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Keywords energy liberalisation, energy privatisation, energy transition

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The role of policy in energy transitions: lessons from the energy liberalisation era

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The aim of this paper is to discuss the period of energy privatisation and liberalisation which began in the 1980s within its wider historical context. The key issues are: what has been learned from this recent period, and; how significant is it in the light of an energy transition to low carbon energy system by 2050? Energy liberalisation has led to positive and globally widespread but modest efficiency gains but a lack of clearly visible direct benefits to households in many countries. It has significantly improved the governance of monopoly utilities (via independent regulators), the prospects for competition and innovation, and the quality of policy instruments for environmental emissions control (through the emergence of trading mechanisms). We conclude that it is not liberalisation per se that will determine the movement towards a low carbon energy transition, but the willingness of societies to bear the cost, which will be significant no matter what the extent of liberalisation.

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Section 1: Introduction

The aim of this paper is discuss the period of energy privatisation and liberalisation which began in the 1980s within its wider historical context. The dialogue that this

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special issue (and the original conference behind it) stimulates is between those of us, including myself, who look at energy policy impacts close up (over the course of 5-10 years) and economic historians used to looking at decades of economic development at a time. The key issues are: what has been learned from this recent period, and; how significant is it in the light of an energy transition to low carbon energy system by 2050?

It is worth stating at the outset that it is not the intention of the paper to address the important, but different, questions of the extent to which liberalised markets can or should be combined with the move towards a low carbon economy (e.g. can a liberalised market allow the financing of nuclear power plants?). It is rather the intention to evaluate the liberalisation period in its own terms and to place it in a wider historical context. This focus also allows us to draw lessons from both developed and developing countries, regardless of their degree of support for action on mitigating climate change or their relative severity of their likely obligations to do so under any future climate mitigation agreement.² The paper is also intended to be reasonably short and accessible and, therefore, does not claim to be a comprehensive review of the literature.

We begin in section 2 by characterising the timeline of the energy liberalisation era and outlining what it consists of. Section 3 discusses why energy liberalisation occurred and, briefly, puts it in the historical context of the energy industries. Section 4 evaluates the evidence on the effects of energy liberalisation and assesses its historical significance. Section 5 concludes with a discussion of what we can learn from the liberalisation era with relevance to the transition to a low carbon economy.

Section 2: Characterising the energy liberalisation era

The energy sector substantially consists of oil, gas, coal, electricity and related emissions (of, for example, carbon and sulphur) markets. The recent period of liberalisation may be characterised as involving the introduction of competition (via structural changes such as the removal of subsidies, vertical unbundling of integrated utilities to facilitate non-discriminatory access to monopoly networks and horizontal unbundling of incumbents to create viable competitors) and the establishment of independent energy sector regulators³. Often (but not always), it is associated with a trend towards the privatisation of state owned energy assets. The introduction of competition in downstream energy sectors, such as electricity and gas supply, facilitates

² Developed and developing countries do often have different starting points with respect to liberalisation. Liberalisation may imply substantial price rises for final consumers of electricity and gas in developing countries where prices are initially too low to allow an economic return on capital. The need to raise prices following liberalisation increases resistance to it and explains why so few developing countries have adopted comprehensive reforms in these sectors.

³ See for instance Jamasb and Pollitt (2005) for a discussion of this trend within the European Union.

competition in upstream gas and coal production sectors; while the general increase in energy trading facilitates the introduction of emissions markets.

In the oil and associated upstream gas sectors liberalisation has involved the full or part privatisation of state owned companies, often in countries which were net importers of fossil fuels (e.g. the privatisation of ENI in Italy).⁴ This has occurred within the context of globalised markets for fossil fuels. Sales of oil and gas assets have occurred throughout the 1980s and 1990s largely in an effort to raise revenue for cash strapped governments.

In electricity and downstream gas supply, liberalisation has often involved privatisation (and/or the introduction of new private entrants) and structural reform of national industries to create competitive wholesale and retail markets with regulated non-discriminatory third party access to monopoly transmission and distribution networks. Early privatisations included that of the Chilean electricity industry in 1982 and the UK domestic gas supply industry in 1986. The European Union has implemented a series of reform directives in 1996, 2003 and 2009 aimed at completing a European single market in electricity and gas via the vertical unbundling of activities and the opening up of retail and wholesale markets to competition. China had a significant electricity reform, mirroring the EU model, in 2002.⁵

In coal, liberalisation has taken the form of the running down of subsidised domestic coal production in many high cost countries (e.g. Spain, UK and Germany and Poland⁶), with some privatisation of the residual coal assets (e.g. in 1994 the UK). The result has been a significant increase in world trade in coal from countries with mostly unsubsidised privately owned coal assets (such as Australia and South Africa).⁷ Liberalisation of coal markets has largely paralleled developments in domestic energy markets for electricity and gas, because domestically produced coal was both a competitor for heating and in input to the production of electricity. For instance, the UK ran down its coal industry sharply ahead of the 1994 privatisation of the remaining nationalised deep mines, as privatised electricity producers reduced their purchases of British coal.⁸ Even the large Chinese coal industry has been subjected to significant liberalisation with many enterprises being privatised and/or decentralised down to local municipalities.⁹ This liberalisation, inter alia, has involved the regularisation of welfare payments to employees and former employees by the government and the removal of such obligations from coal enterprises.

⁴ See Table 1 in Wolf and Pollitt (2008, p.11).

⁵ See Gao and Van Biesebeock (2011).

⁶ Even in the highly subsidised, unionised and largely state-owned Polish coal industry, production has fallen and private firms have had success (see Zientara, 2009).

⁷ See BP Statistical Review of World Energy 2011, p.32, for an overview of world coal production.

⁸ See Parker (2000).

⁹ See Shi and Grafton (2010). They analyse a sample containing 1110 privately owned coal enterprises in 2005.

Alongside the creation of competitive wholesale markets for electricity and the increasing reliance on global markets for oil, gas and coal we have seen the creation of substantial markets for atmospheric emissions from stationary sources (i.e. from power and chemical plants). The best known examples are the market for sulphur dioxide in the US (which began in 1995) and the European Union's Emissions Trading System for carbon dioxide (which began in 2005).

While it is common to talk about the liberalisation of energy markets in recent years, it is important to recognise that liberalisation has occurred over a number of years and is by no means complete.

Oil and upstream gas privatisation has been significant in many countries, but not among major oil producing states in the Middle East. 25 of 39 leading developed and developing countries still have substantial state ownership within their electricity sectors.¹⁰ In the downstream gas sector, 16 out of 39 leading countries have public ownership of 50% or more in the largest gas distribution company.¹¹ State ownership of coal remains significant in the world's largest coal market and coal producer, China. The geographic coverage of emissions markets is limited, with the largest CO₂ market (the European Emissions Trading Scheme) only accounts for perhaps 5% of global emissions of CO₂.¹² A key reason for this incompleteness of liberalisation is that governments continue to be afraid of losing the ability to cross-subsidise favoured groups of consumers or workers (such as elderly energy consumers or mineworkers), who might be exposed to unwelcome market events which could be electorally inconvenient.¹³ Given the sharp rise in world oil and gas prices since 2000 (following a period of benign prices in the previous decade), combined with negative effect on incomes of the 2008 financial crisis, the pressure for governments to 'do something' about energy prices for their favoured consumer groups has been increasing and not diminishing in recent years.

It is also important to recognise that some of the key elements of liberalisation in some countries - such as the UK - existed in other countries prior to the 1980s. Thus in the US, Germany and Japan private ownership has been pervasive in the electricity and gas sectors throughout the post-World War 2 period. The US has also had independent energy sector regulators since the early 20th century¹⁴ and some wholesale electricity

¹⁰ Source: OECD International Regulation Database, 2007 statistics. Available at: http://www.oecd.org/document/32/0,3746,en_2649_37421_35791136_1_1_1_37421,00.html, accessed October 11, 2011.

¹¹ Source: OECD International Regulation Database, 2007 statistics. Available at: http://www.oecd.org/document/32/0,3746,en_2649_37421_35791136_1_1_1_37421,00.html, accessed October 11, 2011.

¹² In 2013 the EUETS cap will be 2.04bn tonnes of CO₂ equivalent (CO₂e) emissions (source: http://ec.europa.eu/clima/policies/ets/cap/index_en.htm, accessed October 11, 2011). Global CO₂e emissions for 2005 were estimated at 44.5bn tonnes (see: <http://www.wri.org/chart/world-greenhouse-gas-emissions-2005>, accessed October 11, 2011)

¹³ See Chick (2011).

¹⁴ For instance, the Massachusetts Department of Public Utilities was formed in 1861 (see <http://www.naruc.org/commissions.cfm>, accessed October 11, 2011).

markets for decades¹⁵. Liberalisation, when it came to these countries, did not focus on privatisation, but on the creation or deepening of a competitive market. Similarly, among some countries that enthusiastically embraced competition, such as Norway, Sweden, New Zealand and Australia, substantial public ownership has persisted within liberalised energy sectors.

Nonetheless it is possible to say that modern era of liberalisation began with Thatcher-Reagan period in around 1980, matured into the 1990s as many OECD and leading developing countries adopted similar approaches to their energy sectors.¹⁶ This can be traced to early developments in airlines and telecoms deregulation which provided successful deregulation models which were then taken up in energy sectors¹⁷. These early deregulations owed something to exogenous changes in technology (e.g. in telecoms) and demand (e.g. in both airlines and telecoms) which meant that minimum efficient scale fell in relation to the size of the market. These trends were present to lesser extent in energy sectors (e.g. in electricity).¹⁸

However since 2000 pressures have been building against energy market reform. The California electricity crisis of 2000-2001 marked a turning point in the progress of electricity and gas market liberalisation in the US and many other countries.¹⁹ In developing countries rising populist opposition to privatisation in general – which we discuss later – has been fuelled by the failure of liberalisation to obviously deliver for the poor while being associated with governance failures and corruption (see Roland, 2008). In the European Union concerns about emissions of greenhouse gases and energy security have led to pressure for more subsidised renewable electricity and less willingness to depend on the market to decide on investments within the energy sector from 2000.²⁰ While the climate change issue is new, the energy security issue is not. Concerns about energy security lay behind the initial state ownership in oil, gas, coal and electricity sectors in many countries. In July 2011, the UK, once a leading proponent of energy market liberalisation announced an electricity market reform which massively increases government intervention in the market in order to achieve environmental targets.²¹ *The Financial Times* labelled the reform as ‘the biggest upheaval of the electricity industry since privatisation 20 years ago’.²²

¹⁵ See Pollitt (2011) for a discussion of the development of independent system operators in the US. The Southwest Power Pool was formed in 1941.

¹⁶ A good overview of electricity market reforms globally is contained in Sioshansi and Pfaffenberger (2006).

¹⁷ See, for instance, Viscusi et al. (2005) for a general discussion of the historical development of deregulation.

¹⁸ In electricity demand expanded through the decades from 1945, while the emergence of combined cycle gas turbine technology (itself transferred from airlines) was associated with less economies of scale.

¹⁹ See Joskow (2006a).

²⁰ See Keay (2006), Pollitt (2009b) and Rutledge (2010).

²¹ See DECC (2011).

²² ‘Huhne heralds green energy upheaval’, *Financial Times*, 15th December 2010, p.16.

It is worth saying that liberalisation is by no means dead in its tracks. Oil, upstream gas and coal markets continue to be extremely competitive and dynamic. China is an increasing participant in global coal markets as its net imports increase. The promotion of competitive electricity and gas markets has been taken up by competition authorities in Europe. The EU Emissions trading market is due to be substantially extended in scope in 2013. The global banking crisis which began in 2008 means many governments are cash-strapped, so clearly large-scale renationalisation is unlikely, and indeed there may be a new wave of privatisation, especially in heavily indebted countries.²³

Section 3: The liberalisation era in its historical context

Marsh (1991) and Moore (1992) give seven reasons for the UK privatisation (and liberalisation) programme: the desire to reduce government involvement in industry and return 'the commanding heights' of the economy to the private sector; increasing the efficiency of the companies; reducing public sector borrowing; curbing trade union power by breaking up heavily unionised state owned companies; wider share ownership to increase those with a stake in society; and gaining political advantage for the government via the popularity of successful share sales.

Other countries had similar reasons or subsets of the reasons for engaging in privatisation. Clearly the perceived success of early privatisations (in the UK) and of the opening up to competition of airlines and telecoms (in the US and UK) substantially motivated other countries.²⁴

The liberalisation era for energy followed a previous period which can be traced from 1945. This period involved substantial increases in state involvement and control of the energy sector (reflecting pre-World War trends).

In oil and upstream gas, rising import dependence among advanced countries entrenched the desire to promote state owned national champions who would secure overseas production assets and negotiate favourable terms for imports. This pressure was heightened by the nationalisation of overseas oil and gas assets in many oil producing countries prior to the oil price hike of 1972-3. Many countries that discovered natural gas (such as the UK, Netherlands, Australia, New Zealand, Argentina etc.) set up integrated national champions to extract and distribute the gas.²⁵

²³ Greece, Italy, Ireland are under pressure to sell more of their stakes in state owned energy company shares to reduce government debt. See <http://www.ihs.com/products/global-insight/industry-economic-report.aspx?id=1065929983>, http://www.bloomberg.com/apps/news?pid=newsarchive&sid=a_oBSG.9bNwQ&refer=home, <http://www.rte.ie/news/2011/0920/esb.html>, accessed 11 October, 2011.

²⁴ See Sioshansi and Pfaffenberger (2006).

²⁵ See for instance, Williams (1981) for a history of the UK gas supply industry.

In electricity, technological change was an important driver of state ownership²⁶. The move from small scale local production towards increasingly large scale thermal and nuclear power plants, needed capital to finance the new power plants and national transmission systems. Electricity demand grew rapidly and large power station building programmes were required which involved strategic decisions about the choice of imported or local technology.

In downstream gas markets the emphasis was on rapid network extension, sometimes involving the replacement of local town gas systems, often overseen by larger state owned gas companies.²⁷

In the coal industry, mine workers in state owned enterprises continued to be powerful. They were given a boost by the hike in oil prices, which ended the widespread use of oil in electricity production in advanced countries and encouraged support for the continued state ownership of locally produced fossil fuels.²⁸

Climate change did not become a serious public issue until the 1990s²⁹, while emissions of sulphur dioxide were largely handled as a local pollutant in Europe and the US. Serious consideration of emissions trading schemes began with the liberalisation era more generally. Robert Hahn (1989) discusses early US emissions trading schemes (for, inter alia, particulates and sulphur dioxide), dating from 1974.

What triggered energy market liberalisation? Developments in liberalisation more generally meant that energy markets would eventually become a focus of privatisation, if for no other reason than the huge value of state energy assets. Energy company asset sales constituted roughly 60% of the nominal value of privatised assets in the UK, between 1979 and 1996³⁰ and hence could significantly reduce the PSBR, widen share ownership and gain political advantage for the government. In addition large numbers of often militant energy workers could be transferred to the private sector³¹ and companies that were perceived as inefficient could be placed under pressure to improve

²⁶ See Chick (2007).

²⁷ See Williams (1980) on the UK.

²⁸ BP Statistical Review of World Energy 2011, p.32.

²⁹ A 1992 Gallup Health of the Planet Survey showed that half of respondents felt that climate change was a significant problem in 13 out of 24 countries surveyed (see Loenzoni and Pidgeon, 2006). The EU was debating a carbon tax in 1991 (see www1.american.edu/TED/eccarbon.htm, accessed 28 October 2011) and put forward a proposal for a directive in June 1992 to introduce one. For a comprehensive discussion of the rise of global warming as a political issue see Weart (2004), by 1998, a poll found that 58% of Americans had heard of the greenhouse effect.

³⁰ See Table 1 in Pollitt (1999). This figure may not be representative, given the presence of oil and gas production in the UK. However the UK's privatisation programme has been more extensive than other countries. As a point of comparison in Argentina (which also has some oil and gas production) electricity privatisation yielded around 1/3 of central government privatisation receipts in 1990-94 period (see Pollitt, 2008, p.1540, and Rodriguez-Boetsch, 2005, p.307). Other countries had significant privatisations in their manufacturing (e.g. in Eastern Europe) and banking sectors (e.g. in France) (see for example Kothenburger et al., 2006), but the potential significance of energy (as a profitable low risk investment) within a national privatisation programme is obvious.

³¹ Mineworkers had brought down the UK government in 1974 (with support from power workers).

performance. However a key idea was the realisation that wholesale markets for electricity (and for gas) were possible. This took hold in the US in the 1980s, as exemplified by Joskow and Schmalensee's *Markets for Power* (1983), and in the European Union where a single market in energy was seen as the inevitable consequence of the EU's Single Market Project (1986)³².

The introduction of competition and independent regulation in electricity and downstream gas markets can be separated from privatisation. In the US many companies were privately owned monopolies to begin with, whereas in the European Union, Australia and New Zealand state ownership has continued after the introduction of competitive markets. However competition does inevitably mean some reduction in state ownership as private companies are free to enter wholesale markets and take market share from incumbents. This has undoubtedly undermined the case for public ownership in some countries (e.g. France) even in the absence of public finance imperative.

Section 4: The effects of energy liberalisation and its historical significance

In this section we first examine the evidence on the effects of liberalisation and then go on to place these effects in a wider historical context.

An important initial observation is that most of the literature on the impact of liberalisation is focussed on an historically very short time frame. Essentially most of the literature looks at a before and after comparison of performance variables around the date of the introduction of liberalisation (or one of its elements, such as wholesale market competition or an independent regulator).

The literature on privatisation and liberalisation of the energy sector is somewhat fragmented. There have been a large number of studies on electricity, but rather fewer on coal and gas liberalisation. Some studies focus on a single company or country, while others look at samples of data from several countries.

In looking at the impact of liberalisation a number of performance metrics are observed in the literature. Total factor productivity (TFP) is an important one (as a measure of productive efficiency), as is the real price of service (as a measure of allocative or price efficiency). However other metrics such as labour productivity (due to the difficulties of measuring capital within TFP), profitability (in markets where output prices are competitively determined) and investment (where building new capacity is important) have been used. In addition there have been attempts to put a net present value on liberalisation or to measure the overall impact on GDP.

³² See European Commission (1988).

A number of methodologies have been employed to analyse the impact of reform. We discuss each briefly.

Performance metric regressions examine the impact of privatisation/liberalisation variables on panel data of performance (e.g. Steiner, 2001). These studies essentially test for the significance of structural break in the data at the time of reform. They have the advantage of allowing flexibility of functional form and the introduction of multiple reform variables of different strengths and as well as any control variables thought to be important.

Statistical tests of before and after performance conduct a t-test for significant differences in performance metrics before and after privatisation (following D'Souza and Megginson, 1999). This has the advantage of simplicity but does not control for other variables as in multi-variate regression analysis. Such studies reduce the time series data requirements where data is challenging to collect. Some of these studies may use frontier efficiency techniques, such as data envelopment analysis or stochastic frontier analysis, to measure productivity (e.g. Waddams Price and Weyman-Jones, 1996).

Social cost benefit analyses of reform (following Jones et al., 1990) look at reform as an investment which has a cost (the costs of the restructuring) and a benefit which is the change in actual (and projected) performance relative to a suitably defined counterfactual of what would have happened in the absence of reform. The counterfactual can be constructed from previous productivity trends (e.g. from the 5 years before)³³, pre-reform announced targets for future performance (e.g. for productivity growth in the public sector)³⁴ or with reference to a comparator firm whose ownership did not change (e.g. Boardman et al., 2009).³⁵ Social cost benefit analysis allows both the overall welfare impact and how it is distributed between government, consumers and private investors to be analysed.

Macro studies of reform attempt to find impacts using general equilibrium models of the economy. These studies track the impact of lower prices and costs in reformed industries on GDP (e.g. Chisari et al., 1999). The advantage of these studies is that they do attempt to model the interaction effects of sector reform with non-reforming sectors and that they do calculate the aggregate welfare effect directly. Using this approach, Copenhagen Economics (2005) – in a report for the European Commission - found reforms in electricity, telecommunications, air transport, rail transport, urban transport, gas and postal services raised GDP by 2% for the EU-15.

³³ Domah and Pollitt (2001) use this type of approach.

³⁴ Newbery and Pollitt (1997) use this approach.

³⁵ Boardman et al. (2009) look at the privatisation of the Canadian National Railway (CN). In order to access how performance improved they compare the relative performance of the CN to its competitor railway, Canadian Pacific Railway, which remained in private ownership throughout the period over which data was analysed.

It is worth highlighting that studies of reform impact are to be distinguished from the large literature comparing publicly owned and privately owned firms (e.g. Foreman-Peck and Waterson (1985) and Millward and Ward (1987) who look at historical data on electricity and gas firms respectively). Such studies, in the main, do not study the impact of liberalisation as a change in the operating environment of a firm (indeed both the studies mentioned above look at data for a single year). A key problem with such comparisons – many of which show little difference between publicly owned and privately owned firm performance – is that publicly owned firms may be a self-selecting group of firms with relatively good performance.

4. 1: Oil, upstream gas and coal

There have been a number of studies looking at oil and upstream gas industry privatisations (see Wolf and Pollitt, 2008, for a summary). The overall result is that privatisation significantly improves performance.

Econometric studies of privatisation, which include oil and gas companies, also show positive impacts from privatisation. Boubakri et al. (2009) look at an international sample of 189 firms (of which 22 are from the petroleum sector) from 39 countries between 1984 and 2002. Using similar metrics to D'Souza and Megginson (1999) they find increased shares of private ownership positively correlated with improved performance. They also find that although government ownership and control sometimes continues this does not prevent a positive improvement in performance.

Wolf and Pollitt (2008) look at a sample of 60 privatisation events of 28 national oil companies, between BP (UK) in 1977 and Inpex (Japan) in 2004. Using statistical testing of before and after performance, they find that performance improves statistically significantly for a range of performance metrics when comparing the 3 years after with the 3 years before privatisation. Profits, output, capital expenditure and labour productivity rise substantially, by 3.6 per cent, 40%, 47% and 50% respectively. In the context of a global oil market where the oil price is exogeneously determined with respect to all of the privatised companies (none of the sample privatisations were in OPEC countries) this suggests unambiguous rises in efficiency and national social welfare. These results are in line with previous studies. Oil companies form a significant part of any general sample of privatised companies. For instance D'Souza and Megginson (1999) find similar overall results for a sample 211 large companies from 42 countries drawn from a number of industries (including oil and gas).

Wolf and Pollitt (2009) conduct a social cost benefit analysis of the partial privatisation of Norway's Statoil in 2001. They find a substantially positive net present value from part privatisation. The counterfactual is constructed from the performance of another non-privatised Norwegian state oil company. This analysis demonstrates the value of part privatisation, even where the state oil company is relatively well run prior to privatisation. It also showed that a substantial share of the benefits accrues to fellow stakeholders in Statoil led operations, in an industry where joint arrangements are

common. Bridgman et al. (2011) show that the threat of liberalisation can have significant performance benefits in the oil and gas sector when they examine the case of Petrobras in Brazil. Petrobras lost its legal monopoly in 1995, but faced no effective competition. In spite of this TFP doubled in the following six years.

Coal has been much less studied than oil and gas globally. However a number of interesting papers have studied the efficiency impacts of reforms in the Chinese coal industry. Although not a study of the impact of ownership change per se, Shi and Grafton (2010) use stochastic frontier analysis to examine data on a panel of coal enterprises between 2000 and 2005. Their results show that privately owned (POCMs) or township, village and individually owned coal mines (TVCMs) are more efficient and have faster productivity growth than traditionally state owned enterprises (SOCMs).

4.2 Downstream Gas

There has traditionally been much less data available on downstream gas companies, than for electricity and hence they have been less heavily studied than electricity companies. However Waddams Price and Weyman-Jones (1996) examined the effect of the 1986 privatisation on the productivity of the twelve regions of British Gas, they found that productivity improved significantly, beginning in the run up to privatisation, and the dispersion of efficiency between the regions fell somewhat.

Rossi (2001) tested the null hypothesis of no change in TFP growth, using a stochastic frontier approach, in the 4 years following the privatisation of Argentine gas distribution companies in 1992. He found significant TFP growth of 2.8% p.a. and interpreted this as evidence of a significant effect from the breakup and privatisation of the former state gas monopoly.

Moving on to price impacts of liberalisation, there seems to be evidence that industrial prices for gas did fall as a result of gas market liberalisation. Copenhagen Economics (2005) found, using panel data econometrics, that industrial prices fell across the EU by 1% in the short run and 4-5% in the long run following liberalisation. Garcia (2006) examined the specific case of Spain where the state gas monopoly was loosened, beginning in 1996. Looking at data from 1993-2004, the margin paid by industrial customers - above the import price - fell from around 2 Euro/GJ to around 1 Euro/GJ at constant prices.

However the price impacts appear to be different for households. Brau et al. (2010) examine the impact of EU gas industry reforms on household prices over the period 1991-2007, using data from 15 EU countries. Their panel data econometrics links changes in the reform variables to prices and finds that more reform is not statistically correlated with lower prices, controlling for other factors such as the change in the oil price. Specifically they find that the vertical separation of the industry, lower incumbent market share and more private ownership do not lower prices; indeed higher public ownership in gas production lowers gas prices. These results suggest that, if anything,

that public ownership is a vehicle (possibly inefficiently) for keeping domestic prices down and that liberalisation is not a vehicle for lowering household prices.

4.3: Electricity

Pollitt (2009a) and Pollitt (2009b) summarise the literature on electricity liberalisation. Compared with oil and upstream gas assessing the impact of electricity liberalisation is more difficult. This is because reform, as in the case of downstream gas, often involves different combinations of a number of elements being implemented simultaneously. Thus privatisation can occur simultaneously with vertical (and horizontal) unbundling, the creation of a wholesale market and the introduction of an independent energy regulator. Thus liberalisation is not just about privatisation. Also assessing the impact is also more complex. This is because liberalisation may change market prices for electricity, both on average and between customer groups, due to the interaction of competition and cross-subsidy removal. This means that prices can rise for some or all customer groups (reducing their welfare) while the overall social welfare goes up. This would be the case if a state owned company kept prices to domestic customers below the market level for political reasons (as was the case in many transition countries)³⁶.

Pollitt (2009a), after examining the econometric studies from developing countries concludes that, in general, privatisation improves efficiency if accompanied by independent regulation; privatisation and independent regulation have no significant effect on prices; and private investment is stimulated by independent regulation.

Jamasb et al. (2004) highlight the positive experiences of the UK, Chile, Argentina, Peru, Philippines, Brazil and Colombia with electricity reform. Some of these individual cases have been analysed by social cost benefit analyses, the results of which are summarised in Table 1. The table illustrates the positive overall results from the privatisations analysed. The nature of the gains is diverse arising primarily from improved operating performance (all countries), the faster delivery of investment (Philippines), the better choice of the technology of investment (England and Wales) and improved access to services (Peru). NPV is indexed by costs or revenue to give a sense of the relative scale of the net welfare impact.

³⁶ See for example the discussion about the countries in South East Europe in Pollitt (2009b).

Table 1: Social Cost Benefit Analyses of Restructuring and Privatisation³⁷

<i>Authors</i>	<i>Reform and Company/Date/Country Studied</i>	<i>Measured NPV of reform (central estimate)</i>	<i>Key distributional impacts identified</i>
Galal et al. (1994)	Privatisation of CHILGENER – generation and transmission /1981-1986/Chile	Permanent gain in welfare of 2.1% of 1986 sales	2/3 of aggregate gains go to foreign share holders.
Galal et al. (1994)	Privatisation of ENERSIS – distribution /1986/Chile	Permanent gain in welfare of 5% of 1986 sales	Paying consumers gain an amount almost equal to the aggregate impact
Newbery and Pollitt (1997)	Privatisation and breakup of CEGB - Generation and Transmission monopoly/1990/UK	Permanent gain of 6% of 1995 turnover	Consumers lose initially and overall, CO ₂ and SO ₂ benefits significant
Domah and Pollitt (2001)	Privatisation of 12 Regional Electricity Distribution Companies/1990/UK	Permanent gain of 9% of 1995 turnover	Consumers lose initially
Toba (2002)	Privatisation of distribution company – Meralco/1986/Philippines	Permanent gain of 6.5% of 1999 sales	Most of net gain is reduction in CO ₂ and NO _x , consumers do gain by more than 50% of aggregate gain
Mota (2003)	Privatisation of distribution companies/1995-2000/Brazil	One off gain equal to 2.5% of GDP	Producers gain around 2/3 of aggregate benefit
Toba (2007)	Introduction of Power Purchase Agreements with Independent Power Producers by incumbent generator, NPC/1990-93/Philippines	One off gain of around 13% of GDP	Economy wide benefit due to earlier ending of power crisis
Anaya (2010)	Privatisation of 2 Distribution and Retailing Companies/1994/Peru	Permanent gain of 27% of costs when earlier connection included	Existing consumers lose, new consumers gain earlier connection

The results in Table 1 can be supplemented by the reform evidence from various US studies. Fabrizio et al. (2007) use time series econometrics of US power plants to show

³⁷ Florio (2004) finds overall welfare gains from the whole of the UK utility privatisation programme in terms of expenditure trends. For electricity he suggests consumers gain by around £1.4bn, with real prices down by 17%. Using data envelopment analysis techniques, Arocena et al. (2011) find that the restructuring of the Spanish electricity sector in 1998 was associated with significant performance improvements (in terms of increased economic value and productivity growth) before and after restructuring. After restructuring, consumers received substantial gains via lower prices and the companies gained (even more than consumers) via increased profits.

that reform is associated with up to 5% reduction in plant level non-fuel generation costs. Similarly, Stratford (2006) found cost savings at coal fired power plants of 2-3% following the opening of transmission systems to wholesale power market competition in 1996, in regions with independent system operators. Joskow (2006b) used time series econometrics to find that competitive wholesale and retail markets reduced prices (relative to their absence) by 5-10% for residential customers and 5% for industrial customers. Barmack et al. (2007) look at the wholesale power market in New England and find a net gain of 2% of costs. Meanwhile Kwoka and Pollitt (2010) show that unbundling appears to raise electricity distribution costs, relative to firms which do not unbundle. However Triebs et al. (2010) show losses on distribution unbundling are more than offset by gains on generation costs. Collectively this appears to paint a picture in the US of modest overall gains from liberalisation.

The European evidence is summarised in Pollitt (2009b). There are three careful econometric studies of reform impacts. Steiner (2001), Hattori and Tsutsui (2004), Fiorio et al. (2007) find evidence of modest productivity improvements. However the impact on prices of the different reform elements is ambiguous.

There is some evidence from China. Gao and Van Biesebroeck (2011) attempt an analysis similar to Fabrizio et al. (2007) using data on Chinese fossil fuel-fired electricity generating firms over the period 1998-2007. They find that state-owned firms that changed their ownership status (in the reform of 2002) became relatively more efficient in their use of both materials and labour, whereas continuing state owned firms only reduced their materials productivity gap with a control group of private, foreign, collective and mixed-ownership firms. The size of improvement is of the order of a reduction in input use of 2.5-6.6%.

An important question arising from the liberalisation era is why a policy that was pursued so widely has remained so controversial. This is especially the case in the light of the early successes of privatisation. Both in Europe and in Latin America dissatisfaction with utility privatisation remains strong (see Fiorio and Florio, 2011, and Checchi et al., 2009), even in the UK individual privatisations rarely commanded majority support prior to their enactment (see Pollitt, 1999).

There is now some good evidence on causes of this and what the impact has been on liberalisation. Ugaz and Waddams Price (2003) note that in Latin America there was substantial tariff rebalancing post privatisation which led to significant price increases for the poorest customers. Haselip and Hilson (2005) report on the fact that reform seems to have substantially favoured capital rather than labour - in terms of share of value added - in electricity and mining sectors in South America and Africa. The impact of these visible re-allocations has been significant. Checchi et al. (2009) examine the impact of privatisation on public opinion in 17 Latin American countries and find that those on lower-middle incomes are least likely to support privatisation. This suggests that the reality of higher prices negatively impacts on public support. Zelner et al.

(2009) go further and attempt to quantify the link between negative public sentiment and policy retrenchment ('the degree to which a government reinstates the objectives of a policy's predecessor' (p.379)), in the electricity sector. Analysing a database of 8.52 million newspaper articles for sentiment towards policy reform, they find that for a sample of 62 developed and developing countries over the period 1989-2001, there is a positive correlation between increased negative sentiment and the renegotiation of the terms of private power generation projects (i.e. reduction in the rate of return). The effect is stronger if there is broader political conflict and if countries related through trade also retrench (i.e. there is a demonstration effect).

The general failure of liberalisation to demonstrably reduce prices is reinforced by fact that electricity prices have been rising across the world, though much of the liberalisation period. Nagayama (2009) examines the behaviour of prices from 1985-2003 and the links to reform dummies using panel data econometrics. While his analysis does not imply causality because it lacks control variables (such as the changing mix of generation sources), the finding of a positive correlation between reform and prices suggests a background of rising prices. This was due to rising commodity prices, unwinding subsidies, and reducing rates of technological progress, in part due to rising environmental concerns around power generation.

Basically the evidence can be summarised as follows. Liberalisation seems to be associated with improved efficiency, greater investment and access to services, but higher prices for at least some customer groups. However the net gains are small, of the order of 5% of costs. Thus price rebalancing and the raising of utility rates of return can easily leave some customers substantially worse off. This would be especially true if poor consumers (who could be most of the customers in a developing country) were getting heavily subsidised (or even free) electricity. There have also been some very well publicised failed reforms such as in the Ukraine or California (see Besant-Jones, 2006). Arguably these are failures to fully implement an appropriate reform model, but undoubtedly the California case highlighted how difficult it was even for a developed country to get the appropriate package of reforms right.

4.4: The performance of emissions markets

Ellerman et al. (2003) offer an appraisal of the cap and trade programme for sulphur dioxide in the United States. It allowed the US to reduce annual emissions by 85% in course of 10 years and saved around \$350m per year relative to a command and control alternative with no trading. This suggests the role of private emissions markets (combined with dispersed private (and some public) ownership of electricity assets) to cost effectively reduce emissions. An interesting consequence of the cap and trade scheme was the innovative ways in which firms reduced SO₂ emissions and the impact on innovation in the supply chain. Power plants made greater use of low sulphur coal and costs of FGD clean up equipment ('scrubbers') fell rapidly per tonne of SO₂ emitted. The improvement in scrubber costs was due to greater competition in the market for

scrubbers because the Environmental Protection Agency did not mandate a single design. This had the impact of favouring the introduction of cheaper but less technically effective scrubbers (i.e. scrubbers with lower capture rates of SO₂, but cheaper per tonne captured).

The EU Emissions Trading market for CO₂ has had a much more varied experience since it began in 2005. Unlike the SO₂ market in the US, it was set up with three separate trading periods: 2005-07, 2008-2012, 2012-2020. During the first 2005-2007, permits could not be banked towards the second period (unlike between the second and third), while the third period will include significantly more sectors than the second and a tighter cap (adjusting for the level of general economic activity). The initial allocation of permits (which were the sum total of national allocations decided by the governments concerned) was too generous and prices fell to close to zero by the end of the first trading period. Prices are now fluctuating within a range, supported by banking to the third period.³⁸ The scheme has been successful in meeting the caps at relatively low cost (as indicated by the relatively low prices of permits). The scheme has also demonstrated the value of a market based instrument in facilitating area wide agreement on environmental targets and their enforcement in the absence of agreement on the harmonisation of fiscal measures such as a carbon tax. The impressiveness of this agreement on a carbon market in Europe has been well illustrated by the failure of any country, with the possible exception of Sweden (and, from mid-2012, Australia) to implement a reasonably comprehensive carbon tax.³⁹ However a cost benefit on the effectiveness of the EUETS is difficult given the relative looseness of the 2005-2007 cap and the high prices of natural gas relative to coal during the period. Convery et al. (2008) do however note that some unanticipated abatement did occur as UK and German coal fired stations improved their carbon efficiency.

4.5: Putting the evidence from the liberalisation era in historical perspective

It is an important thought experiment, encouraged by this special issue, to put the detailed results above into an historical perspective. We will do this in two ways, by looking at the long sweep of history as illustrated in Fouquet and Pearson (2006) and by direct comparison with the previous era as done by Millward (2010).

Fouquet and Pearson (2006) examine the price of lighting services from the 1300s to 2000 in England and Wales. The technology of production changes significantly: it changes from candle power, to kerosene, to gaslight and finally to electricity. In 2000 the real price per lumen fell was 1/3000 what it had been in 1800. The demand for lighting (in terms of lumens per capita) had risen 6500 times. Technological progress was key to both the fall in price and the rise in demand. But rising incomes clearly supplemented the effect of the efficiency improvements in production. This scale of

³⁸ Borrowing is also, now, permitted.

³⁹ See Johansson (2000). Finland was the first country to introduce a carbon tax (in 1990) but changed this to an energy/carbon tax (see <http://www.carbontax.org/progress/where-carbon-is-taxed/>, accessed on October 11, 2011).

efficiency change puts the impact of liberalisation firmly in perspective, if we consider the net impact of liberalisation to be 5% lower costs. When just considering lighting services alone over the period 1980 to 2000, technological improvements (such as the invention and diffusion of the compact fluorescent bulb) have much more of an impact on the efficiency of lighting services than the impact of energy market liberalisation.

The Fouquet and Pearson (2006) paper however raises an important issue for liberalisation – its impact on longer run technological progress. Clearly, the impact on this could significantly outweigh the short run impact on efficiency. Jamasb and Pollitt (2008) show that theoretically liberalisation could be expected to reduce research and development (R&D) expenditure in the liberalising electricity sectors due to the impact of horizontal and vertical unbundling on the returns to R&D. Falling R&D expenditure by electricity companies in liberalised electricity markets is clearly observable in the UK and the US. Jamasb and Pollitt (2011) further show that UK electricity liberalisation in 1990 did not initially impact on innovative output (as measured by number of patents) from electricity companies, but eventually as the companies passed into foreign ownership this innovative output collapsed (from 2002). What remains to be seen is whether innovation moved up the supply chain (to equipment manufacturers) or is capable being supported in other ways (by electricity customer levies, such as the UK's Low Carbon Networks Fund⁴⁰) or has been internationalised and now comes from abroad. This overall impact is difficult to distinguish, but the total number of energy patents in the UK has remained about the same since electricity privatisation. Theoretically we might expect benefits from the refocusing of innovation in equipment manufacturing and away from incumbent electricity companies, in the form of the exposure of R&D expenditure to more competitive pressure and the greater incentives for disruptive innovation.

The recent era in electricity has also been characterised by significant subsidies for the strategic roll out of renewables. These can be justified on the grounds of learning by doing benefits (see Neuhoff, 2008). If these subsidies do eventually deliver lower priced electricity than that from conventional alternatives then this may show up as faster TFP growth than would otherwise be the case. However to date large renewable subsidies simply increase the capital to output ratio substantially within the electricity sector and reduce TFP growth (at constant output prices).

Millward (2010) reviews the history of public and private ownership in utility sectors in the western world over the period c.1830 to 2000. He notes that the period of public ownership in the post-World War 2 period was characterised by rapid productivity growth and that 'there is no evidence that privatisation raised productivity' (p.17). This approach to evidence raises the interesting issue of the difference of perspective of historians and energy policy analysts. Historians observing two adjacent periods in history – the nationalisation period and the privatisation period in the case of UK

⁴⁰ This allows companies to competitively bid for research projects via a process run by the energy regulator, the costs of which can be largely recovered by raising monopoly distribution charges.

electricity – tend to rely on broad measures of TFP to look for impact. This is of course natural and necessary when summarising long periods of history. However it is not a reliable basis for policy advice.

Millward's basic counterfactual is that TFP growth should have been the same between 1950-73 (a period state ownership in the UK, France and Germany) and the later period 1973-95. 1973-95 is not the liberalisation era we have been discussing – it starts and ends too early. Indeed Millward (2010) largely ignores the literature in 4.1-4.3. The only shared reference is Florio (2004) which does suggest a positive improvement in performance in UK electricity.⁴¹

TFP trend is a suspect measure to look for performance impacts of liberalisation. Crude measures of TFP⁴² usually look at real revenue growth minus input growth. If revenue is falling due to increased competition or regulation then falling input growth (due to the efficiency effect of liberalisation) may be offset by falling revenue growth and TFP may appear to grow slowly, when efficiency is accelerating. Similarly, if competition reduces output prices or input prices then even a well specified measure of TFP will not measure any impact. TFP in the 1950s and 1960s is flattered by strong demand growth (driven by high GDP growth) and technological progress in equipment both of which no longer existed by 1980 as demand slowed and technological progress fell, in part due to rising environmental costs at power plants (this effect was significant in the US as documented by Jorgensen and Wilcoxon, 1990⁴³). Indeed a key side effect of liberalisation in the UK (and across the developed world) was the use of cleaner natural gas in electricity production, a trend which was promoted by liberalisation and whose environmental benefits need to be accounted for in any assessment of liberalisation (as they were in the social cost benefit analysis of Newbery and Pollitt, 1997). Indeed the rapid decarbonisation of the UK economy which this move from coal to gas facilitated is among the most globally significant of any national decarbonisation, comparable to that in France or in Sweden due to the scaling up of nuclear power (Keay, 2006).

Thus setting the liberalisation era in its historical context suggests that it has a minor role compared to more significant secular economic trends. This implies that 'measuring' the impact of liberalisation requires much more finely calibrated tools, such as social cost benefit analysis, than economic historians normally work with.

⁴¹ O'Mahony and Vecchi (2001) find similar results to Millward (2010) for electricity over the period 1960-1997. They compare the TFP performance of the electricity industry in the UK, France, Germany and the US and find low TFP growth for the early post privatisation period in the UK compared to the other countries. However they also find much higher labour productivity growth in the UK post liberalisation and larger falls in prices in the UK in the final years. Their analysis can be subjected to the same critique as we offer on Millward (2010).

⁴² 'Crude' measures of TFP fail to adjust for different input and output price trends. The difference this makes is well illustrated by Uri (1999) in the context of US telecoms.

⁴³ Sueyoshi et al. (2010) support this finding. They analyse the evolution of relative productive efficiency of US coal fired power plants over the period 1995-2007 and find that unified efficiency, which includes the abatement of sulphur dioxide, nitrous oxides and carbon dioxide as well as conventional operational inputs and outputs, improves. However conventional operational efficiency on its own falls over the period.

Section 5: What can we learn from the energy liberalisation era?

The era of energy liberalisation has been a significant manifestation of the general trend towards liberalisation of the economy. The extent to which it has been pursued in each individual country has reflected general political beliefs in the efficacy of markets (see for example Ruffin, 2003). These beliefs in turn reflect the robustness of the competition policy associated with liberalisation and the independence of regulatory policy towards energy markets. Energy liberalisation has led to positive and globally widespread but modest efficiency gains across all energy sectors but a lack of clearly visible direct benefits to households in many countries. However it has significantly improved the governance of monopoly utilities (via independent regulators), the prospects for competition and innovation, and the quality of policy instruments for environmental emissions control (through the emergence of trading mechanisms).

Arnulf Grubler (2011) names Delhi compressed natural gas (CNG) buses, catalytic converter (cat) cars and UK smokeless zones as examples of energy policies which can be identified as successful energy transitions. Energy market liberalisation is a set of policies whose impact in the historical data is more subtle to detect. Indeed in the context of climate change the only policies which will prove identifiably significant will be those that significantly change energy consumption behaviour or energy production technology. By this reckoning liberalisation, or the lack of it, will either have a small effect or will be important in facilitating or hindering changes which will have a significant impact.

Grubler (2011) also notes the keys to effective energy policy are 'patience, predictability, credibility, alignment and documentation of success'. One of the consequences of liberalisation is to create a predictable, credible, aligned set of market based arrangements which are costly to change. Changes which are inconsistent with liberalised arrangements are, quite properly, problematic. Public transparency of corporate actions is a key consequence of the liberalisation of energy markets. Thus liberalisation induces patience and invites documentation of success (and failure). Whereas monopoly allowed often expensive policies to be implemented without informed criticism or scrutiny, liberalisation has made each individual policy change more difficult to implement.

The challenge for policy makers within a liberalised environment is that the costs of ambitious climate policy goals will be increasingly obvious to energy customers. Political support for liberalisation in the face of tougher climate policy will to some extent depend on the calculation of whether the monetary benefits of liberalisation outweigh the environmental benefits of accelerating decarbonisation via more government intervention. That calculation in turn hangs on whether a return to more state intervention in the energy market will successfully accelerate decarbonisation and at what cost. In the end, as the incomplete progress of liberalisation around the world demonstrates, it is not liberalisation per se that will determine the movement towards a

low carbon energy transition, but the willingness of societies to bear the cost, which will be significant no matter what the extent of liberalisation.

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