ANALYSIS OF MARKET POWER POTENTIAL IN THE ELECTRICITY CONTRACT MARKET: A CASE STUDY OF THE PERUVIAN ELECTRICITY MARKET

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Overview

Electricity markets are highly dynamic due to the simultaneous interaction of endogenous and exogenous factors within the sector. As a result, the price signal provided by the system may exhibit significant volatility, a characteristic typically viewed as a source of risk for market participants. In this context, one of the tools that emerge to mitigate risk is contracts, which allow agents to limit their exposure to spot market variability and stabilize long-term financial cashflows, thus enabling risk-sharing among different agents and facilitating investment decisions, such as in new generating plants or the installation or expansion of large consumer loads.

However, despite presenting notable benefits, the use of long-term contracts may also have potentially negative effects that must be addressed properly. Among such effects, one of the most significant is the potential reduction of competitiveness due to the capture of the consumer market by incumbent generators, given the reduction in market size for new competitors over considerable periods, a phenomenon known as the lock-in effect. Furthermore, the decrease in available supply for other consumers, associated with the obligation to contract due to eventual regulatory framework impositions, may favor incumbent generators in exercising market power, a phenomenon known as buyer-to-buyer externality. Finally, since contracts are often used as a tool to ensure systemic reliability by different regulators, especially in the Latin American context, regulations established in a different paradigm but still in force may have the opposite effect, inhibiting the entry of new competitors into the market and encouraging concentration among existing generators. In [1], the Peruvian regulatory framework is specifically analyzed, raising the possibility that its current state may facilitate the use of market power by the largest generators in the system.

In this context, this work seeks to quantitatively analyze the interactions between multiple agents in a Wholesale Electricity Contract Market, with a special focus on the analysis and quantification of the potential Market Power exercised by the agents. The impact of different regulatory frameworks applied to wholesale electricity systems is analyzed, quantifying their impacts on the mitigation or intensification of market power. As a case study, the proposed model is applied to the Peruvian Market, studying the impact of different regulatory measures on contract equilibrium and market concentration, such as (i) the obligation to back up consumer consumption in long-term contracts, (ii) the level of exposure allowed to the spot market, and (iii) separate or joint contracting of energy and capacity products. To this end, an optimization model is proposed, that determines based on market equilibrium principles, the prices and quantities negotiated in contracts between generators and consumers. The optimization model takes into account the inherent uncertainties of energy markets, such as those related to hourly renewable generation and hydraulic inflows. Finally, the impact of transaction costs on market equilibrium is analyzed by introducing a friction factor into the optimization model.

Methods

In order to quantify such issues, allowing to investigate the current market condition in the face of different regulatory realities, a model is proposed that, based on historical data from the Peruvian electrical system and from results obtained by the dispatch simulation model, seeks to represent the market equilibrium that would result from bilateral negotiations between agents trading available contracts in order to acquire a portfolio of contracts that is more suitable to their assets and preferences. The proposed methodology incorporates issues such as the spatial distribution of generators and consumers, supply restrictions imposed by regulation, such as maximum exposure in the spot market, generator portfolios, and agents' risk aversion, based on the representation of preferences based on conditional value at risk (CVaR). Additionally, the model also takes into account potential frictions in the Peruvian contract market that may impact agents' ability to mitigate their market exposure, related to intermediation costs and/or liquidity.

Although in the current Peruvian paradigm contracts are typically associated with load profiles and in the form of a "package" consisting of power capacity and associated energy products, the proposed model allows for the representation of different profiles at an hourly level and multi-product or single-product contracts, thus allowing the analysis of the impact of innovations to the current Contract Market. Finally, the model allows for the assessment of different regulatory policies that have the potential to impact market equilibrium, such as the consideration of regulated capacity prices and the consideration of energy and firm capacity constraints. The objective function of the proposed model seeks to maximize the sum of the utilities of the system agents, being an extension of the formulation presented in [2] and [3].

Inputs for the contract market optimization model include the results from a computational tool for stochastic optimization that utilizes mixed-integer linear programming to determine the least-cost investment schedule for the construction of new power generation or natural gas facilities and new circuits for the transmission network, calculating the tradeoff between investment costs for new projects and the expected value of system operation costs. The operation simulation is conducted considering detailed representations of the generation fleet, such as thermal commitment constraints, and the detailed operation of hydroelectric plants on an individual approach. Both the

operation and simulation stages are performed with hourly discretization of demand and renewable generation, taking into account potential network constraints and nodal marginal costs.

Results

Based on the detailed methodology outlined previously, it was possible to analyze the influence of the current regulatory framework on the contract market equilibrium, highlighting the degree of market power potentially exercised by the incumbent generators. Due to the current requirement for distributors to back their consumption with long-term contracts, associated with limits on trading imposed on generators in terms of firm capacity, a market concentration is observed among incumbent generators with a more diversified portfolio, especially those with a surplus of firm capacity in their portfolio. Additionally, there is considerable sensitivity of the current market equilibrium to the risk aversion of generators with more diversified portfolios, a factor that leads to a decrease in system utility and highlights a dangerous potential of market power in the current system.

As mitigation measures, it is noted that reducing the mandatory degree of contracting by distributors in long-term contracts has limited potential, although it is meritorious. Similarly, it is observed that increasing the possibility of exposure to the spot market, currently limited to 10% for only certain market agents, allows for a reduction in the market power of incumbent generators with larger portfolios, especially in shorter-term contracts.

Finally, structural measures such as separating energy and capacity products, introducing hourly energy blocks, and considering contracts with different profiles have significant potential to reduce market power and especially the current barriers to entry for new generators companies and even existing ones. In the cases analyzed, there is a potential reduction in revenue for generators with large portfolios of nearly 10%. On the other hand, current generators with few assets benefit from increased competition, increasing their revenues by almost 15%. Regarding demand, there is a potential cost reduction of almost 5%, especially in more extreme scenarios.

Finally, measures related to wholesale market management are also analyzed. It is noted that an increase in the market friction factor (which may represent administrative transaction costs related to commercial management) may result in a reduction in observed utility, especially for consumers. This fact is even more relevant considering the current proposals under discussion for greater liberalization of the Peruvian electricity sector, including the inclusion of new categories of consumers in the free market.

Conclusions

This study aimed to quantify the impacts of Market Power on the equilibrium of the Peruvian Contract Market, using an optimization model developed by the authors. Additionally, it analyzed the impact of different regulatory measures in mitigating Market Power and encouraging the entry of new competitors.

It can be concluded that the regulatory measures currently in place in the Peruvian Framework, although initially developed as measures to protect regulated users and as a tool for systemic reliability, have the counterpart of incentivizing market concentration, presenting a high barrier to entry for new competitors. It was observed that easily implementable regulatory measures, such as increasing the possibility of exposure to the Spot Market, help mitigate the Market Power presented, although they do not solve the problem structurally.

On the other hand, as measures with the potential to increase competitiveness structurally, allowing the separation energy and capacity products for new contracts and the implementation of hourly energy blocks stand out, allowing for greater competition, especially with the entry of new renewable generators.

References

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