Juan Rosellón, Ingo Vogelsang and William Hogan

A COMBINED MERCHANT-REGULATORY MECHANISM FOR ELECTRICITY TRANSMISSION EXPANSION

Juan Rosellón: Centro de Investigación y Docencia Económicas (CIDE) División de Economía,
Carretera México-Toluca 3655, Col. Lomas de Santa Fe, México D.F., 01210, MEXICO,
Tel.: 52-55-5727-9870; 52-55-57-27-9800 X2711, Fax: 52-55-57-27-9878
Email: juan.rosellon@cide.edu
William Hogan: Kennedy School of Government, Harvard University
Ingo Vogelsang: Department of Economics, Boston University

Overview

Electricity transmission pricing and transmission grid expansion have received increasing regulatory and academic attention in recent years. Since electricity transmission is a very special service with unusual characteristics, such as loop flows, the approaches have been largely tailor-made and not simply taken from the general economic literature or from the more specific but still general incentive regulation literature. An exception has been Vogelsang (2001)1, who postulated transmission cost and demand functions with fairly general properties and then adapted known regulatory adjustment processes to the electricity transmission problem. A particular criticism of this approach has been that the properties of transmission cost and demand functions are little known but are suspected to differ from conventional functional forms. Hence the assumed cost and demand properties in Vogelsang (2001) may actually not hold for transmission companies (Transcos). Loop-flows imply that certain investments in transmission upgrades cause negative network effects on other transmission links, so that capacity is multidimensional. Hogan (2002)2 shows that total network capacity might even decrease due to the addition of new capacity in certain transmission links. Therefore the transmission capacity function can be discontinuous.

The literature exhibits two main approaches: one employs the theory based on long-run financial rights to transmission (merchant approach), while the other is based on the incentive-regulation hypothesis (regulatory approach). The first approach proposes auctions of long-term financial transmission rights (LTFTR) awarded by an independent system operator (ISO).[3] The second approach relies on regulatory mechanisms for a transmission company that both owns the network and carries out system operation (Transco). The transmission firm is regulated through benchmark or price regulation to provide long-term investment incentives while avoiding congestion. In this paper we combine the merchant and regulatory approaches in an environment of price-taking generators and loads.

Methods

Based on LTFTRs, merchant mechanisms are designed for incrementally small expansions in meshed networks under an ISO environment. The price-cap method seeks to regulate a

---

[1] Vogelsang, I., 2001. Price Regulation for Independent Transmission Companies. *Journal of Regulatory Economics*, 20, no. 2 (Sept.), pp. 141-165.

[2] Hogan, W., 2002. Financial Transmission Right Incentives: Applications Beyond Hedging. Presentation to HEPG Twenty-Eight Plenary Sessions, May 31, http://www.ksg.harvard.edu/people/whogan.

[3] Kristiansen, T., Rosellón, J., 2006. A Merchant Mechanism for Electricity Transmission Expansion. *Journal of Regulatory Economics,* 29, no. 2 (March), pp. 167-193

Transco. The regulatory model in this paper is an extension of Vogelsang (2001) for meshed projects. Transmission output is redefined in terms of incremental LTFTRs (or total LTFTRs, if a long period is assumed) so as to be able to apply the Vogelsang's incentive mechanism to a meshed network. Our model combines merchant and regulated investments for lumpy and large transmission projects so that the fixed part of the tariff plays the role of a complementary charge. The model fulfills desirable properties of transmission pricing: the variable part of the tariff is based on nodal prices; pricing for the different cost components of transmission is such that they do not conflict with each other (fixed costs are allocated so that the variable charges are able to reflect nodal prices); variations in fixed charges over time partially counteract the variability of nodal prices giving some price insurance to the market participants.

Results

While deriving optimality conditions for the model, we consider two types of weights: chained Laspeyres weights and idealized weights. Laspeyres weights are easily calculated and have shown nice economic properties under stable cost and demand conditions[4]. Idealized weights correspond to perfectly predicted quantities and posses strong efficiency properties.[5] With idealized weights we are able to identify the conditions for marginal cost pricing. Under Laspeyres weight --and assuming that cross-derivatives have the same sign-- if goods are complements and if prices are above marginal costs, current quantities will exceed last period's quantities, which means that prices are intertemporally lowered. If goods are substitutes, we are only sure to get this effect if the cross effects are smaller than the direct effects. If prices are below marginal costs we get the opposite results. So, we get a closer approximation of prices to marginal costs unless cross effects are too large.

Regarding transmission cost functions, we argue that in a variety of circumstances they have very normal economic properties. This holds, in particular, if the topology of all nodes and links is given and only the capacity of lines can be changed. We then argue that unusually behaved cost functions require a change in the network topology.

Conclusions

This paper makes a comprehensive analysis of the topic, including institutional setups, transmission cost and demand functions, sequencing of moves, formal models as well as other considerations such as irreversible investments. It intends to be a first step in a research agenda that would evolve into various simulations and applications.

---

[4] Ramírez, J. C. and J. Rosellón (2002) "Pricing Natural Gas Distribution in Mexico," *Energy Economics*, vol. 24, no. 3, pp. 231-248.

[5] Laffont, J.J., and J. Tirole (1996) "Creating Competition Through Interconnections: Theory and Practice," *Journal of Regulatory Economics*, 10: 227-256.