

2nd Conference on Applied Macroeconomics

Power Play

How Structural Shocks Drive European Electricity Markets

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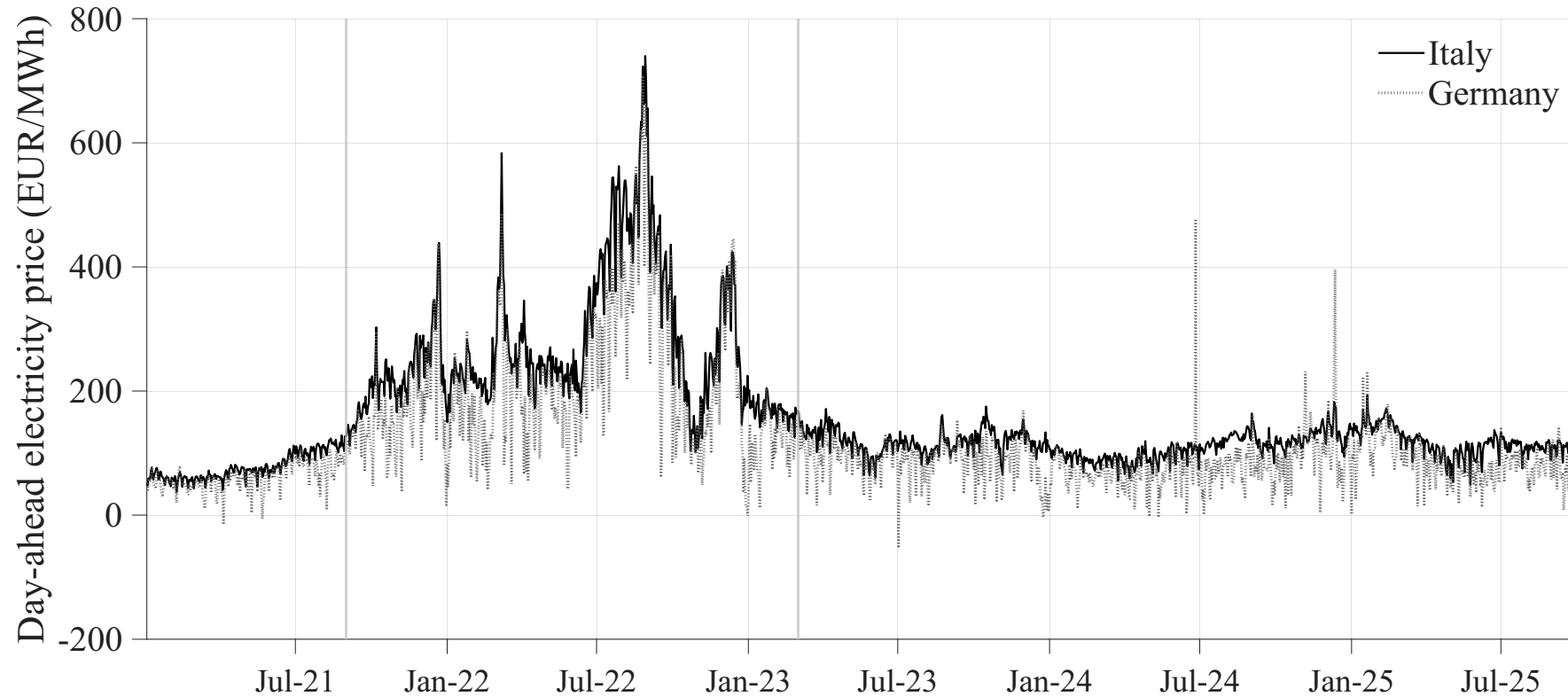
BI Norwegian Business School

Banca d'Italia, Rome

8–9 October 2026

The energy crisis and its aftermath

Surging electricity prices during the energy crisis before reverting to lower levels.



Vertical lines : 1 September 2021 and 2 March 2023 (**energy crisis**). Sample ends on 1 October 2025.

Daily-average spot electricity prices.

Electricity-price formation: evidence and policy debate

- **Fossil-fuel exposure.** Gas can set electricity prices much more often than its generation share would suggest.

Zakeri et al. (2023).

- **Renewable generation.** Wind and solar can lower wholesale prices, while their variability increases the importance of dispatchable generation and system flexibility.

Paschen (2016), Joskow (2019).

- **Electricity-market conditions.** Market rules and bidding incentives also influence electricity-price formation. Cross-border transmission and constraints can amplify the effects of local shocks.

Fabra (2023), Cevik and Zao (2025), Decarolis (2026).

- **Economic activity.** Energy-price increases can affect inflation and economic activity, while higher costs, uncertainty and financing constraints can reduce investment.

Neri (2025), Anaya Longaric et al. (2025).

Research questions

The appropriate policy response depends on the sources of electricity-price variation and on how persistent their effects are.

1. Which shocks drive day-ahead electricity prices in Germany and Italy, and how does their importance change after the crisis?
2. How do electricity prices respond to these shocks during and after the crisis?
3. Which shocks explain the 2022 price surge and the subsequent decline?

We consider a daily SVAR model with renewable generation, demand, and electricity, fossil-fuel, and carbon prices.

Data and SVAR specification

A daily SVAR for each country, January 2021–October 2025.

Electricity-market variables

- Forecasted wind and solar generation
- Forecasted electricity demand
- Day-ahead electricity price

Fuel and carbon prices

- Brent oil, TTF gas and API2 coal
- EU ETS emission allowances
- Daily closing prices

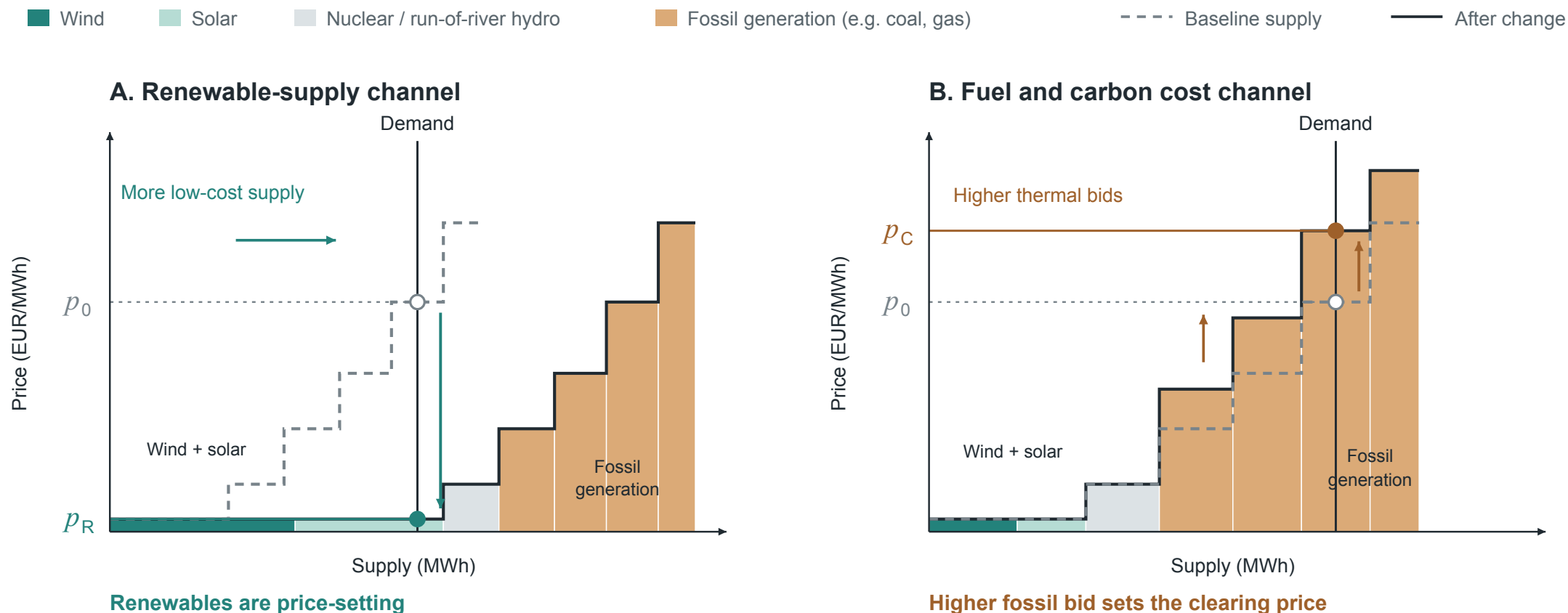
$$B_0 y_t = C \nu_t + \sum_{j=1}^5 B_j y_{t-j} + w_t.$$

Variables in logs and 5 lags (10 in a robustness check).

ν_t is a deterministic vector of seasonal harmonics and dummies for calendar effects and demand outliers.

Source: LSEG. Daily spot electricity prices are averages of hourly prices; forecasted quantities are daily sums.

The merit-order mechanism



At given demand, the marginal accepted bid determines the clearing price.

Nuclear and hydro appear only for context.

Identification through the timing of market outcomes

Day $t - 1$: the auction

Forecasts of wind, solar generation and load concern delivery on day t .

The day-ahead electricity price for delivery on day t is settled.

Day t : delivery and market close

Oil, gas, coal and carbon prices are measured at the close of day t .

Subsequent unanticipated price innovations cannot change an auction price already determined.

Recursive ordering

$$y_t = (\text{wind}_t, \text{solar}_t, \text{demand}_t, \text{electricity}_t, \text{oil}_t, \text{gas}_t, \text{coal}_t, \text{carbon}_t)'$$

The ordering within the fossil-fuel block is given by the distinction between global vs. local markets. Electricity-price responses to fuel and carbon shocks are zero on impact by construction.

For robustness, we also consider an alternative ordering in which demand and electricity prices are placed last, and we use realised rather than forecast demand.

The structural drivers differ across countries

Shares of electricity-price forecast-error variance (%).

Country	Horizon	Wind	Electricity	Gas
Germany	1	36.3	56.8	0.0
	10	32.2	43.8	12.1
	30	26.7	36.5	22.4
Italy	1	6.3	82.5	0.0
	10	3.1	39.7	47.2
	30	2.1	22.6	61.4

Germany has a stronger renewable-supply channel. Gas becomes important for Italy at longer horizons.

Full-sample estimates; selected shocks. “Electricity” denotes electricity-market-specific shocks.

Electricity-price variation during and after the crisis

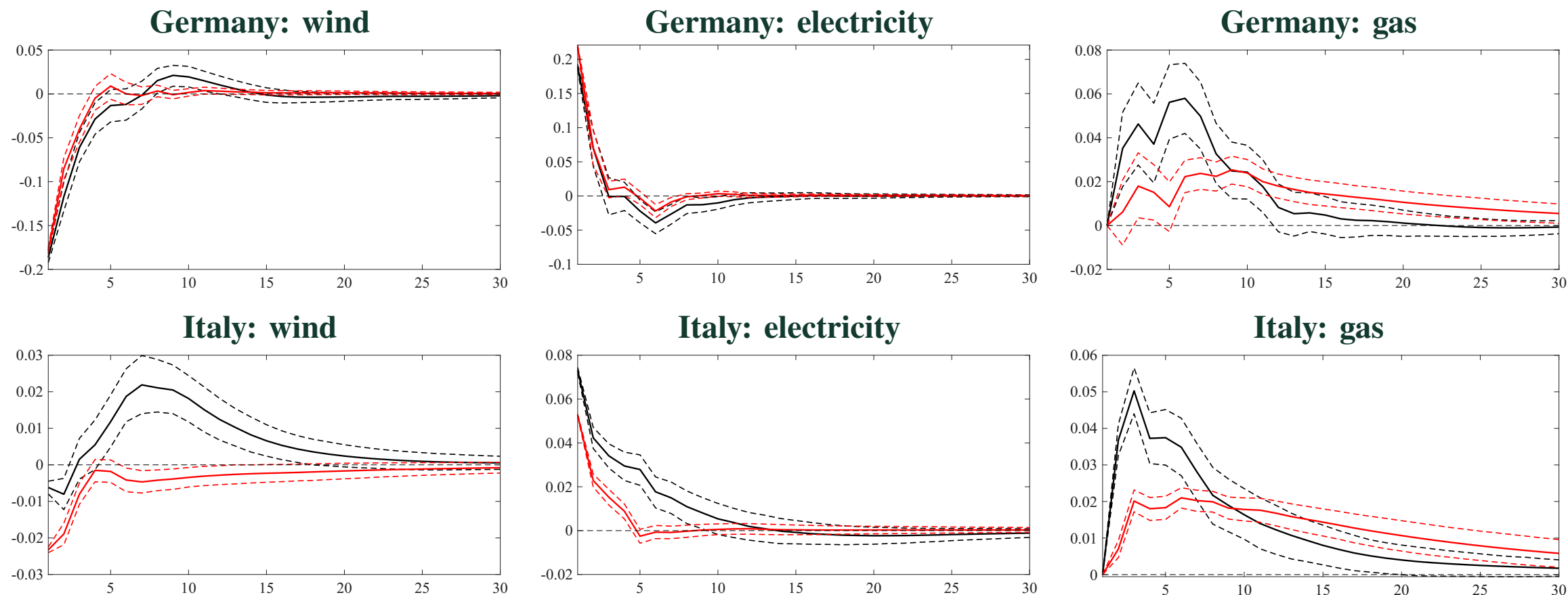
Shares of electricity-price forecast-error variance (%).

Country	Horizon	Crisis			Post-crisis		
		Wind	Electricity	Gas	Wind	Electricity	Gas
Germany	5	41.5	33.5	7.1	38.0	49.5	1.2
	30	34.7	28.6	12.1	34.4	45.0	6.0
Italy	5	2.2	52.9	35.8	14.7	53.4	16.7
	30	10.4	33.4	33.7	9.4	27.7	40.9

- Germany: higher renewable availability and imports help explain the smaller gas contribution.
- Italy: recovery of imports and hydro, yet gas need not diminish its role in setting prices.

Context: Bundesnetzagentur (2024), ACER (2025), GME (2025).

Electricity-price responses to wind, electricity and gas shocks

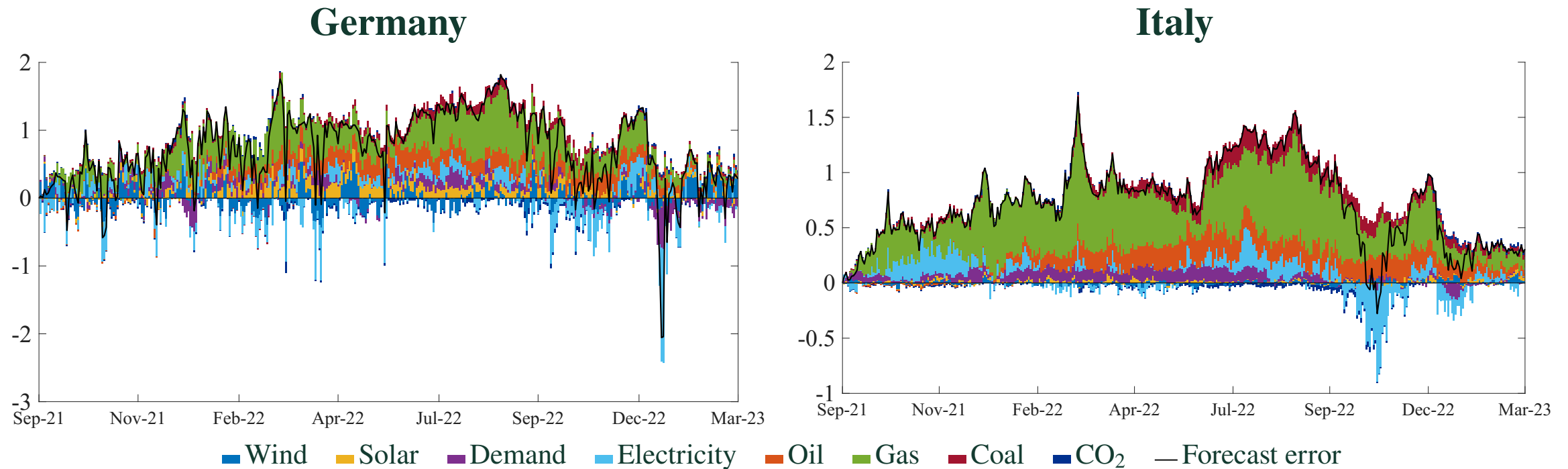


Black: crisis. Red: post-crisis. Solid lines: bootstrap-mean IRFs. Dashed lines: 68% pointwise bootstrap confidence intervals.

All variables in logs. Multiplied by 100, the IRFs display approximate percentage changes in electricity prices following a (country- and period-specific) one-standard-deviation structural shock. Context: Paschen (2016), Bundesnetzagentur (2021), Terna (2023), Fezzi and Bunn (2009).

Historical decomposition during the energy crisis

Gas-price shocks make the largest contributions, particularly during 2022.

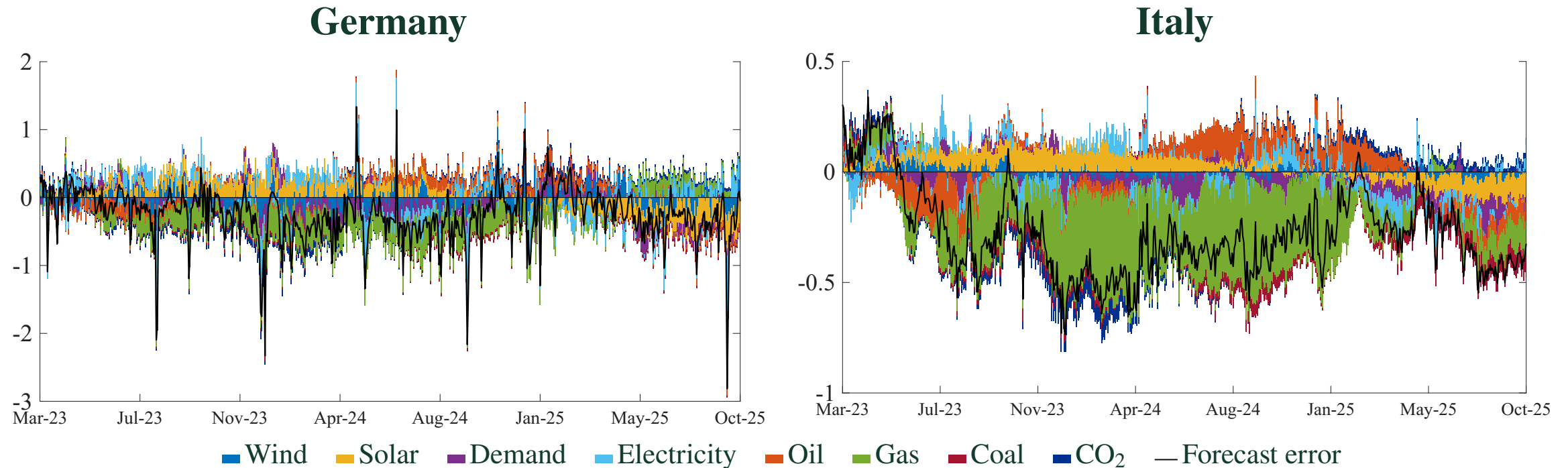


Beyond wind and electricity-market shocks, oil-price shocks also contribute during 2022.

Full-sample five-lag estimates. Starts on 1 September 2021; this display window ends on 1 March 2023.

Historical decomposition after the crisis

Gas contributions turn negative, and volatility seems higher.



E.g., Germany, December 2024: low wind generation and conventional-plant outages can raise electricity prices even with negative gas contributions.

Same as in the previous slide. Starts on 1 September 2021, but this display window goes from 2 March 2023–1 October 2025. Context: ACER (2025).

Main findings

- Wind lowers prices on impact, with a stronger renewable-supply channel in Germany.
- Electricity-market-specific shocks matter most at short horizons. Gas gains importance at longer horizons, especially in Italy, including after the crisis.
- Gas shocks account for a large part of the 2022 price surge and the subsequent decline.

Discussion and conclusions

- **Low-carbon generation.** Germany's nuclear exit removed an existing alternative. Italy's renewed interest represents a longer-term diversification option.
- **Renewable expansion.** Storage, transmission and flexible demand can make short-run price benefits more persistent.
- **Economic resilience.** Higher energy costs, uncertainty and financing constraints can weaken investment, particularly in energy-intensive firms.

Discussion in the paper: ACER (2025), Glynos and Scharf (2024), Repubblica Italiana (2026), Anaya Longaric et al. (2025).

Thank you!

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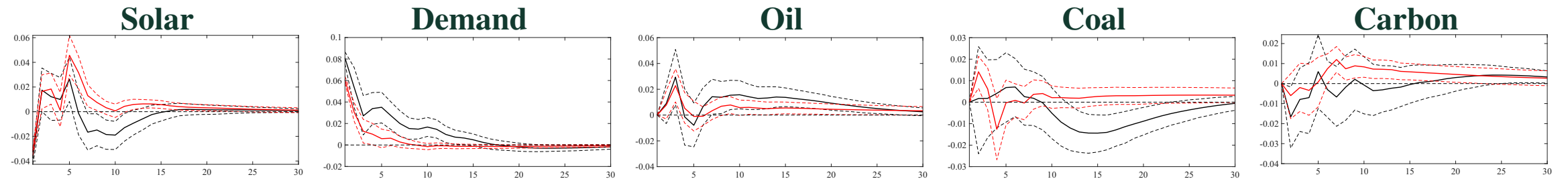
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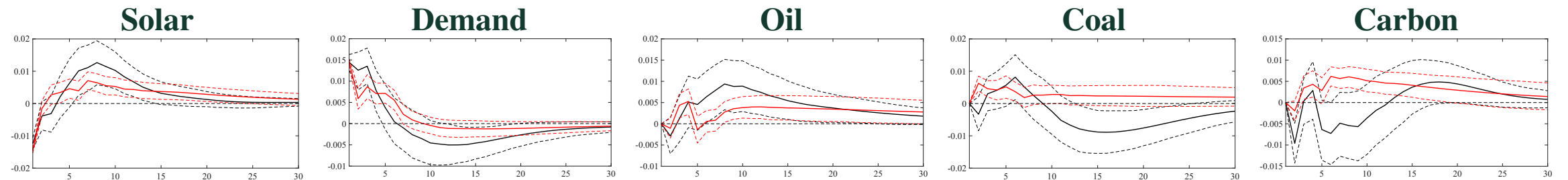
Appendix

Electricity-price responses to the remaining shocks

Germany



Italy



Black: crisis. Red: post-crisis. Solid lines: bootstrap-mean IRFs. Dashed lines: 68% pointwise bootstrap confidence intervals.

All variables in logs. Multiplied by 100, the IRFs display approximate percentage changes in electricity prices following a (country- and period-specific) one-standard-deviation structural shock.

Alternative ordering

The main cross-country differences remain.

$$y_t = (\text{wind}_t, \text{solar}_t, \text{oil}_t, \text{gas}_t, \text{coal}_t, \text{carbon}_t, \text{electricity}_t, \text{demand}_t)'$$

Actual demand replaces forecasted demand. Fuel and carbon shocks can affect electricity prices on impact.

Country	Ordering	Wind	Electricity	Gas
Germany	Baseline	26.7	36.5	22.4
	Alternative	27.2	40.3	23.0
Italy	Baseline	2.1	22.6	61.4
	Alternative	2.3	18.0	66.7

Selected FEVD contributions (%) at horizon 30. Both specifications use five lags.

Sample dates

Full sample	2 January 2021–1 October 2025
Crisis FEVD	1 September 2021–1 March 2023
Crisis IRF comparison	2 September 2021–1 March 2023
Post-crisis FEVD and IRFs	2 March 2023–1 October 2025
Historical decompositions	Full-sample estimates, starting on 1 September 2021
