Who is the good neighbour?
A simulation approach to market integration between Colombia and Ecuador

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Overview

Since the beginning of the liberalization era, the integration of electricity markets has been promoted in many regions, based on the argument that it may bring benefits in terms of security of supply and efficiency. However, little progress has been made in the last decades in most regions – with some successful exceptions such as the Nordpool – and more research is needed to find out if and when those benefits are achievable. In this sense, understanding the effects of integration on the adequacy of generation and transmission capacities is extremely important. Indeed, the liberalization of electricity markets implies the unbundling of generation and transmission activities, which creates new challenges for expansion planning: a high level of coordination is required in order to develop a system in which generation and transmission capacities are jointly optimal.

Furthermore, not only are generation and transmission investments interdependent, they are also affected by the regulatory framework. Thus, economic signals must be sent in order to coordinate both investment decisions. However, as Pérez-Arriaga and Olmos (2006) state, the interaction between transmission and generation expansion is a major unsolved problem. There is no agreement in terms of what the right policies are, how much capacity is enough to guarantee an appropriate level of reliability, and whether or not imports should be relied on.

The regulatory issue gets even more complex when we consider cross-border transmission, as different market mechanisms and incentives may be adopted in each country. In most cases, national policies are defined without taking into account the interdependencies between neighbouring countries, considering only the possibility of exporting, while being extremely cautious when considering the option of importing, which leads to overinvestment incentives. As Cepeda and Finon (2011) discuss, this lack of coordination may lead to unexpected, and probably undesirable, outcomes.

Our aim is to improve the understanding of the implications of regional electricity market integration on the long term electricity supply, and on the effect of policies aimed at guaranteeing security of supply. We develop a simulation model that allows us to analyse the evolution of two neighbouring countries under different scenarios of interconnection and different policies regarding the implementation of capacity payments. The analysis is focused on the particular case of Colombia and Ecuador, which have been trading electricity for more than a decade, and offer an interesting case study given their complementary hydropower supply. However, the model is easily adaptable to other countries by modifying the parameters (e.g. installed capacity, generation costs, etc.).

Methods

Simulation. System Dynamics.

Results

We analyse 12 scenarios considering different degrees of interconnection (Isolated, Grid Expansion and Unlimited Grid) as well as different policies regarding the implementation of capacity payments (No Capacity Payments, Capacity Payments in Both Countries, Capacity Payments only in Colombia and Capacity Payments only in Ecuador). The main conclusions are as follows:

First, the size of the interconnector plays a key role in how adequate generation capacity is achieved, since it affects both technology choice and localization of new plants, as well as the total installed capacity.

Second, the effect of policies aimed at guaranteeing a certain capacity margin, such as the implementation of capacity payments, is strongly linked to both the interconnector capacity and the policies implemented in the neighbouring country.

Third, a large interconnector capacity may result, in the absence of capacity mechanisms or state intervention, in extreme import dependency for one of the partners.

Fourth, the large difference in size between Ecuador and Colombia may result in an asymmetrical distribution of the benefits.

Conclusions

Our model helps in understanding the new challenges market coupling causes for the electricity market regulators. The analysis of the different scenarios indicates a strong interdependence between interconnector and generation investments, as well as between the generation capacities on both sides of an interconnector. Moreover, the effect of the interconnector capacity on generation investments is non-monotonic, so the outcome of market coupling may vary significantly depending on both the starting conditions in each region, and their respective policies. While integration may indeed bring benefits in terms of lower supply costs and better use of resources, these benefits are highly dependent on the degree of interconnection and differ across countries, depending among other things on their relative size.

In particular, while the impact of integration is stronger on the smaller country, objectives such as the maximization of the total social welfare tend to favour the larger country. But sacrificing one's own welfare in favour of a neighbour will not be acceptable for the smaller country. A redistribution mechanism is thus needed in order to take advantage of the opportunities of integration, while avoiding that one country loses out. However, designing a mechanism to compensate the looser, without adversely affecting market signals, is a very complex task.

In some cases there is a trade-off between lower prices and independence from the neighbouring country, which raises the question of confidence in international relations. The regulator may thus decide to implement capacity payments to guarantee a certain level of national capacity margin, but these may lead to counterintuitive and undesirable outcomes depending on the degree of interconnection as well as on the policies implemented by the neighbouring country.

Overall, a high level of coordination and political stability are required in order to achieve the potential benefits of integration for all the countries involved.

References

Cepeda, M., & Finon, D. (2011). Generation capacity adequacy in interdependent electricity markets. *Energy Policy*, *39*(6), 1–16. doi:10.1016/j.enpol.2011.02.063

Pérez-Arriaga, I. J., & Olmos, L. (2006). Compatibility of investment signals in distribution, transmission and generation. In F. Lévêque (Ed.), *Competitive Electricity Markets and Susteinability* (pp. 230–288). Edward Elgar Publishing Limited.