Energy Policy ∎ (∎∎∎∎) ∎∎∎–∎∎∎

Contents lists available at ScienceDirect

Energy Policy

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

Strategic investment in merchant transmission: The impact of capacity utilization rules ☆

Federico Boffa [a,*], Viswanath Pingali [b], Francesca Sala [c]

[a] Free University of Bolzano, Faculty of Economics and Management, Piazza dell'Università 1, 39100 Bolzano, Italy
[b] Indian Institute of Management Ahmedabad, Vastrapur, Ahmedabad 380 015, India
[c] UK Competition and Markets Authority (CMA), Mergers, Victoria House, Southampton Row, London WC1B 4AD, United Kingdom

HIGHLIGHTS

- We model merits of Must offer (Mo) versus non-Must offer (NMo) regimes.
- With fluctuating demand, NMo in general may generate more investment in capacity.
- At the same time it may reduce capacity utilization.
- With market power in the inefficient generating node, Mo is welfare-enhancing.
- Collusion is mitigated with '*must offer*' regime in place.

ARTICLE INFO

Article history:
Received 4 November 2014
Received in revised form
12 February 2015
Accepted 31 March 2015

JEL classification:
L 94
D 24

Keywords:
Electricity transmission
Merchant lines
Capacity utilization
Vertical integration
Collusion

ABSTRACT

In this paper we look at the relative merits of two capacity utilization regimes in the merchant electricity transmission network: Must offer (*Mo*) where the entire capacity installed has to be made available for transmission and Non Must Offer (*NMo*) where some capacity could be withheld. We look at two specific cases: (i) demand for transmission varies across time, and (ii) vertical integration is allowed between investors in transmission network and electricity generators. In the case of time-varying demand under *Mo*, we find that a monopolist may underinvest in transmission when compared to *NMo*, although *NMo* may lead to more capacity withholding. In the case of vertical integration, we find that when the market power is with the generators of the exporting node, without vertical integration no welfare-enhancing merchant investment would occur, neither under *Mo* nor *NMo*. Further, if the generators in the importing node have market power, in case vertical integration is allowed, *Mo* is better than *NMo*. Finally, we also argue that the incentive to collude among various transmission network investors is mitigated with *Mo* in place.

1. Introduction

Till recently, two important segments of electricity markets – transmission and distribution – were regarded as examples of natural monopolies, whose ownership (or at least management) had to be left in the hands of public sector/government. However, technological advancements in the transmission sector have spurred the debate on the feasibility of merchant investments, and welfare outcomes thereof in the electricity sector. Merchant investments in the transmission sector refer to investments made by non-governmental (private) investors who are transferred the property rights of the line. As Joskow and Tirole (2005) point out, merchant investments rely, "[O]n competition, free entry and decentralized property-rights based institutions, and market-based pricing of transmission service to govern transmission investment."

While the debate on the welfare-effects of merchant investments is still ongoing, an increasing number of countries, including those in the EU, Australia and Argentina, have moved towards allowing them. Merchant lines are regarded as effective means to solve the problem of transmission capacity deficit, which has affected, and is still affecting, several countries across the world, including many in Europe. With the entry, and subsequent

☆ The views expressed in this paper are those of the authors and do not necessarily reflect those of the UK Competition and Markets Authority.

* Corresponding author.
E-mail addresses: fboffa@unibz.it (F. Boffa), viswanath@iimahd.ernet.in (V. Pingali), francesca.sala@cma.gsi.gov.uk (F. Sala).

http://dx.doi.org/10.1016/j.enpol.2015.03.027
0301-4215/

expansion, of renewable energy supply, which significantly affects energy prices (see, for instance, Clò and D'Adamo, 2014), the economic effects of such shortfalls are further exacerbated. For example, a recent report by ENTSO-E (2012) estimates that, in Europe alone, 52,300 km of high voltage transmission lines will have to be added in the 2010–2020 time span. Many of the interconnection projects, which have been prioritized by the European Union by being included in the list of "Projects of Common Interest" (PCIs), involve merchant transmission investment (MTIs).

Within this policy framework that contemplates merchant transmission, some key questions emerge. Two questions that are particularly important are (i) optimal design and regulation of MTIs, and (ii) whether or not generators themselves ought to be allowed to invest in the transmission network. Given the importance of the questions pertaining to market design, Joskow and Tirole's (2005) claim that "…there has been surprisingly little research on the institutions governing transmission network," still remains valid.

In this context, our paper contributes to the existing literature by theoretically characterizing welfare effects of two aspects of the market design – the mode of capacity utilization and vertical integration between generators and merchant investors. To elaborate further, we compare the effects on incentives to invest and welfare in the transmission sector under two alternative settings: (i) the investor has to offer the entire installed capacity for transmission (a 'must offer' (*Mo*) condition), that is, it cannot withhold part of the capacity, and (ii) the investor can choose the amount of capacity that can be offered for transmission (a non-must offer (*NMo*) condition). Prima facie, it is not clear which of the alternatives is welfare superior. An *Mo* provision prohibits capacity withholding, thereby mandating the line's owner to make available the full line's capacity at the market price. While it has been generally recognized that *Mo* has to be imposed on pre-existing non-merchant lines (often built under regulated regimes), it is not clear whether or not it should be applicable to the new merchant investment as well. Imposition of the *Mo* provision could in principle affect investment decisions, for instance by inhibiting entry of new investors, or by inducing investors to inefficiently downsize their investments. On the other hand, it is clear that since an *NMo* provision encourages capacity withholding, it can create certain deadweight loss *ex post*. Therefore, characterizing the circumstances under which one alternative is welfare superior to the other, under various assumptions on the demand function and on competition in the underlying energy markets, becomes important from a policy perspective.

A prominent feature of electricity transmission market is the fluctuating demand across various time periods. The first issue we investigate in this paper is to understand the effects of *Mo* and *NMo* in the case where there are multiple periods with varying demand. In this scenario we model both the monopoly situation, with an individual investor in capacity, and sequential entry. Under monopoly an interesting trade-off emerges with *Mo* provision. Intuitively, if the monopolist installs capacity keeping peak period in mind, then the price of transmission in off-peak period is essentially lower (or even zero); as a result, he gives up profit in the off-peak period. On the contrary, *NMo* allows the monopolist to plan for peak period, while still reaping some profit in the lean period, by withholding sufficient capacity. Therefore, *Mo* provision can lead to the monopolist under-investing in the market in order to keep lean period prices higher. We find that the monopoly capacity invested is weakly larger under *NMo* when compared to *Mo*, although the aggregate amount of capacity made available may be greater under *Mo* (due to a weakly higher capacity utilization rate). Further, profits under *Mo* are weakly lower when compared to *NMo*. When we allow for sequential entry of two merchant investors, however, the results are not unambiguous. For some parameter values we show that *Mo* encourages greater transmission of electricity, and allows more easy entry than *NMo*. Brunekreeft and Newbery (2006) answer a slightly similar question in the context of a single period without demand fluctuations. They show that in a scenario with multiple potential entrants and sequential entry with quantity competition, *Mo* provision yields mixed results. *Mo* provides a powerful form of commitment device for the incumbent monopolist to deter the entry of other potential investors. Such preemptive investment is not always possible under the *NMo* provision because, if the first mover were to install an excessive capacity, he might find it in his interest to withhold some of it should entry indeed take place. While such commitment may lead to higher profit and higher capacity choice by the first mover, overall welfare may be harmed, since, under certain conditions, *Mo* induces less entry, and thus reduces overall investment in the transmission network. We show that Brunekreeft and Newbery's (2006) result that *Mo* (weakly) reduces entry prospects is partially reversed when there are multiple periods with different demands.

The second issue we investigate is to characterize the effects of vertical integration between merchant investors and electricity generators, and the welfare properties of the capacity utilization regimes *Mo* and *NMo*, under these circumstances. In the legal scholarship, the question of the desirability of vertical integration has been analyzed by Nowak (2010), who argues that such integration can hinder efficiency in the market, and by de Hauteclocque and Rious (2011), who, to the contrary, argue that it ought to be allowed.

We explore under what conditions integration is better (or worse) from an economic efficiency standpoint. This question is particularly significant when the nodes are asymmetric in the efficiency of electricity generation, and some generators have market power in one of the nodes. We show that in the case in which the generator in the efficient node has market power (monopoly), the choice regime (*Mo* or *NMo*) does not make a difference. Only the monopolistic generator, and not an independent merchant investor, has an incentive to invest in merchant transmission. We believe that this result is relevant from a policy perspective. The main lesson is that in markets where efficient nodes are characterized by the presence of significant market power held by the generators, merchant investment by vertically integrated firms improves welfare, regardless of whichever capacity utilization regime is in place. This result is similar to Van Koten (2012), who, albeit in a very different framework (capacity is allocated through an explicit auction with many bidders with private values), finds that the value of merchant investment is larger if it is undertaken by an investor who owns an efficient generator in the exporting zone. Sauma and Oren (2009) also obtain a similar result, but their analysis does not consider the differential incentives brought about by *Mo* and *NMo* respectively.

When market power prevails in the inefficient node, on the other hand, we argue that the capacity utilization regime matters. If there is vertical integration, *Mo* is generally less harmful than *NMo* is. This result mirrors that obtained by Joskow and Tirole (2000), although in a different framework, and in particular in comparing financial transmission rights vis-à-vis physical transmission rights.

A final issue we address in this paper concerns collusive behavior on the part of merchant investors. The economics literature has suggested several ways to model collusion. A common insight is that excess capacity left idle can be used as a threat to punish the defector, and therefore as a tool to sustain a cartel. Therefore, if there is a fear of collusion among merchant investors, the policy maker should consider imposing *Mo* as against *NMo* in order to preclude the use of excess capacity as a threat.

Finally, observe that, in the context of liberalized electricity

Please cite this article as: Boffa, F., et al., Strategic investment in merchant transmission: The impact of capacity utilization rules. Energy Policy (2015), http://dx.doi.org/10.1016/j.enpol.2015.03.027