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Linking the energy-only market and the energy-plus-capacity market

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ABSTRACT

This article analyzes the implications of capacity markets and allocation mechanisms for cross-border trade and market welfare by applying an analytical model where two markets with different market designs, the energy-only market and the energy-plus-capacity market, are interconnected and operate under different transmission capacity allocation schemes. The findings suggest that having an energy-only market at one side of the border and an energy-plus-capacity market at the other side may impede cross-border trade and result in underusage or misusage of transmission in the case of an explicit allocation of transmission capacity. Implicit allocation or market coupling, in principle, would increase the efficiency of cross-border trade, but may result in distributional effects, involving for instance a free-riding effect.

1. Introduction

An internal market for electricity is a key part of the EU 2020 strategy (European Commission, 2010). Efficient cross-border trade facilitates efficient use of resources and an increase in social welfare. The sharing of resources enables consumers in high-cost regions to have access to low-cost electricity generation in other regions, resulting in more efficient use of resources and increasing the probability that the demand will be met by the least-cost means of production. Moreover, opening the national markets to foreign participants should enhance market competition and strengthen the security of supply (Booz&Co, 2013; Creti, 2010; Jasamb and Pollit, 2005; Pellini, 2012). However, in order to facilitate efficient cross-border trade, transmission capacity allocation methods should be market based. In Europe, explicit and implicit transmission auctions are used to allocate transmission capacity. Under explicit allocation of transmission capacity, the available transfer capacity of the interconnector is sold separately for each direction to market participants through a uniform-pricing auction of transmission capacity on a yearly, monthly, or daily basis. After obtaining transmission capacity rights, traders are allowed to trade energy through the interconnector. However, as a result of trading costs resulting from separate markets for transmission and energy, together with the asymmetry of information on electricity prices in the trading markets, explicit allocation brings about inefficiencies in the form of underusage (flows lower than the available capacity when there is a price difference) or misusage (flow against price differential) of transmission capacity (Bunn and Zachmann, 2010; Kristiansen, 2007; Newbery and Mc Daniel, 2002). Under implicit allocation of transmission capacity (or market coupling) no separate auctions exist for transmission capacity, and the flows on the interconnectors are determined by the clearing of the energy markets. Market coupling ensures that the use of transmission capacity is welfare maximized. Efficiency gains from the introduction of market coupling are examined in detail in various studies (Hobbs et al., 2005; Creti et al., 2010; Pellini, 2012). Market coupling is the target model for cross-border transmission capacity allocation in the EU member states.

Numerous EU member states are currently considering moving from energy-only markets to energy-plus-capacity markets (CREG, 2012). The discussion about the need for capacity markets in Europe centers on how to ensure that there is enough capacity to meet the future demand and back up increasing proportions of renewable energy sources (RES) in the long term (Brunekreft, 2011; Nicolosi, 2012; Cepeda and Finon, 2013). However, as more European markets become increasingly interconnected, uncoordinated capacity remunerative mechanisms (CRMs) may create negative cross-border effects and hinder the achievement of the Internal Electricity Market in Europe. A concern is that market design changes at the level of EU member countries might conflict with the European target of a single market. However, the degree to which individual CRMs could impact cross-border trade depends on the degree of interconnectivity among markets and the correlation of

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prices and scarcity conditions (ACER, 2013; Meyer et al., 2014; Sweco, 2014; Thema, 2013). A few real-life examples of the interaction of energy-only and CRM markets are available, including the PJM and the Midwest ISO control areas in the US, Ireland and Great Britain, and Russia and the Nordic market. Inefficient cross-border trade has been observed in all these cases because of the CRM (Gore et al., 2014; Lawlor, 2012; McInerney and Bunn, 2013; Viljainen et al., 2013). Experiences in these markets demonstrate how challenging the integration of energy-only and energy-plus-capacity markets can be.

This article analyzes the implication of capacity markets and cross-border allocation mechanisms on cross-border trade and market welfare by applying an analytical model where two markets with different market designs, namely the Nordic energy-only market and the Russian energy-plus-capacity market, are interconnected and operate under different transmission capacity allocation schemes. The article is structured as follows. The second section provides an overview on the Russian energy-plus-capacity market and the Nordic energy-only market and describes the main differences in the operation of the markets. The third section presents the simulation that we developed to analyze the implications of capacity markets and cross-border allocation mechanisms for the cross-border trade and market welfare. The fourth section reports the results of the simulation and welfare analysis consisting of welfare indicators such as the TSO income, the producers' and consumers' surpluses from the energy market, and the capacity payments, and discusses the limitations of the analysis. The fifth section discusses the policy implications for the European energy markets that are considering to implement capacity remuneration mechanisms. The sixth section concludes the main findings of the article.

2. Main differences in the operation of the Finnish energy-only market and the Russian energy-plus-capacity market

2.1. Energy-only market compared with energy-plus-capacity market

In energy-only markets, generators are paid for the volume of electricity (kWh, MWh, or GWh) produced, but are not compensated for keeping capacity available. In a competitive energy-only market, generators bid their short-run marginal costs, and the hourly market-clearing price equals the marginal cost of the last generating capacity or the demand-response resource that clears the supply and the demand given that the demand does not exceed the available capacity. The fixed costs of the dispatched generators are recovered through inframarginal rents and scarcity rents. Inframarginal rents are reflected in the difference between market clearing prices and marginal costs of generation. Scarcity rents, again, are reflected in the difference between scarcity prices that are charged when demand exceeds the generation available in the market and the marginal costs of the last available unit in the system. In theory, in the absence of market failures, energy-only markets should generate sufficient revenues to cover the full costs of power plants over their whole lifetime and attract new investments, thereby ensuring generation adequacy in the market. However, a threat of market-power abuse during scarcity conditions may force regulators to set a price cap in the energy-only market. Capped scarcity prices may cause a missing money problem, that is, a situation where the electricity prices are not high enough at times of peak demand to recover the fixed costs of power plants and incentivize new investments (Joskow, 2006). Because of the concern that energy-only markets alone may not be able to ensure resource adequacy, different forms of capacity remuneration mechanisms have been introduced in addition to the energy markets. The objective of capacity remuneration mechanisms (capacity markets and capacity payments) is to ensure the profitability of the existing power plants and to support investments in new power plants by restoring the missing money of the energy-only market. Providing stable revenues for power producers, capacity mechanisms aim to increase both the short-run reliability and the long-run adequacy of power supply (Cramton and Ockenfels, 2012; De Vries, 2007; Joskow, 2008). The focus of this article is on capacity markets.

2.2. Finnish energy-only market

Finland represents one price zone of the Nordic energy-only market, which has the zonal pricing model. Geographically, the Nordic electricity market covers Denmark, Finland, Sweden, Norway, Estonia, Lithuania, and Latvia (Nord Pool, 2014). In the absence of inter-zonal transmission congestion, a uniform market clearance price is formed for the entire market. In the case of transmission congestion, the Nordic electricity market is divided into fourteen price zones, and separate prices are calculated for each zone. In 2010–2012, the market uniformity (the same price in all price zones) was achieved about 20% of the time, which is well below the targeted 65% market uniformity. Owing to the rapid congestion of the line between Finland and Sweden, Finland decouples from the Nordic market 80% of the time and forms a price zone of its own with zonal electricity prices significantly higher than the system price in the Nord Pool market. Finland is considered a net importer of electricity; imports accounted for 18.8% of the annual Finnish consumption in 2013. The maximum transmission capacity between Nord Pool and Finland is 2850 MW, and between Russia to Finland, the capacity is 1400 MW (Viljainen et al., 2012). The total generation capacity in Finland is about 13,000 MW while the peak demand is 15,000 MW.

2.3. Russian energy-plus-capacity market

In the Russian energy-plus-capacity market, generators earn revenues by selling their volumetric production into the wholesale electricity market and selling their production capacity into the capacity market (Gore and Viljainen, 2012).

2.3.1. Market of electric energy

The day-ahead market is the central exchange for electricity trade in Russia. The day-ahead market model in Russia employs the concept of bid-based centralized dispatch with nodal prices. Trading in the day-ahead market is organized as a closed auction with one trading cycle per day. Electricity prices are defined for each location of the grid, and include the marginal cost of produced electricity, the cost of transmission, and the cost of power losses. The commercial operator ATS (or power exchange) operates the day-ahead market by collecting supply and demand bids of the market participants and computing electricity market prices in 8100 nodes for each hour of the following day. The Russian electricity market is natural gas dominated, with 65% of electricity production based on gas generation. Domestic gas prices in Russia are regulated by the government and are at levels that are one-fourth of the gas prices in Finland, making the price of electricity imported from Russia cheaper than the gas- and even coal-produced electricity in Finland.

Fig. 1 presents the historical development of the electricity prices in Finland and Russia as well as the interconnector flow.

[1] All series are moving average filtered (28 days). The Russian price is converted into euros by using daily exchange rates as quoted by the Central Bank of Russia.