THE EFFECTS OF RES IN THE ITALIAN ELECTRICITY MARKETS

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Overview

We aim at investigating the effect of RES generation on Italian wholesale electricity prices, looking at both the spot and regulation markets. We follow Skytte (1999) who first conducted a joint analysis of day-ahead prices and regulation power using data from the Oslo area, in Norway. The idea of this paper is to extend his contribution to a more general setting in which electricity is exchanged in day-ahead, intraday and regulation markets. We expect that the high RES penetration into electricity markets may have influenced both premia for readiness and the cost of regulation. Specifically, we consider the Italian market, IPEX, where the intermittent generation has substantially increased over the last years. Indeed, we study the dynamics of prices from 2012 to end of 2014 looking at the Italian physical zones where most of renewable generation is placed, namely in North, where hydro plants are located, South and Sicily, which are characterized by a high share of wind and photovoltaic generation. After selecting hours on the basis of intra--daily profiles for load, wind and solar generation, we determine the relationship between spot and regulation prices, providing implications on the premia for readiness and cost for regulation occurring into Italian zones.

Methods

We model the relationship between prices determined on day-ahead, intraday and regulation markets. The regulating power markets play an important role in controlling the balance between supply and demand. Indeed, if less power is delivered (or if an excess demand has occurred), then the suppliers have to pay for up-regulating power in order to be able to fulfil the agreements on the spot market, whereas other suppliers get paid to deliver the lack of supply (or, equivalently, some buyers are paid to reduce their demand). On the contrary, if there exists an excess of supply (or less power is used than agreed), then the down-regulation takes place to ensure the right balance into the system. According with thisese observations we expect that: 1) the regulating power price should follow the spot price; 2) the difference between the spot and regulating power prices should depend on the amount of regulation; 3) the regulating power prices may behave differently to up- or down-regulation; 4) the spot prices can be affected differently. Hence, the model can be formulated as follows:

$$P_t = \alpha S_{t-1} + I_{Q_{t-1}<D_t}[\beta S_{t-1} + \gamma(Q_{t-1} - D_t) + \eta] + I_{Q_{t-1}>D_t}[\beta' S_{t-1} + \gamma'(Q_{t-1} - D_t) + \eta']$$

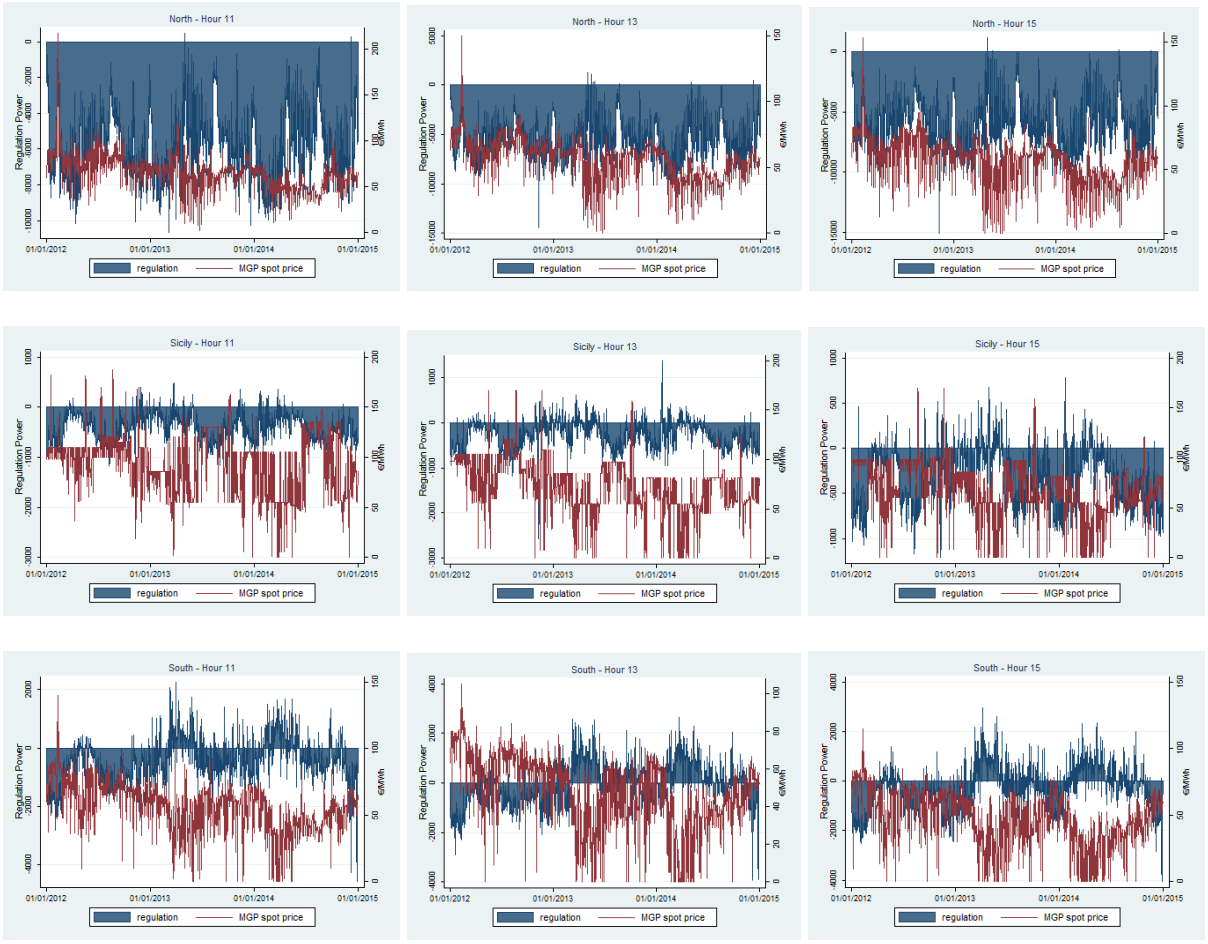
where P_t is the regulation price, S_{t-1} is the spot price determined on the day--ahead market, and Q_{t-1} is the awarded quantity to be sold on the spot market; whereas D_t is the actual delivery. The difference $(Q_{t-1} - D_t) = QR_t$ is the regulating power, which can be positive or negative: there is an excess demand for power when $Q_{t-1} < D_t$, and the indicator function I is equal to one and zero otherwise and there is an excess supply in the reverse case. Moreover, the regulating power price equals the spot price if there is no need for regulation. The coefficients γ and γ' represent the marginal regulating power prices per unit of regulated power, whereas the other coefficients, β and η as well as β' and η', are independent of the amount of regulation and are used to determine the premium of readiness paid to the suppliers of regulation services, given their availability to ensure the system balance and their ability to react with a short notice. It is natural that these compensations depend on the spot price levels and that their amounts are different across the situations of excess demand or excess supply, formally:

$$PR_t^- = I_{Q_{t-1}<D_t}[\beta S_{t-1} + \eta]$$
$$PR_t^+ = I_{Q_{t-1}>D_t}[\beta' S_{t-1} + \eta']$$

Results

We found that the regulation price is always positively related to spot prices in all considered zones and hours, and in both cases of up- and down- regulation with different magnitudes. Secondly, the global effects of spot prices on regulation prices depend on the status of excess demand or excess supply, namely, if there is excess demand in North the effects of spot prices on regulation prices are €0.145/MWh in hour 3, 0.093 in hour 13, and 0.045 in hour 15. If we move to South, we observe that up- or down- regulation is never found significant in terms of prices and quantities and indeed, we have observed bids on MB only for hours 20 to 24. In Sicily, spot

prices affect regulation prices almost similarly in case of excess demand (or excess of supply, in brackets): for €0.097/MWh (0.016) in hour 3, 0.297 (0.021) in hour 13, and 0.238 (0.212) in hour 15. Finally, the amount of regulation plays a very low effect on regulation prices since it ranges among 0.1% and 2.8%, when significant. Finally, the constants η and η' are significant and very large, hence affecting the premia of readiness paid to the suppliers of regulation services independently from the amount of regulation.



Conclusions

Our results confirm the expectation on regulating power prices following spot prices, and in some cases, being the former ones amplified by two or three times the latter ones. Contrary to our expectations, we generally observe that the amount of regulation does not clearly affect regulating power prices, even if they actually behave differently to up- and down-regulation. In addition, we find an important empirical evidence on premia for readiness. It is very interesting to note that these premia are very large considering the effect of financial crisis, and compared to those found by Skytte (1999). This may indicate that operators are finding into the regulation markets higher profits that compensate their lower earnings realized on MGP as consequence of the increasing share of production by RES. On the contrary, the limited number of market participants acting on the regulation markets gives the opportunity to exercise here the market power no longer executable on the spot market.

References

Skytte K., (1999), The regulating power market on the Nordic power ex-change Nord Pool: an econometric analysis, *Energy Economics*, 21, 295-308.