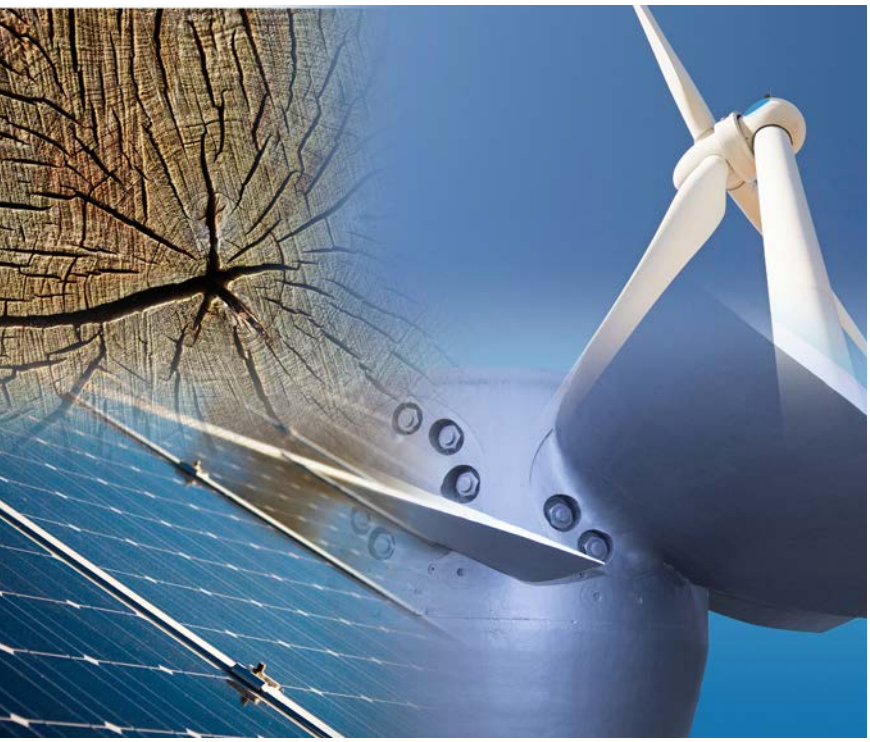
Understanding Competition among Renewables

Natalia Fabra and Gerard Llobet



How would electricity producers compete in a 100% renewables market? Would they be willing to sell their electricity for free given that their marginal costs of production are essentially zero? These are the questions that Natalia Fabra and Gerard Llobet address in their paper "Auctions with Unknown Capacities: Understanding Competition among Renewables."

The shift from fossil fuels to renewable resources – in particular, for the production of electricity – is a key step in the energy transition that most countries are undertaking to mitigate the effects of climate change. From a policy perspective, **it is crucial to understand how competition will play out in these markets, whether firms' incentives to invest in additional capacity will be adequate and, as a result, what kind of regulation will these markets require.** These are the issues that Natalia Fabra and Gerard Llobet investigate in their most recent research.

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Natalia and Gerard point out that the shift from fossil fuels to renewable resources will change the competitive paradigm in electricity markets. Unlike fossil fuels, the marginal costs of renewables are known. However, for most renewable technologies (e.g. wind or solar energy), the available capacity of each plant changes over time in ways that are difficult to predict. Natalia and Gerard provide compelling evidence showing that this uncertainty contains a private information component, i.e., firms have more information about their own availability than what their competitors can muster using public data. The contrast with conventional power plants – whose capacity is known (except for the rare outages) while their marginal costs remain private information – implies that the nature of competition in future, renewables-based markets, will likely depart from competition in current, fossil-fuel based, electricity markets.

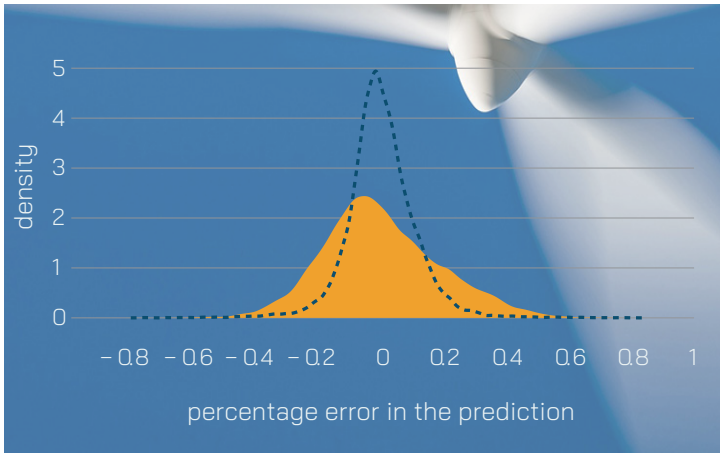
To characterize this new competitive paradigm, Natalia and Gerard build a model in which energy producers have private information about their available capacity. Firms are allowed to choose not only the price at which they are will-

ing to offer their output, but also how much output they want to offer (as long as they have enough available capacity to produce it). The model thus combines features of Bertrand and Cournot competition models, which have traditionally been used to analyze competition in this and other markets. Interestingly, they show that the equilibrium outcome that emerges very much depends on each firm's installed capacity relative to demand. If the installed capacity is low, firms choose to compete in prices and offer all their available capacity (acting like Bertrand competitors). Instead, when the installed capacity is high, firms find it optimal to withhold part of it (acting like Cournot competitors).

Strategic bidding implies that, even if firms have enough capacity to cover total demand at zero marginal costs, electricity will not be sold for free. The resulting price will depend on the available renewable capacity relative to demand, as well as on the distribution of that capacity across firms. **Prices will be lower in less concentrated markets at times when renewable availability is high**, but could well increase up to the marginal costs of fossil fuels when renewable availability is weak. Hence, market power – together with the inherent intermittency of renewable power sources – will give rise to price dispersion. Only when the total investment in capacity is enough will electricity market prices convergence towards (zero) marginal costs.

To understand the consequences of available capacities being privately known, Natalia and Gerard compare the model's results to cases in which capacities are purely uncertain (i.e., without private information) and cases in which capacities are known to all firms. The results show that the uncertainty in the availability of renewable energy mitigates market power as compared to when capacities are known (e.g., as it is the case of conventional technologies). However, the presence of private information leads to less competitive outcomes as compared to when capacity is purely uncertain.

Figure: Percentage error in the day-ahead prediction of the production for a sample of Spanish wind farms. The solid line is based only on public information. The dashed line also includes firm-specific information.



Although their model is motivated by the future performance of electricity markets, it can well be applied to many other contexts where firms face uncertainty about the supply of their rivals or where buyers are not well informed about the demand of other competing buyers. For example, online travel agents might not know the available rooms of a rival agency in a city, banks participating in treasury bill auctions might not know the hedging needs of their rivals, or buyers of emission permits might be unaware of the expected production of other firms. In all these contexts, just as in electricity markets, understanding how private information on capacities impacts competition is key to any discussion aimed at analyzing their performance ·

Prices will be lower in less concentrated markets at times when renewable availability is high

Further reading

Fabra, N. and Llobet, G. (2020) "Auctions with unknown capacities: Understanding competition among renewables" available here.