	2007	2008	2009	2010	Trend
EU15 average	**172**	**169**	**171**	**171**	**173**	**167**	**146**	**148**	
Austria	160	125	125	136	160	141	>140	129	Declining
Belgium	45	48	54	23	28	31	34	37	Stable
Denmark	113	75	70	65	38	36	33	33	Declining
Finland	>100	>100	>100	>100	>100	>100	>100	>100	Stable
France	166	166	166	160	>177	177	177	177	Stable

[168] These data are from Eurostat and are on the UK basis.

Germany	940	940	940	1042	1020	940	1000	1000	Stable
Greece	5	4	4	4	2	2	3	11	Stable
Ireland	6	8	9	9	9	9	9	8	Stable
Italy	390	400	430	380	400	350	360	268	Stable
Luxembourg	11	11	11	12	13	14	11	11	Stable
Netherlands**	42	33	32	38	39	38	32	36	Stable
Portugal	5	9	10	4	4	4	6	10	Stable
Spain*	375	383	382	375	394	459	142	202	Declining
Sweden	127	130	122	119	120	113	75	134	Stable
United Kingdom	24	32	33	26	23	23	21	22	Stable
US average	**63**	**63**	**63**	**63**	**64**	**64**	**65**	**70**	
AK		73	72	72	72	71	71	71	Stable
AL	63	62	62	62	62	63	63	62	Stable
AR	39	38	37	36	36	37	37	37	Stable
AS	1	1	1	1	1	1	1		Stable
AZ	45	45	45	45	45	45	46	49	Increasing slightly
CA	82	69	72	73	72	74	83	85	Stable
CO	67	62	62	62	62	62	65	65	Stable
CT	16	16	16	18	24	29	32	32	Increasing
DC	5	5	9	11	12	15	14	17	Increasing
DE	17	16	15	20	23	27	27	27	Increasing
FL	54	53	53	53	53	53	53	54	Stable
GA	98	98	98	98	97	97	98	97	Stable
GU	1	1	1	1	1	1	1		Stable
HI	7	7	5	4	5	5	5	5	Stable
IA	186	185	183	185	185	185	185	183	Stable
ID	32	30	30	30	30	32	32	33	Stable
IL	90	91	88	89	97	100	100	96	Stable
IN	119	119	119	119	119	120	120	120	Stable
KS	154	156	156	156	154	153	153	152	Stable
KY	62	61	62	61	61	62	60	60	Stable
LA	43	40	40	40	40	39	39	39	Stable
MA	62	62	67	64	66	68	70	71	Increasing
MD	20	24	26	30	34	34	35	37	Increasing
ME	25	26	25	26	24	26	29	28	Stable
MI	78	76	76	74	74	74	77	72	Stable
MN	179	177	177	177	178	178	180	179	Stable
MO	137	136	137	136	135	136	134	134	Stable
MS	51	51	51	51	51	51	51	51	Stable
MT	44	43	43	44	42	41	40	39	Stable
NC	111	108	108	108	108	107	107	107	Stable
ND	39	39	39	39	38	37	37	37	Stable
NE	162	162	162	162	161	160	160	160	Stable
NH	19	16	16	16	17	18	20	20	Increasing
NJ	33	36	36	35	35	37	37	41	Increasing
NM	34	34	34	34	33	32	32	32	Stable
NV	19	19	20	21	22	23	23	22	Stable
NY	90	92	88	98	101	105	101	103	Increasing
OH	131	133	130	127	125	127	129	132	Stable

OK	98	97	99	99	98	98	96	97	Stable
OR	41	44	44	44	45	46	46	44	Stable
PA	77	77	76	76	75	76	80	93	Increasing
PR	1	1	1	1	1	1	1		Stable
RI	7	7	8	10	9	11	15	14	Increasing
SC	47	47	47	47	47	48	47	47	Stable
SD	72	72	73	72	72	73	73	73	Stable
TN	94	91	96	96	93	92	91	91	Stable
TX	210	207	215	213	215	222	227	225	Increasing
UT	52	53	52	51	51	51	51	51	Stable
VA	38	38	38	39	39	35	35	33	Decreasing
VI	1	1	1	1	1	1	1		Stable
VT	22	21	21	21	20	20	20	20	Stable
WA	68	67	66	66	69	68	69	66	Stable
WI	125	125	119	119	118	118	118	118	Decreasing
WV	17	16	17	16	16	12	12	10	Decreasing
WY	35	35	35	35	35	36	36	36	Stable
New Zealand	9	8	9	9	10	11	12	12	Increasing

Note: * Until end of June 2009, distribution companies were included in the number of electricity retailers to final customers. Starting with July 2009, a new law was implemented and the distribution companies deal only with grid management. ** Total number of retailers selling electricity only to small consumers.
Where a figure was not specified exactly (e.g. <100), the figure was not included in calculation of the averages.
Source: Eurostat for EU15, US Energy Information Administration and New Zealand regulator

The fact that many suppliers are scale operators is confirmed by the information provided in Table 8 which shows the number of suppliers accounting each for more than 5% of total supply in their country/state.

It is notable, that despite the full opening to competition of electricity supply in the last decade in the EU15, the number of major suppliers accounting for more than 5% of whole retail market has not increased significantly in any of the EU Member States (including the United Kingdom) with the exception of Portugal. Among the larger EU15 Member States, the UK has the fewest retail electricity suppliers (see Table 8).

In fact, among the EU Member States of interest, the UK has the highest number of suppliers with a market share of over 5% (seven until 2008 and six thereafter) with the exception of Austria which reached eight suppliers in 2006.

However, in contrast to the situation in Europe, a number of US states, small and large, have more suppliers with a market share of 5% each than the UK in 2010, namely Delaware, Connecticut, Illinois, Kentucky, Massachusetts, Maine, North Dakota.

Moreover, the number of suppliers with a market share of more than 5% grew clearly over the past decade in a number of US states such as Connecticut, District of Columbia, Delaware, Massachusetts, Maine, New Hampshire and Rhode Island.

While a greater number of "large" suppliers are active in these states than in EU Member States, it does not necessarily imply that here is more competition as each of the suppliers may serve a distinct geographical market within their country/region.

Table 8: Number of main electricity retail suppliers, 2003- 2010									
Country	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**Trend**
EU15 average	**3**	**3**	**4**	**4**	**3**	**3**	**3**	**4**	
Austria	-	5	6	8	7	6	6	6	Stable
Belgium	2	3	3	3	3	3	3	3	Stable
Denmark*	5	-	7	8	-	-	-	-	Stable
Finland	3	3	3	3	3	3	3	3	Stable
France	1	1	1	1	1	1	1	1	Stable
Germany	4	4	3	3	3	3	3	3	Stable
Greece	1	1	1	1	1	1	1	1	Stable
Ireland	4	4	5	4	3	4	5	5	Stable
Italy	3	1	2	3	3	3	2	3	Stable
Luxembourg	3	3	3	4	4	4	4	4	Stable
Netherlands**	≥3	5	5	5	4	4	4	3	Stable
Portugal	1	1	1	1	1	1	2	4	Increasing
Spain	6	6	6	4	3	3	3	4	Decreasing
Sweden	3	3	3	3	3	3	3	3	Stable
United Kingdom	7	7	7	7	7	7	6	6	Stable
US average	**4**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	
AK	5	5	5	5	5	5	5		Stable
AL	3	3	3	3	3	3	3		Stable
AR	4	4	4	4	4	4	4	4	Stable
AS	1	1	1	1	1	1	1		Stable
AZ	4	4	4	4	4	4	3	3	Decreasing
CA	6	5	4	4	4	4	4	4	Decreasing
CO	2	2	2	2	2	2	2	2	Stable
CT	2	2	2	2	5	7	9	7	Increasing
DC	3	2	5	5	4	4	4	5	Increasing
DE	7	6	5	8	9	10	11	10	Increasing
FL	3	3	3	3	3	3	3	3	Stable
GA	1	1	1	1	1	1	1	1	Stable
GU	1		1	1	1	1	1		Stable
HI	4	4	3	3	3	3	3	3	Decreasing
IA	3	4	4	3	2	2	2	2	Decreasing
ID	4	4	4	4	4	3	4	4	Stable
IL	6	7	7	7	11	10	10	8	Stable
IN	6	6	6	6	6	6	6	6	Stable
KS	5	5	5	5	4	4	4	4	Decreasing
KY	8	8	7	7	7	8	8	8	Stable
LA	5	5	6	5	5	5	5	5	Stable
MA	5	6	7	6	7	7	9	8	Increasing
MD	8	10	11	6	6	6	8	7	Stable
ME	8	7	7	6	7	10	11	9	Increasing
MI	5	4	3	3	3	3	3	3	Decreasing
MN	2	3	2	2	2	2	2	2	Stable
MO	4	4	4	5	4	4	4	5	Stable
MS	4	4	4	3	3	4	4	4	Stable
MT	7	6	6	6	6	6	6	5	Decreasing
NC	2	2	2	2	2	2	2	2	Stable

ND	8	8	9	8	8	8	9	9	Stable
NE	5	5	5	5	5	5	5	5	Stable
NH	4	4	4	7	8	5	6	8	Increasing
NJ	3	6	5	5	5	6	7	5	Stable
NM	7	6	7	7	5	5	6	5	Decreasing
NV	4	4	4	5	5	5	5	5	Stable
NY	7	6	7	8	7	8	8	7	Stable
OH	9	9	9	9	9	8	7	7	Decreasing
OK	2	2	2	2	2	2	2	2	Stable
OR	4	4	6	5	6	6	5	4	Stable
PA	8	7	7	6	7	6	5	9	Stable
PR	1	1	1	1	1	1	1		Stable
RI	4	3	2	3	3	4	5	6	Increasing
SC	4	4	4	4	4	4	4	4	Stable
SD	5	5	5	5	6	7	6	6	Stable
TN	5	5	5	5	6	6	6	6	No tend
TX	8	10	9	10	10	10	7	8	Stable
UT	1	1	1	1	1	1	1	1	Stable
VA	2	2	2	2	2	2	2	2	Stable
VI	1		1	1	1	1	1		Stable
VT	4	4	5	5	5	5	5	5	Stable
WA	6	8	9	8	7	7	8	8	Stable
WI	6	6	6	6	6	6	6	6	Stable
WV	4	4	4	4	4	4	4	4	Stable
WY	5	5	5	5	5	5	5	5	Stable
New Zealand	5	5	5	5	5	5	5	5	Stable

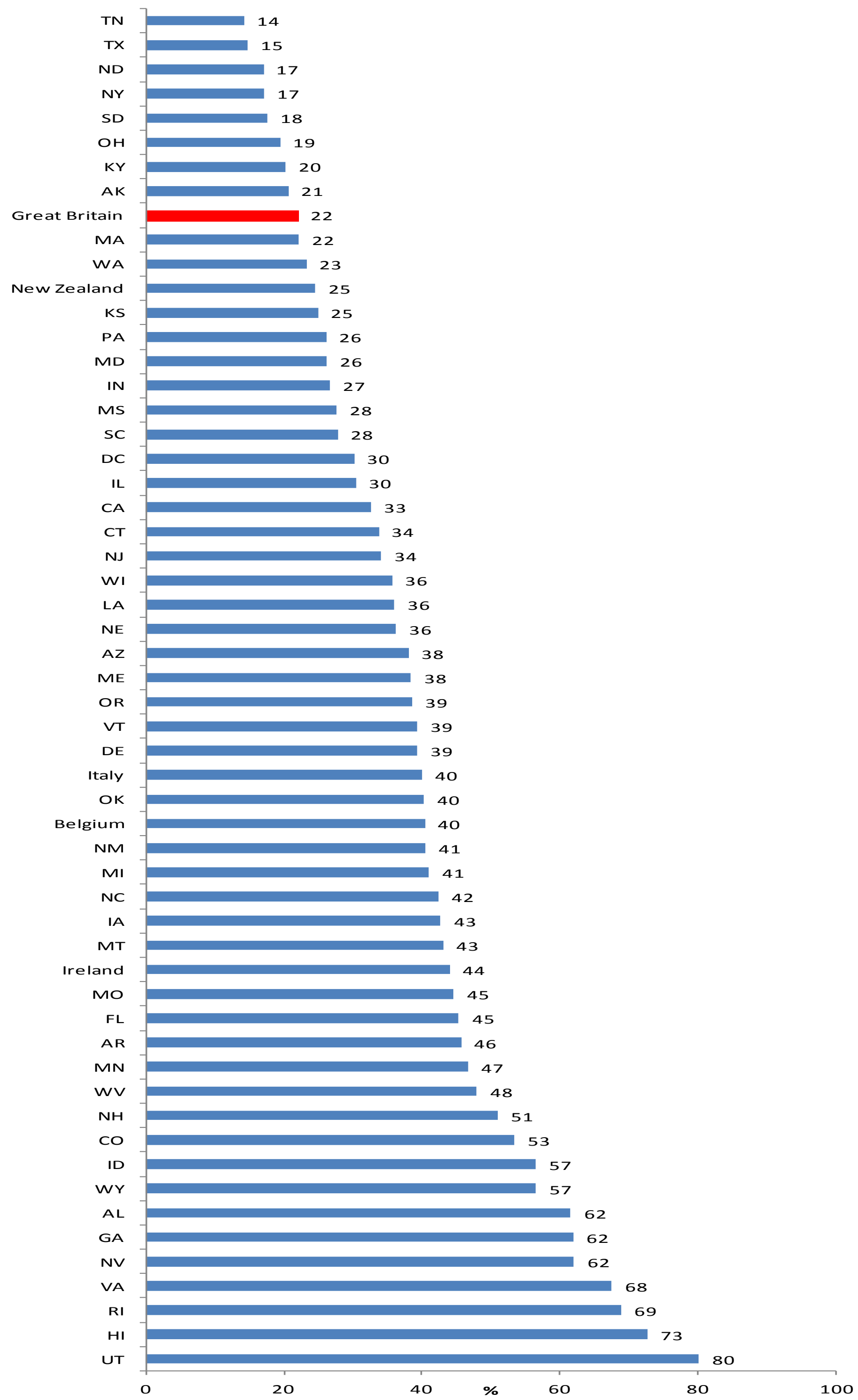
Note: retailers are considered as "main" if they sell at least 5% of the total national electricity consumption. * Information on number of main retailers not available. ** Number of main retailers selling electricity only to small consumers.
Where a figure was not specified exactly (e.g. ≥3), the figure was not included in calculation of the averages.
Source: Eurostat, US Energy Information Administration and New Zealand regulator

2. Energy supply market concentration in 2010

The three figures below provide information on the market share of the largest supplier (C1), the three largest suppliers (C3) and the Herfindahl index. The key facts to note are that, among the countries/states for which the information is available, Great Britain has:

- One of the lowest C1. In fact among the 51 jurisdictions for which the information is available, Great Britain has the 9th lowest C1 at the level of the jurisdiction and the lowest among the few EU Member States for which such information is available;
- One of the lowest C3. Again, Great Britain ranks 8th lowest. But, in the case of C3, two Member States (Germany and Italy) post slightly lower C3 at the level of country; and
- Great Britain is also among a limited set of countries and states showing an HHI below the 1,800 level which is typically viewed as the threshold above which competition issues are likely to arise in the market.

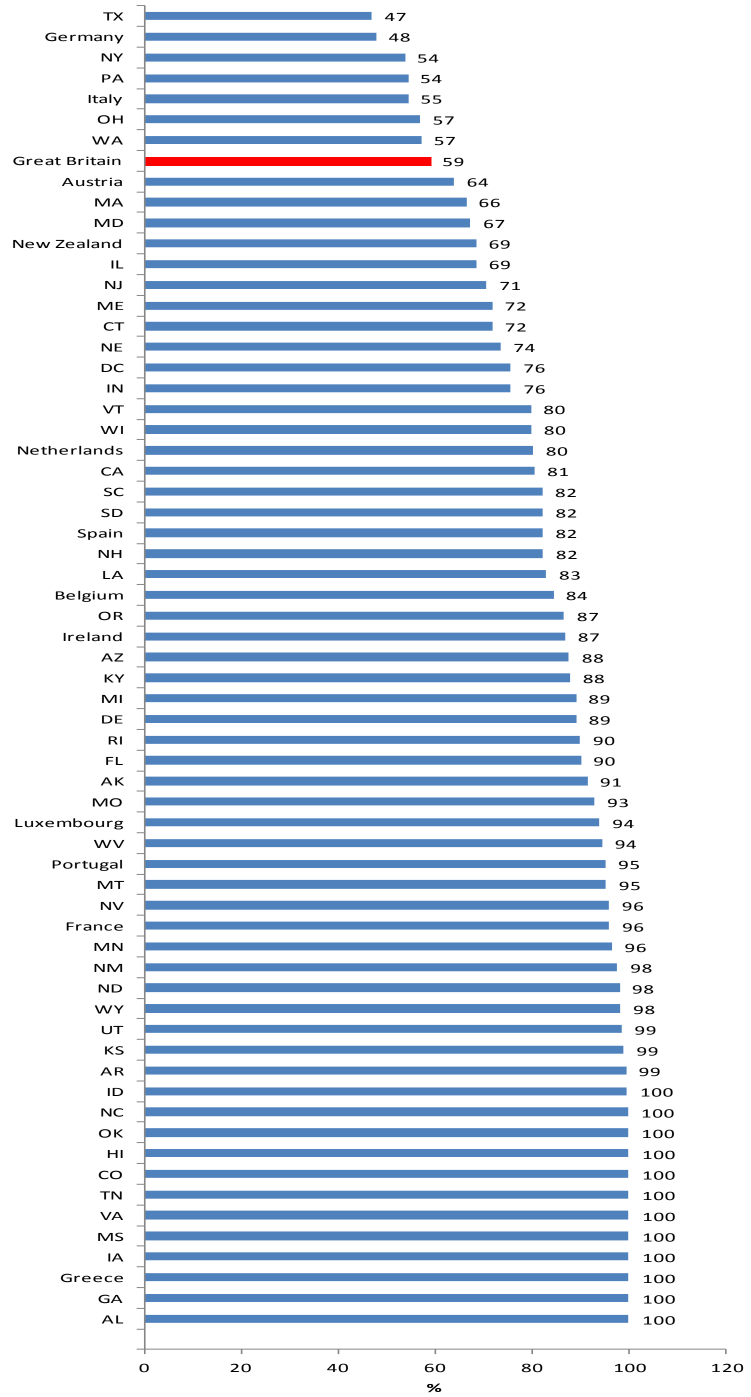
Figure 48:Market share of the largest electricity supplier C1 in selected markets 2010 (in %)



Note: Belgium and Italy 2009, Great Britain 2007

Source: EC Report on Progress in Creating the internal Gas and Electricity Market June 2011, US Energy Information Administration and New Zealand regulator, responses to survey, various publications of regulators

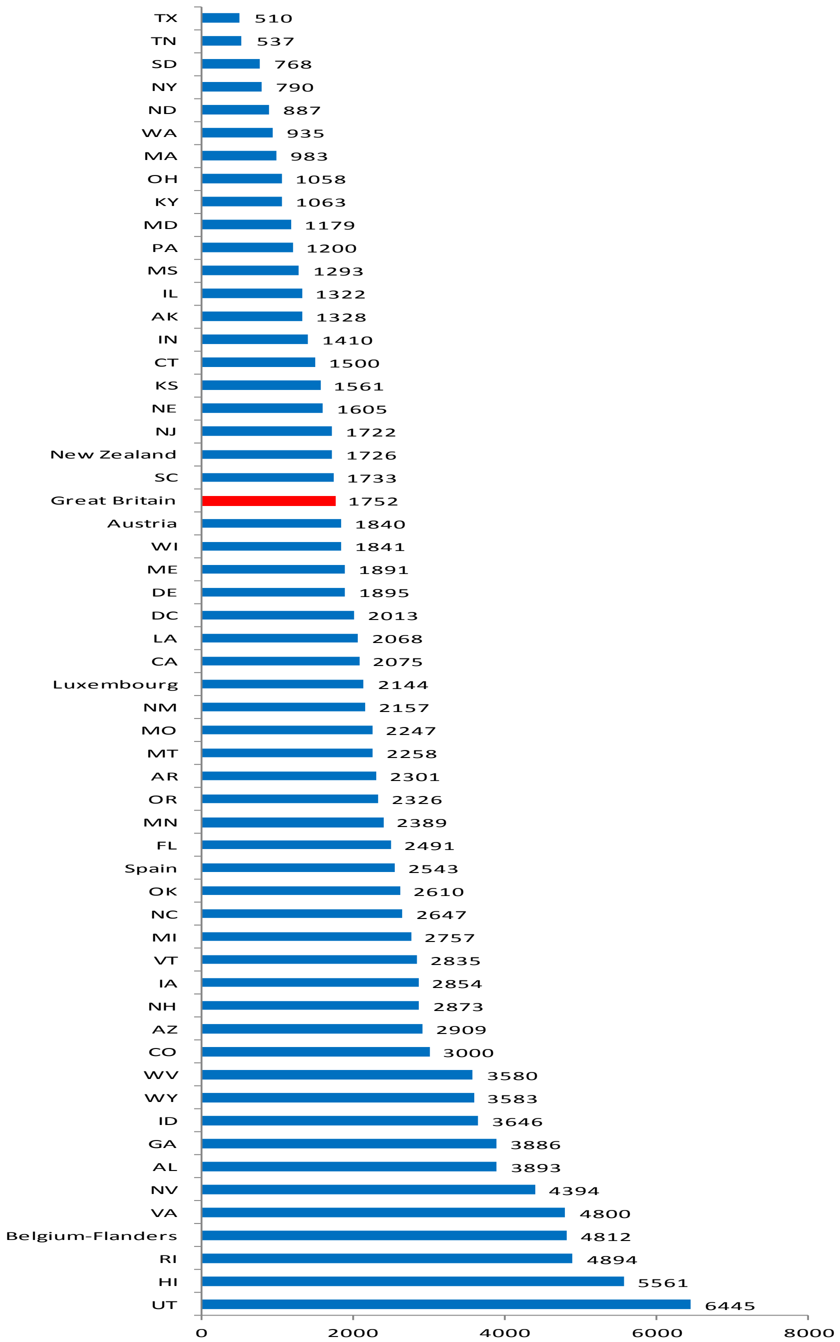
Figure 49: Market share of the three largest electricity suppliers (C3) in selected markets 2010 (in %)



Note: Great Britain 2007, Austria, Finland, France, Germany, Greece, Ireland, Luxembourg, Portugal and Spain 2009, Netherlands 2011

Source: EC Report on Progress in Creating the internal Gas and Electricity Market June 2011, US Energy Information Administration and New Zealand regulator, responses to survey, various publications of regulators

Figure 50: HHI electricity supply in selected markets 2010 (in %)



Note: Great Britain 2007, Austria, Finland, France, Germany, Greece, Ireland, Luxembourg, Portugal and Spain 2009, Netherlands 2011
Source: EC Report on Progress in Creating the internal Gas and Electricity Market June 2011, US Energy Information Administration and New Zealand regulator, responses to survey, various publications of regulators

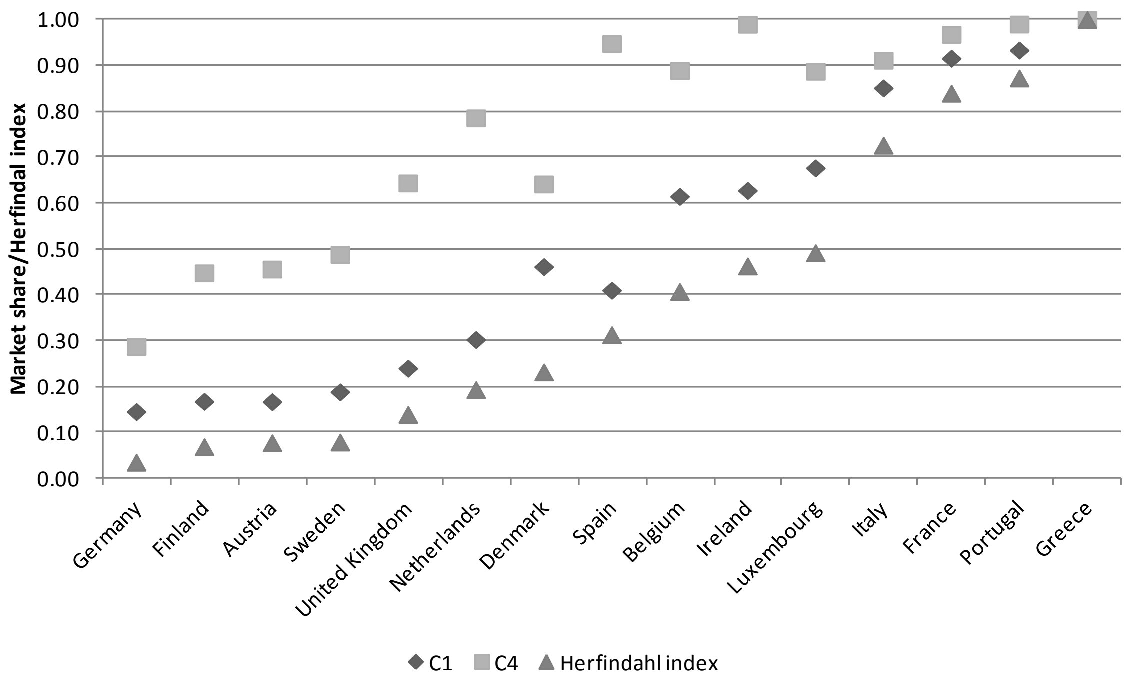
3. 2010 Concentration indicators based on the customer survey undertaken for EC DG Health and Consumers

Additional information was identified from the 2010 customer survey undertaken for EC DG Health and Consumers. The market shares were calculated using the number of customers that identified themselves as customers of a particular electricity supplier in the survey.

Because the dataset was based on a consumer survey, it may not have sampled customers of all active suppliers in each country, meaning that the market shares of small suppliers may not be estimated correctly and the Herfindahl index may be overestimated. This bias is unlikely to affect the overall conclusions of this study due to the large number of customers surveyed.

The figure below shows the C1, C4 and Herfindahl index for each of the EU15 countries in order of C1.

Figure 51: Electricity supply market concentration (2010)



Source: ECME Consortium general consumer survey (The EC survey was done for the UK rather than GB)

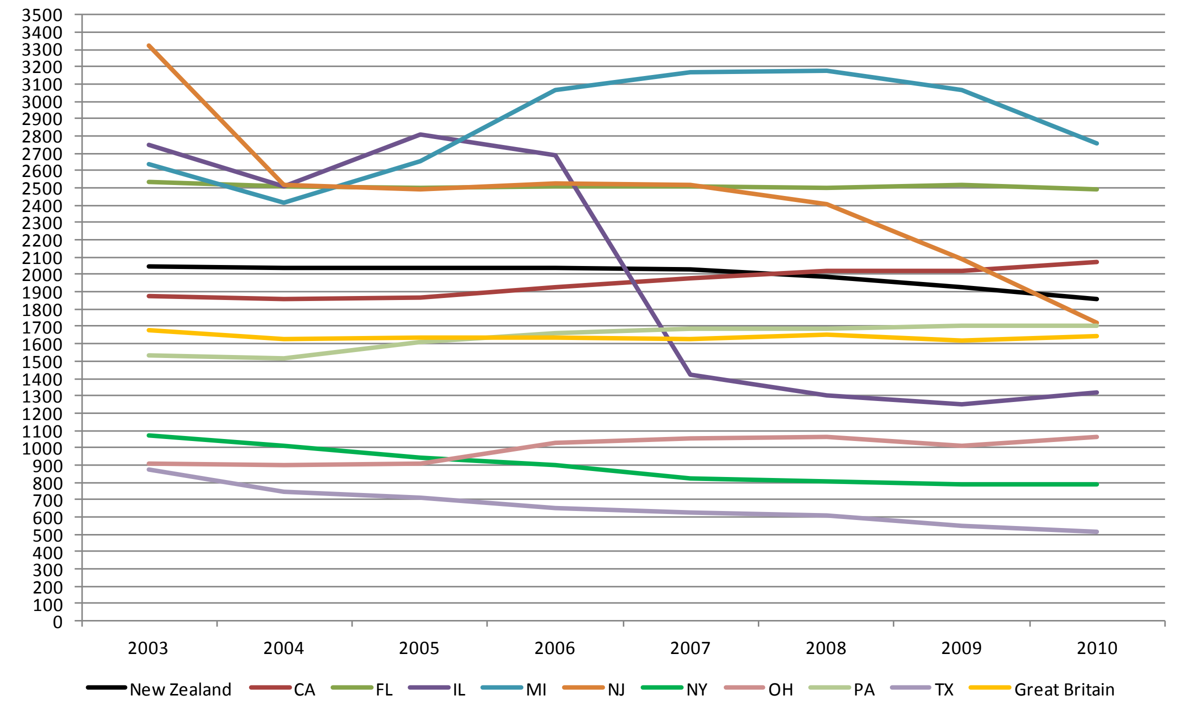
Greece, Portugal, France and Italy have the highest C1 and C4 values which indicate that the largest electricity retailers in those countries command a larger share of the domestic market than the main retailers in other countries. In each of these countries, there is a supplier with over 85% of the market share and the four largest suppliers together account for over 90% of the market. In these countries the Herfindahl index is higher than 0.7.

Germany, Finland, Austria and Sweden have the lowest C1, C4 and Herfindahl index values. Low values are characteristics of a market with many suppliers each with a low proportion of the market. In fact, Germany, Austria and Sweden rank first, second and third in terms of the number of total suppliers in their electricity markets and Finland ranks fifth. The UK follows with the next lowest C1 and Herfindahl index figures and the joint next lowest C4 figure.

4. Evolution of concentration in the domestic electricity supply market from 2003 to 2010 in major jurisdictions

Among the largest US states (CA, FL, MI, NJ, NY, OH, PA and TX), New Zealand and Great Britain, the latter jurisdiction is one of the five posting a HHI which always below the 1,800 mark over the period 2003-2010. Of note is the large decrease in HHI in Illinois over the period.

Figure 52: Electricity supply market HHI in domestic retail market 2003-2010



Source: DECC, US Energy Information Administration and New Zealand regulator

8.3.2 Benchmarking GB natural gas supply market concentration

Key points to note

The natural gas supply structural market indicators reported below show that:

- Among the EU15, the UK[169] (together with Spain) has highest number of suppliers with a market share over 5% in the whole retail market, suggesting that the natural gas supply market is less concentrated than in the other Member States;

[169] The number of main suppliers is again from Eurostat and is on the UK basis.

- In terms of C1, GB shows the 5th highest C1 of the 12 EU Member States for which information is available; and
- It is not possible the benchmark the C3 performance of Great Britain as the relevant information is not available beyond 2007, but GB ranks 4th in that year.

1 Total number of suppliers and number of suppliers with a market share over 5% in the whole retail market

Despite the full opening to competition of electricity supply in the last decade, the number of major suppliers accounting for more than 5% of whole retail market has not changed significantly in many countries, including the United Kingdom. Compared to many EU15 Member States, the UK has relatively few natural gas companies active in the retail segment of the value chain.

Table 9: Number of retailers selling natural gas to final customers, 2003-2010

Country	2003	2004	2005	2006	2007	2008	2009	2010	Trend
Average	**90**	**88**	**91**	**86**	**86**	**92**	**96**	**94**	
Austria	29	27	28	30	30	31	>30	40	Rising
Belgium	27	32	41	41	41	41	41	41	Constant since 2005
Denmark	4	7	5	12	17	16	13	13	Stable
Finland	27	30	30	29	29	30	25	25	Stable
France	31	34	36	36	34	36	36	50	Rising
Germany	701	700	700	700	700	700	820	820	Rising
Greece	1	2	4	4	4	4	4	4	Stable
Ireland	2	2	4	4	4	6	8	8	Gradually rising
Italy	412	389	415	323	312	396	295	303	Stable
Luxembourg	6	6	6	7	7	7	7	8	Gradually rising
Netherlands *	24	25	21	24	31	30	24	29	Stable
Portugal	10	10	11	11	11	13	15	18	Rising
Spain	43	41	40	42	43	44	28	32	Stable
Sweden	7	7	7	7	6	6	6	5	Gradually falling
United Kingdom	23	15	18	17	17	17	17	19	Stable

Note: * Number of retailers selling natural gas only to small consumers.
Where a figure was not specified exactly (e.g. >30), the figure was not included in calculation of the averages.
Source: Eurostat.

Table 10: Number of main natural gas retailers, 2003-2010

Country	2003	2004	2005	2006	2007	2008	2009	2010	Trend
Average	**3**	**4**	**3**	**4**	**4**	**4**	**4**	**4**	
Belgium	3	2	3	5	5	5	5	5	Stable
Denmark	4	5	3	6	:	:	5	5	Stable
Germany	1	1	1	4	2	2	3	2	Stable
Ireland	1	2	1	3	3	3	3	5	Rising
Greece	1	2	1	1	2	2	3	3	Rising
Spain	3	4	5	5	5	6	6	6	Rising
France	2	2	3	3	3	2	2	3	Stable
Italy	5	5	4	2	2	3	5	5	Stable
Luxembourg	3	4	2	4	4	4	5	4	Stable

Netherlands*	4	5	6	6	3	3	3	3	Stable
Austria	3	5	4	4	4	4	4	3	Stable
Portugal	4	4	4	4	4	4	5	6	Stable
Finland	1	1	1	1	1	1	1	1	Stable
Sweden	5	5	5	5	5	:	6	4	Stable
United Kingdom	5	7	7	7	7	7	8	6	Stable

Note: retailers are considered as "main" if they sell at least 5% of the total natural gas consumed by final customers.
* Number of main retailers selling natural gas only to small consumers.
Source: Eurostat.

2 *Concentration in natural gas supply market 2007-2010*

Of the 13 jurisdictions for which C1 information is available, Great Britain shows the fifth-highest C1, assuming the 2007 figure is very close to the 2010 figure which is not available.

Table 11: Market share of the largest natural gas retailers, 2007-2010 (in %)

Country	2007	2008	2009	2010	Trend
Austria	:	:	49.0	43.0	Declining
Belgium	44.8	39.3	48.5	31.0	Rising until drop in 2010
Finland	95.0	95.0	95.0	95.0	Constant
France	75.0	78.0	81.0	65.0	Rising until drop in 2010
Germany	7.0	9.0	12.6	8.7	Stable
Greece	87.8	87.8	82.5	84.7	Stable
Ireland	87.2	76.5	74.8	65.0	Declining
Italy	43.9	37.5	31.9	24.7	Declining
Portugal	58.7	58.7	35.6	36.3	Declining
Spain	37.7	36.0	27.1	26.8	Declining
Sweden	53.0	:	:	47.0	Stable
GB	47				

Source: Eurostat, Ofgem and New Zealand regulator

The variation in the market share of the three largest suppliers is somewhat greater in the case of natural gas than in the case of electricity. Overall, Great Britain had the 4th lowest C3 in 2007, the last year for which GB figures are available. However, among the jurisdictions showing a lower C3, two (Denmark and Germany) had significantly lower concentration.

Table 12: Market share of the largest three natural gas retailers, 2000-2010 (in %)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Austria		75		90				80	80	80	70
Belgium	95	39		95				92.3		89.6	
Denmark	92	73		65				35			
Finland				0				100			
France	95			91			90	98.5		97	
Germany		6		10			30.9	26.3	35.2	30.1	
Greece							100	100	100	100	
Ireland		47		88			100	100	100	96	
Italy	40	93		63			66.5	66.5	62.7	57.5	54.5
Luxembourg	85			0			0	88.5	85.7	74.7	
Netherlands				0						79.4	78.6
Spain	70	78		80			75	74	71	62	63.8
Sweden	100	55		79			88	85			
Great Britain			83	82	79	76	75	73			
New Zealand											72.3

Source: Eurostat, Ofgem and New Zealand regulator

High C3s in electricity supply are typically associated with high C3s in natural gas supply as reflected by a correlation of 83.3 between the two C3 series.

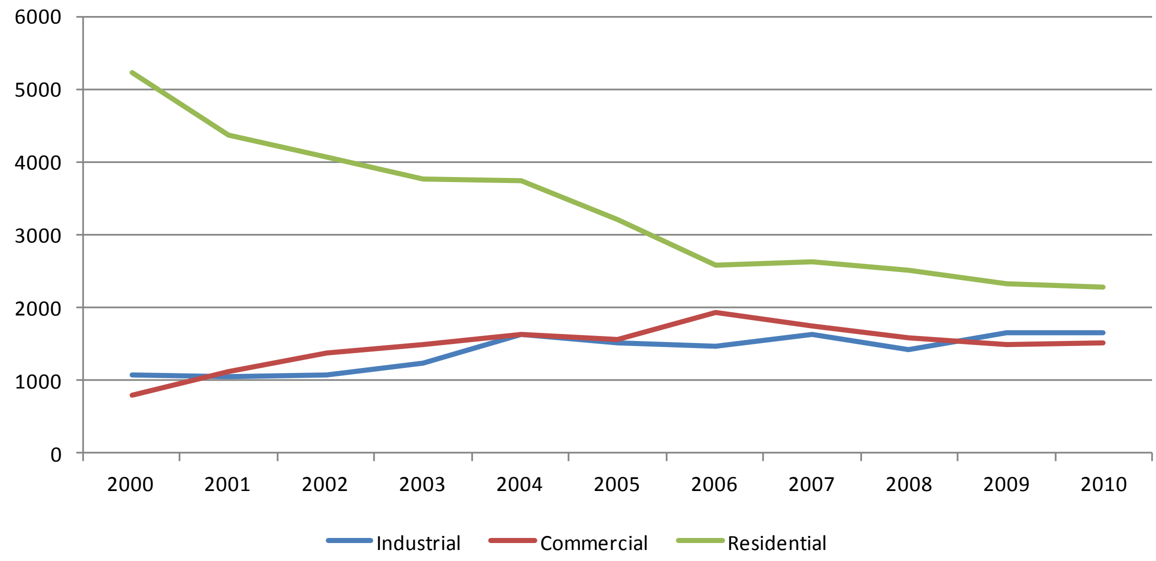
While the Eurostat data do not contain information on C3 for GB post 2007, this information can be calculated from other data sources including the Ofgem Retail Markets Review[170]. Using this data gives a gas market C3 of 88% for gas only suppliers, or 69% when including dual fuel suppliers for 2010. This would put GB at the highest of the 6 available for the gas only C3, or the third lowest of the six available using the dual fuel concentration in 2010.

Unfortunately, very little information is available with regards to HHI. In 2010, it stood at 2274 in Austria (all customers), 4680 in Belgium-Flanders (all customers), 1839 in Spain (all customers), 2284 in Great Britain (residential customers) and 1523 in Great Britain (commercial sector).

No HHI time series are available except for Great Britain (see figure below). Of note is the fact that, among the three markets considered (industrial, commercial and residential), the residential HHI figure remains above the threshold figure of 1800 to 2000 (above which competition concerns arise) despite having dropped steadily and significantly over 2000-2010 period. Most of the drop occurred from 2000 to 2006 and since little additional improvement is observed.

[170] The Retail Market Review - Findings and initial proposals Supplementary appendices, 2011.

Figure 53: HHI in natural gas end-user market-2000-2010



Source: DECC

8.3.3 Conclusions about benchmarking concentration in electricity and natural gas supply markets

In short, the review of concentration in electricity and natural gas supply markets in jurisdictions for which concentration information is available, yields the following key results:

- Among the EU15, the UK has highest number of electricity suppliers with a market share over 5% in the whole retail market, suggesting that the retail electricity market is less concentrated than in the other Member States;
- Great Britain is among the few jurisdictions covered by the study showing in the case of electricity supply low concentration figures (C1 and C3) and a HHI below the threshold at which competition concerns arise;
- Among the EU13[171], the UK (together with Spain) has highest number of suppliers with a market share over 5% in the whole retail market, suggesting that the retail natural gas supply market is less concentrated than in the other Member States; and
- In terms of C1, GB shows in the natural gas supply market the 5th highest C1 of the 12 EU Member States for which information is available.

[171] No data are available for Finland and Sweden

8.4 Consumer experience of electricity and natural gas supply markets

8.4.1 Overall consumer-focused assessment of the functioning of the electricity and natural gas supply markets

The present sub-section presents information on how retail electricity and natural gas supply customers judge these two markets to perform from a customer perspective.

In principle, over the longer run, a highly competitive market should deliver a good product or service to customers as customers not satisfied by the performance of their suppliers will switch to other suppliers and under-performing suppliers are forced out of the market. In practice,[172] however, consumers may not fully exert their power to drive competition because of potential supply side impediments (such as opacity of offers, very large number of offers making it difficult to compare offers, complexity of switching, etc.) and consumers' cognitive limitations and behavioural biases.

In order to assess how markets work for consumers, the EC DG Health and Consumers compiles regularly a Consumer Market Scoreboard[173], which provides at the EU-wide level a quantitative assessment of how different markets work for consumers., According to the October 2011 Scoreboard, at the EU27 level, natural gas supply services rank 38th and electricity supply services rank 42nd among the 51 markets considered by the scoreboard and overall their performance is rated rather poorly (see figure below).

The rating value shown for each market is the "Market Performance Indicator" (MPI) which is a composite index based on the results of survey questions on four key aspects of consumer experience, namely:

- The ease of comparing goods or services;
- Consumers' trust in retailers/suppliers to comply with consumer protection rules;
- The experience of problems and the degree to which they have led to complaints; and
- Consumer satisfaction, i.e. the extent to which the market lives up to what consumers expect. Consumer satisfaction can be viewed as an indirect indicator of the extent to which competition in the market place is working for customers. In theory, perfect competition should deliver the lowest price at the best quality of service. In practice, however, because of less perfect competition, informational asymmetries, frictions in the market and consumer myopia and behavioural biases, markets do not always deliver the "perfect competition world" outcome.

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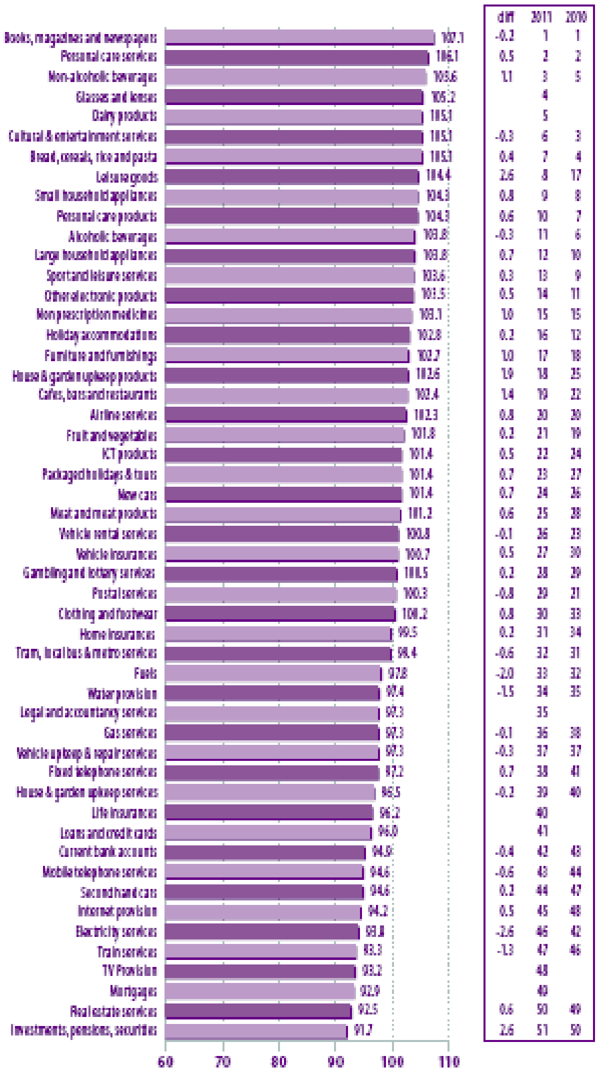
172 See, for example, Fingleton (2010), The next decade: ensuring that competitive markets continue to deliver good outcomes for UK consumers and the economy, Speech to Regulatory Policy Institute and ESRC Centre for Competition Policy's conference on the Role of Competition in Public Policy

173 See European Commission, DG Health and Consumers (2011), 'The Consumer Markets Scoreboard: Making Markets Work For Consumers', 6th edition, October

The four aspects of consumer experience discussed above are equally weighted when creating the overall score variable.

Figure 54: Market Performance Index – EU27 2011



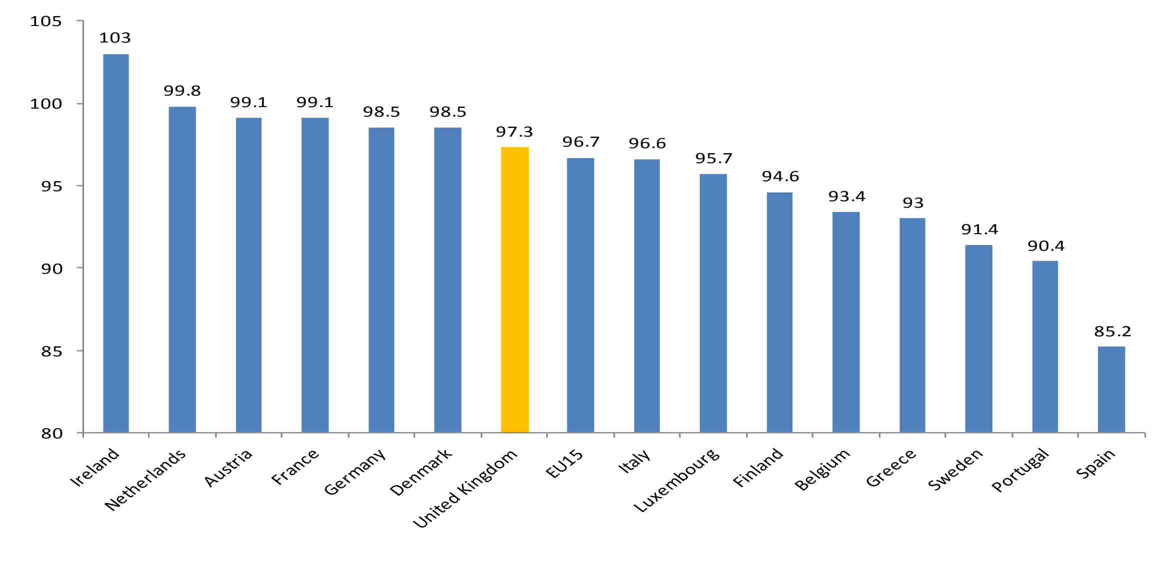
Note: Market Performance Index normalised by Member State population

Source: EC DG Health and Consumers, October 2011 Consumer Market Scoreboard

Among the EU15 Member States, the Market Performance Indicator for electricity supply is the highest in Ireland. The United Kingdom stands just above the EU15 average. The indicator for Spain is the lowest.

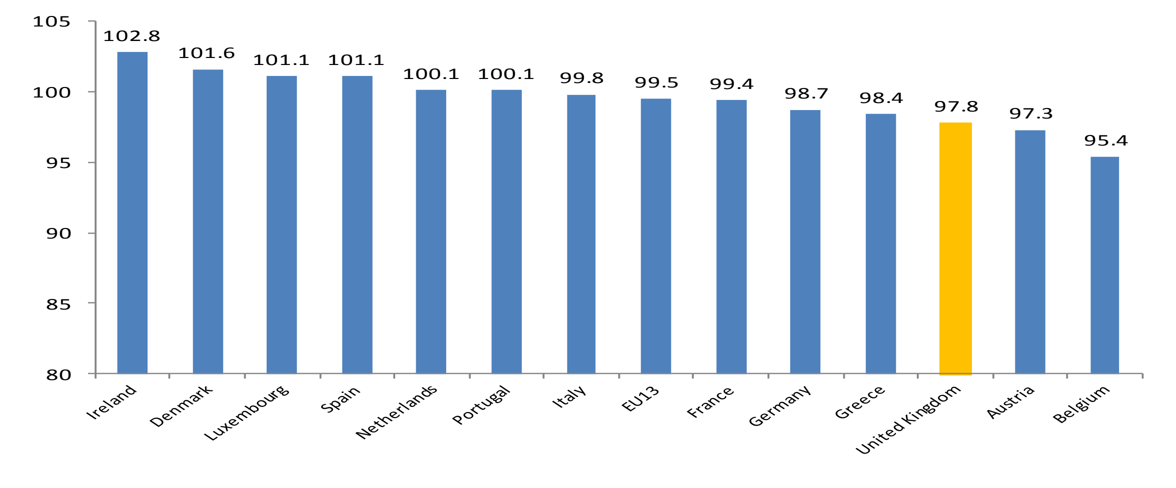
The UK's natural gas market ranking is not as high as its electricity market ranking, with consumers' judgments placing the UK third from the bottom among the Member States of interest, even if in absolute terms the Market Performance Indicator is marginally higher in the case of electricity.

Figure 55: Market Performance Indicator – electricity supply in EU15 Member States 2011



Note: EU15 Market Performance Index = unweighted average of EU15 Member State indicator
Source: EC DG Health and Consumers, October 2011 Consumer Market Scoreboard

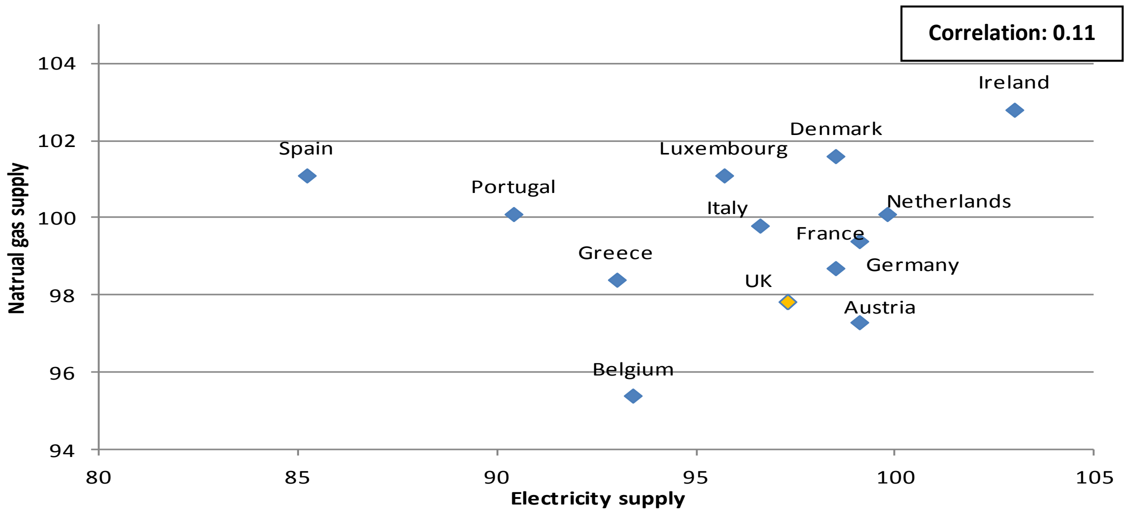
Figure 56: Market Performance Indicator – natural gas supply in EU13 Member States 2011



Note: EU13 Market Performance Index = unweighted average of EU13 Member State indicator. No data on natural gas supply in Finland and Sweden
Source: EC DG Health and Consumers, October 2011 Consumer Market Scoreboard

A more detailed review of the different components used to compute the overall MPI is provided in the annexes.

Figure 57: Correlation between Market Performance Indicators for electricity supply and natural gas supply in EU13 Member States 2011



Note: No data on natural gas supply in Finland and Sweden

Source: EC DG Health and Consumers, October 2011 Consumer Market Scoreboard

We have received from EC DG Health and Consumers the individual, anonymised responses of the respondents to the survey run across the EU27 in 2011 to collect the data required for the construction of the October 2011 Consumer Market Scoreboard indicators.

The survey asked consumers to provide an assessment on a scale of zero to 10 of different aspects of the electricity and natural gas markets and to indicate whether they had complained about the service received and has switched contract/supplier. The precise questions were, among others, the following:

- Did you complain to a supplier, third party, friend or family?
- Did you switch service at the same supplier or switch supplier?

The tables below display the frequency of complaints concerning electricity and natural gas supply among the survey respondents and switching patterns of those who did/did not complain.

- In the case of electricity supply, the UK has the 12th highest rate of complaints (13%) together with Belgium and Finland, among the 15 EU Member States.
- Moreover, in the case of natural gas, the UK shows the highest rate of complaints (16%).
- The other key point to note is that the switching rate is typically higher among the group of consumers who complained than among those who did not complain. The difference in switching pattern is particularly pronounced in the case of natural gas. While the consumer survey does not ask survey participants to indicate whether they switched before or after their complaints, it is reasonable to assume that, in general, switching occurred because consumers had complaints about their supply service.

Table 13: Complaints and switching – electricity supply

		Complained			Did not complain		
	Complained (as a % of total	Switched service but not supplier	Switched supplier	Did not switch	Switched service	Switched supplier	Did not switch
Country							
EU15	10%	8%	20%	72%	4%	10%	87%
AT	4%	0%	21%	79%	2%	5%	93%
BE	13%	5%	17%	79%	4%	7%	89%
DE	8%	16%	42%	42%	10%	5%	85%
DK	6%	0%	13%	87%	1%	6%	93%
ES	28%	6%	5%	89%	4%	6%	91%
FI	13%	3%	24%	73%	3%	13%	83%
FR	5%	9%	30%	61%	7%	3%	90%
IE	9%	4%	33%	62%	2%	31%	67%
IT	11%	11%	26%	63%	3%	12%	85%
LU	4%	0%	0%	100%	3%	2%	95%
NL	7%	6%	24%	70%	3%	14%	83%
PT	9%	24%	0%	76%	4%	1%	95%
SE	9%	12%	27%	62%	6%	13%	81%
UK	13%	7%	31%	61%	2%	12%	86%

Source: London Economics analysis of the responses of the survey undertaken for EC DG Health and Consumers for the October 2011 Consumer Market Scoreboard

Table 14: Complaints and switching – natrual gas supply

		Complained			Did not complain		
	Complained (as a % of total	Switched service but not supplier	Switched supplier	Did not switch	Switched service	Switched supplier	Did not switch
EU13	7%	7%	23%	70%	3%	6%	91%
AT	3%	0%	12%	88%	1%	4%	95%
BE	8%	5%	23%	73%	2%	7%	91%
DE	6%	43%	17%	40%	11%	5%	84%
DK	3%	0%	7%	93%	1%	2%	97%
EL	7%	3%	3%	94%	1%	1%	98%
ES	7%	11%	19%	70%	1%	11%	89%
FR	5%	24%	8%	68%	6%	4%	90%
IE	10%	0%	34%	66%	2%	19%	79%
IT	9%	2%	22%	75%	1%	3%	96%
LU	1%	33%	33%	33%	4%	0%	96%
NL	6%	10%	31%	59%	3%	7%	90%
PT	8%	0%	11%	89%	0%	3%	97%
UK	16%	1%	39%	59%	2%	13%	86%

Source: London Economics analysis of the responses of the survey undertaken for EC DG Health and Consumers for the October 2011 Consumer Market Scoreboard

8.5 Conclusions on competition

The overall conclusion from this chapter is that the UK (Great Britain[174]) generally appears more competitive than average based on market structure indicators but in terms of market outcome indicators and certain particulars of energy supply markets, the comparative results are mixed and the UK compares less favourably in some instances.

For market structure measures the UK is ranking in the less concentrated half generally, and in some cases of key measures towards the least concentrated in the sample. For example, the GB has the 5th out of the EU15 for electricity supply, and the UK is among the countries in the sample with the most main suppliers, being tied for having the most main suppliers among the EU15. We note that some countries that might appear less concentrated than the UK on market structure measures likely have regional/local markets, so the number of suppliers on a national basis might tend to overstate the level of competition.

The comparison of competition levels and market structure across countries and jurisdictions is very difficult. Of particular importance is the difficulty in measuring market structure and market performance. In addition, the existence of mixes of regulated tariffs, suppliers with historic incumbency, default universal service providers and differential competition effects from local, regional and national markets all combine to make even the measurement of the factors difficult. Therefore, even the available data has only recently begun to be collected. Thus while keeping these caveats in mind, a number of conclusions still emerge in the comparisons of the UK/GB across the sample. The sample is effectively the EU15 plus US States where information was available and New Zealand.

1. Market structure

Electricity supply

The first conclusion is that the UK ranks as having a relatively high number of suppliers and ranks as having relatively low concentration.

In terms of the number of *main suppliers* the UK has six (previously seven). No EU country has more although Austria also has six. Some US States are appearing to have more than six, but this may in part be explained by regional effects within States. In general, while the total number of suppliers for GB might seem low vis-à-vis certain jurisdictions, such as Germany or Finland, this is due to these countries having small local suppliers who are integrated with the local grid and who are also former monopoly providers (in the case of the USA, many still are the local monopoly providers). Even in countries such as Germany, the levels of switching from the local small former incumbent have tended to be low.

In terms of the C3 for electricity suppliers, Great Britain ranks 8th out of a large sample (66) of EU Member States, US States and New Zealand. The GB electricity market ranks slightly less favourably in terms of the HHI although the C3 might be the more comparable measure considering the existence of many small local incumbents in some jurisdictions. Notably however,

[174] The measures of market structure from Ofgem are on the basis of GB. Some of the EC results, such as those based on consumer surveys are for the UK.

Texas, ranked first, is a very large State and has low concentration (but high prices—see the section on prices and background).

In terms of absolute levels for the traditional market structure measures, there are rule-of-thumb benchmarks for what would be considered concentrated/problematic (for markets in general). In general, a market share C1 greater than 30%-60% can be indicative of potential problems; a C3 of between 50% and 70%, and an HHI of over 1800 are also indicative of potential problems. Great Britain in these terms is generally below the thresholds for electricity supply.

Gas supply

For natural gas suppliers and traditional measures of market structure, the conclusions are similar qualitatively to the conclusions for electricity, although gas data tends to be a bit patchier. In addition, the levels of liberalisation across the EU and US States (*de facto*) tend to be more variable. For example, the UK seems to have a low overall number of suppliers, but this measure is not indicative of the true market structure in countries such as Germany and Finland where local suppliers are incumbents and have maintained market share. When comparing the number of main suppliers, the UK is again tied for first in the rankings among EU15 countries. In terms of the market share of the largest three gas suppliers (C3), Great Britain is ranking as the3rd least concentrated out of the small sample of available countries in 2007, the most recently available year for data. Furthermore, the only countries appearing less concentrated than Great Britain are Germany and Denmark, of which Germany has local markets and the national C3 might be less valuable as an indicator. It is notable that some of this information is not available for Great Britain for the most recent years which make comparisons more challenging.

However in terms of the absolute levels for gas, we do have the HHIs for Great Britain, for residential markets (2284) and commercial markets (1523). Thus the residential market would be considered somewhat concentrated by the rules-of-thumb.

2. Consumer experience of market outcomes (performance)[175]

In measures of market outcomes (performance), the UK ranks between the middle to top of the group(s) – about average in electricity and among the top of the EU15 on the overall indicators of market performance for gas.

Electricity

In terms of an overall score of market performance, electricity supply in the UK ranked middle of the pack to slightly above average of the EU15. In terms of the detailed factors, the UK ranked above average on ‘ease of switching’ and ‘choice’, ranking 4th and 3rd respectively.

In terms of ‘trust’ the UK was just about average, and somewhat below average for ease of comparison and met expectations. The one indicator that was well below average was ‘number of complaints’, where the UK ranked 2nd most % consumers having complaints.

[175] The term market performance is often used to describe the SCP, structure-conduct-performance paradigm of Bain. See for example: Joe S. Bain, 1956. Barriers to New Competition: Their Character and Consequences in Manufacturing Industries, Harvard University Press. Bain, Joe, S, 1968. Industrial Organization, John Wiley & Sons. Richard E. Caves, 2007. "Joe S. Bain," in Pioneers of Industrial Organization, H. W. de Jong, W. G. Shepherd, ed., pp. 224-231.

Gas

While for electricity and the overall indicator the UK ranked about average, in natural gas, it ranked 12th out of 14 (3rd worst).

In terms of the breakdown into detailed measures, for ease of comparison (4th), complaints (4th), ease of switching (3rd), and choice (2nd) the UK ranked in the top positions in comparison to EU15 countries. In terms of trust the UK ranked near the middle of the group. However, in terms of "met expectations", the UK ranked 13th of 14, or 2nd lowest.

9 Econometric synthesis

This section studies the explanatory determinants of prices and profits for retail energy markets globally using econometric techniques. The section presents a number of econometric models of the residential and industrial gas and electricity prices for our sample of countries. The section tests a number of hypotheses such as the extent to which fuel mix and commodity prices, socio-economic cost factors, and local supply conditions *explain* the variation prices across countries and across time. These factors were discussed in general in the background sections with the country reviews discussing the differences in fuel mix, import needs, environmental policy and other such factors. The importance of such factors was further presented in the discussion of prices, but our analysis and discussion in the previous prices section was merely qualitative. The analysis here thus enables us to test the previous qualitative analysis on the drivers of price differences across time and jurisdiction.

9.1 Data, variables and method

In general, the data are from the IEA Electricity information and IEA Gas information online databases. Data for the USA States is from the US EIA.

Most variables such as prices are in the models as the natural logs of the variables. Variables such as shares or percentages are in the levels.

In general, all monetary and price variables are in nominal USD converted based on exchange rates. We tried a number of models and also included measures of inflation in the regression, but in most cases these were insignificant.

We estimated two main classes of models, that is, models using ordinary least squares and models using panel data techniques, for each of electricity and gas, and residential and industrial customers.

The following data come from the IEA:

- Lnp_reselec: Residential electricity price (log), average annual values for the 22 countries from 1979-2010 as available.
- Lnp_indelec: Log of the industrial electricity price, average annual values for the 22 countries from 1979-2010 as available.
- Lnp_resgas: Residential gas price (log), average annual values for the 22 countries from 1979-2010 as available.
- Lnp_indgas: Log of the industrial electricity price, average annual values for the 22 countries from 1979-2010 as available.
- Lnp_stot: Log of the fuel price, cost share weighted average of the logged fuel prices for gas, petrol, and coal, from IEA. The cost is calculated as the total consumption in fuel heat content, and the fuel price is in USD/TJ, 1979-2010 as available.
- Ln_energysupply: the total energy supply per capita in each country and year, 1980-2010.
- _cons: the constant term in a linear (log linear) regression. We generally do not interpret the constant terms.

The following data are from the EIA, 1990 - 2010:

- Share_hydro: for each country for each year, the share in total gross generation output of hydroelectric generation, conventional, storage run of river, not including pumped storage.
- Share_nuc: The share in total gross generation from nuclear power for each country and each year.
- Share_renew: the share in total gross generation from non-hydro renewables.

The following data are from the OECD:

- Ln_averagewage: the average industrial wage in each country in each year – 1990-2010.
- Ln_gdpcap: the GDP per capita in each country 1980-2010.
- Pop: population.

Data on competition from the European Commission:

- C1 – the market share of the largest supplier (gas and electricity)
- C3 – the market share of the three largest suppliers (gas and electricity)
- MMS – the market share of the 'main' suppliers (gas and electricity)
- Num_main_sup – the number of main suppliers (gas and electricity)
- Num_tot_sup – the total number of suppliers in the market (gas and electricity)
- Date of market opening—coded as 0=closed (no choice), 1=fully open, 0.5 (partially open). This variable was available for industry and commercial, and for residential for both electricity and gas.

Only in the case of Ofgem's data in their report to the EU Commission did we have any data that varied the concentration measures by industry and residential.

These data were collected for electricity and gas and in general were available, with some missing values and gaps, for 2003-2010.

9.2 Summary findings

This section presents a summary of our findings. We present together a discussion of the model results and our intuition for the findings as this, we hope, makes the discussion of the technical results more readable[176].

9.2.1 Electricity econometric models

Five different regression specifications were included in the final analysis of electricity prices. These models were selected as the strongest mix of explanatory variables discovered at each specification.

Previous studies, such as (Yucell and Swadley 2011, Andrews 2010 and Joskow 2006), included variables such as commodity prices and shares for different generation resources (hydro, nuclear,

[176] Note, in the discussion that follows, any coefficient that is deemed to be statistically significant has been determined so against a critical value of 10% significance.

renewables), as well as other explanatory variables for cost and economic conditions. Our methods are consistent with the existing studies.

Commodity

The first uses an OLS estimator with variables that relate to the fuel commodity cost and fuel mix. This specification is marked as commodity in the summary tables. It includes fuel cost index, and the shares of nuclear, hydro and renewables as explanatory variables. These variables were selected according to the literature reviewed and the results from the price benchmarking analysis. Results from retail price benchmarking compared against company specific fuel mix and commodity conditions provided good indications about what variables may have relevance in an econometric analysis.

Socio-economic

The second specification builds on the first one and is labelled as socio-economic in the summary tables. In addition to the variables used in the previous specification some socio-demographic variables were added to the model. GDP per head, average wage, and energy supply per capita were among the variables tested for relevance. In the end, the model presented included wages and energy supply per capita only. We believed this was the best balanced choice, in our judgement, as in a number of instances wages and GDP per capita were collinear and essentially picking up the same effect in terms of explain prices. These variables represent above all the changing shape and trends of an economy and attempts to capture how energy is being used by consumers (both residential and industrial).

Panel

Our next set of regression results develops panel models. The third, fourth and fifth specifications are all panel models. Panel models can be estimated with OLS or generalized least squares (GLS) techniques. In general, the panel model takes account of unobserved heterogeneity in the sample across countries over time. The same variables, in general, are used for the panel regression as are used for the OLS regressions, but other variables/parameters are used to estimate the impacts of the unobserved heterogeneity. In general, this heterogeneity can take many forms, but we assume that the unobserved heterogeneity is across country, and fixed in time. Thus, in the case of the fixed-effects estimator, the panel model is akin to including a country-specific dummy variable. In the case of the random-effects estimator, the panel model is akin to including a country-specific error variance term in the error variance-covariance matrix.

Besides including the country-specific panel parameters in the panel models, we also added some additional variables to the panel models which we did not include in the OLS regression, such as the competition variables. The reason we did not include these variables in the simple OLS models was to raise the bar in terms of estimating the links between competition/market structure and prices. In other words, we can be reasonably assured that the market structure variables are not measuring impacts from unobserved heterogeneity only in the panel models.

Simply stated, panel models exploit the fact that we have observations that are organised across observational units, such as states and countries, and over time. They are distinct from time series models in that the same units (States, countries, regions, etc.,) generate the observations. Unobserved heterogeneity means factors that cause the variation in prices across country which are not observable or measurable (in the existing data). These factors may be nonetheless specific to a country, or they could be specific to a time-period. For example, if countries had different specificities of their regulatory regime, even the best data available might not be able to account for these differences. The panel data model would allow the base-cost of each country to be different, however, as a reflection of these unmodelled differences.

We present the random effects model for each case. We performed Hausman tests on the models and in general, the indication was for the random effects model (although not in every case). The fixed-effects model is also called the within-groups model; the between groups model is equivalent to the OLS regression on the means of the groups (countries in this case, averaged over time). The random-effects model is the weighted average of the two. The random effects model is estimated as a feasible Generalised Least Squares model, and we use the default STATA estimation procedure (others are possible). In general, the model results, in terms of coefficient estimates did not differ greatly between fixed effects and random effects models—there tended to be fewer variables significant in the fixed effects models, however, which is perhaps due to the inefficiency of that model under the standard hypothesis.

We also checked the models using standard diagnostics and did not find any particular problems.

Another potential problem that was considered was the potential of outliers to impact the results. This did not prove an issue as no outliers were found when testing whether any one observation was more than 2.5 standard deviations from the mean (within country) (the fixed effect and random effects models allow for different means across different countries).

Another area of potential interest was to consider price-cost mark-ups and the Lerner Index. We did regressions with these values but the results were not good in terms of fit and significance of key coefficients, probably due to the fact that we are effectively using average fuel cost, rather than marginal cost, and the average cost may not have correlated to the marginal generation unit, but would reflect the average cost of the average fuel mix and fuel prices of the country during the year.

In general, as well, the rho-statistic reported gives an indication of the need for the panel model versus the pooled OLS model (i.e., no panel effects estimated). A rho-value close to zero would indicate no need for panel estimation. These values were in general larger than zero for all the models.

The overall statistical significance of the model is indicated by a Wald-chi-squared statistic and an appropriate p-value for that statistic close to zero. The R-squared value of the "overall" regression is reported and is the appropriate measure of goodness-of-fit for the random-effects model.

Panel competition models

Our next set of models for electricity prices are the panel models as before, but now we add measures of market structure and market opening. We collected data on a number of concentration and market structure measures from a variety of sources. This, however, proved quite challenging to collect consistent and meaningful variables across time and space. Measures such as C1 (the concentration of the market, or market share of the largest supplier), C3, the market share of the three largest suppliers, MS_main, the market share of the main suppliers, the total number of suppliers, and the total number of main suppliers were all available from the

European Commission. As discussed previously in the literature review competition has provided good explanatory power over prices in past studies. These results which are in line with the theory behind deregulation provided reason to include such a variable in our econometric analysis.

After trying a number of models, we believed the C3 was the best indicator of competition and market structure, and also in general the most widely available. HHI as a market structure indicator contains the most information, but is not widely available, as regulators do not often publish this indicator. The choice of C3 is based on the availability of data (C3 more widely available than C1 and HHI), but also that C3 gives a better indicator of market structure than merely the number of main suppliers, the number of suppliers, or C1. For example, with C1, the market share of the largest firm, the market could have three equally-sized firms of 25% and still have an HHI of 1875 (the former being below a benchmark indicator for a competitive market, the latter being just above – see the section on Competition previously presented in this report.)

Panel comp score

This specification uses a market opening dummy that is interacted with the C3 variable to estimate whether separating markets into deregulated and regulated would help to give some explanatory power to market concentration in our models.

9.2.2 Electricity results

Residential IEA countries only

Under the sample group of 22 IEA countries[177] the results of the econometric analysis of residential electricity price drivers, is contained in table 9.1.

Under the first regression specification the regression of the log residential electricity price on the fuel cost index, and the shares of nuclear, hydro and renewables. This regression for the 22 countries gives us 338 observations, and R-squared of 39.5%, which seems reasonably good for a panel model with only a short set of regressors. The F-stat indicates the total regression is significant.

All coefficients save nuclear are show significance. The sign of all coefficients are in line with expectations. Although it is important to note that hydro power may sometimes in dry weather scenarios are more expensive than fossil fuel energy. Due to big capital costs both nuclear and renewable energy are expected to be more expensive.

Under the socio-economic specification all regressors have the expected sign except nuclear power. All regressors are significant except hydro power. These are presented in bold type and the p-values below the coefficient estimates close to zero are the indicator. The R-squared of73% is considered high with 325 observations.

[177] The basis of the selection of the countries sample was presented previously in the Summaries and the Introduction. The IEA countries include the OECD. Our IEA countries include all OECD main countries, excluding Korea, Turkey and Mexico.

Under the panel regression specification the expected value are much the same as the OLS models. The share of hydro, nuclear and renewables all lose significance as does the fuel cost index. This last result is somewhat surprising.

The model offers a good overall R-squared of 69.8% using 325 observations.

The panel comp and panel comp score specifications see no major difference in results from previous models. All regressors have values that are in line with expectations. The new competition variables does achieve significance under the panel comp model suggesting that prices fall the more concentrated a market is which would go against conventional expectations.

Table 15: Regression outputs-Residential Electricity- IEA countries

	Regression specification				
	commodity	socio-economic	panel	panel comp	panel comp score
c3_elec				**-0.002 (0.065)**	
c3_elec_mrkt_closed					0.000 (0.787)
c3_elec_mrkt_open					-0.001 (0.201)
ln_averagewage		**0.658 (0.000)**	**0.896 (0.000)**	**0.823 (0.000)**	**0.988 (0.000)**
ln_energysupply		**-0.795 (0.000)**	**-0.957 (0.000)**	**-0.600 (0.001)**	**-0.975 (0.000)**
lnp_stot	**0.366 (0.000)**	**0.145 (0.000)**	**-0.010 (0.671)**	**0.195 (0.000)**	0.012 (0.678)
share_hydro	**-0.540 (0.000)**	-0.022 (0.744)	0.108 (0.466)	-0.080 (0.718)	0.022 (0.883)
share_nuc	0.008 (0.924)	**0.174 (0.003)**	0.102 (0.534)	**-0.512 (0.070)**	0.157 (0.365)
share_renew	**1.892 (0.000)**	**1.235 (0.000)**	0.287 (0.135)	-0.349 (0.312)	**0.482 (0.069)**
_cons	-3.811 (0.000)	-8.357 (0.000)	-9.723 (0.000)	-10.319 (0.000)	-10.746 (0.000)
R-squared	0.395	0.734	0.698	0.644	0.611
N	338	325	325	82	242

Source: London Economics

Industrial prices IEA countries only

The next table represents the same group of model specifications as in the table above with industrial electricity prices as the dependant variable.

The commodity regression specification with industrial electricity as the dependant variable gives very similar results to those on residential prices. An R-squared of 41% with 321 observations shows a model of reasonably good fit. The signs and significance of the variables fell in line with expectations. It can be inferred that industrial prices are relatively lower in nuclear dominated systems than residential prices might be. The opposite may also be true for renewables; it is showing a significant effect on residential prices while showing an ambiguous effect on industrial prices.

Under the socio-economic specification regression there are 308 observations with a strong R-squared of 64.7%. All regressors are significant expect for hydro as found before. The signs of the coefficients are all as expected with nuclear displaying its expected negative sign.

Under the panel specification all significant coefficients were signed as expected. The only change from residential prices is that the fuel cost index regains significance. This makes sense as industrial prices should be driven by fuel cost changes more than residential prices. The model has308 observations and shows a good R-squared of 59.1%.

Using industrial IEA prices with the panel comp and panel comp score models there are no gains in explanatory power. All regressors appear to be in line with expectations; however neither model can give any explanatory power to market structure.

Table 16: Regression outputs-Industrial Electricity- IEA countries

	Regression specification				
	commodity	**socio-economic**	**panel**	**panel comp**	**panel comp score**
c3_elec				-0.002 (0.290)	
c3_elec_mrkt_closed					0.000 (0.588)
c3_elec_mrkt_open					-0.002 (0.134)
ln_averagewage		**0.512 (0.000)**	**0.941 (0.000)**	**1.000 (0.000)**	**1.039 (0.000)**
ln_energysupply		**-0.659 (0.000)**	**-0.867 (0.000)**	**-0.837 (0.000)**	**-0.868 (0.000)**
lnp_stot	**0.553 (0.000)**	**0.390 (0.000)**	**0.127 (0.001)**	**0.333 (0.000)**	**0.313 (0.000)**
share_hydro	**-0.491 (0.000)**	0.063 (0.463)	0.128 (0.509)	-0.334 (0.367)	0.070 (0.737)
share_nuc	**-0.450 (0.000)**	**-0.293 (0.000)**	-0.188 (0.321)	**-0.841 (0.007)**	-0.045 (0.819)
share_renew	-0.577 (0.160)	**-1.018 (0.002)**	-0.501 (0.109)	-0.559 (0.409)	-0.267 (0.547)
_cons	-5.212 (0.000)	-8.782 (0.000)	-11.596 (0.000)	-13.124 (0.000)	-13.532 (0.000)
R-squared	0.410	0.647	0.591	0.702	0.546
N	321	308	308	75	201

Source: London Economics

Residential IEA countries with US states

The next table contains outputs from similar regressions used before but with residential electricity prices from IEA countries and US states used as the dependant variable.

US states were added to the country list to provide an extra set of observations. The hope was that it would allow more rigid analysis. However the results from this dataset were similar to those with only IEA country data used. With 651 observations the returned R-squared was 44.6% showing good explanatory power.

The significance and sign of each coefficient did not change from the IEA country data run of the same specification. Therefore it provided no more insight into the drivers of residential electricity prices.

The socio-economic specification regression provides 606 observations and an excellent R-squared of 69.2%. All the regressors have coefficients similar in size and direction to that of the similar IEA only model. In this sample group the share_nuc variable loses its significance while the share_hydro is once again significant. This change is most likely due to the US states not having huge nuclear capacities in relation to hydro and the other International states examined.

The panel model unlike when only IEA country data is used has all regressors significant except for hydro and nuclear. All sings are in line with expectations. The model uses 606 observations and shows a good R-squared of 57.4%.

Under the panel comp model all regressors are in line with expectations. A good R-squared of 74.3% is achieved while 362 observations are used. Crucially the C3 variable achieves significance under this model although its negative sign goes against conventional expectations of this metric.

Under the panel comp score model again results are largely in line with expectations. 523 observations were included and a considerable R-squared of 60.9% was captured in the model. The only new result of note in this model is the negative significant coefficient of C3 market open dummy. This is suggesting that in a deregulated market the higher the concentration the lower the prices. This is against conventional regulatory theory but at a 5% significance level the result is no longer meaningful suggesting some ambiguity to the result.

Table 17: Regression outputs-Residential Electricity- IEA countries with US states

	Regression specification				
	commodity	**socio-economic**	**panel**	**panel comp**	**panel comp score**
c3_elec				**-0.001 (0.079)**	
c3_elec_mrkt_closed					0.000 (0.394)
c3_elec_mrkt_open					**-0.001 (0.070)**
ln_averagewage		**0.289 (0.000)**	**0.710 (0.000)**	**0.732 (0.000)**	**0.748 (0.000)**
ln_energysupply		**-0.331**	**-0.554**	**-0.202**	**-0.518**

		(0.000)	**(0.000)**	**(0.000)**	**(0.000)**
lnp_stot	**0.386 (0.000)**	**0.243 (0.000)**	**0.070 (0.000)**	**0.149 (0.000)**	**0.086 (0.000)**
share_hydro	0.080 (0.214)	**-0.378 (0.000)**	0.046 (0.710)	-0.134 (0.337)	-0.059 (0.634)
share_nuc	**-0.274 (0.000)**	0.024 (0.636)	0.096 (0.458)	-0.122 (0.351)	0.096 (0.473)
share_renew	**1.623 (0.000)**	**1.267 (0.000)**	**0.339 (0.047)**	0.304 (0.220)	0.223 (0.305)
_cons	-4.088 (0.000)	-5.653 (0.000)	-8.565 (0.000)	-9.656 (0.000)	-9.001 (0.000)
R-squared	0.446	0.692	0.574	0.743	0.609
N	651	606	606	362	523

Source: London Economics

Industrial prices IEA countries with US states

The specification of the regressions here represents a change of dependant variable. Industrial electricity prices were used from 22 IEA countries and 51 US states.

Under the commodity specification results were largely similar to those previously gotten. These outcomes were all in line generally with expectations. The model has 634 observations and shows good explanatory power with an R-squared of 49.3%. The only change from the industrial price model on IEA countries is that the renewable coefficient changed sign but was still insignificant.

Under the socio-economic specification regression the results are again similar to that shown under IEA only version with US state data included. The model runs 589 observations and shows a relatively strong R-squared of 59.1%.Interestingly the share of nuclear and hydro have significant negative effects on industrial electricity prices. All regressors show significance with the exception of renewables, which is a somewhat expected result.

The panel regression specification gives results that are in line with those seen previously and are no different than expectations. The model shows an R-squared of 43.2% and has 589 observations.

The panel comp and panel comp score regression adds no explanatory power to our model. All regressors are in line with expectations but no new competition variables are found to be significant.

Table 18: Regression outputs-Industrial Electricity- IEA countries with US states					
	Regression specification				
	commodity	socio-economic	panel	panel comp	panel comp score
c3_elec				0.000 (0.831)	
c3_elec_mrkt_closed					0.001 (0.169)
c3_elec_mrkt_open					0.000 (0.865)
ln_averagewage		**0.118 (0.000)**	**0.638 (0.000)**	0.065 (0.689)	**0.731 (0.000)**
ln_energysupply		**-0.198 (0.000)**	**-0.327 (0.000)**	0.075 -(0.224)	**-0.286 (0.000)**
lnp_stot	**0.478 (0.000)**	**0.421 (0.000)**	**0.214 (0.000)**	**0.228 (0.000)**	**0.260 (0.000)**
share_hydro	**-0.260 (0.000)**	**-0.409 (0.000)**	-0.100 (0.525)	-0.120 (0.564)	-0.256 (0.126)
share_nuc	**-0.359 (0.000)**	**-0.288 (0.000)**	-0.091 (0.551)	-0.268 (0.139)	-0.025 (0.879)
share_renew	0.152 (0.556)	-0.086 (0.732)	0.048 (0.853)	**1.097 (0.006)**	0.219 (0.506)
_cons	-4.972 (0.000)	-5.502 (0.000)	-9.470 (0.000)	-11.813 (0.000)	-10.745 (0.000)
R-squared	0.493	0.591	0.432	0.608	0.456
N	634	589	589	355	482

Source: London Economics

9.2.3 Gas introduction

In general, previous studies have suggested a range of potential explanatory variables for gas prices. Commodity prices is an obvious variable. Other variables such as consumption and imports are suggested by studies such as Davis and Muehlegger (2010)[178].

Commodity

We begin with a basic OLS model relating the residential gas price to basic commodity conditions. These commodity regressors are a bit different than from the electricity models, where fuel input prices and cost and fuel mix were included. In the case of gas, there is no fuel mix per se. Gas commodity is estimated using gas commodity wholesale price and the difference between total annual consumption less production, divided by consumption (gas_imprt_cons). This is effectively the ratio of net imports to consumption. Of course, some small differences between net imports due to annual differences in stocking and storing, and withdrawals will exist, but as storage is

[178] Davis, L., and Muehlegger, E., "Do Americans Consume Too Little Natural Gas? An Empirical Test of Marginal Cost Pricing," RAND Journal of Economics, Winter 2010.

mostly for short term balancing, and for seasonal use, the impacts of this on an annual basis are expected to be small.

Socio economic

As previously with the electricity equations, we next include some socio-economic variables in the gas price OLS equation estimates. Besides measuring real cost-related impacts, such as higher wages need to pay higher costs across the spectrum of the supply chain and economies of scale, addition of these variables is possibly proxying for a variety of impacts, and improves the significance and fit of the equations in general.

The first equation is the regression of the log residential gas price, lnp_resgas, shows the impact of wages, energy intensity, the gas commodity price, lnp_gas_commod, and the gas commodity availability. This last variable, gas_imprt_cons is the ratio of the difference of consumption less production, divided by total consumption. It is a proxy variable for the measure of how available the local commodity it.

Panel

Our gas equation estimation proceeds along the same lines as the electricity, in that now we turn to panel analysis. The panel nature of the data and the vast number of factors that are country-specific is suggestive of unobserved heterogeneity and thus the need for panel models[179]. We present the results from the random-effects models as our preferred approach[180].

Panel comp

Our approach now continues as before, to build the models with adding the competition measures. We had a number of competition measures, but in the end settle on C3, the market share of the 3 largest firms, and also the OECD market liberalisation score indicator.

We only present the detailed panel models with the socio-demographic and commodity variables included, as these are considered the most robust models, in terms of fit, omitted variable biases (or lack there-of), etc. Essentially, we only study the competition measures in this context.

Note only IEA country analysis was possible under this specifications due to insufficient US state data.

Panel comp score

The next set of equations looks at the impacts of market opening and concentration. The same approach is taken for each of residential and industrial gas prices.

[179] The Breusch and Pagan Lagrangian multiplier test for random effects was positive in all cases, i.e., reject the Ho that OLS could be used.

[180] Hausman tests were run. In some cases, these indicated the fixed effects model would be consistent under the null hypothesis. In general, the test is only for the difference between the two estimators and the preference is a comparison of an efficient versus a consistent estimator. The fixed effects model, aka, the within-groups estimator, does not make use of variation in the variable across groups (countries in this case). The choice of the random effects versus the fixed effects model did not make qualitatively large differences in the coefficient estimates.

Essentially, what was done was that a semi-dummy variable for when the market was opened for retail choice. This variable was coded as 0==no choice, 0.5==partial opening/choice, 1==full choice, for each of residential and industrial gas customers in each year. This variable was then interacted with the C3 measure. Further, the C3 was set to 100% when the market was fully closed, because customers who are captive essentially are customers of a monopoly (albeit a regulated one). The C3_market_open (C3_resgas_mrkt_open, and C3_indgas_mkt_open) and C3_market_closed (C3_resgas_mrkt_closd and C3_indgas_mrkt_closd) variables were then both included in the regressions.

Note only IEA country analysis was possible under this specification due to insufficient US state data.

9.2.4 Gas results

Residential IEA countries only

The first regression results are found below. The model is showing a reasonable R-squared value of 31%; especially with the panel nature of the data just two regressors, this might be considered to be high. The coefficient estimates are positive and significant. The expected sign on the wholesale price is naturally positive. The expected sign on the import to consumption variable is perhaps harder to interpret. If a country has low imports, it may indicate that they have sufficient local commodity and low prices. Alternatively, some countries, such as Norway, have high exports, but little home use, and the Netherlands is an exporter but prices are high. There is also the potential of the presence of simultaneity here causing the ambiguous results.

Under the socio-economic specification there is an R-squared of 65% and 347 observations. All regressors are in line with expectations and with the exception of the import ratio all show significance.

Under the panel spec the overall R-squared is reasonably good at 52% for 347 observations. The variable coefficient estimates all have statistical significance.

The coefficient estimates all have the expected signs, save the commodity imports/consumption variable, which is now negative and significant (previously insignificant in the OLS equation). As discussed previously, there may be other factors such as imports reducing price, rather than this variable indicating tight supply, and so it could be argued that the expected sign of this variable is negative or positive.

The panel comp specification has an R-squared that is reasonably high overall, at 47%. Similar to the electricity, the number of observations has been reduced by data availability. The sample now consists only of EU15 countries, as these were the only countries with reliable C3 data on retail gas market opening.

All the regressors are in fact statistically significant, save the gas import/consumption variable.

All of the significant regressors have the expected sign. This is quite interesting because the C3 variable is showing significant and positive, whereas in the electricity equation the variable was insignificant. Thus the model supports the hypothesis that higher concentration tends to lead to higher prices.

The panel comp score specification has an R-squared at 55%, and the number of observations has been increased now to 254. This is because for years prior to market opening, when C3 in many cases was in the previous model coded as “missing” we have now coded the C3, given the market was not open, as 100%.

The results are very similar to the previous models, with largely the same qualitative results. That is to say, all the regressors are statistically significant, save the C3 market open variable. All the significant coefficient estimates have the expected sign; with the negative sign on the imports/consumption variable being possibly as expected (see previous discussion).

The result is mildly surprising in that the C3 seems to have a positive and significant impact on price when markets are not open, but an ambiguous impact on price when markets have opened; Perhaps a very weak indication of evidence of progress from deregulation, with the usual caveats.

Table 19: Regression outputs-Residential Gas- IEA countries

	Regression specification				
	commodity	**socio-economic**	**panel**	**panel comp**	**panel comp score**
c3_gas				**0.00 (0.016)**	
c3_gas_mrkt_closed					**0.00 (0.01)**
c3_gas_mrkt_open					0.002 (0.14)
gas_import_cons	**0.14 (0.000)**	-0.03 (0.413)	**-0.12 (0.026)**	0.14 (0.394)	**-0.13 (0.034)**
ln_averagewage		**0.62 (0.000)**	**0.81 (0.000)**	**0.61 (0.000)**	**0.83 (0.000)**
ln_energysupply		**-0.88 (0.000)**	**-0.53 (0.000)**	**-0.39 (0.097)**	**-0.62 (0.000)**
lnp_gas_commod	**0.59 (0.000)**	**0.41 (0.000)**	**0.31 (0.000)**	**0.40 (0.000)**	**0.37 (0.000)**
_cons	5.28 (0.000)	0.68 (0.288)	-1.64 (0.002)	-0.24 (0.869)	-1.98 (0.001)
R-squared	0.31	0.65	0.52	0.47	0.56
N	475	347	347	59	254

Source: London Economics

Industrial IEA countries only

The commodity regression with industrial prices has a considerably high R-squared of 58% considering it is a panel model with two regressors. 458 observations were used in the model. All coefficients are similar in size and significance to the results from the previous model with residential prices.

Under the socio-economic specification there is an R-squared of 79% and 294 observations. All regressors are in line with expectations and all variables show significance. The imports/consumption variable is positive and significant. The positive expected sign is correct under the hypothesis that more imports are indicative of either higher costs or scarcer commodity[181].

Under the panel specification the overall R-squared is reasonably good at 74% for 294 observations. The variable coefficient estimates all have statistical significance.

The coefficient estimates all have the expected signs, save the commodity imports/consumption variable, which is now negative and significant (previously insignificant in the OLS equation). As discussed previously, there may be other factors such as imports reducing price, rather than this variable indicating tight supply, and so it could be argued that the expected sign of this variable is negative or positive.

Under the panel comp model the R-squared is reasonably high overall, at 81%. Similar to the electricity, the number of observations has been reduced by data availability. The sample now consists only of EU15 countries, as these were the only countries with reliable C3 data on retail gas market opening.

In spite of the reduced sample, the results seem reasonably good all things considered. Very broadly, the order of magnitude of the coefficient estimates on some the standard variables such as wages, energy supply per capita, commodity prices, and imports have not changed.

Like the residential gas price equation, all the regressors are in fact statistically significant, save the gas import/consumption variable.

All of the significant regressors have the expected sign. This is quite interesting because the C3 variable is showing significant and positive. Similarly, the conclusion is the model supports the hypothesis of higher concentration leading to higher prices.

Under the panel comp score specification the R-squared of the model is reasonable at 76%, and the number of observations has been increased now to 190. Similarly to the residential explanation above, this is because for years prior to market opening, when C3 in many cases was in the previous model coded as “missing” we have now coded the C3, given the market was not open, as 100%.

The results are very similar to the previous models on industrial gas prices, as well as largely the residential gas prices, with largely the same qualitative results, with one notable exception. That is to say, all the regressors are statistically significant, save the *C3 market closed* variable (C3_indgas_mrkt_closd). All the significant coefficient estimates have the expected sign; with the negative sign on the imports/consumption variable being possibly as expected (see previous discussion).

[181] The caveat of possible simultaneity here should still be borne in mind.

The results are quite interesting in terms of the impact of market opening and concentration. Seemingly, there is some evidence that the impacts of market opening in gas have benefited industry where concentration is lower (or alternatively, lower concentration *and* market opening tend to lower industrial prices), while market concentration and the market being closed have an ambiguous impact. This could perhaps be interpreted as evidence that market opening has benefited industrial customers in the general sense.

While it is perhaps more tenuous to compare across the equations, one might suggest with the appropriate caveats that the evidence is consistent with the hypothesis that market opening has been beneficial for industrial users more than residential users.

While again, we suggest due caution in the strength of such conclusions, at least largely consistent with the broad evidence that switching, customer choice and the state of development of gas market opening has been slower to develop for retail customers than for industrial customers in the EU.

Table 20: Regression outputs-Industrial Gas- IEA countries

	Regression specification				
	commodity	**socio-economic**	**panel**	**panel comp**	**panel comp score**
c3_gas				**0.00 (0.023)**	
c3_gas_mrkt_closed					0.00 0.15
c3_gas_mrkt_open					**0.00 (0.035)**
gas_import_cons	**0.31 (0.000)**	**0.11 (0.000)**	**-0.10 (0.074)**	0.17 (0.224)	**-0.16 (0.026)**
ln_averagewage		**0.63 (0.000)**	**0.59 (0.000)**	**0.33 (0.029)**	**0.38 (0.000)**
ln_energysupply		**-0.59 (0.000)**	**-0.65 (0.000)**	**-0.45 (0.015)**	**-0.75 (0.000)**
lnp_gas_commod	**0.71 (0.000)**	**0.55 (0.000)**	**0.56 (0.000)**	**0.73 (0.000)**	**0.66 (0.000)**
_cons	4.24 (0.000)	-1.04 (0.057)	-0.39 (0.572)	1.33 (0.349)	1.78 (0.031)
R-squared	0.58	0.79	0.74	0.82	0.76
N	410	294	294	47	190

Source: London Economics

Residential IEA countries with US states

The commodity specification here has little change from that with just IEA residential prices. The number of observations in the model is 838 and the R-squared of 24% is considered reasonable given the parameters of the regression. Both regressors are showing significance and are in line with expectations.

The next model is the socio-economic specification with IEA and US residential prices as the dependant variable. The model shows a good fit with an R-squared value of 52% with 644 observations. All except the import ratio constant display statistical significance and all regressor results are in line with expectations.

Under the panel specification the overall R-squared of 41.6% is considered reasonable with 644 observations.

All coefficients show significance at 10% critical value the major new result here is the significance of the import ratio in a panel model. This shows the possibly ambiguous effect the import patterns have on residential gas prices. As previously discussed it is reasonable to get both a positive and negative sign on this variable. It maybe that imports are reducing price rather than prices being driven by supply issues. All other coefficients are in line with expectations.

Table 21: Regression outputs-Residential Gas- IEA countries with US states

	Regression specification				
	commodity	**socio-economic**	**panel**	**panel comp**	**panel comp score**
c3_gas					
c3_gas_mrkt_closed					
c3_gas_mrkt_open					
gas_imprt_cons	**0.04 (0.000)**	0.00 (0.711)	**-0.02 (0.067)**		
ln_averagewage		**0.27 (0.000)**	**0.61 (0.000)**		
ln_energysupply		**-0.41 (0.000)**	**-0.36 (0.000)**		
lnp_gas_commod	**0.43 (0.000)**	**0.55 (0.000)**	**0.41 (0.000)**		
_cons	5.42 (0.000)	3.32 (0.000)	0.11 (0.764)		
R-squared	0.24	0.52	0.42		
N	838	644	644		

Source: London Economics

Industrial IEA countries with US states

The commodity specification regression run with IEA and US industrial price data shows results that are largely in line with those previously discussed. Explanatory power here is strong with an overall R-squared of 46.8%. However, the import ratio variable loses significance under this model which goes against expectations; this could be due to the presence of simultaneity that has been previously discussed.

The r-squared value of 60% shows good explanatory power. All regressors are In line with results previously examined. The import ratio is significant but in contrast the sign is now negative suggesting an ambiguous relationship that has been discussed already.

The panel model shows again, a reasonable overall R-squared of 41.6% with 644 observations included.

All coefficients are in line with the IEA country only model with the same specifications. The sign and significance of each are consistent with expectations. The import consumption ratio variable is again a significant with a negative coefficient. This ambiguous effect has been discussed at length.

Table 22: Regression outputs-Industrial Gas- IEA countries with US states

Regression specification					
	commodity	**socio-economic**	**panel**	**panel comp**	**panel comp score**
c3_gas					
c3_gas_mrkt_closed					
c3_gas_mrkt_open					
gas_imprt_cons	0.00 (0.794)	**-0.03 (0.000)**	**-0.02 (0.049)**		
ln_averagewage		**0.10 (0.002)**	**0.35 (0.000)**		
ln_energysupply		**-0.30 (0.000)**	**-0.20 (0.002)**		
lnp_gas_commod	**0.69 (0.000)**	**0.79 (0.000)**	**0.65 (0.000)**		
_cons	4.39 (0.000)	3.82 (0.000)	1.43 (0.006)		
R-squared	0.47	0.60	0.54		
N	762	582	582		

Source: London Economics

9.2.5 Cost efficiency and the impact of competition on prices

In much of our findings, our work suggests the inclusion of competition variables cannot be proved to have reduced prices. There are many possible reasons for this, including correlations between which jurisdictions decide to adopt reform (most likely not the low cost jurisdictions), along with measurement and data problems across time and space.

One of the classical challenges of measuring the impact of competition is the different interactions between various measures of price, cost, and margin. In theory, measuring the impact of competition is best done on some kind of price cost margin, for example, the Lerner Index or the price-cost-markup. On the other hand, our study here was concerned with prices to end-users; from a policy perspective rightly so—users care most about their price, not about margins of their supplier. However, it has been well understood by competition economist that often results of studies of the impacts of competition or market structure, or other such competition variables on margins has yielded mixed results, in part because of the possibility of embedded inefficiency in the industry that previously lacked competition.

In our study, we also ran regressions with margins, with results being poor to much worse than our regressions using price levels. A suggestion then is that inefficiency is a potential explanatory factor that has not been measured.

One way then to study this would be to adjust markups for inefficiency. One way to measure cost inefficiency is with a cost efficiency frontier approach. There are a variety of possible methods and approaches to this: econometric and linear programming, assuming stochastic inefficiency term (Stochastic Frontier Analysis SFA) or assuming a fixed inefficiency term (akin to a fixed effect in a cost model).

Cost efficiency could be a major factor in explaining prices and price cost margins. In general, two firms could have the same margins, and same costs: $(P_1\text{-}C_1)/\ C_1\text{=}M$, for firm one, and say,

$(P_2\text{-}(C_1\text{+}X)/\ C_2\text{=}M$, for firm two. The price differential could be due to inefficiency: $(P_1\text{-}P_2) = X$, where X is the measure of inefficiency.

In the end, we decided not to include margins or any attempt to measure efficiency. There are two main problems with employing such an approach for our study. First, the data needed would be a particular challenge. We would need sufficient data on prices and units of inputs such that we characterised the full set of inputs in production. Much more effort would be needed to ensure the prices of labour, capital, and materials (fuels) were properly measured. In terms of the data we already had, the accounting data had already proved to be poor, and therefore to attempt more sophisticated analysis, in our opinion, would be unlikely to yield good results. For the IEA datasets, data on fuels and fuel inputs, prices, and quantities were available, but the coverage is not always so good for all fuels. Further, the main thing that would be missing is data on cost of capital and capital stock. A final data problem of particular interest would be utilisation rates for power plants, forced outage rates. It isn't *a priori* obvious how this would be modelled—although there is a large literature on the possibilities.

The second problem is that using a cost-efficiency frontier approach would have substantially complicated the econometrics section. The main goal of the project was to 'explain' prices, and so if we began positing two-part error terms and including many other variables on capital stock, labour hours, etc. (depending on what model we used for cost), there is a risk that the results we did obtain would have been clouded, in the econometric sense, such as when regressors become insignificant, by the more complicated models.

There are a range of methods and techniques for estimating inefficiency, and the most state-of-the art is the stochastic frontier approach, which could use a production function or duel cost function approach. It should also be noted that there are a variety of techniques such as stochastic (econometric) and non-parametric (deterministic, such as DEA), and it is most likely that more than one technique should be used to check for model assumptions robustness.

In general, however, cost function measurement or production function measurement and the correct measurement of inefficiency (either deterministic of stochastic—this is usually by assumption as to the nature of the inefficiency) would require developing data on the main inputs and input prices, as well as output quantities because producers in general, may choose different mixes of capital, labour and fuel due to differences in input prices.

We note also that if the final goal is in fact to further the estimation of the impact of competition on prices and/or margins, then additional effort on the measurement of competition and market structure would probably be warranted. Additional work outside the scope of this research would be required to develop the data and models needed to measure efficiency across time and space in the relevant sectors.

9.2.6 Checking for endogeneity with instrumental variables (IV) regressions

In both sets of regression models, that is for electricity and gas, we included some measure of energy intensity of use: energy supply per capita. This variable was showing a negative and significant impact in almost all cases and models. The main purpose of this variable was as a control variable, and our hypothesis was that this was controlling for supply conditions and things such as scale and scope economies. There is the possibility, however, that there is endogeneity in this variable with the price variables. That is to say, that lower price countries tend to use more energy per capita; in other words, the causality can go from price (the dependent variable) to the independent variable, energy use per capita. In the presence of endogeniety, coefficient estimates are potentially biased, and so it is important to investigate the issue more deeply.

We therefore re-estimated all of the main models with an IV approach for the energy supply per capita variable. The approach, a standard IV approach, can be summarized as follows:

- First, we estimated a predictive equation for energy supply per capita, using a number of exogenious variables, the key one being a 1-year lag of energy supply, which is not contemporaneously correlated with the price variable.
- The predicted value from the previous regression gives an instrumental energy supply per capita variable (the IV);
- The IV is then inserted into the original prices regression;
    - It should be noted that as it is the potential contemporaneous correlation between the error term and the regressor in the original regression, the IV approach removes this since the predicted value by construction is not correlated with the new error term.
- We then compared the two regression results for each model.

Overall, not much change was found in the coefficients of interest and the overall hypotheses. In some cases, the value of the coefficient on the energy supply per capita variable changed, but remained of the same and expected sign, and retained statistical significance. As interpretation of the magnitude of this coefficient was not necessary for the project and its terms of reference, we concluded that inclusion of complete IV results was not necessary.

Below we present an example of the results of one of the IV regressions, and comparison to the non-IV regression outputs. The change in the value of the coefficient was well within the confidence interval of each on the energy supply variable. We note that this gives us some assurance that the overall results are not being driven by endogeneity, but also note that more detailed testing and investigation of the endogeneity issue could be done. Our approach, however, was in part guided by the fact that our primary goal was not to study the energy intensity variable, and we do not feel that the significance of this variable is being driven by endogeneity alone.

Figure 58: IV regression outputs – residential electricity prices

```
Random-effects GLS regression                   Number of obs      =       325
Group variable: co_indx                         Number of groups   =        19

R-sq:  within  = 0.8139                         Obs per group: min =         9
       between = 0.5457                                        avg =      17.1
       overall = 0.6850                                        max =        20

                                                Wald chi2(6)       =   1312.04
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

------------------------------------------------------------------------------
     ln_reselec |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
----------------+-------------------------------------------------------------
 ln_averagewage |   .9147245   .0432592    21.15   0.000     .8299381     .999511
ln_energysupply |  -.9694773   .0710153   -13.65   0.000    -1.108665   -.8302898
      share_nuc |    .105568   .1641208     0.64   0.520    -.2161028    .4272388
    share_hydro |   .1377725   .1486764     0.93   0.354    -.1536279    .4291728
    share_renew |    .295492   .1942067     1.52   0.128    -.0851461    .6761301
       lnp_stot |  -.0330356   .0249364    -1.32   0.185    -.0819101    .0158389
          _cons |  -9.786247   .3709186   -26.38   0.000    -10.51323   -9.059259
----------------+-------------------------------------------------------------
        sigma_u |   .2001698
        sigma_e |  .09898446
            rho |  .80351445   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Note: IV regression

Source: LE, IEA, OECD data

Figure 59: Non-IV regression outputs – residential electricity prices

```
Random-effects GLS regression                   Number of obs      =       325
Group variable: co_indx                         Number of groups   =        19

R-sq:  within  = 0.8170                         Obs per group: min =         9
       between = 0.5671                                        avg =      17.1
       overall = 0.6968                                        max =        20

                                                Wald chi2(6)       =   1344.01
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

------------------------------------------------------------------------------
     ln_reselec |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
---------------+--------------------------------------------------------------
 ln_averagewage |   .9017465   .0426653    21.14   0.000     .8181241    .9853688
ln_energysupply |  -.9548731   .0681976   -14.00   0.000    -1.088538   -.8212081
      share_nuc |   .1003712    .162708     0.62   0.537    -.2185306    .4192729
    share_hydro |   .1045593   .1476246     0.71   0.479    -.1847797    .3938982
    share_renew |    .294888   .1923244     1.53   0.125    -.0820609     .671837
       lnp_stot |  -.0154901   .0246799    -0.63   0.530    -.0638617    .0328815
          _cons |  -9.758065   .3675433   -26.55   0.000    -10.47844   -9.037694
---------------+--------------------------------------------------------------
        sigma_u |  .19895288
        sigma_e |  .09819746
            rho |  .80410882   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Note: IV regression

Source: LE, IEA, OECD data

9.2.7 Profits regressions WACC

Methodology

The starting point for this analysis of company profits (EBIT) was the group of 163 companies which was selected based on reasoning described elsewhere in the document. A particular variable that was thought likely to influence company profits was the weighted average cost of capital (WACC)[182]. In order to gather information on the WACC for each firm, it was decided that the most appropriate place to try to do this was on Bloomberg.

Starting from this list of companies, the first step was to try to identify the Bloomberg ticker for each firm, which is the unique security identifier used to identify companies on Bloomberg. This was done by searching for each of the company names and the location where the company was based, in case there was more than one Bloomberg ticker associated with a company name.

A large number of the companies in the sample were not listed on Bloomberg, which was to be expected as it is not imperative that companies are. In situation where this was the case, an attempt was made to identify a parent company, whose WACC could be used as a proxy to that of the subsidiary company.

[182] WACC is calculated on Bloomberg as: WACC = [KD X (TD(V)] + [KP X (P/V)] + [KE X (E/V)]. Where KD = Cost of Debt; TD = Total Debt; V = Total Capital; KP = Cost of Preferred; P = Preferred Equity; KE = Cost of Equity; E = Equity Capital. Total Capital = Total Debt + Preferred Equity + Equity Capital.

After having identified the Bloomberg tickers for all available firms, or their parents, in the sample, historical WACCs were downloaded. Data was downloaded from the year 2000 up until the present day, where available.

Information on WACC was not available for all of the firms that we had a Bloomberg ticker for, which meant that the final sample of companies was made up of 32 companies. These companies came from a wide range of countries/states across the world.

Table 23: Countries/states in which the companies in the sub-sample were based

Australia	Maryland
Austria	Minnesota
Belgium	New Zealand
British Columbia	Norway
Delaware	Oregon
Finland	Portugal
France	Spain
Germany	Switzerland
Greece	United Kingdom
Italy	Washington

***Source:* LE subsamples**

After having gathered the information on WACC for the 32 companies, this data was merged with the information on EBIT for these companies, which had previously been collected, in order to be able to analysis the link between WACC and the level of profits.

To make this regression analysis more complete, additional country-level variables were also added to the dataset. Variables such as the market share of the three largest companies (C3) and the share-weighted average log price in each country are examples of variables which were included in this analysis to try to discover a link between them and the level of profits.

Both the GLS random effects and between effects estimators were used to try to identify whether there were links between any of the variables and profits. From the regression output tables below it can be seen that over this sample of companies the more concentrated the market of electricity suppliers, the higher the level of profits.

In both the first and second GLS random effects regressions, the coefficient on the market share of the three largest electricity suppliers (Electricity market C3) is 0.18 and is significant at the 5% level. This suggests that, all else being equal, the higher the degree of market concentration in the market for electricity suppliers, the higher the level of company profits.

The fact that in the third regression none of the coefficients are significant may itself tell a story. The fact that higher prices do not seem to lead to higher profits is a notable result. Whilst the fact that in neither the second nor the third regressions are the weighted average costs of capital seen to have a significant impact on profit levels, is again a noteworthy outcome.

The fourth and fifth regressions were run to investigate whether there were links between profits and average wage or GDP per person. However, neither of these variables appeared to have a significant impact of the profit levels of companies.

Table 24: GLS random effects regressions on EBIT

	1st regression	2nd regression	3rd regression	4th regression	5th regression
Weighted average cost of capital		-1.02 (0.62)	0.57 (0.70)		
Electricity market C3	0.18** (0.08)	0.18** (0.08)			
Share-weighted average log price			-3.32 (3.61)		
Log average wage				-2.19 (3.95)	
Log GDP/capita					-0.88 (4.55)
Constant	-5.55 (6.01)	1.62 (7.44)	-8.33 (16.28)	29.90 (41.25)	16.00 (47.67)
Overall R-squared	0.051	0.067	0.029	0.010	0.001
N	141	141	133	189	165

Note: ** p<.05
Source: London Economics

Table 25: Between effects regression on EBIT

	1st regression	2nd regression	3rd regression
Weighted average cost of capital		-2.2 (2.44)	2.00 (2.57)
Electricity market C3	0.14 (0.10)	0.18 (0.11)	
Share-weighted average log price			-3.82 (7.57)
Constant	-2.84 (7.16)	10.40 (16.54)	-21.27 (35.29)
Overall R-squared	0.051	0.058	0.016
N	141	141	133

Note: ** p<.05
Source: London Economics

9.3 Conclusions to the econometric synthesis

9.3.1 Retail prices as a function of commodity, and competition

IEA Sample-EU15 Competition measures

Electricity

The first set of regressions was for residential electricity. Overall, a large portion of the residential electricity price is explained by the variables, the weighted average of fossil fuel input prices (where the cost shares in the fuel mix form the weights), the share of nuclear, the share of hydro, and the share of non-hydro renewables.

Across the five models estimated between about 40% and 73% of the variation in the residential price is explained by the models and the signs of the variables are as expected in general. The shares of nuclear and hydro tend to decrease prices, while the share of renewables tends to increase prices. The share of hydro and nuclear's impact was somewhat sensitive across models, and in some cases ambiguous, but this might be explained by high-cost nuclear power in North America and the sensitivity of hydro dominated systems to weather.

In general, wage had a significant positive (as expected) impact on price, and this is likely due to both their impacts on costs, as well as controlling/proxying for a range of local cost conditions.

In general, the total energy supply per capita of the country had a negative impact, and this was significant and as expected. This variable is expected to be a proxy for economies and scale and related supply condition variables.

The final step was to add variables on competition and market structure. A range of measures was tried including market shares and numbers of suppliers. These data across country were only available in comparable and panel format for the EU15. We chose the C3, the market share of the three largest suppliers. However, this showed an ambiguous impact on prices. Interacting this with a market open/closed dummy variable did not change the ambiguity.

The inclusion of a composite score variable from the OECD had similarly ambiguous results, with the other variables remaining significant.

The conclusion is that there is little evidence that these limited measures of market structure have reduced residential electricity prices in the sample of IEA countries. On the other hand, socio-economic variables, commodity prices, and fuel mix variables all retain significance and expected sign.

The results of the electricity market regressions for industrial electricity prices are very similar to the residential prices for the IEA sample of countries. The impact of fuel commodity prices, fuel mix and socio-economic variables is high, and of the expected sign. Similarly, the impact of nuclear and hydro was negative and significant, but this was somewhat sensitive to the model chosen, although we believe this is consistent with the realities of these technologies' costs.

Similarly, the inclusion of variables on C3 and market liberalisation score did not improve the regression or show up significant.

Thus, overall, commodity conditions, fuel prices, fuel mix and socio-economic variable explain large portions of the variation across countries and within countries over time. The inclusion of competition variables cannot be proved to have reduced prices. We note that the lack of a competition impact is not interpretable as no effect, but merely that we have not found one. It may be because we do not have the data, or it may be that there is no effect because low concentration and market opening are necessary but not sufficient conditions for markets to work. No doubt, many factors and better data are needed to uncover such an effect.

Gas

Our regression approach was then repeated for gas. For gas, rather than fossil fuel mix (weighted average price), we included the IEA estimates of the commodity prices, and also the ratio of imports over total consumption. The expectation of the first variables impact is naturally positive on prices, and this was significant in all models. The expectation of the latter variable could be positive or negative, but it was negative and significant in most models. In the basic commodity models it was positive, but in the panels it was negative.

Overall, the models are showing reasonable goodness of fit statistics, with R-squares of 50% to 78%.

Wages, and energy supply per capita, similarly had positive, and negative, and significant impacts respectively on the residential and industrial gas prices.

The more interesting outcome from the gas equations was in our panel models that the C3 variable was showing up positive and significant. Thus, there is some evidence that higher concentration is leading to a small impact of higher prices in gas. The significance of the C3 variable was true for both residential and industrial gas prices. However, the sample was limited due to data availability.

These results in general did not change when including a dummy for market opening, although, for the residential gas sector, the combined impact of market opening *and* higher C3 was ambiguous, but positive for market closed and higher C3. For industrial gas, the impact of market opening and higher C3 was significant and positive, while it was ambiguous for market closing. While it is difficult to interpret these result precisely, one explanation could be that market opening has worked for industrial consumers more than residential consumers, but that C3 in general is still leading to higher prices where market opening has worked.

However, the above interpretation is somewhat in conflict with the evidence from the market liberalisation score for gas from the OECD. In this measure, it is the residential prices where more liberalisation has a significant impact to lower prices, and the impact on industrial prices is ambiguous. It is notable that with a much expanded sample (and so this measure is in fact picking up wholesale and upstream liberalisation which occurred earlier)

The gas modelling approach was then repeated for the sample including the US States. Qualitatively, the results were very similar to the models using the IEA countries, with commodity prices, imports/consumption, and wages and energy supply per capita all have similar values, (expected) signs, and significance-indicating low p-values. Unfortunately, data did not allow us to repeat the competition modelling for the sample including the USA States.

Thus, we conclude that overall, commodity prices and supply and demand conditions are explaining a very large portion of gas prices. This is true for both residential and industrial prices. There is some weak evidence that market structure is leading to higher prices, and that market liberalisation has impacted residential prices downward.

9.3.2 Profits as a function of cost of capital and competition

Our regression approach also included studying the impacts of explanatory variables on profits. This approach overall was not as successful as the explanation of prices using the variables, with the regression achieving low R-squares (goodness-of-fit) and related statistics. Similar variable such as wages and commodity prices were tried. The low explanatory value of such variable for profits was perhaps to be expected, as in general, econometric models of profits have not been widely used, probably for this reason among others.

Of particular interest however, was the inclusion of the weighted average cost of capital. This is also a measure of the riskiness of a company. For companies where the WACC was available, we had a panel with 141 observations and the WACC and the competition variable, C3 showed up significant and positive (expected sign) with a value of 0.18.

These results are broadly indicative that higher concentration might be leading to higher profits for the selected companies, but it should be reiterated that overall, the regressions for profits were weak and of limited value. Our interpretation of these results it that they are challenging and indicative of the importance and potential for further research and better data.

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