Introduction of Nodal Pricing into the new Mexican Electricity Market through FTR Allocations

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Executive Summary

(1) Motivation

The change from a subsidized zonal pricing system to a full nodal pricing regime in the new Mexican electricity market could improve the efficiency of electricity system operation, but resulting price modifications might also change surplus across generation plants and loads. We calculate nodal prices for the Mexican power system, and further analyze how allocations of financial transmission rights (FTRs) can be used to mitigate resulting distributional effects. Such a role for FTRs is studied as a second step of an electricity tariff subsidy reform agenda which includes, as a first step, the change to nodal pricing and, as a third, the reformulation of actual regressive subsidies in a progressive way. In this paper, we carry out the first two steps in a realistic nodal-price setting, based on an hourly modeling of the Mexican power system.

(2) Research Performed

We develop models to explore initial free allocations of FTRs after a transition to nodal pricing in Mexico. The analysis is applied to the continental system of the Mexican electricity market, which, as of 2016, is undergoing a deep reform process where the generation system is fully liberalized, an independent system operator (ISO) has been introduced, and a nodal pricing system has been set up. Simulated results for the Mexican power market are obtained, so as to quantify the distributional merits of different FTR allocation approaches. We focus on simplified FTR allocation methods that are available and implementable in practice. The logic of this paper is to first analyze the implementation of a transparent nodal pricing system, using our own models, and then study the implementation of FTRs to compensate the potential adverse distributional impacts from such a change.

The general modeling set-up relies on two models. The first model follows the idea of nodal pricing and combines the economic dispatch of power plants in the spot power market with the optimal operation of the physical transmission network. This model captures the currently adopted new market design for the Mexican electricity market. A second model assesses the allocation of FTRs to market participants, based on the results of the nodal pricing market model. The feasibility and the revenue adequacy of the FTR allocation are also checked for different initial FTR allocations. We analyze two distinct approaches for the initial allocation of FTR obligations (instead of more complex FTR options). The first approach considered uses information on installed capacities to allocate FTRs to conventional and renewable generators. The second approach distributes FTRs to generation groups following average production volumes of the different generation technologies, based on historical data.

We apply the above general modeling framework to the Mexican power system using a publicly available dataset of the Mexican power system published in the national network development plan PRODESEN. The dataset provides detailed data on transmission lines, conventional and renewable generators as well as regional load pattern and fuel prices in a reduced representation of the Mexican transmission system: 44 network nodes, 416 generation units and 61 transmission lines. It includes detailed information on technical characteristics as well as the available transmission capacity for individual links. Total generation capacity is approximately 60 GW, of which approximately 15 GW is renewable generation capacity (hydro, wind, and solar) while the rest is composed of 25 GW gas-fired, 12 GW oil-fired, 6 GW coal-based, and 1.5 GW nuclear generation capacity. The hourly electrical load

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is given on an aggregated level for the seven Mexican control regions. We consider a summer and a winter week where the summer week is characterized by high load and renewable generation, while the winter week faces low load combined with a lower availability of hydro-based generation.

(3) Results

Nodal Prices

In the summer week, average nodal prices are in the range of 47 USD/MWh but decline to 35 USD/MWh in the winter week. On a regional level, nodal prices are highest in the northern part in the summer week, which is mainly caused by limited transmission capacity to southern regions. Lowest prices are observed on the Mexican peninsula, while central Mexico shows intermediate prices. In the winter week, the regional differences mostly vanish and nodal prices are on a comparable level in all regions.

Surplus

We analyze in the distribution of surplus among demand, conventional generation, renewable generation and the transmission system operator. The surplus of these market participants is defined as the sum of the product of nodal prices and nodal generation or demand volume minus nodal generation costs or demand expenditures, respectively. For renewable generation, generation costs are set to zero. The congestion rent is calculated as the product of nodal price differences and the transmission flows. Congestion rent amounts to approximately USD 7 million in the winter week due to a lower level of congestion; it nearly doubles to approximately USD 13 million in summer week. Congestion rent is of particular interest as it can be redistributed to the different market participants through FTRs.

FTR allocations

Our results point out that the two FTR allocations methods explored – volume-based and capacity-based – are actually able to initiate a redistribution of congestion rents to market participants so as to mitigate distributional effects. The two allocation approaches primarily differ in their distribution of FTRs among the two generation groups, conventional and renewable generation, whereas the distribution of FTRs among regional demand remains unchanged. In the summer week, the volume-based approach allows for greater amounts of FTRs and, likewise, the absolute change between the two generation groups is affected. In the capacity-based approach, all existing generation units receive FTRs. By contrast, in the volume-based approach, FTRs are granted to plants that are operating according to their average utilization. This impacts dispatchable conventional generation as some generation units are not operating and, consequently, are not included in the FTR allocation. This also results in higher amounts of FTRs allocated to renewable generation, and a reduction of FTR payments to conventional generators in the volume-based approach in the summer week.

(4) Policy Implications

Our study makes clear that transition to a new subsidy scheme in Mexico requires financial hedging that will make implementation of nodal prices feasible, especially in the context of integrating renewable energy. Namely, legacy, or grandfathered, FTRs must meet several goals, such as congestion management, definition of property rights for network investment, adequate hedging against price fluctuation, efficient redistribution of congestion rents, as well as laying the foundation for the subsequent redesign of lump sum progressive subsidies. Institutional barriers to achieving this last goal remain, though, since energy subsidies in Mexico are not handled either by the regulator (CRE), the ISO (CENACE) nor the energy ministry (SENER), but by the finance ministry (HACIENDA), which of course has distributive goals beyond the electricity sector.