



Privatisation and cross-border electricity trade: From internal market to European Supergrid?



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ABSTRACT

The perspective European Supergrid would consist of an integrated power system network, where electricity demands from one country could be met by generation from another country. This paper makes use of a bi-linear fixed-effects model to analyse the determinants for trading electricity across borders among 34 countries connected by the European Supergrid. The key question that this paper aims to address is the extent to which the privatisation of European electricity markets has brought about higher cross-border trade of electricity. The analysis makes use of distance, price ratios, gate closure times, size of peaks and aggregate demand as standard determinants. Controlling for other standard determinants, it is concluded that privatisation in most cases led to higher power exchange and that the benefits are more significant where privatisation measures have been in place for a longer period.

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1. Introduction

For the greatest part of the last century European electricity markets have operated as separate national or regional networks. This is because of the historical role of national monopolistic energy utilities which developed grids under the assumption that each country could meet its energy demand through national supply and imports. Although full market liberalisation still presents heterogeneous features and arguably has not been completely achieved [20], the three European Union packages on the liberalisation of energy markets have marked the progress towards the highest level of integration of energy markets ever experienced in Europe. The slow, but inevitable liberalisation of European energy markets over the last ten years has been coupled with privatisation measures [31,33]. The European project for the liberalisation and integration of Member States' electricity markets has historically relied on privatisation as a mean to increase competition and reduce prices for consumers [23]. Historically trade across borders has favoured optimal balancing of demand and supply and increased the integration of European electricity markets.

The European Union move towards a low-carbon economy depends in part upon a transformed cross-border electricity system that can integrate renewables and smart meters alike, offering energy consumption savings at source and extended market potential for selling at remote end points. The increasing penetration

of renewables and the introduction of smart metering devices are expected to increase the needs and opportunities for cross-trade electricity exchange. This has prompted policy-makers and scholars to go beyond the concept of smart grids and consider a so-called European Supergrid. This would consist of an integrated power system network, where electricity demands from one country could be met by generation from another country. It has been argued that besides increasing penetration of renewable energy sources and improving security of supply, a European Supergrid would potentially reduce congestion in the existing system [44,46].

No research thus far has directly addressed the question of which are the main determinants of power exchange in the European Supergrid. This paper investigates the extent to which the privatisation of European electricity markets affected cross-border trade. It analyzes what impacts distance, gate closure and ratio between prices have on power exchange among 34 countries. As a premise to this work, trade across border is examined here as direct evidence that the internal European market is successful and as indirect evidence, that privatisation is successful. A higher volume of electricity flows indicates a functioning European electricity trade market.

The paper commences by describing current cross-border electricity transmission across Europe and plans for the European Supergrid (Section 2); introduces a bi-linear fixed-effects methodology for modelling the impacts of privatisation on cross-border trade (Section 3); reports findings from the modelling and robustness tests (Section 4); and concludes by discussing findings and policy implications (Section 5).

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2. Cross-border electricity system

2.1. The European Supergrid

The EU (European Union) Governments' move towards a low-carbon economy depends in part upon a transformed cross-border electricity system that can integrate renewables, offer energy consumption savings at source and extended market potential for selling at remote end points. According to National Grid, an integrated European Supergrid for the UK's offshore wind delivery could provide a 25% discount for the UK consumer on the capital cost compared to connecting each offshore wind farm with a dedicated radial connection [29].

Congestion associated with peak demand is a problem for trading electricity across borders, when intermittent renewables in one member state are producing so much electricity that transmission capacity to other countries is exceeded. Congestion costs across the most busy interconnectors in Europe are currently estimated to be €1.3 bn each year [9]. Key policy documents by DECC (Department of Energy & Climate Change) and [35] highlight that peak congestion of the UK electricity grid may create significant impacts on system costs because of the need for higher marginal cost generation, lower capacity margins, higher cost system balancing and increasing grid reinforcement investment.

Congestion has been addressed in European electricity markets discussions through implicit auctions [11,19,25]. In 2006, Germany, France and Belgium inaugurated the of their electricity markets in a trilateral market when limited to these three countries, which brought about a higher convergence of prices and stimulated other market coupling projects connecting in 2009 Denmark and Germany, in 2010 Germany and Nordic regions, in 2011 Italy and Slovenia as well as Netherlands and Norway [36,37]. The literature in the area of market coupling is vast and rapidly increasing, mainly focussing on issues of whether price convergence between couples of electricity prices really occurred [5,21,24]. At the time of writing this paper there are several proposals and projects to develop further market coupling, including across Iberian and Scandinavian countries.

2.2. Cross-border transmission capacity in Europe

Since the year 2000 in Europe there has not been any significant increase in cross-border transmission capacity, but cross-border trade has increased significantly (Fig. 1).

One possible explanation for this increase can be in part a rise in consumption. In principle, according to economic theory privatisation can play a role in enhancing cross-border trade [47,48]. These dynamics have already been explored empirically for other sectors, including transport [16], banking [27], telecommunications [22] and financial markets [14] In practice, the high complexity of electricity

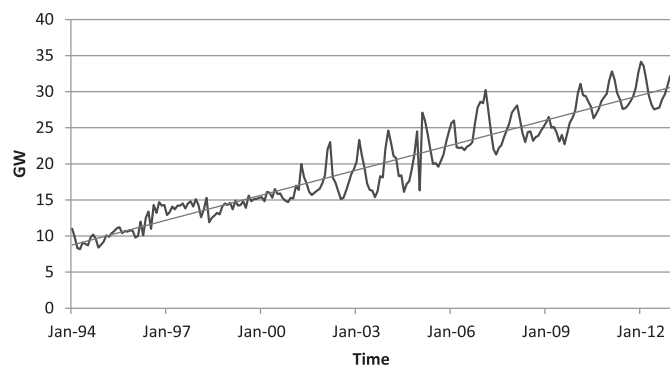


Fig. 1. Total cross-border trade (data source: [10]).

markets in terms of governance, processes and operations [7,49] means that a set of contextual issues need to be taken into account. The substantial increase in cross-border trade in electricity has not brought about higher investments in interconnecting capacity. Until recently, Transmission System Operators did not need to invest in cross-border interconnectors to balance electricity demand and supply. However, recently concerns have been raised over the need for higher cross-border trade. In the UK, these policy issues are in connection with the unprecedented need for about £200 billion investment in capacity; the closing of power stations which could cause mid-decade energy shortfall; the challenge to raise finance needed to meet low carbon targets; and the current trading arrangements which need to be improved to provide security of supply and efficient energy prices. Indeed, the capacity assessment by Ref. [35] points to a 4% capacity margin for the years 2015 and 2016. This can be interpreted as a 1 in 12 year chance of a 2.75 GW loss. In Italy, the motivation for the financing cross-border investments include the desire to address combination of problems with financing generating capacity; the absence of storage and efficient Demand Side Management programmes; the failure to coordinate investments in generation and transmission following the removal of a central entity; and the penetration of renewable sources of energy which increase price volatility, reduce market price levels and worsen the commercial attractiveness of conventional capacity. In France, the main reasons for considering cross-border electricity trade arrangements are the high imbalance settlement prices for capacity owners and suppliers along with critical reports by the French Electricity Transmission Network on the balance between electricity supply and demand. For these reasons, any analysis on the effects of privatisation on electricity flows needs to take into account the duration of the privatisation, the volume of the market object of the cross-border trade, the peak purchasing power of the net importer, the geographical ease or difficulty to trade electricity, the ratio of prices between net importer and net exporter and the presence of the same gate closure time.

2.3. Privatisation of electricity markets

In Europe, the gradual privatisation of electricity markets has introduced competition in different parts of the industry. The increasing level of competition is expected to lead to higher efficiency in investment decisions, including for cross border trade [31,33]. Despite the introduction of privatisation in the area of generation in the early 1990s, vertically integrated utilities persisted in holding the majority of interconnector capacity, hence preventing competition from other markets [45].

In principle, trade across country borders allows to achieve higher efficiency gains thanks to market division of capital assets. In practice, in European electricity markets this was implemented through measures which set out to restructure the sector by unbundling vertically integrated utilities [26,43]. The aim of vertical unbundling is to separate potentially competitive generation and supply from the natural monopoly activities of transmission and distribution networks [13,38].

Privatisation is supposed to facilitate cross-border in three ways. First, privatisation and induce the necessary competition so that cross-border electricity trade can enable countries to balance historically grown generation with current demand [1]. Second, in combination with the presence of international interconnectors, annual demand variations can be better balanced by using prices which are closer to the real cost of generating electricity [18]. Third, privatisation enables countries to use more efficiently complementary resources. For instance, flexible hydroelectric generation can be used to export peak power and import thermal power during off peak hours [30].

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