

What Shapes Regulated Electricity Contract Prices in a Hydro-Thermal Power System? Evidence from Colombia Using Quantile Regression and Autoencoders

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Abstract-

This study examines the determinants of regulated electricity contract prices in Colombia during the period 2009–2021, with a particular focus on the role of electricity-market fundamentals and macroeconomic conditions. Although regulated contracts are designed to reduce exposure to short-term volatility, limited evidence exists on how their price formation behaves across different segments of the distribution. To address this issue, the analysis combines quantile regression with autoencoder-based dimensionality reduction, allowing the incorporation of a large set of macroeconomic variables without overparameterizing the model. The results show that regulated contract prices are more consistently associated with electricity-system factors than with broad macroeconomic conditions. In particular, the spot price becomes significant only in the upper quantiles, where it appears to operate as an indicator of operational stress, while hydropower and thermal generation exhibit localized effects across the distribution. By contrast, most macroeconomic factors display weak, uneven, or non-significant effects, with only the exchange-rate-related component becoming clearly relevant at relatively high price levels. A robustness analysis based on principal component analysis broadly supports these patterns. Overall, the evidence suggests that the Colombian regulated market behaves as a relatively stable contractual system, in which price formation is shaped mainly by electricity-sector conditions, indexation rules, and long-term risk-management mechanisms, while macroeconomic influences appear more limited and non-uniform across quantiles.

Index Terms- regulated contracts; electricity prices; quantile regression; autoencoders; Colombia

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