

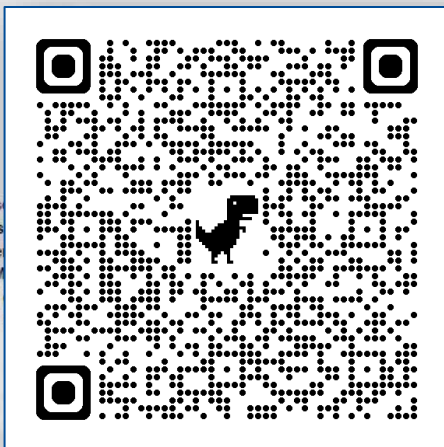
INTERNATIONAL MONETARY FUND

Nowcasting GCC GDP:

A Machine Learning Solution for Enhanced Non-Oil GDP Real-time Prediction

Greta Polo, Yuan Gao Rollinson, Yevgeniya Korniyenko,
Tongfang Yuan

WP/25/268



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DEC**



WORKING PAPER



Nowcasting GCC Non-Oil GDP:

A MACHINE LEARNING SOLUTION FOR ENHANCED NON-OIL GDP REAL-TIME PREDICTION

February 2026

Greta Polo, Yuan Gao Rollinson, Yevgeniya
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Outline

- **Motivation and innovation**
- **Framework and data**
- **Machine learning and interpretability**
- **Results and country insights**
- **Robustness check**
- **Policy implication**

Why Nowcasting Matters in the GCC?



Policymakers need real-time signals



GDP data released with lags in some countries



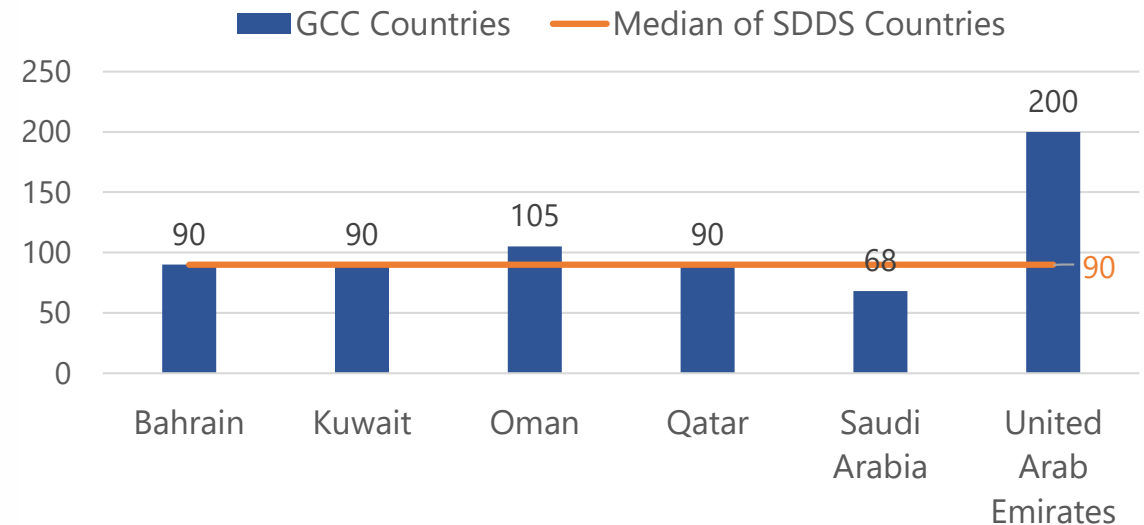
Oil volatility masks domestic momentum



Structural reforms create fast-moving dynamics

Timeliness of Quarterly GDP Publication

(Numbers of days, Publication lag of supply-side GDP)



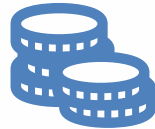
Source: IMF Data Adequacy Database. The SDDS is the IMF's data dissemination standard, to which 49 economies report, including 34 EMs and 15 AEs.

Note: UAE's quarterly GDP publication lag varies by emirates.

Why Focus on Non-Oil GDP?



Better proxy for domestic demand



More informative for policy-making



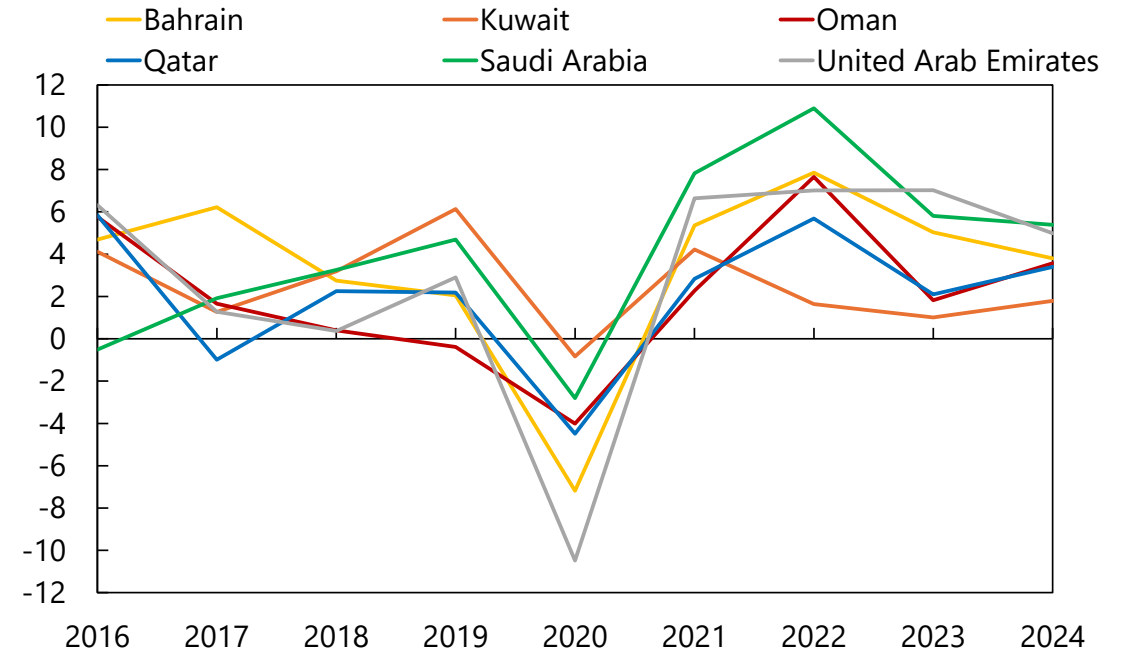
Central for diversification agendas



Less mechanically driven by oil prices

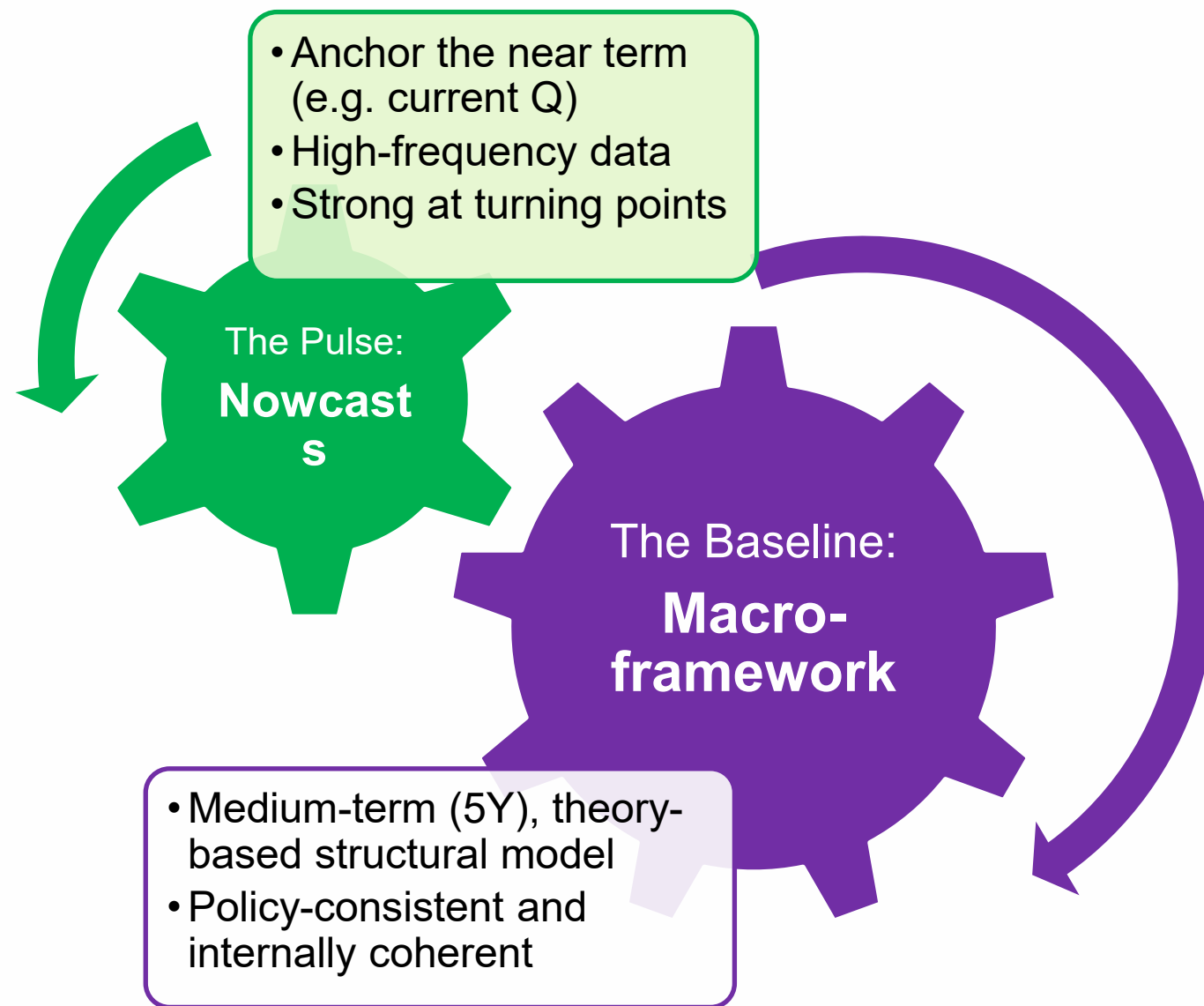
GCC: Real Non-Oil GDP Growth

(Annual Percentage Rate)



Sources: IMF January 2026 WEO.

Two Ways We Forecast Non-Oil Growth

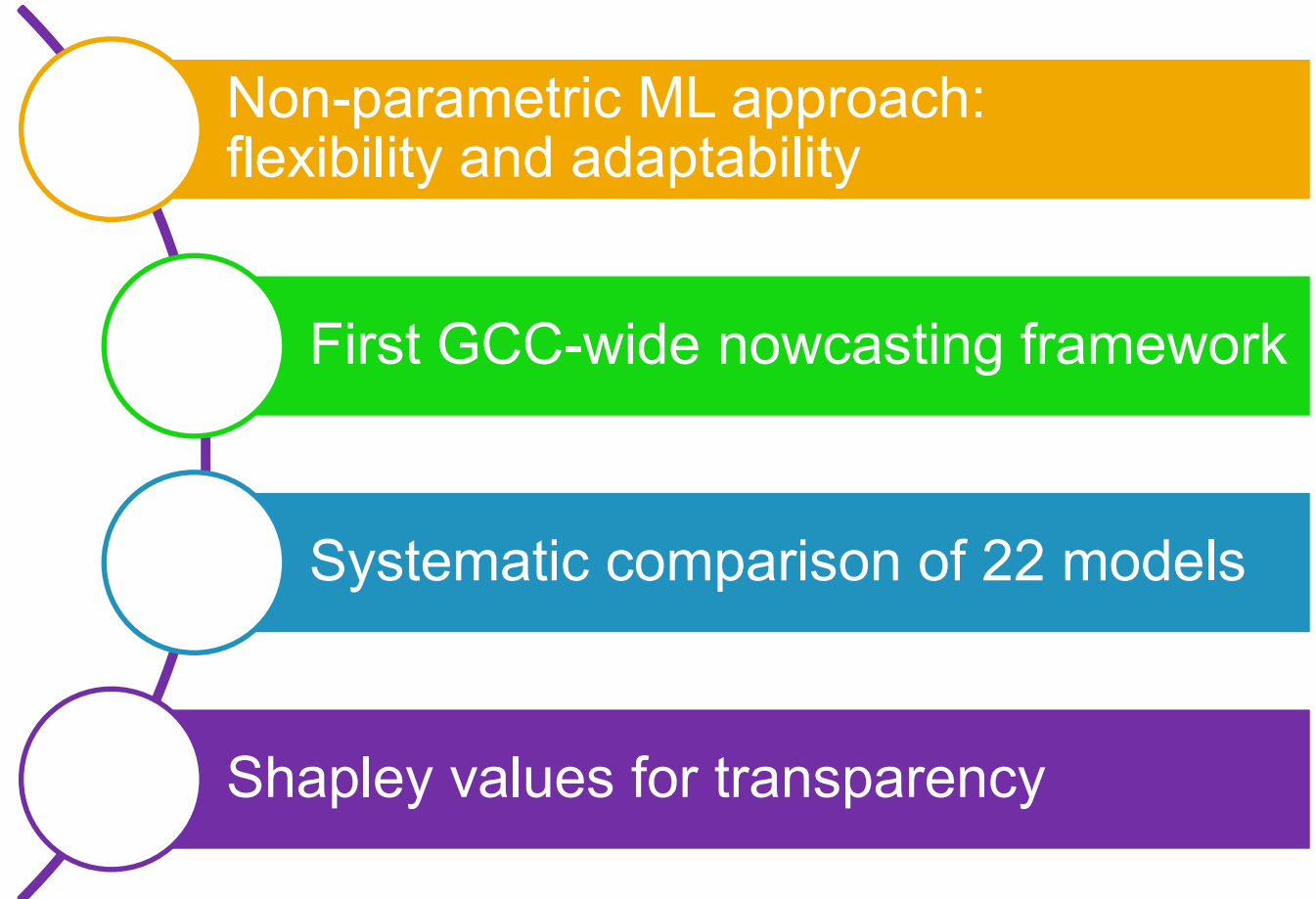


Tailored Innovations

Existing Literature

- Conventional parametric model (e.g., DFMs, bridge models)
- Growing use of Machine Learning (ML) in advanced economies
- Very limited MENA/GCC coverage
- Mostly single-country or single-model approaches

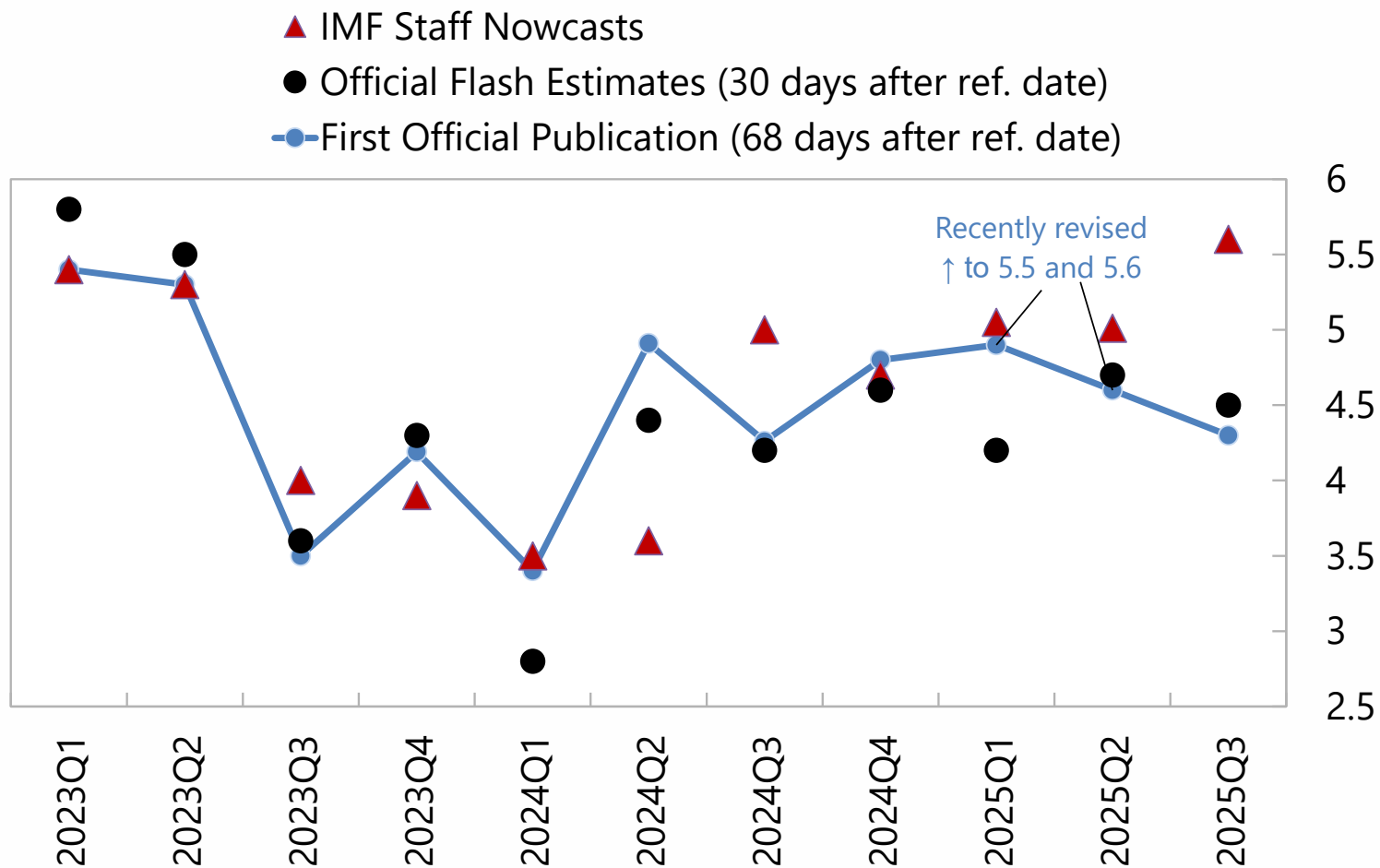
Our Paper



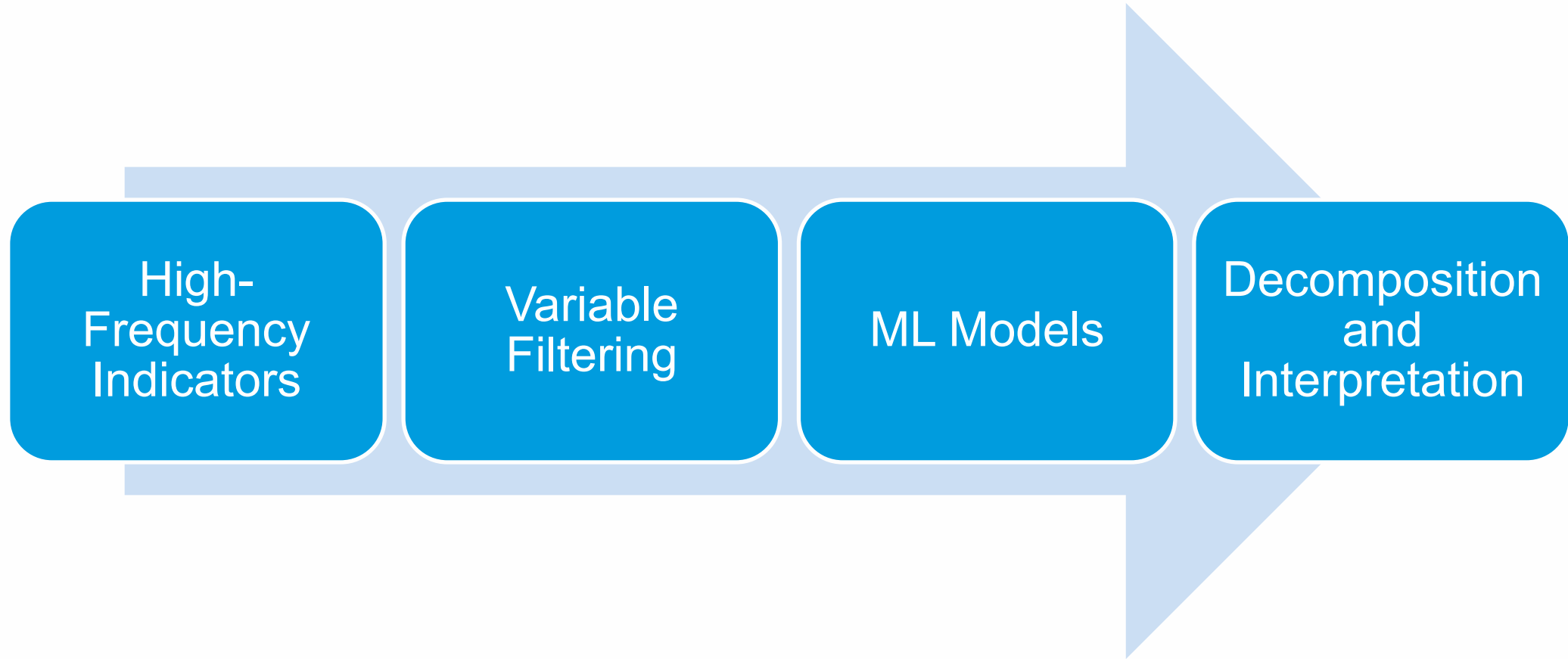
Preview: Nowcasts of Saudi Arabia

Saudi Arabia: Staff Nowcasts vs. Official Flash Estimates

(Percent, Non-Oil Activities Nowcasts)



Overall Nowcasting Framework



High-Frequency Data Strategy



DOMESTIC ACTIVITIES

- *Inflation (CPI, PPI)*
- *Employment*
- *Point-of-Sales (POS)*
- *Stock market*
- *Flights and hotels tracker*



MANUFACTURING AND SENTIMENT

- *Production Index*
- *Purchasing Managers' Index (PMI)*
- *Business sentiments*



OIL AND COMMODITY PRICES

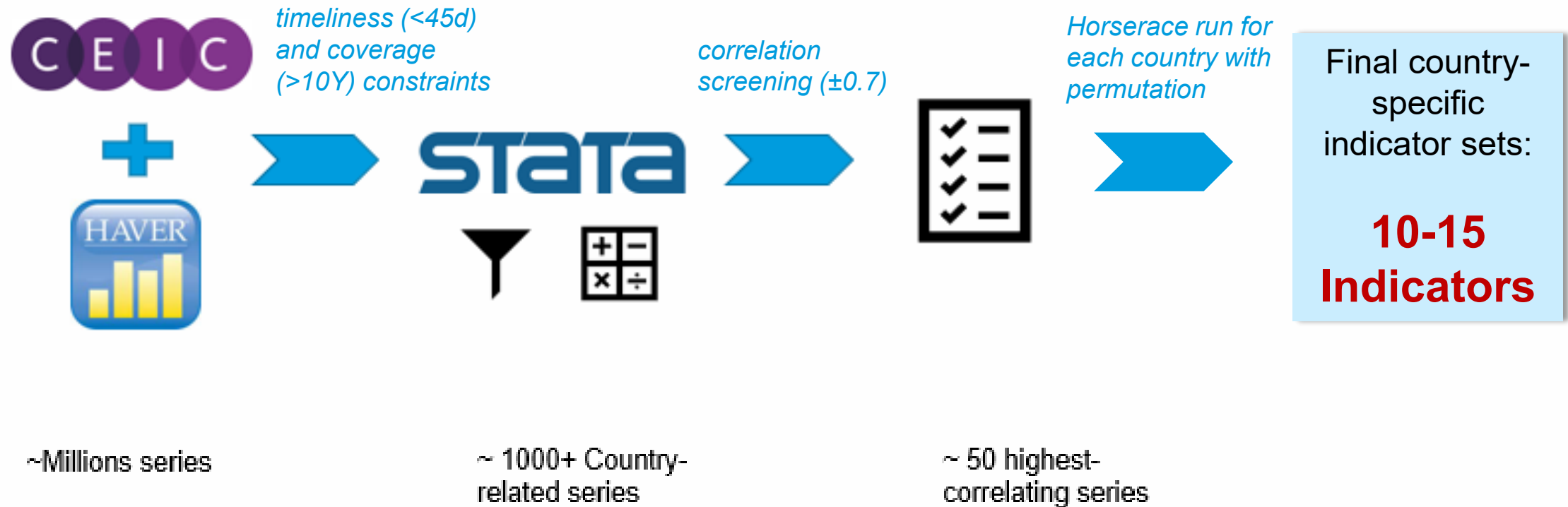
- *Volume of commodity trade*
- *Price of commodity (energy, metal, agricultural products)*



REGIONAL AND GLOBAL SPILLOVERS

- *Trading partner performance (growth, stock, trade)*
- *Global financial condition*

From Thousands of Series to 10-15 Indicators



Machine Learning Phases



Input Variables and Models - Bahrain

Leading Indicators (predictors)

Real and External Sector:

- POS Value
- POS Transaction Number
- Consumer Price Index
- CPI: Recreation and Culture
- Global PMI: Composite Output
- Developed Markets PMI: Composite
- OPEC Reference Basket Price
- Saudi Arab Light: Spot Crude Price

Monetary and Financial:

- One Month Deposit Rates
- Money Supply: M2
- Monetary Survey: Other Domestic Assets
- Public Debt: Development Bonds
- Public Debt: Conventional Instruments
- Stock Exchange: All Shares Index



Other Input Variable Examples

Leading Indicators: Saudi Arabia

Real and External Sector:

- Consumer Price Index
- Non-oil Exports
- Crude Oil Production: Saudi Arabia
- Saudi Arabian Light: Spot Crude Price
- Global Manufacturing PMI
- Cement Deliveries

Monetary and Financial:

- 3 Month SIBOR (Average, %)
- Stock Market: Number of Transactions (Number)
- Stock Market: Number of Shares Traded (Mil)
- Stock Market: Tadawul All Share Index (EOP)
- Foreign Reserves: Investment in Foreign Securities (EOP)
- 4 Week SAMA Bill (Average, %)

Leading Indicators: UAE

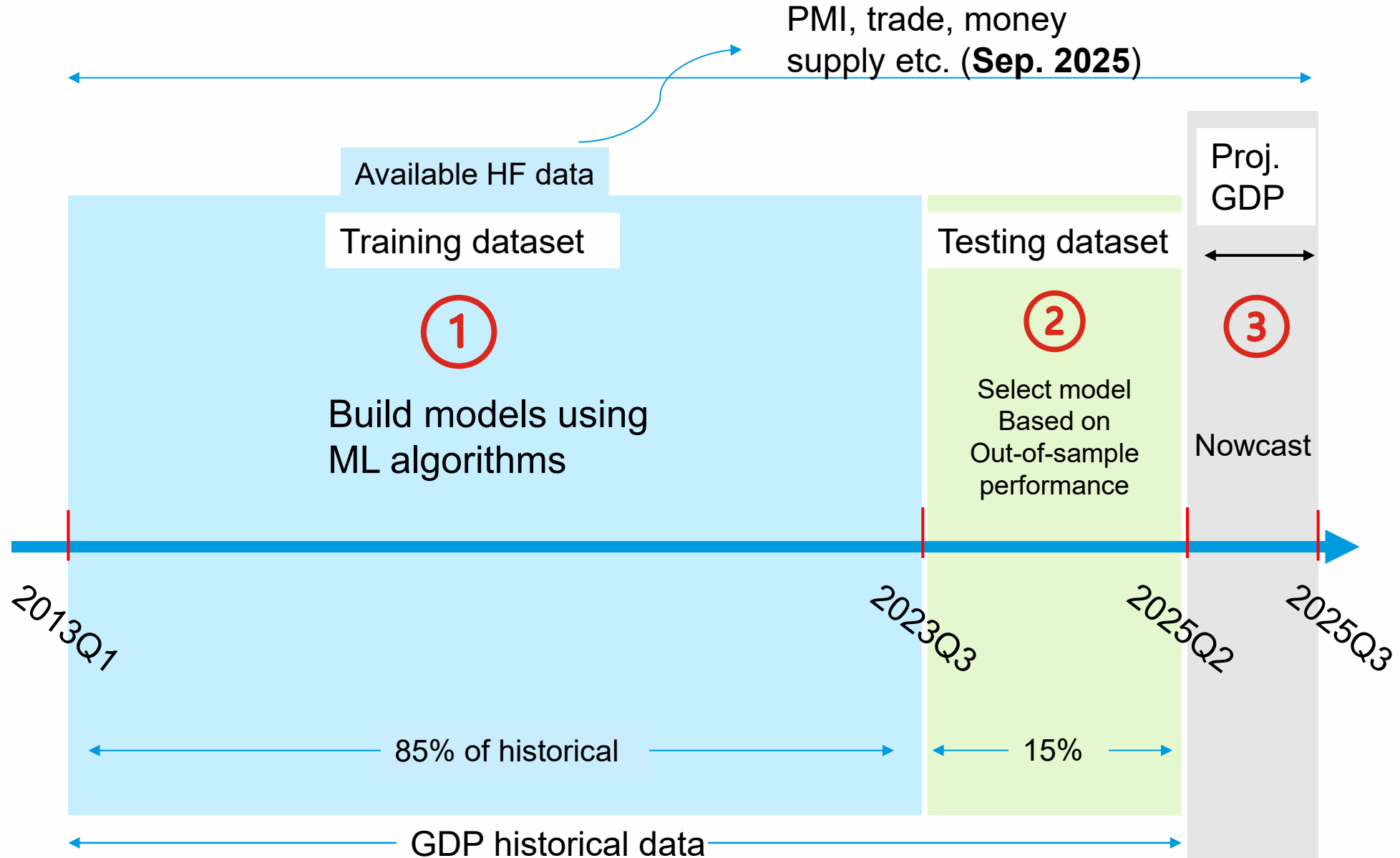
Real and External Sector:

- Cargo Traffic: International
- Passenger Traffic: International
- European Brent Spot Price
- Dubai Fateh: Spot Crude Price
- United Arab Emirates Murban: Spot Crude Price
- UAE PMI Total Economy
- Global PMI: Composite Output
- Global PMI: Composite New Orders
- Global PMI: Services Business Activity
- Saudi Arabia PMI: Total Economy New Orders
- Saudi Arabia PMI: Total Economy
- UK: Index of Production
- U.S. Industrial Production excluding Construction
- Germany Industrial Production, Total Industry

Monetary and Financial:

- CBOE Market Volatility Index: VIX
- CBOE Vix Volatility Index

Example Dataset Partition



Main ML Models Used

Linear & Regularized Regression

Step.Model

Elastic Net

Elastic Net (oneSE)

Elastic Net (+ Variable Selection)

Dimension Reduction Models

Principal Component Regression (PCR)

PCR (+ Variable Selection)

Partial Least Squares (PLS)

PLS (+ Variable Selection)

Tree-Based Models

MARS

MARS (+ Variable Selection)

Random Forest

Random Forest (oneSE)

Random Forest (+ Var. Selection)

Gradient Boosting (GBM)

GBM (oneSE)

Support Vector Machines (SVMs)

SVM (Linear)

SVM (Linear) (oneSE)

SVM (Polynomial)

SVM (Polynomial) (oneSE)

SVM (RBF)

SVM (RBF) (oneSE)

SVM (+ Variable Selection)

Model Evaluation

Out-of-sample RMSE as primary metric

Rolling window validation

Robustness to MAE and bias

Final model chosen per country

Indicator Refinement with Shapley Values

Why Shapley Values?

- Break down **each variable's marginal contribution** to model accuracy
- Enable **transparent interpretation** of complex machine learning outputs

Iterative Process

- Start with top 50+ high-frequency indicators
- Run all models with **different selection of indicators** → **compute Shapley values**
- Remove low-contribution indicators
- **Re-estimate models** on refined set and **test** with actual data when released
- Repeat until convergence

Benefits

- **Data-driven selection**, not reliant on intuition
- **Avoids overfitting** from noisy or redundant variables
- Final models are **lean, stable, and interpretable** across countries

Why Interpretability Matters for Policy

Trust in ML-based tools



Clear communication



Understanding drivers of revisions



Avoiding black-box forecasts

Results: Big Picture



MODELS TRACK NON-OIL GDP CLOSELY



GOOD PERFORMANCE AROUND TURNING POINTS



COVID-19 SHOCK CAPTURED WELL

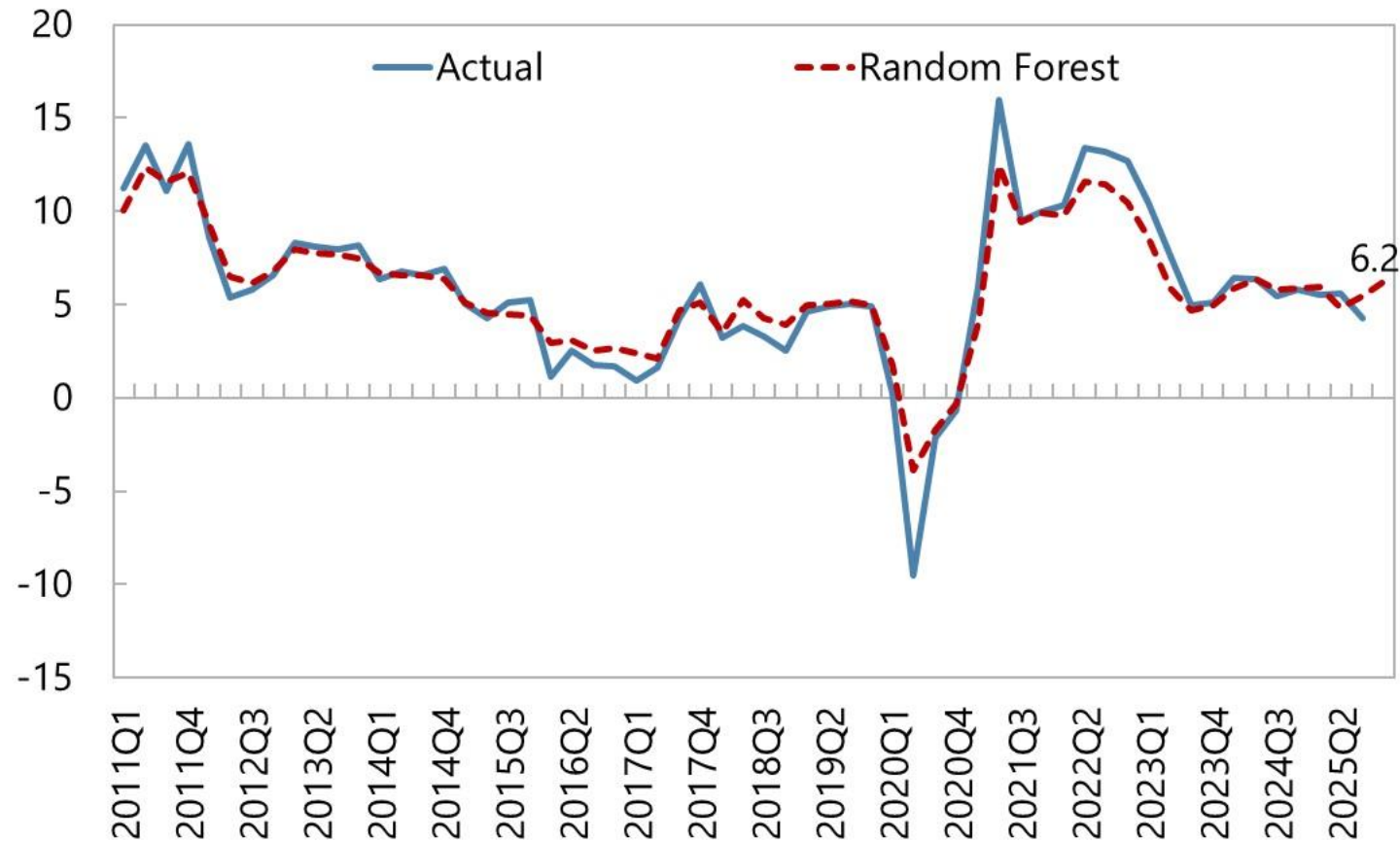


PERFORMANCE VARIES WITH DATA RICHNESS

Q4 2025 Results: Saudi Arabia

Saudi Arabia Non-Oil GDP Nowcast Q4 2025

(Year on year percent change)

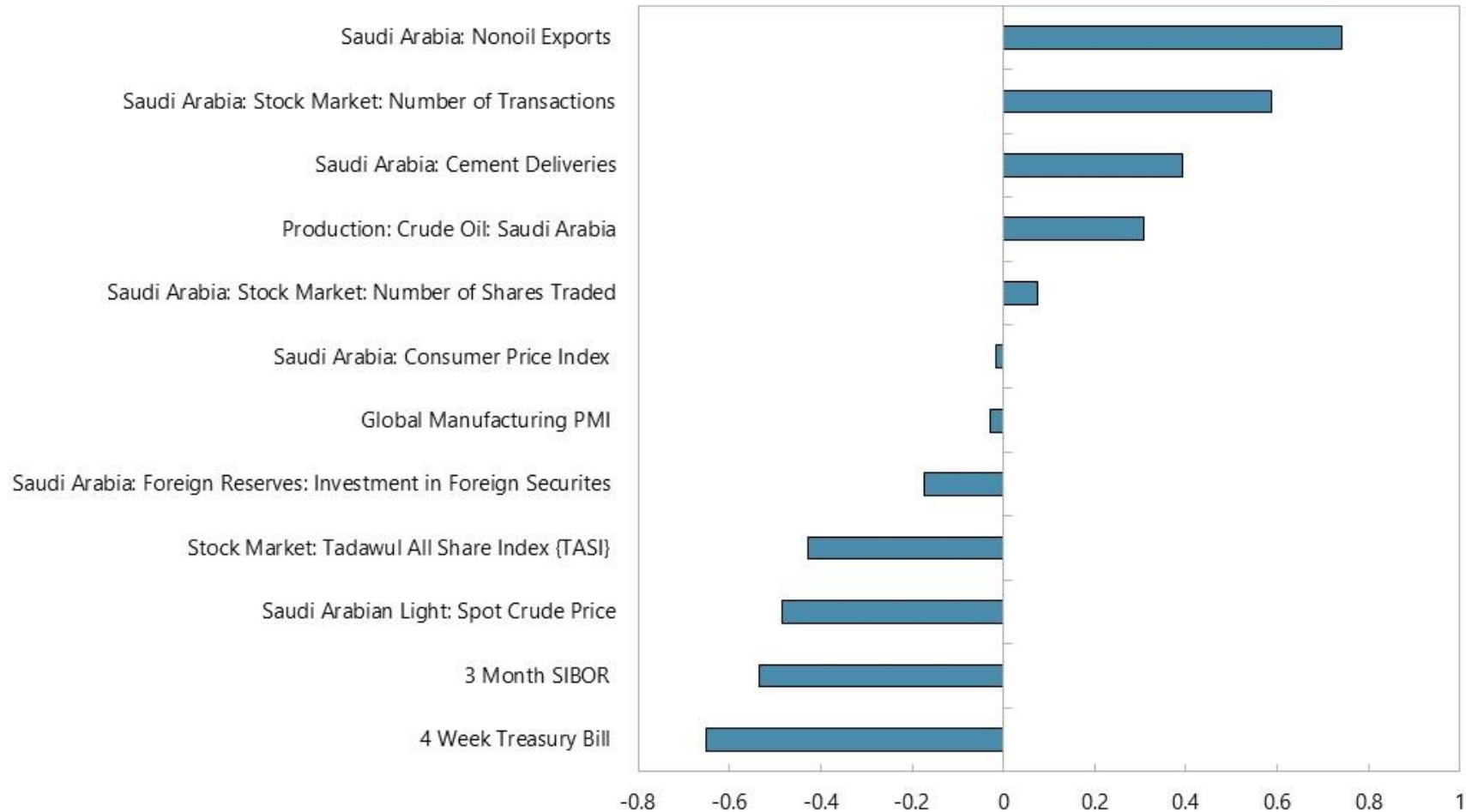


*vs. official Q4 flash
Estimate of 4.1%*

Sources: Haver Analytics and IMF staff calculations.

Q4 2025 Results: Saudi Arabia

Q4 2025 Saudi Arabia Shapley Value Decomposition

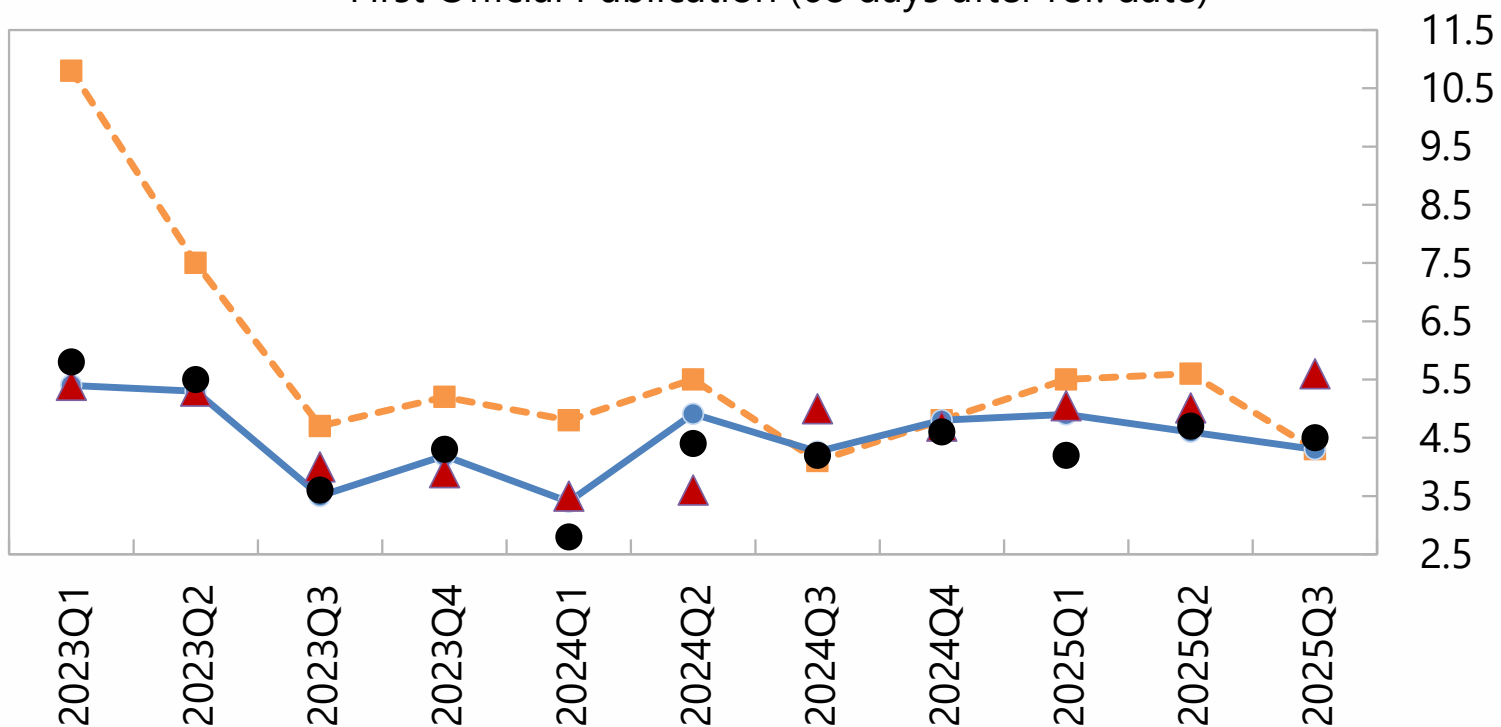


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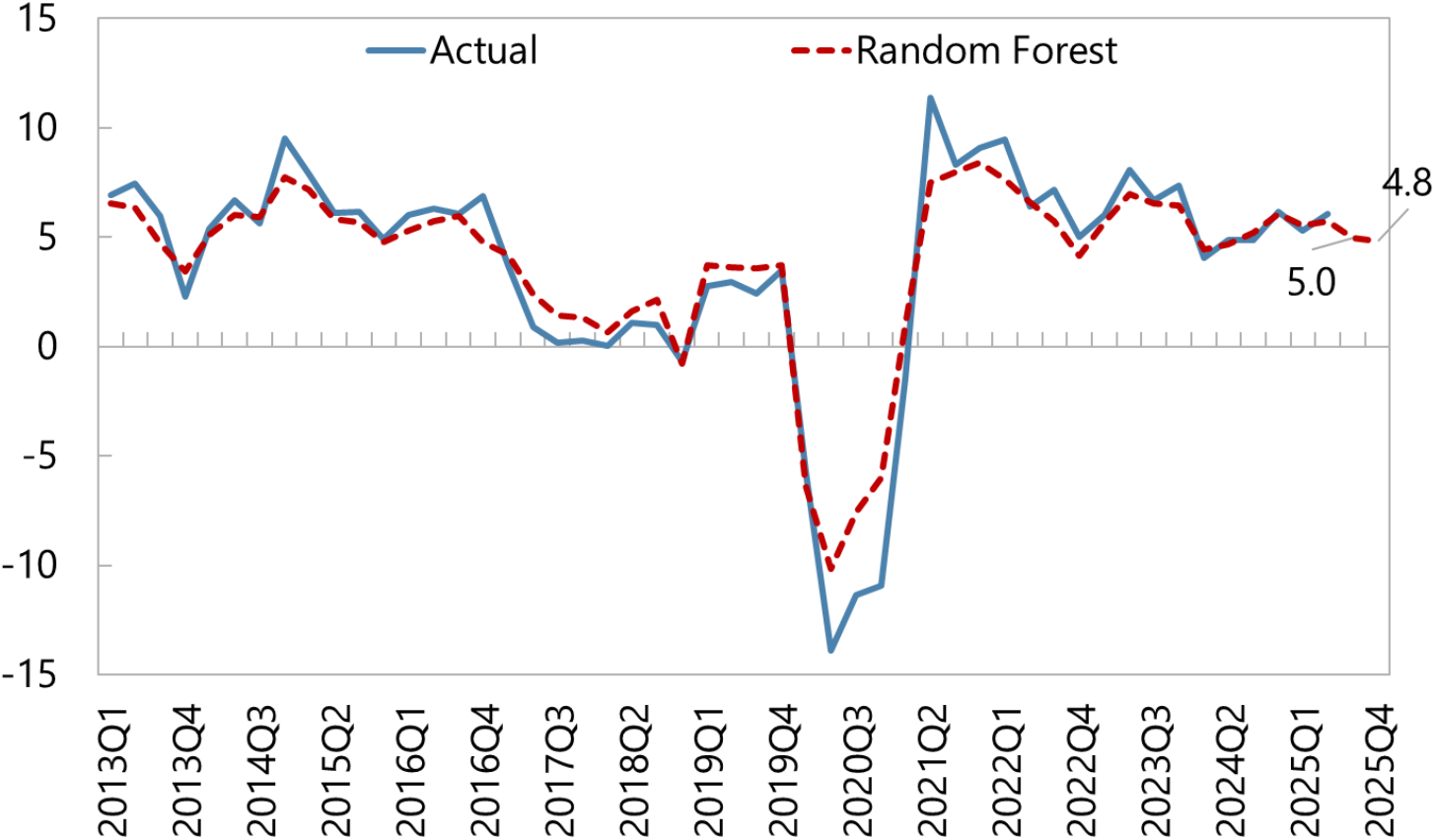
- ▲ IMF Staff Nowcasts
- Official Flash Estimates (30 days after ref. date)
- GASTAT official (latest publication)
- First Official Publication (68 days after ref. date)



Q3 and Q4 Results: UAE

United Arab Emirates Non-Oil GDP Nowcast Q3, Q4 2025

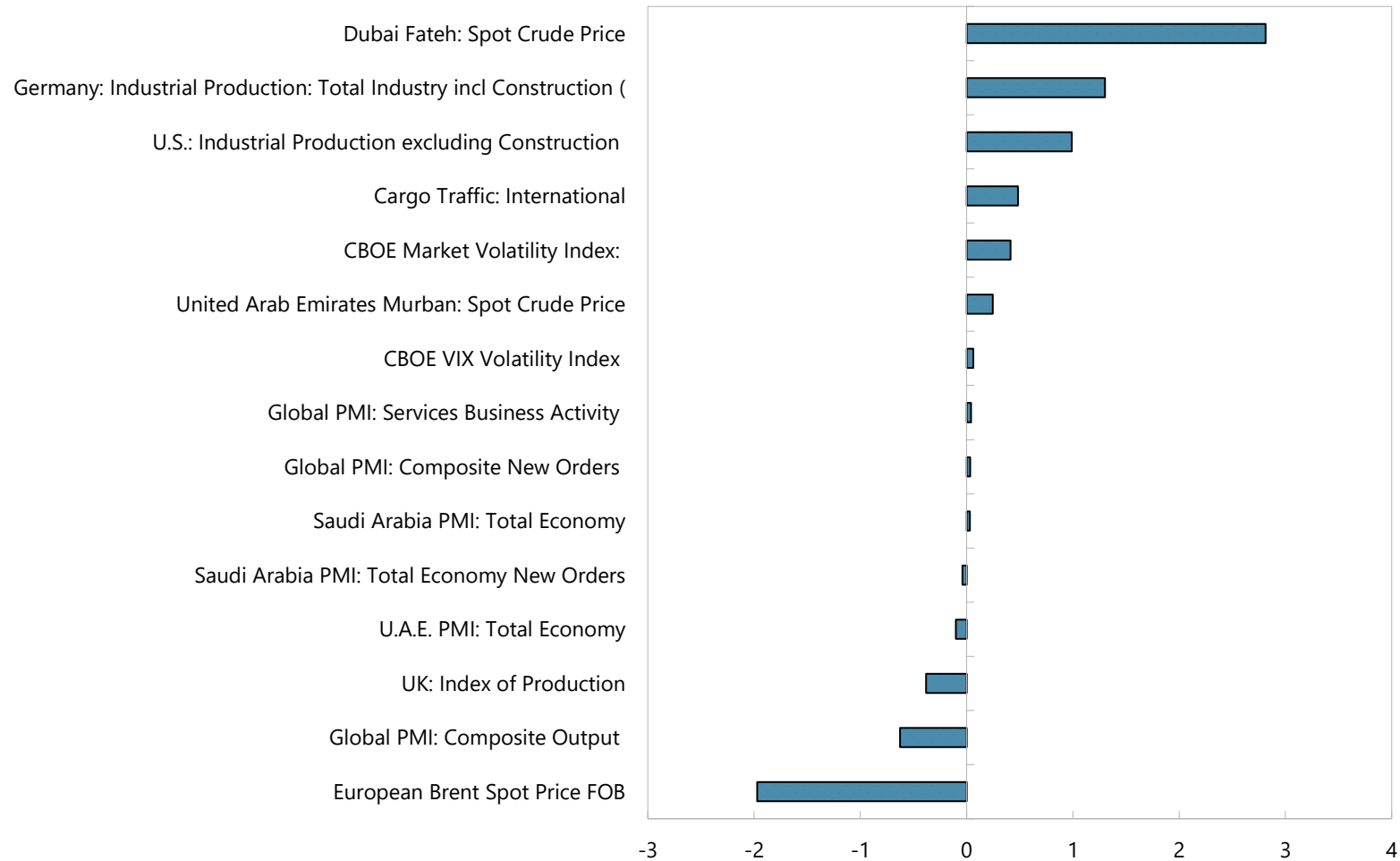
(Year on year percent change)



Sources: Haver Analytics and IMF staff calculations.

Q3 and Q4 Results: UAE

Q4 2025 United Arab Emirates Shapley Value Decomposition



Cross-Country Differences

Saudi Arabia: Strong performance, robust domestic demand

UAE: Strong performance, highly-integrated to global market

Bahrain: consumption-driven

Oman, Kuwait: external indicators matter more

Reflects structure and data availability

Saudi Arabia: Operational Validation

Close alignment
with flash estimates
using previous GDP
construction

Slightly lower
average forecast
error

Demonstrates
complementarity

Robustness Checks

Rolling-window stability

Alternative loss functions

Bottom-up sectoral validation

External composite indices

Bottom-Up Check: Oman

Separate services and tradables models

Aggregation matches total non-oil GDP

Services drive short-term volatility

Tradables sensitive to external shocks

How This Helps Policymakers



Earlier detection of
growth slowdowns



Better timing of
policy responses

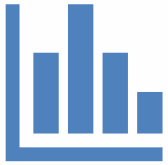


Granular sectoral
insights



Improved risk
assessment

Limitations



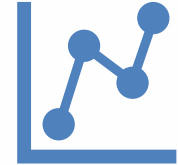
Data revisions



Uneven data
availability



ML models
require monitoring



Statistical, not
causal

Conclusion



Real-time signal
of domestic (non-
oil) growth



ML improves
accuracy around
turning points



Transparent via
Shapley
interpretation



Strong
complement to
official GDP



Direct
surveillance
application

Thank You!

Appendix

Explaining Shapley Prediction I

- Shapley Decomposition: A concept based on cooperative game theory [players collaborate to generate a “payoff” that is fairly distributed].
- Each feature is treated as a player contributing to the model’s prediction (payoff).
- Shapley evaluates each feature contribution across all possible subsets of features (coalitions).
- How each feature changes predictions, averaging these marginal contributions to ensure a fair allocation.

Explaining Prediction II

- Consider a single instance x , the sum of all feature contributions (plus a baseline term) will add up to the model's actual predicted value for x .

$$\underbrace{f(\mathbf{x})}_{\text{Model's Prediction}} = \underbrace{f(\mathbf{x}) - f(\emptyset)}_{\text{Total Payoff}} = \phi_1 + \phi_2 + \dots + \phi_p$$

where ϕ_j is the Shapley value (or “fair share”) for feature j , and $f(\emptyset)$ is the model’s “baseline” (e.g., average prediction with no features).

Three Ways We Forecast Non-Oil Growth

