

When Renewables Meet Market Power

The Persistence of High Prices in Italy

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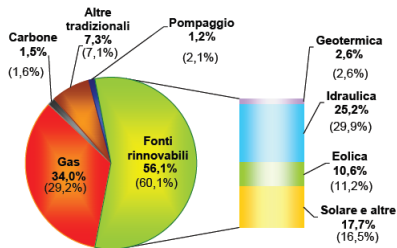
November 22, 2025

- Italy has had a significant penetration of renewable generation technology with lower marginal costs of production.
- More than 40% of electricity produced by RES: solar (9%), wind (10%), hydroelectric (12%), [2023]
- Yet wholesale electricity prices remained high.
- We turn to study the link between Competitiveness and Market Structure

Current Situation: April 2025

Grafico 4: MGP, struttura delle vendite Sistema Italia

Fonte: GME



Tra parentesi sono indicati i valori dell'anno precedente.

Grafico 5: MGP, quota rinnovabili

Fonte: GME

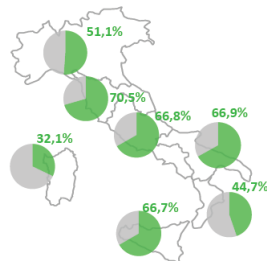
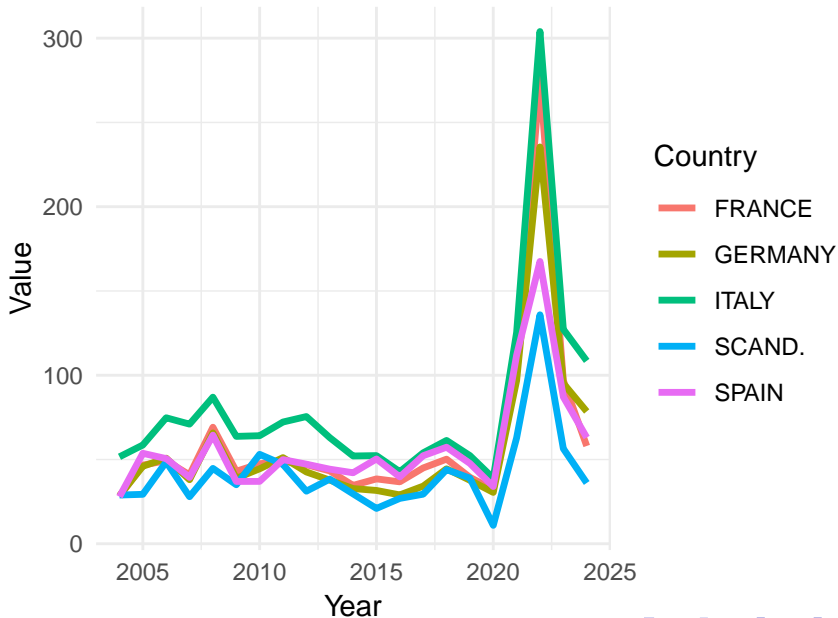


Figure: GME Newsletter April 2025

Average Price



What Game Are You Playing At?

The Day-Ahead-Market is organized as a uniform-price auction. However there are **small and BIG** players... so: consider the **bids**

- Which plants are more likely to **make** the price? How many are they?
- How has the sensitivity to natural gas changed over **time** (also due to wars, geopolitical frictions, Covid19)
- Are **RES** (not gas or coal) able to **make** the price? How do they behave?
- What is the impact of RES and Bilateral Contracts on bids?

Insights from the Theory: Hypothesis

We build a model with two firms $k = i, j$ competing in an **auction** where

- **Demand** Q is known and inelastic.
- **Firms** are **symmetric** and both have **base load** E and a **peak load** q generation.
- **Costs:** While E is produced at 0 marginal cost, the marginal cost for q is c_k , which is privately known, and distributed according to $F(c_k)$.
- **High Demand:** Both firms are sure to be dispatched $Q \geq 2E + q$.

- **Uniform Price Auction:** In equilibrium, firms bid 0 for supplying E , while they bid $b_k^* = \beta^u(c_k)$ for q .
- **Pay-as-Bid Auction:** In equilibrium, the supply schedule of both firms is flat, i.e. they bid both lots at the same $b_k^* = \beta^d(c_k)$
- Bilateral Contracts ($Q - BC$) and Renewable Energy production (E) reduce the equilibrium bids.

Wholesale Day-Ahead Market: 24 separate hourly markets, run with a uniform auction mechanism, bids are ranked according to Merit Order (MO), and solar and wind bid a zero price. We use PU-level (production unit) data of bids from 2015 to 2023. We restrict the analysis to 4 hourly markets:

H03 night-time, low demand, low competition

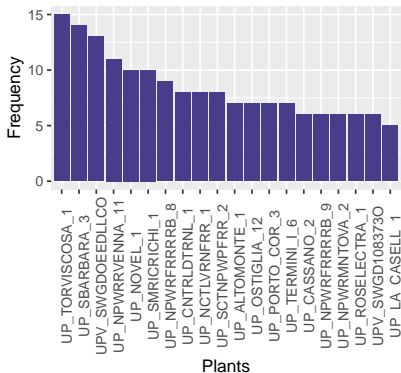
H09 morning peak, high demand

H13 mid/low demand, peak for solar generation

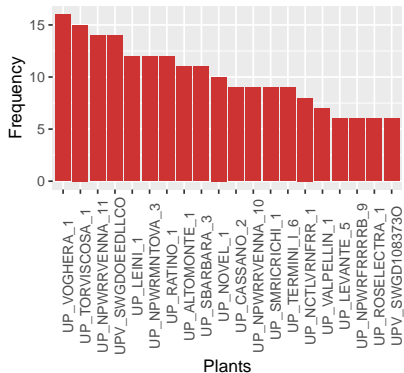
H20 evening peak, high demand, less solar

National market splits into Zonal Markets: we consider the largest zone, i.e. the one the NORTH zone is grouped with.

Identification of the Pivotal Group

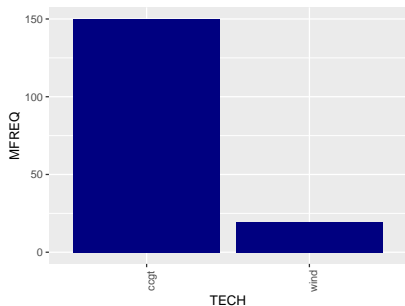


(a) Top20 most marginal plants H13 for 2023.

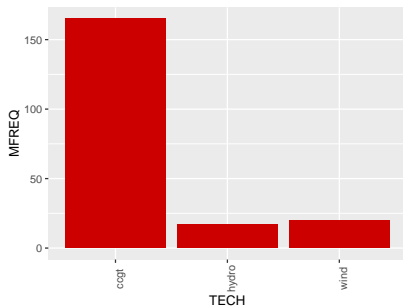


(b) Top20 most marginal plants H03 for 2023.

... and Pivotal Technology



(a) Top20 most marginal plants H13 for 2023.



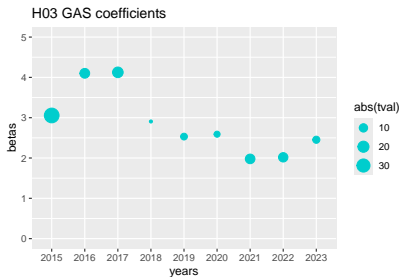
(b) Top20 most marginal plants H03 for 2023.

$$b_{it} = \beta_0 + \beta_1 QB0_t + \beta_2 QBIL_t + \sum_y \beta_3^y 1[t \in y] GAS_t + \beta_4 ETS_t + \sum_j f_j 1[i \in F_j] + \epsilon_{it}$$

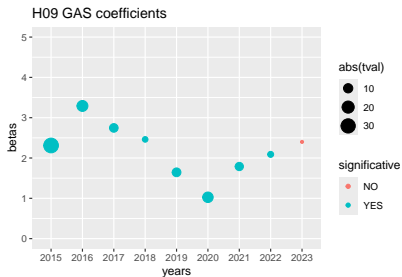
Where:

- b_{it} the bid of plant i at time (aka day) t
- $QB0_t$ the total daily quantity bid on the market at 0 price
- $QBIL$ total daily quantity supplied by bilateral contracts
- GAS_t the daily price of natural gas
- ETS_t the daily price of carbon emission
- f_j fixed effects for Producers
- $1[x \in X]$ is the indicator function.

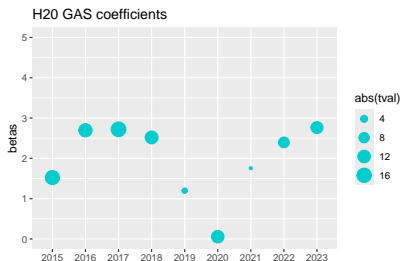
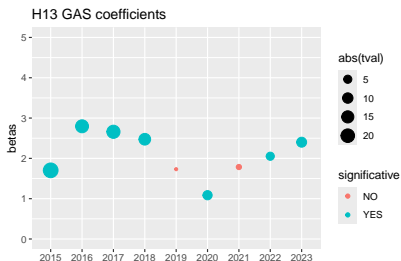
Results # 1: Time-Varying Gas coefficients



(a) H03



(b) H09



Results # 2: What Actually Matters

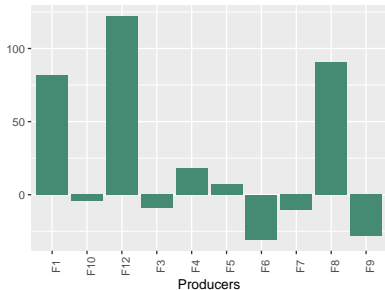
Adjusted R Square values for different models (on CCGT units)

	GAS	GAS+ETS	GAS+ETS+QB0+QBIL	complete
H03	0.5437	0.5444	0.5447	0.5448
H09	0.6710	0.6710	0.6714	0.6719
H13	0.5981	0.5981	0.5987	0.5990
H20	0.5853	0.5853	0.5860	0.5865

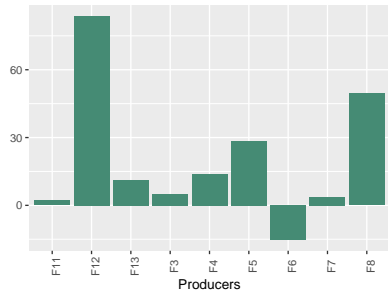
- QB0 consistently not significant for every hour
- QBIL significant but very small and negligible

Results # 3: Fixed Effects for Producers

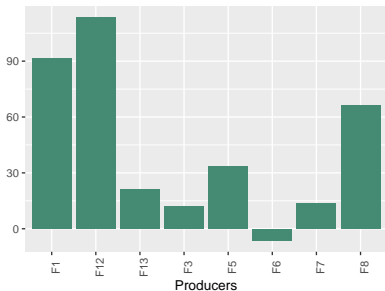
FE H03



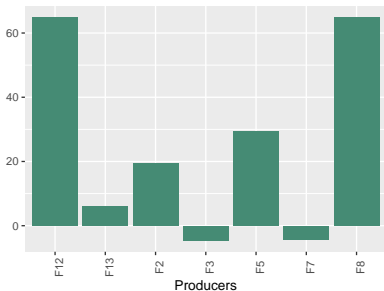
FE H09



FE H13



FE H20



Results # 4: Hydroelectric Plants bid Strategically

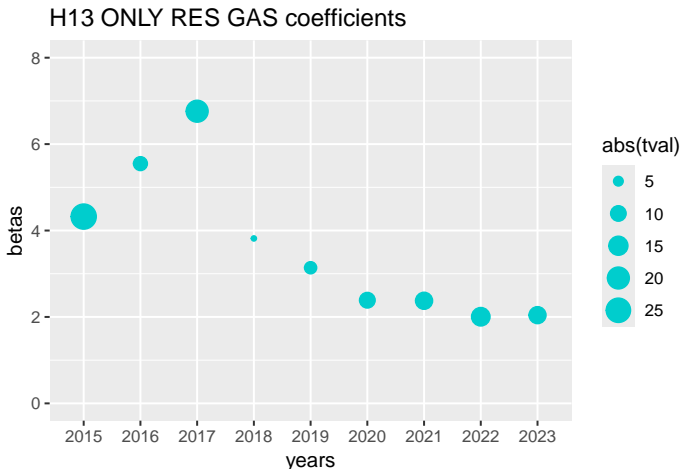


Figure: Coeff of natural gas for hydro plants H13.

Results # 4: RES bids are strategic

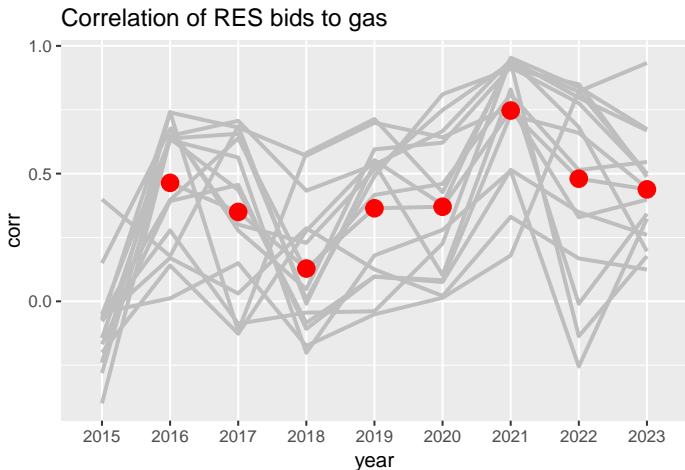
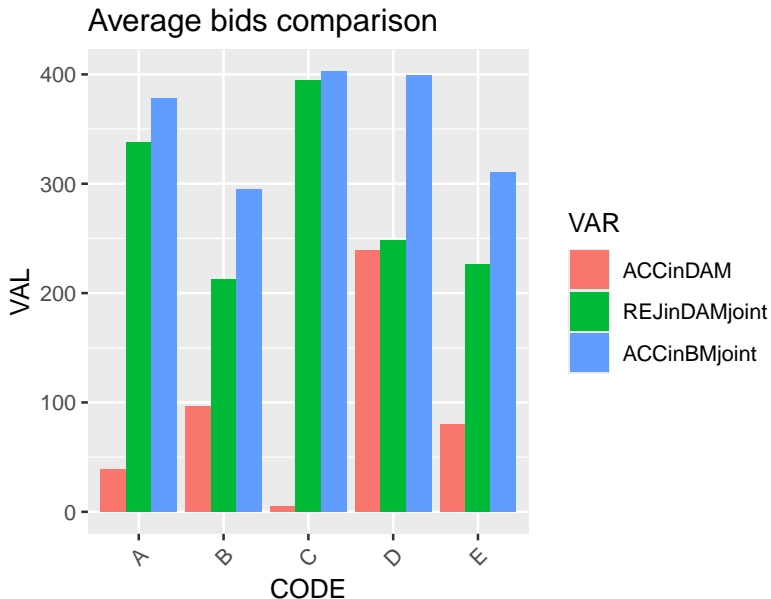


Figure: Correlation of bids to gas price H13.

Market Jumping: from DAM to BM



To Sum Up

- Existence of a Pivotal Group
- Natural Gas still dominates the Price-Making
- Hydro plants (RES) bid strategically
- Gas prices are a common signal to coordinate prices and hinder competition
- The massive introduction of RES and Bilateral contracts does not seem to have altered the supply strategy of the pivotal producer

Further Research

- Extending the analysis to the Balancing Market
- Examine the intra-market pricing strategy