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Should an incumbent generator be allowed to buy import transmission capacity?

Bert WILLEMS
(K.U.Leuven-CES-ETE)

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secretariat:
Isabelle Benoit
KULeuven-CES
Naamsestraat 69, B-3000 Leuven (Belgium)
tel: +32 (0) 16 32.66.33
fax: +32 (0) 16 32.69.10
e-mail: Isabelle.Benoit@econ.kuleuven.ac.be
http://www.kuleuven.be/ete

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Bert Willems*
Center for economic studies - K.U.Leuven
http://www.econ.kuleuven.ac.be/bert.willems

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Abstract

A small region has a high cost monopolistic electricity generator. It is connected through a low capacity transmission line with a large, competitive low cost region. Access to the transmission line is auctioned. I show that, if consumers arbitrate on the regional price differences, the monopolist will buy the transmission capacity. It is then welfare improving not to allow the monopolist to buy transmission rights. In theory, if consumers could co-ordinate and overcome free-riding, then they would bid more than the monopolist.

Keywords: electricity, congestion, network, monopoly
JEL Classification: D42, L12, L94

The paper tries to give some simple intuition for what happens when an incumbent monopolist is allowed to buy import capacity. The results in this paper are not entirely new (see for instance Joskow and Tirole, 2000), but are – hopefully – explained somewhat simpler.

We consider the standard two node network, with a monopoly at the importing region, and a competitive market in the exporting region. Access to the transmission line is auctioned. We study whether the consumers or the monopolist of the importing region will buy the transmission capacity.

The model has been inspired by the situation at the French-Belgian border. France has an overproduction of cheap nuclear power. Given the small transmission capacity between France and Belgium the interconnecting transmission lines are almost always congested. Belgian consumers are concerned that the Belgian incumbent generator would buy all transmission capacity to keep out its competitors. We show that this will be the case. Note that the paper assumes that the French electricity market is competitive, which most people think is not the case.

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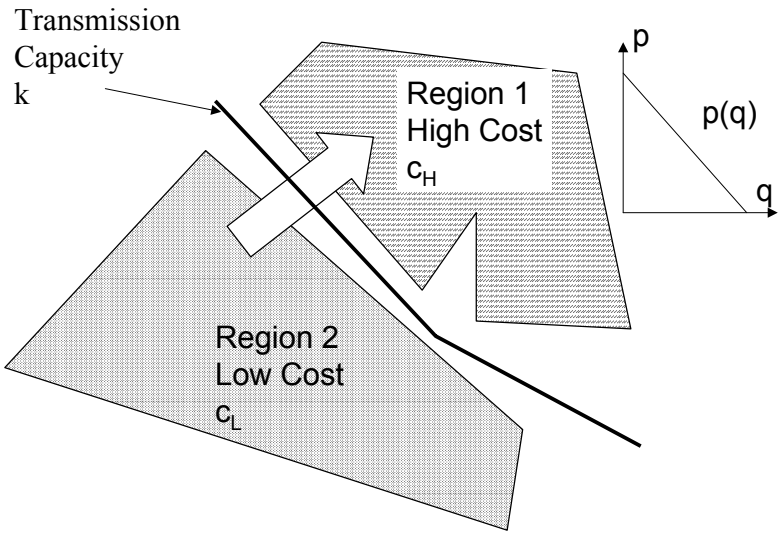

FIGURE 1: The model considers two regions, region 1 has a high cost monopolist, and region 2 has a low cost perfectly competitive market. Consumers in region 1 have a demand function $q(p)$.

Set up of the model Consider two regions $i \in \{1, 2\}$. See Figure 1. Region 1 has consumers with a demand for electricity $q(p)$, and a monopolistic generator with a constant marginal production cost c_H. Region 2 has a competitive electricity market with a constant marginal production cost c_L. Production costs are higher in region 1 than in region 2.($c_H > c_L$). As region 2 is competitive, its price for electricity is c_L.

A transmission line with limited capacity k connects both regions. It is assumed that transmission capacity is small, such that the transmission constraint is always binding. Access to the transmission line is auctioned. To simplify the results, it is assumed that all transmission capacity is sold in one package; i.e. either the consumers or the monopolist end up with all the transmission rights.

The model has two stages. In the first stage, the generators or the consumers obtain the transmission capacity, in the second stage the monopolist sets his price for electricity.

First we look to the second stage of the game. Then we will solve the solution of the first stage.

Second Stage We compare the two possible allocations: (1) Consumers have all the transmission rights (Index C), and (2) The monopolist has the transmission rights. (Index M).

If *consumers* own the rights (See figure 2), then the monopolist has a residual

demand function $p(q) - k$ and obtains a profit:

$$\pi^C(p) = (p - c_H)(q(p) - k) \tag{1}$$

He sets a price $p^C = \arg\max_p \pi^C(p)$. In figure 2 the monopolist obtains a profit $B = \pi^C(p^C)$.

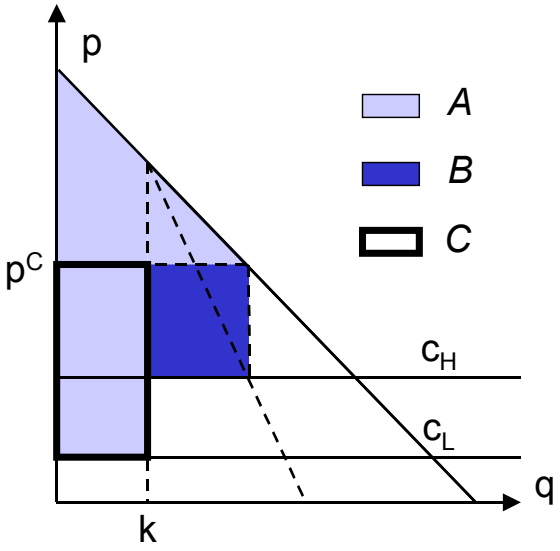

FIGURE 2: Consumers own the transmission capacity. The optimal price for the monopolist is p^C. The area B is the monopoly profit, area A the consumers surplus, and area C the value of the transmission rights for consumes who behave as arbitrageurs.

If the *monopolist* owns the rights, he obtains a profit

$$\pi^M(p) = (p - c_H)\, q(p) + k(c_H - c_L) \tag{2}$$

He maximizes against the full demand function and receives a profit $k\Delta c$ from importing cheap electricity. See figure 3. He sets the price $p^M = \arg\max_p \pi^M(p)$. In figure 3 the profit of the monopolist is the area B'.

First Stage In stage 1, the players bid for the transmission rights. Without specifying the actual mechanism we assume that the player with the highest valuation receives the transmission rights. As there is perfect information in the game, this is what happens for the standard auctions. The value of owning the transmission right for the monopolist is $V^M = \pi^M(p^M) - \pi^C(p^C)$. In the figures this is area $B' - B$.

The value for the consumers depends on (I) whether they will arbitrate on prices, or (II) whether they will correctly anticipate the behavior of the monopolist and coordinate.

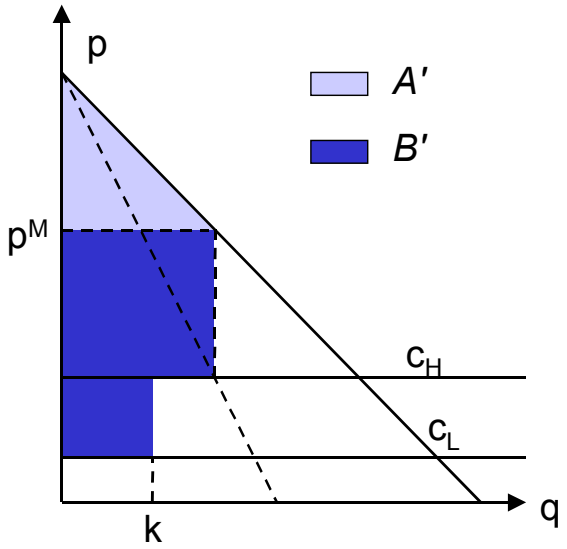

FIGURE 3: The monopolist owns the transmission capacity. The optimal price for the monopolist is p^M. The area B' is the monopoly profit. Area A' the consumers surplus.

Case I. The consumers *arbitrate* on the price difference. The value for consumers of a unit of transmission rights is equal to the price difference between the regions: $p^C - c_L$. Their total valuation for k transmission rights is $V^C_{arbitrage} = (p^C - c_L)k$. See region C in figure 2. The monopolist has a higher valuation than the consumers

$$V^M > V^C_{arbitrage} \tag{3}$$

The proof is simple and uses a revealed preference argument for the monopolist. It is obvious that $B + C < B'$, as otherwise p^M would not be the optimal price for the monopolist. Rearranging the terms gives $C < B' - B$, which is equation 3.

Welfare is higher if consumers obtain all the transmission capacity. Therefore it is optimal to forbid the monopolist to buy the transmission rights.

The results are opposite to the ones found by Gilbert, et al., (2002) who state that arbitrators will outbid the monopolist.[1]

Case II. The consumers play *strategically.* They organize themselves and take into account their inframarginal rents. Their valuation for transmission rights is now equal to:

$$V^C_{strategic} = U(p^C) + k(p - c_L) - U(p^M) \tag{4}$$

[1] Page 9: "A monopolist (n=1) would not buy any transmission contracts "

with $U(p) = \int_p^{\bar{p}} q(t)dt$, the net consumer surplus, and $\bar{p}$ the reservation price. It is the difference of the consumers surplus in both allocations. In the figures $V^C_{strategic} = A - A'$. Consumers have a higher valuation than the monopolist.

$$V^M < V^C_{strategic} \tag{5}$$

The proof follows directly from the fact that welfare is higher if transmission rights are allocated to consumers. $(A + B > A' + B')$. Rearranging the terms implies that $B' - B < A - A'$ which is precisely equation 5.

Note that if consumers can coordinate in the transmission market ($i.e$ the first stage), it would be natural to assume that they would do the same in the electricity market (the second stage). Here we assumed that consumers always behave competitively in the second stage.

Conclusion The paper considers a small, high cost, and monopolistic region, that imports electricity from a large, low cost, and competitive region. Import capacity is limited by transmission constraints, and transmission capacity is auctioned to consumers and to the monopolist.

We show that if consumers arbitrate on the price difference between the two regions, the monopolist buys the transmission capacity. Forbidding the monopolist to buy importing capacity is welfare improving. However, as shown in Joskow and Tirole (2000), it is very difficult to generalize these conclusions in a meshed network and variable demand.

If the consumers act strategically in the transmission market, they have a higher valuation than the monopolist, and buy the transmission rights. For this to happen, consumers need coordination to overcome free-riding. If a consumer buys transmission rights, he reduces the electricity price in the importing region, and creates an positive external benefit for other consumers.

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