Energy Policy 63 (2013) 628–637

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Electricity prices and generator behaviour in gross pool electricity markets☆

Amy O'Mahoney*, Eleanor Denny

Trinity College Dublin, Department of Economics, Dublin 2, Ireland

HIGHLIGHTS

- We consider whether a gross pool achieves competitive behaviour.
- We analyse the Irish pool system econometrically.
- Results indicate the Irish pool system appears to work efficiently.
- Generators appear to be bidding appropriately.

ARTICLE INFO

Article history:
Received 29 May 2012
Accepted 30 August 2013
Available online 3 October 2013

Keywords:
Electricity markets
Auction theory
Multiple regression analysis

ABSTRACT

Electricity market liberalisation has become common practice internationally. The justification for this process has been to enhance competition in a market traditionally characterised by statutory monopolies in an attempt to reduce costs to end-users. This paper endeavours to see whether a pool market achieves this goal of increasing competition and reducing electricity prices. Here the electricity market is set up as a sealed bid second price auction. Theory predicts that such markets should result with firms bidding their marginal cost, thereby resulting in an efficient outcome and lower costs to consumers. The Irish electricity system with a gross pool market experiences among the highest electricity prices in Europe. Thus, we analyse the Irish pool system econometrically in order to test if the high electricity prices seen there are due to participants bidding outside of market rules or out of line with theory. Overall we do not find any evidence that the interaction between generator and the pool in the Irish electricity market is not efficient. Thus, the pool element of the market structure does not explain the high electricity prices experienced in Ireland.

1. Introduction

Electricity is a major expenditure for all households, and is a key input in virtually all production and commercial processes. As electricity has few, if any, substitutes, the wholesale electricity price can directly impact on a country's competitiveness through its cost base and exports. As electricity is a necessary input into all households and industries, the price paid for electricity directly affects the monetary and fiscal structure of nations (Harris, 2006).

In the 26 member countries of the International Energy Association (IEA), energy policy aims include diversity, efficiency, and flexibility within the energy sector; the ability to respond promptly and flexibly to energy emergencies; and the environmentally sustainable provision and use of energy (IEA, 1993). Thus, energy can be summed up by three main aims: security of supply, sustainability, and competition. In recent history, the liberalisation and deregulation of electricity markets has also become common practice internationally in an effort to increase competition and reduce prices.

In the EU, the Internal Market in Electricity Directive came into force in August 2003. This put forward several measures designed to open up the electricity market to benefit end-users; among these were the right for all consumers to choose their electricity supplier. The overall objective of liberalising the EU electricity market was to enable it to be fully competitive and remove any existing difference between Member States (European Commission, 2003).

While the main driver of liberalisation is a reduction of production costs and prices to end-users, the process of deregulation has proven to be less straightforward than initially considered (Bunn, 2004; Neuhoff and Newbery, 2005). Reasons for this are primarily issues related to the technical limitations of generators,

☆This work was conducted in association with Teagasc under the Walsh Fellowship Programme and the Electricity Research Centre (ERC). The ERC is supported by the Commission for Energy Regulation, Bord Gáis Energy, Bord na Móna Energy, Cylon Controls, EirGrid, Electric Ireland, EPRI, ESB International, ESB Networks, Gaelectric, Intel, SSE Renewables, UTRC and Viridian Power & Energy.

* Corresponding author. Tel.: +353 (0)1 896 1325.
E-mail address: omahonea@tcd.ie (A. O'Mahoney).

0301-4215/$ - see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.enpol.2013.08.098

the size of the incumbent, economies of scale, the natural monopoly of networks and the long lead times in building new capacity.

Table 1 presents the installed capacity and electricity prices to end-users in the EU 15 countries as of 2009 (Eurostat, 2010; SEAI, 2009b). It shows Ireland, whose electricity market is the focus of this paper, to have the second smallest capacity of countries shown while having some of the highest end-user prices. Italy, on the other hand, has one of the highest installed capacities and still has relatively high end-user prices, which implies market structure may be an important determinant of the costs faced by consumers for the electricity they consume. If this is in fact the case, then high end-user prices could be reduced through a change in electricity market structure. In this paper we will investigate whether electricity costs are driven by market structure in the Irish context.

Prior to being consumed, electric power must first be generated, transported across the transmission network, and then distributed to end-users. Electricity is generated by converting energy stored in fuels (fossil, nuclear, hydro or other renewable) into electricity in power stations. These stations can be independent or part of a larger companies and their sole role is to generate electricity. This is then transported via the electricity infrastructure through, firstly, high voltage/long distance transmission lines and then, low voltage, local area distribution lines. This infrastructure is used for all electricity generated, and as such is generally owned by the state or another monopoly in order to ensure that it is properly maintained and can be accessed by all. In a deregulated environment this infrastructure is operated by independent transmission system operators and distribution system operators to ensure reliable operation and fair access for generation and supply companies (Harris, 2006; Kirschen and Strbac, 2005). Electricity is then supplied to end-users via a supply company; while in some cases this can be the same company as that generating electricity this is not always the case. Electricity cannot be stored easily, and thus must be generated, transmitted and supplied to the end-user when needed (Weron, 2006).

Methods of liberalising wholesale electricity markets have included structures such as bilateral contracts and gross pool systems. Where bilateral contracts are in operation, generators and suppliers enter into contracts without involvement, interference or facilitation from a third party and as a result there is no official price for electricity as each transaction is set independently by the parties involved (Kirschen and Strbac, 2005). A pool, similar to an auction, provides a mechanism to systematically determine the equilibrium quantity without relying on interactions between consumers and suppliers (Harris, 2006; Kirschen and Strbac, 2005).

The method of increasing competition within electricity markets which this paper will focus on is the use of mandatory gross pool electricity markets. Where implemented, participation in such a pool is mandatory, thus ensuring no physical trade of electricity outside of the pool. Each generator bids a price at which it is willing to supply electricity. These bids are then ranked to form a merit order, with electricity demand being met by dispatching units (switching plants on), beginning with the lowest cost unit, until demand is satisfied. Firms are expected to bid based on the prices at which they will cover the variable costs of operating their power plants. These power plants are then ranked based on a merit order, thus making generation costs and network constraints the determining factors for dispatch. The market clearing price is then established by a one-sided auction at the intersection of the supply curve and the forecasted demand for each period (Weron, 2006). In the early 1990s a gross pool system was in operation in England and Wales; however it was later replaced by New Electricity Trading Arrangements (Bunn, 2004; Green and Newbery, 1992; Weron, 2006). Gross pools are currently in operation in Spain, Ireland, and Alberta (Weron, 2006). Fig. 1 illustrates an example of a gross pool structure.

Our approach is to consider the drivers of the electricity price, similarly to Boogert and Dupont (2008) and Alberola et al. (2008). Other approaches, as discussed in Jouvet and Solier (2013), include error correction models and pass through rates, which identify the proportion of costs which suppliers pass through and show that CO_2 pass through rates are not statistically significant during Phase II of the ETS. Sijm et al. (2006) use pass through rates to estimate the proportion of CO_2 costs passed on in an imperfect market, and find that in Germany and the Netherlands pass through rates vary from 60 to 100%. Bonacina and Gulli (2007) also consider the pass through rates of CO_2 emissions from the EU ETS and find that the marginal pass-through rate is lower in the peak than in the off-peak hours and can be even nil if the degree of market concentration is high enough. Our dataset does not include bids by individual units in each period, and therefore we were unable to consider the pass through rates of generators based on the fuel inputs. However, given the specific market rules in the case study system, i.e. the requirement for all generators to bid spot fuel and carbon prices, the lack of individual bid information does not preclude the determination of the drivers of the system marginal price.

This paper estimates the magnitudes of the main determinants of electricity prices using historical data. While much work has

Table 1
End-User Prices in EU 15 countries, €2008.

Country	Industrial prices (c/kWh)	Domestic prices (c/kWh)	GW Installed
Austria	8.82	14.71	20.75
Belgium	N/A	15.21	16.70
Denmark	7.42	22.63	12.50
Finland	5.55	9.87	16.64
France	6.00	9.41	117.62
Germany	N/A	N/A	133.94
Greece	6.43	8.98	14.24
Ireland	10.64	15.29	7.20
Italy	16.59	17.48	97.88
Luxembourg	7.02	12.34	1.64
Netherlands	7.99	13.88	24.83
Portugal	7.52	12.57	15.70
Spain	7.16	12.48	90.19
Sweden	5.45	12.49	33.94
UK	8.37	13.27	85.58

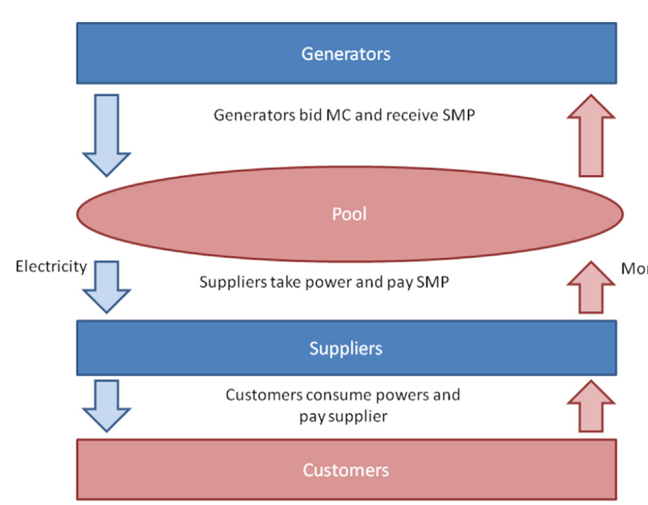

Fig. 1. Example of a gross pool market structure.