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European power markets–A journey towards efficiency

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ABSTRACT

The liberalization process of European electricity markets has been a work in progress since early reforms beginning in the 1990's. A key goal of these reforms was to enable increased integration and attendant efficiency within these markets. In this paper, we analyse three major European electricity markets - (APXUK, NordPool and Phelix) – before and after the 2009/72/EC Directive was introduced, to examine the extent to which those markets are efficient and whether they have become more integrated. We find little evidence of significant long run relationships between the different markets. We also find that the NordPool and Phelix markets in particular exhibit volatility persistence and clustering behaviour that is inconsistent with the postulations of market efficiency. The existence of continued inefficiencies across these power markets indicates that the desired goal of achieving an efficient and unified electricity market in the EU context is still a work in progress.

1. Introduction

The deregulatory process for European electricity markets that began in the 1990s was intended to allow for the introduction of competition in monopolised market structures. The economic rationale behind the deregulation of power markets was the need to stimulate and facilitate competition among electricity market participants and to bring a higher degree of efficiency to the markets (Vasconcelos, 2009). The creation of a single integrated energy market is one of the building blocks of the EU's broad energy policy, which is concerned with sustainability, competitiveness, security of energy supply, and also to the development of cross border trade in electricity that addresses the scarce interconnection of electricity capacities across Europe (Rademaekers et al., 2008).

The EU faces major challenges regarding the physical interconnectivity between its constituent energy markets, and also in terms of concentration levels which are a major area of concern for policy makers and energy regulators. The high levels of concentration in the electricity markets have caused scepticism among large energy consumers that question the existence of fair competition in the formation of prices on the spot and forward wholesale markets. It is argued that market liberalization and integration can stimulate increasing levels of security of supply, while also time promoting lower energy prices in the long run. However, in the short run many challenges may persist, including the potential for undersupply and poor quality of service.

Understanding market connections and their level of integration and efficiency across Europe would offer important insights in terms of market competition, market organisation and the identification of benefits that the liberalization of power markets might bring to Europe. From an analytical point of view, Joskow (2006c) argues that there are three main approaches for examining the effects of liberalization reforms. These are: (i) “before and after” studies using time series data; (ii) inter-country and inter-state comparisons where liberalization instructions vary from country to country or state to state; and (iii) structural simulation approaches. In this paper we adopt the first approach whereby we examine whether and to what extent the selected European power markets have become more efficient following the introduction of the 2009 EU electricity directive. By looking at power market dynamics through an analysis of daily spot prices, this study seeks to identify potential signs of market efficiency by testing for random walks, the existence of long run relationships, volatility persistence and clustering behaviour in the wholesale electricity prices across the three major European power exchanges.

The main contribution of this paper is a focused discussion and analysis of some of the most developed European power markets in the context of price market efficiencies after the introduction of the latest EU electricity directive. A further contribution of this paper is the application of a key combination of econometric models that allow us to robustly derive inferences about the consistency of research findings in this area and to resolve potential conflicts that arise from the use of different research methodologies. This is an issue that to our knowledge has not been sufficiently addressed in the extant literature. The remainder of the paper is structured as follows: Section two offers a general overview of the European power markets. Section three

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presents the data and proposed research methodology. Section four outlines the main results and attendant discussion and section five concludes.

2. An overview of European power markets

In this section we trace the reforms designed to develop the European power markets. We also look at some of the basic characteristics of an efficient market as it pertains to the electricity context.

2.1. The reform of power markets across Europe

Over the past two decades, the structure of European energy markets has been undergoing major reform with a view to moving towards a single integrated market. This process is characterised by high levels of complexity due to technological, environmental and geo-political factors associated with the different countries and regions. Indeed, these factors play a major role, as they add extra barriers to the unified approach that the EU has taken regarding its energy policy. The integration process has been orchestrated by the European Commission which has tried to encourage individual member states to progress towards a broader and more open perspective as opposed to one solely focused on national interests (Karan and Kazdagli, 2011). The outlined EU directives are designed to enhance competition via better functioning of the markets as a whole, rather than the fragmented and incoherent manner in which these markets have operated heretofore (Sioshansi, 2006). More integrated markets should increase efficiency and this in turn should facilitate lower electricity prices as compared with separate and individually run markets (Ehrenmann and Neuhoff, 2009). Another issue of importance is the need to reduce the influence of national monopolies with the purpose of improving the supply and stability of the sector, as countries would be able to cooperate through their interconnected systems helping them to become more integrated. Through market integration, countries that experience high-variable costs in their generational capacity should be able to obtain positive welfare gains. In this regard, the liberalization and integration process is characterised by a dynamic process of discovery, and continuous interactions between the different market players and the regulatory authorities. The process of market liberalization has also contributed to an increase in trading activity across Europe, where wholesale power trading is dominated by over the counter markets (OTCs). These markets have gained in importance in terms of the negotiation of energy products and derivatives trading as evidenced by substantial increases in prices and volume risks. Through the intensive market activity that is being registered across power markets, market competition should be enhanced with an attendant increase in market efficiencies.

2.2. Towards an efficient power market

The key issues for energy markets in attempting to address market inefficiencies have been identified as the liberalization, privatization and restructuration of the energy supply and distribution industry. In the particular case of the EU the need to reform energy markets became acute due to its heavy dependence on oil and gas from external sources. Therefore, the need to develop an energy sector that is more integrated and competitive and where national energy models co-ordinate more closely in the development of strategic policies that are aligned with current market trends has become a major priority (Karan and Kazdagli, 2011). The initial stages of market reform in the EU can be found on the British and Nordic electricity markets which were made with the goal of creating a unique energy market (Kroes, 2007). The creation of an efficient and unique energy market structure is supported by four major pillars as described by Pollitt (2009a): The first stage is the privatization of publicly owned electricity assets; this is followed by the opening up of the market to competition; the extension of vertical unbundling of transmission and distribution from generation and retailing; and finally, the introduction of an independent regulator. Some of the major challenges associated with the whole process are the combination of political and economic barriers that have negative impact and that give rise to divergences across countries. To address these issues, the European Commission (2010b) envisaged a single European approach to integration rather than a regional one (Directive 25009/75/EC, 2009).

2.3. Price dynamics in power markets

Trading activities in power markets are associated with large amounts of information. Understanding these activities requires an in-depth knowledge of utility markets and the information systems they support. In this regard, the dynamics of how historical information is managed and the level of efficiency that these markets exhibit is key, due to the implications of having official market prices that are transparent and that offer all available information at trading times to market players (León and Rubia, 2004). Price fluctuations in energy markets are clearly associated with profit opportunities to investors, but they are also linked to high levels of risk. The main characteristic of electricity relates to its limited storability, making it difficult to insure against price risks by building appropriate reserve levels. Fluctuations in electricity demand and supply which is affected by weather conditions and/or failures of power plants respectively lead towards the generation of extremely high costs. Additionally, the inelasticity of electricity demand creates major jumps or spikes in prices that are frequently followed by a quick return to normal price levels. This type of behaviour is a particular feature of spot prices in most electricity markets, as are the associated high volatility levels. Price movements are also conditioned by the patterns exhibited by economic and business activities. Therefore, electricity prices reveal cyclical patterns that account for markets needs which are closely linked to human activity and to climate conditions. Electricity prices are further characterised by their complexity, as they are affected by seasonal behaviour, mean reversions, and major shocks which translate into extreme price fluctuations (Paraschiv, 2013).

Following the idea of price formation under conditions of *"market efficiency"*, price changes should behave in a random fashion and should not exhibit serial correlation to allow the incorporation of all available information to the market. Thus, price behaviour and their level of efficiency need to be studied to identify if prices in power markets exhibit a trend and whether the identification and predictability of patterns is possible on power exchanges. In addition, further analysis of price efficiencies in EU power markets is of importance, given the nature of existing research which has shown some inconsistency in terms of the results which has been linked to both methodology and research sample periods. For example, advanced models tend to confirm the existence of market efficiency, while older research techniques are more inclined to reject it. In general, it would appear that energy and power markets are not especially efficient, and this is an issue of concern when understanding the real impact that energy directives are having on electricity price formation (Avsar and Goss, 2001). Therefore, understanding the implications and impact of energy directives on electricity price behaviour is a significant matter. Policy makers should be able to identify tools that help them analyse the impact of implemented directives with a view to ensuring that markets dynamics are moving closer to expectations.

3. Data and methodological framework

Daily spot electricity prices are analysed for the period September 2004 to September 2014, for the Nordic region (NordPool), the UK (APX/ICE) and Germany (EEX/Phelix) – the dataset includes 2620 observations per each market under analysis.[1] The research sample is

[1] See the following for more detailed information:.