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Navigating Uncertainty: Renewable Bidding and Price Premia in Sequential Electricity Markets

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Sequential wholesale electricity markets are designed to enhance allocative efficiency by allowing market participants to adjust positions as information unfolds over time. In theory, prices across these sequential stages, e.g., the Day-Ahead and Intraday markets, should converge in expectation. Empirically, however, systematic price premia persist, and in high-renewable systems such as Germany these premia exhibit a pronounced and highly regular diurnal pattern. Existing explanations emphasize market power, liquidity frictions, or aggregate risk aversion, but largely abstract from heterogeneous bidding behavior of renewable producers under uncertainty. In particular, they remain silent on why price premia change sign over the course of the day.

This paper develops a micro-founded analytical framework that links renewable producers'bidding rationales to expected price premia between the Day-Ahead and Intraday markets in a perfectly competitive setting. I model a simplified two-stage market with inelastic demand and a strictly convex marginal cost curve, in which renewable producers choose Day-Ahead positions under three alternative bidding rationales: bidding expected production, risk-neutral profit maximization, and risk-averse bidding that accounts for tail risk arising from asymmetric price responses to forecast errors. Closed-form expressions are derived for optimal bids and the resulting expected price premia. The framework is extended to allow for heterogeneous bidding behavior across renewable technologies. The model is parameterized using German market data from 2024–2025, including hourly demand and renewable forecasts, forecast uncertainty, and empirically derived measures of hourly supply curve convexity based on transformed Day-Ahead bid curves.

The results show that risk-neutral bidding implies price convergence in expectation, while bidding expected production generates systematically negative premia that increase with forecast uncertainty and supply curve convexity. Risk-averse bidding, by contrast, induces positive premia in hours characterized by high convexity and uncertainty. When allowing for heterogeneous bidding rationales across technologies—specifically, photovoltaic producers bidding expected production and wind producers bidding risk-aversely—the model reproduces the full diurnal structure observed in German market data: negative premia around midday and positive premia during morning and evening hours. These findings suggest that technology-specific risk exposure and bidding behavior of renewable producers constitute a key structural driver of systematic price premia in sequential electricity markets.

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