The Impact of Intermittent Power Generation on the Wholesale Electricity Prices of the MIBEL Iberian Market

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Executive Summary

1. Motivations underlying the research

Intermittent renewable energy sources, such as wind, solar photovoltaic, or wave energy, are becoming a mainstream electricity generation option. If current targets of international agreements on climate change are met, many countries in the world will achieve high penetration of these power sources in the coming decades. In fact, several countries are trying to accelerate this shift towards generation of intermittent renewable energy, giving further importance to the question of how these changes will weigh on the costs of the electricity system.

Intermittent renewable energy sources () demonstrate the ability to generate significant quantities of electricity at low marginal costs. Their reduced marginal costs are expected to have a short-term negative impact on wholesale electricity prices, owing to their capacity to displace other technologies featuring higher marginal costs. Our research deals with this aspect by evaluating the sensitivity of wholesale electricity prices to the supply of . Moreover, this research also ascertains whether (and why) this sensitivity varies significantly within the set of available technologies.

Another common feature of these power sources is the fact that they generate variable and unpredictable quantities of electricity over time. Consequently, greater penetration could increase price volatility and cause the frequent occurrence of extremely low prices, thereby hampering profit margins of conventional power plants that operate at low variable costs and that cannot be switched on and off. Moreover, further back-up capacity could be required to cope with the variability and unpredictability of production to ensure the stability of the power grid.

By impacting the generation mix of the power grid towards flexible (and more expensive) conventional power sources, the impact of on electricity prices is more uncertain in the long-term than in the short term. In addition, increasing investment in installed capacity may result in diminishing marginal returns as the share of renewables rises above a certain threshold. This study advances current knowledge on this issue by investigating the long-term dynamics of the sensitivity of prices to the output generated by , which is relevant for evaluating the point at which net gains turn negative.

Finally, this research also explores the potential benefits arising from market coupling. It adds to the debate on this issue by empirically assessing the impact of coupling on the sensitivity of prices to the output generated by . Coupling with adjacent markets may help reduce price volatility stemming from variable and unpredictable weather conditions that affect the supply of . As electricity storage faces technical restrictions and high costs, inter-temporal arbitrage is not feasible. However, coupling with adjacent markets permits carrying out spatial arbitrage in different zones and promotes risk sharing. By addressing this topic, this study contributes towards a better understanding of the impact of integration on energy markets.

2. A short account of the research performed

This study addresses the effect of on the dynamics of electricity prices using empirical data from the Iberian (Portugal and Spain) market for the period 2010-2015. The first research question explores the presence of the merit-order effect in the Iberian market, i.e. a negative sensitivity of wholesale electricity prices to the output generated by . By means of regression analysis, the (semi-)elasticity of prices to (the penetration ratio of) supply is estimated. The findings confirm the presence of a merit-order effect in that generation brings prices downward (on average, +1% increase in supply cuts the price by roughly -0.5%). This result is consistent

with the notion that by displacing more expensive non-renewable technologies from the wholesale market, supply cuts electricity prices.

Using a similar econometric setting, it is also examined whether wind and solar photovoltaic power technologies produce effects of different magnitudes on prices. Notably, wind power produces a greater impact on price vis-à-vis solar photovoltaic. Wind power supply benefits from greater correlation effects with the demand than solar photovoltaic power supply. Consequently, wind supply could be used more effectively as a hedging tool for demand variation, thereby bringing about greater gains.

The second research question asks whether the sensitivity of prices to supply has fallen over time. The long time span available from our sample enables the examination of the pattern of the (semi-)elasticity of prices to supply (penetration ratio) over time in a period marked by a sharp increase in installed capacity (in Spain, between 2010 and 2013, the installed capacity of wind and solar photovoltaic sources augmented 17% and 21%, respectively). Our findings show that the (semi-)elasticity varied considerably during the six-year span. However, the path of that measure is not signaling a declining sensitivity of prices to supply. Since the supply of these sources is positively correlated with demand, there are hedge effects that constitute a positive externality from the expansion of installed capacity. Together, these results reveal that potential downside effects of the expansion of are still contained, at least when considering an average penetration ratio close to 30%.

Finally, an evaluation was made of the effects of a coupling agreement with France (applicable after May 14, 2014) on the semi-elasticity of prices to the penetration ratio of . The results demonstrate that from that date forward, semi-elasticity dropped considerably. By reducing the sensitivity of prices to changing weather conditions, market coupling added efficiency to the allocation of resources and improved risk sharing.

3. Main conclusions and policy implications of the work

This study addresses the effect of generation on the dynamics of electricity prices in the Iberian market during the period 2010-2015. The findings indicate that output has a material negative effect on electricity price. Still, that effect varies with the technology employed: wind power produces a greater impact on price vis-à-vis solar photovoltaic energy. In view of this result, policy makers and the industry could consider the correlation of each technology with the demand when deciding new investments in installed capacity and defining the target for the generation mix of the power grid.

Notably, there is no evidence that the impact of these sources on price has been declining over time. In other words, no evidence was found to indicate that penetration reached a saturation point where benefits are surpassed by costs. This could be a relevant indicator for energy producers to (still) consider the expansion of in the near future.

Finally, market coupling weighs (negatively) on the elasticity of price to supply. This result is consistent with the notion that further market integration improves risk sharing and resource allocation, so that policy makers could encourage integration of regional electricity markets in order to maximize benefits from further penetration of .

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