

Structural approach to forecast combination

A model risk mitigation technique

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The logo for OGResearch, featuring the letters 'OG' in a green, rounded font, followed by the word 'Research' in a dark blue, sans-serif font.

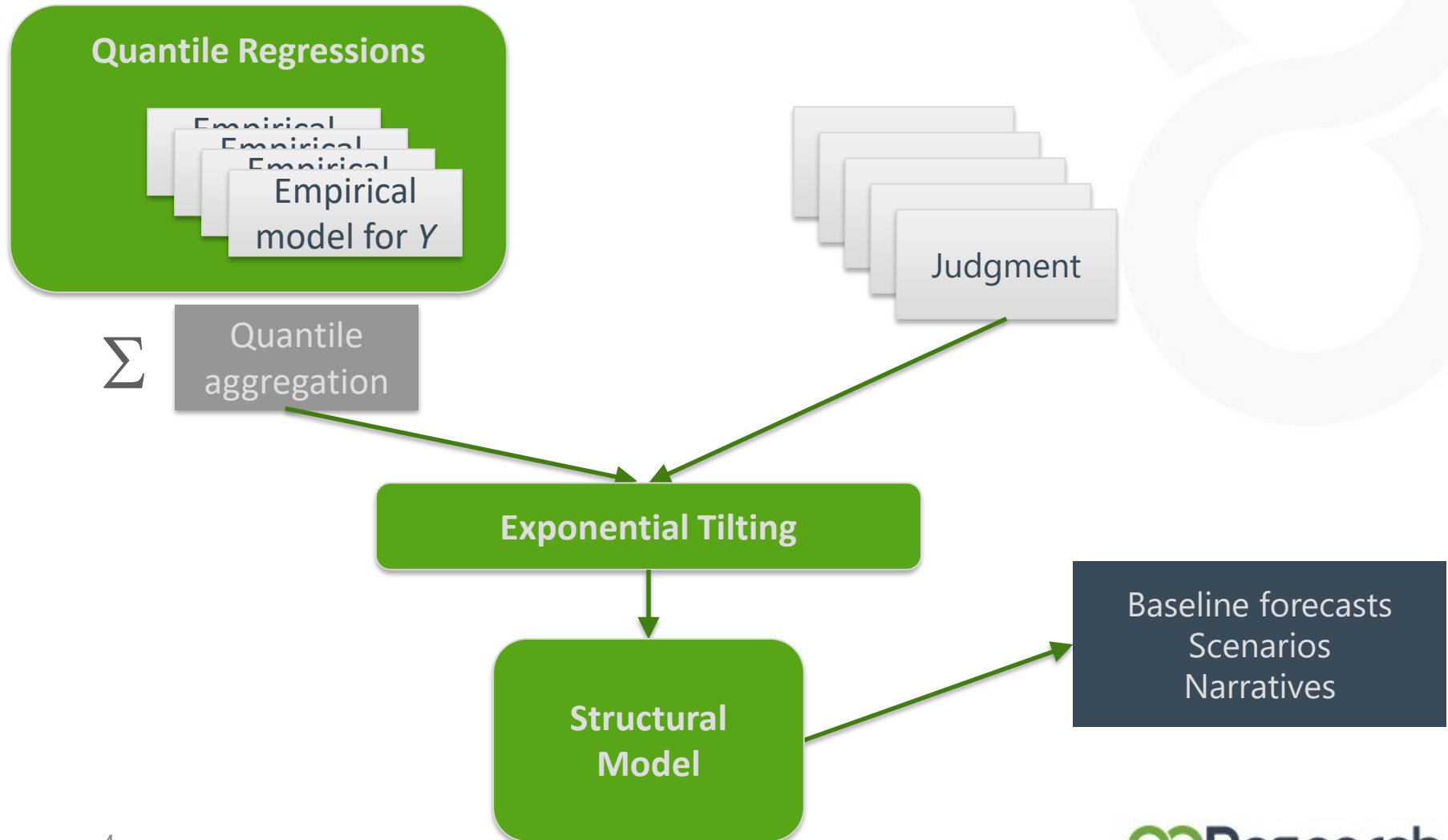
OGR's Core Business Exposed to Extreme Model Uncertainty

- Macroeconomic consultancy helping to assess and incorporate macroeconomic risk into clients' business decisions
 - Risk management
 - Pricing of financial instruments
 - Investment decisions
- Focusing also on frontier markets where uncertainties are high, and data quality and availability are low
- Models are indispensable tools in our analysis

What is a Structural Approach to Forecast Combination

- A model risk mitigation technique addressing a model misspecification risk
- Technique dealing with the trade-off between empirical-oriented reduced-form models and structural theory-based models
- Advanced forecast combination technique
- I demonstrate the approach on an Economic Scenario Generator (ESG) example

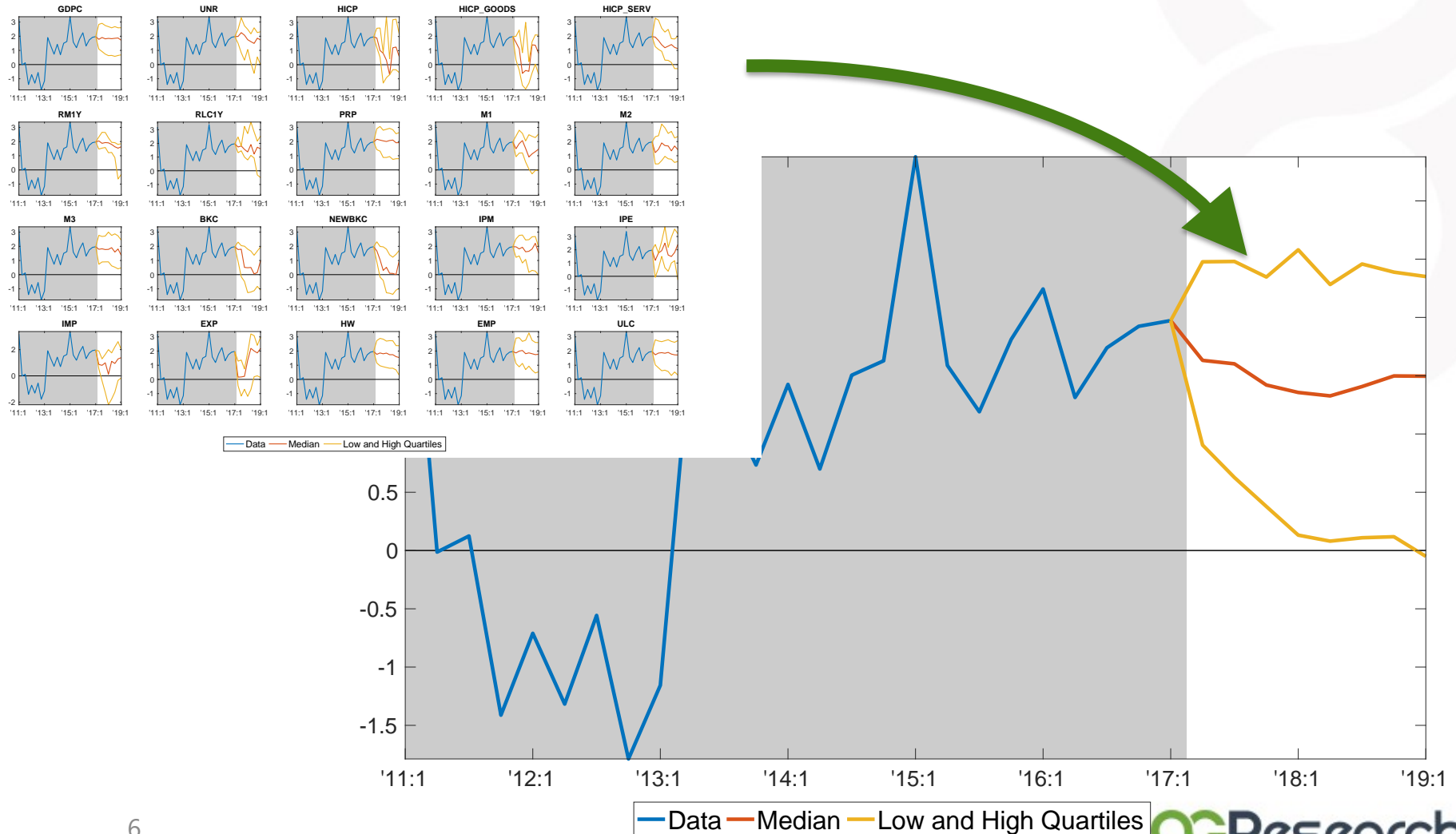
Design of the Structural Forecast Combination Approach



How Do Quantile Forecasts Help?

- Better sense of uncertainties than combined point forecasts
 - Important for pricing, risk management, etc.
- Robust to errors in input data, detect outliers
- Different relationship among variables at the extreme ends of the distribution

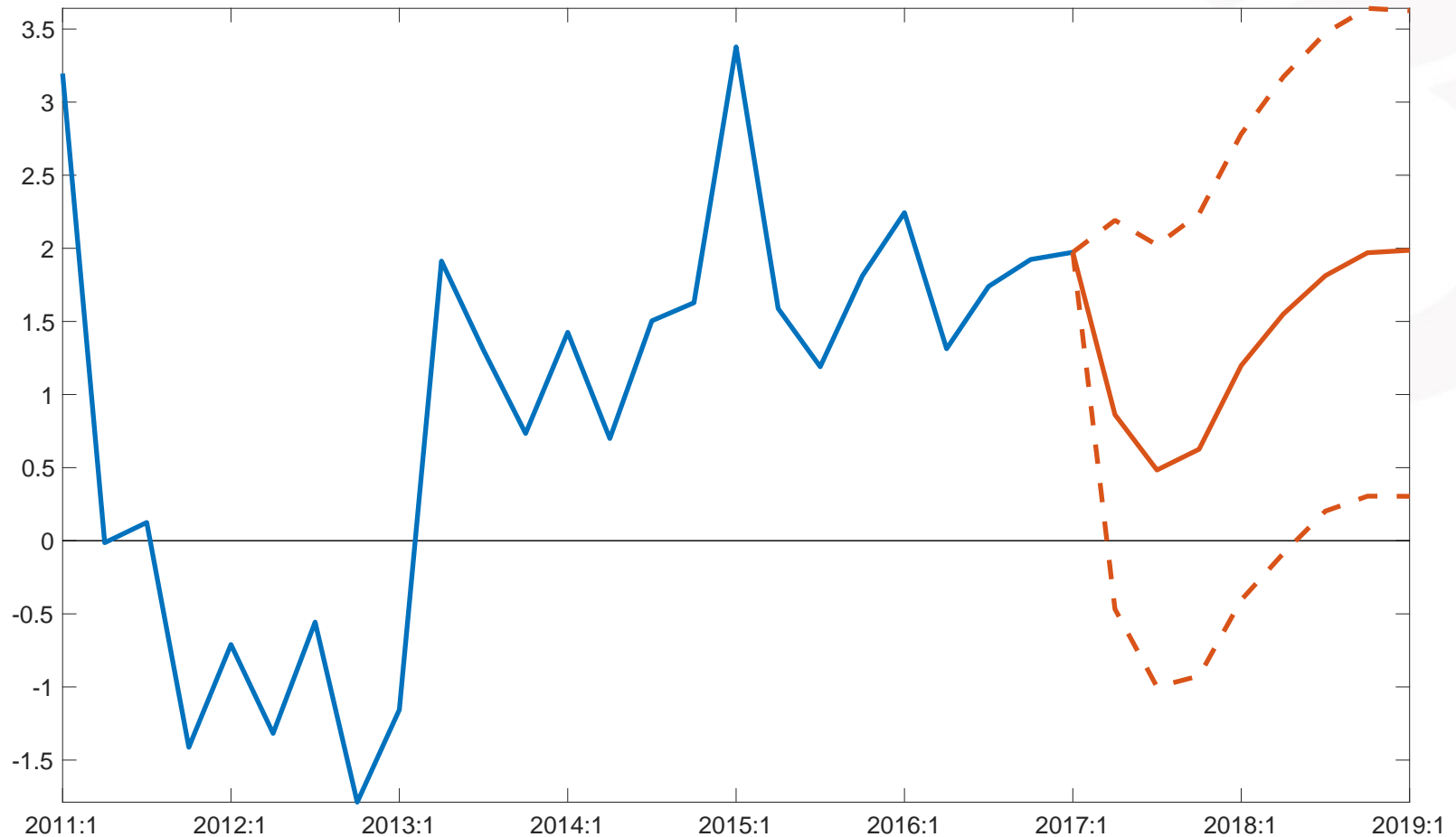
Step 1: Get Forecast Distributions from Various Models and Aggregate



How Do Structural Models Help?

- Map reduced form observations into macroeconomic primitives
- Improve consistency of combination of independent forecasts
- Help apply basic smell tests under model uncertainty: “Does it make sense?”
- Facilitate communication of outcomes and uncertainties within your institution

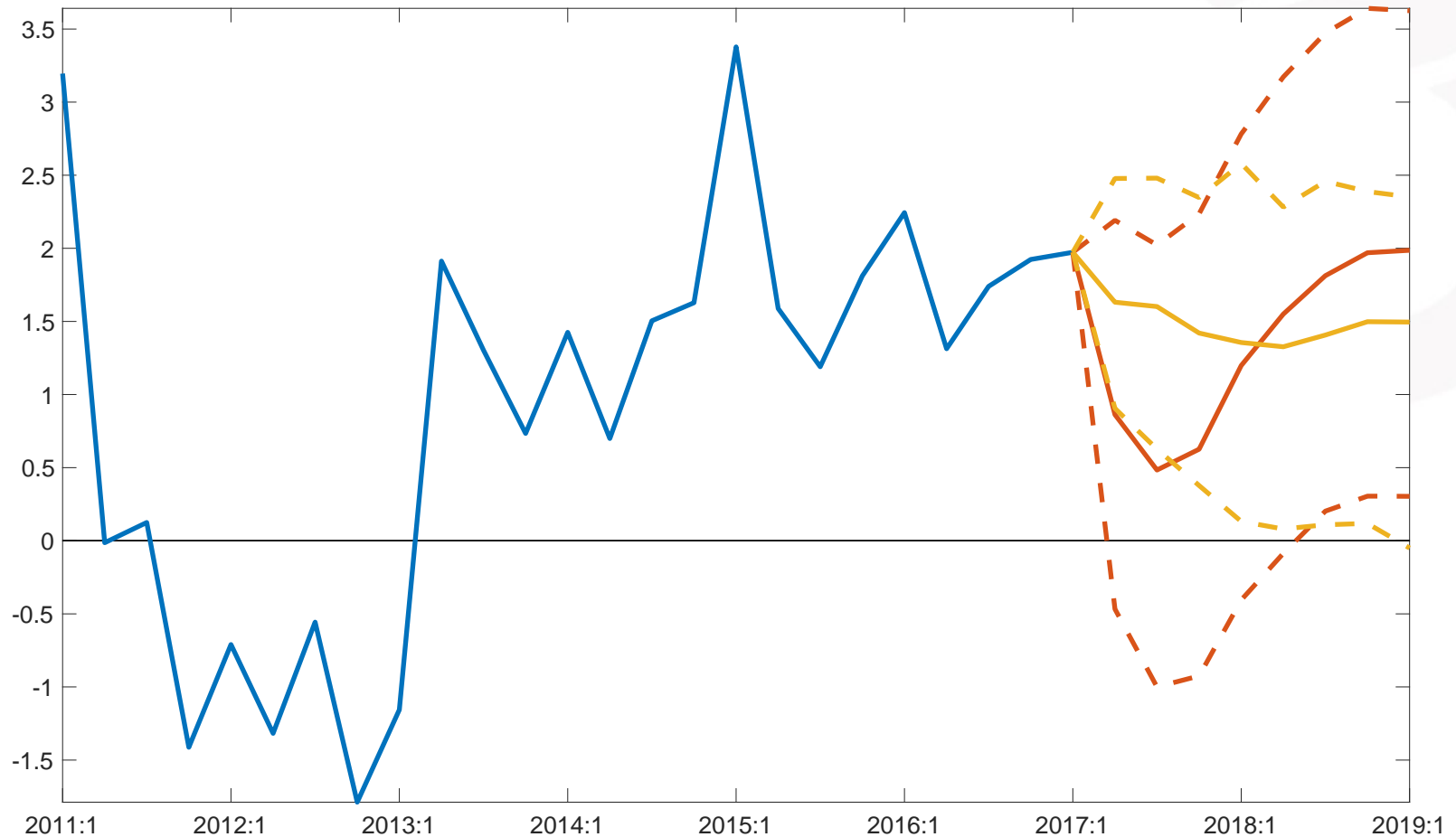
Step 3: Pure Structural Model Forecast Density



How Does Exponential Tilting Help?

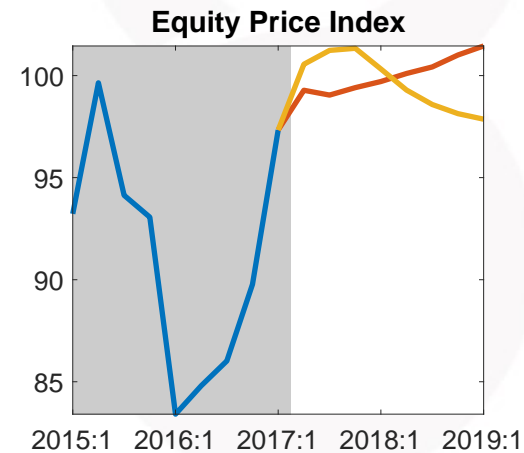
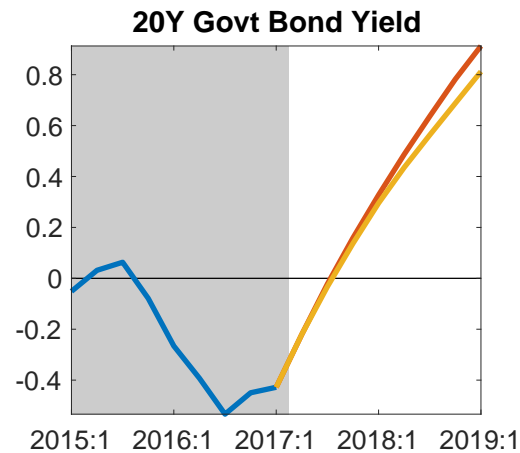
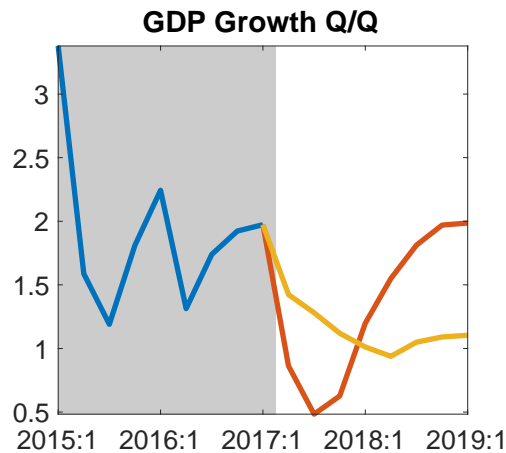
- Combine almost any piece of information on the platform of a structural model
- Allows for economic interpretation of the combination of forecasts from essentially non-structural models
 - “smell tests”, what-if scenarios

Step 4: Impose Properties of the Combined Forecast on the Structural Model Density



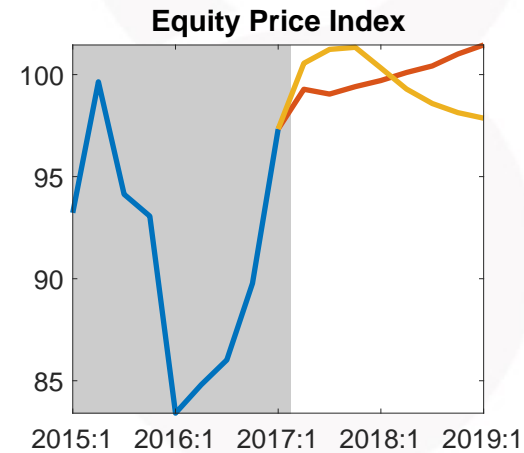
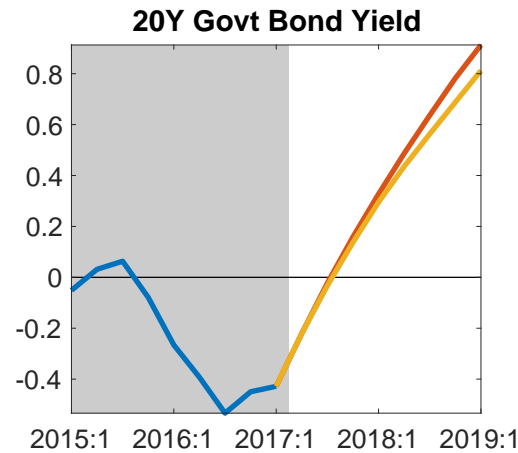
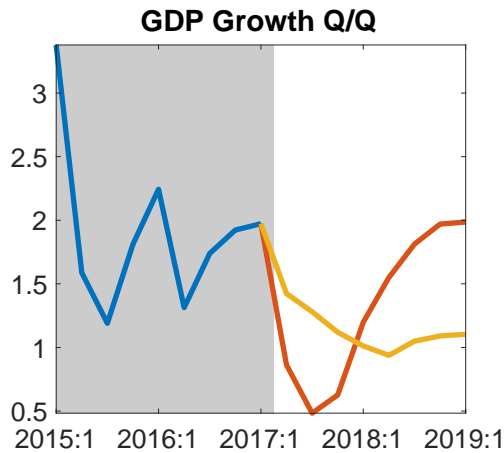
Structural Model Helps to Achieve Consistency Across All Variables

Eurozone

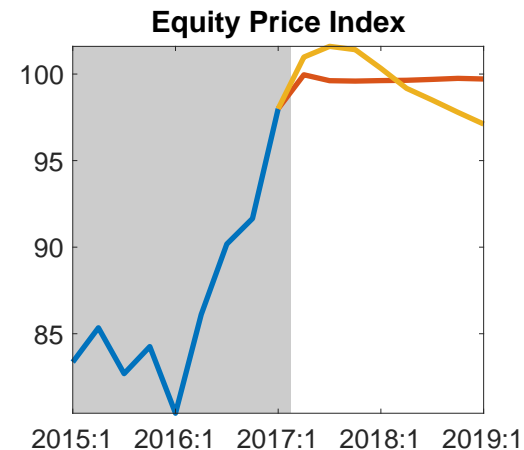
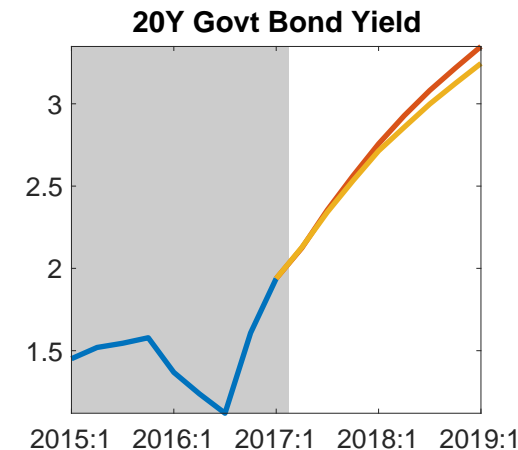
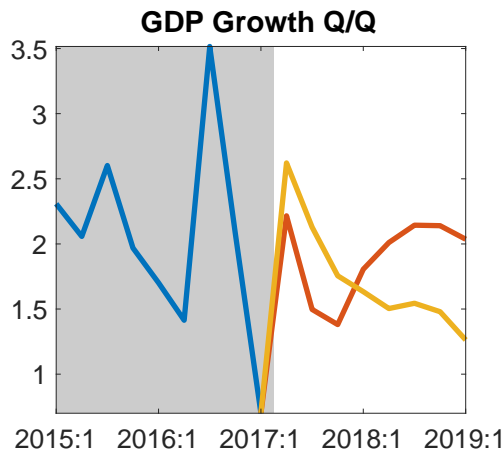


Structural Model Helps to Achieve Consistency Across All Variables

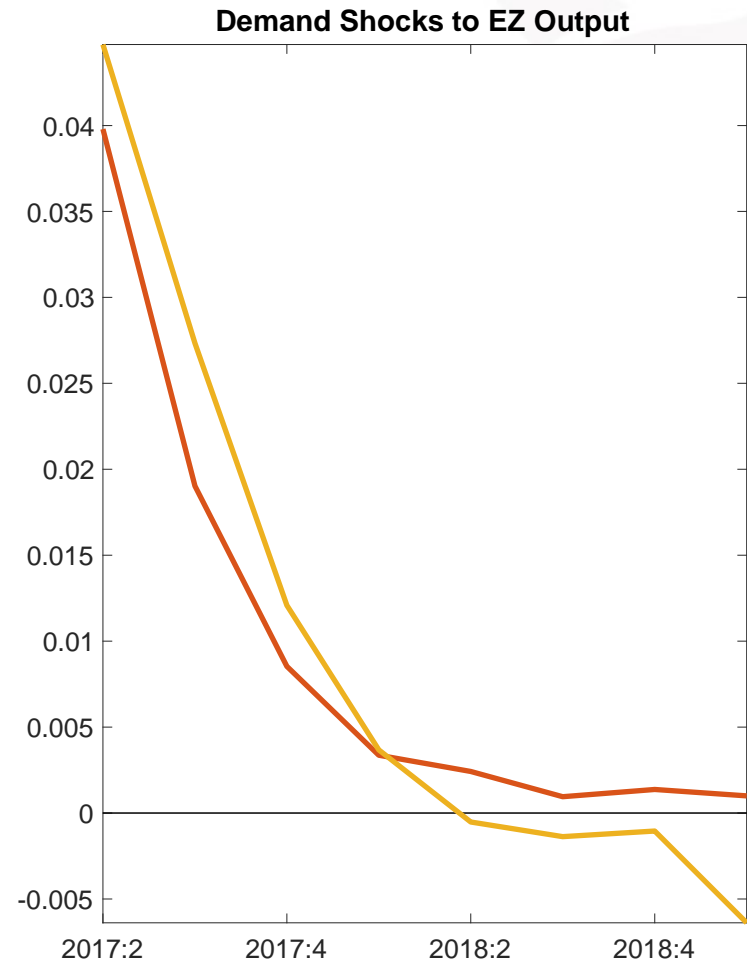
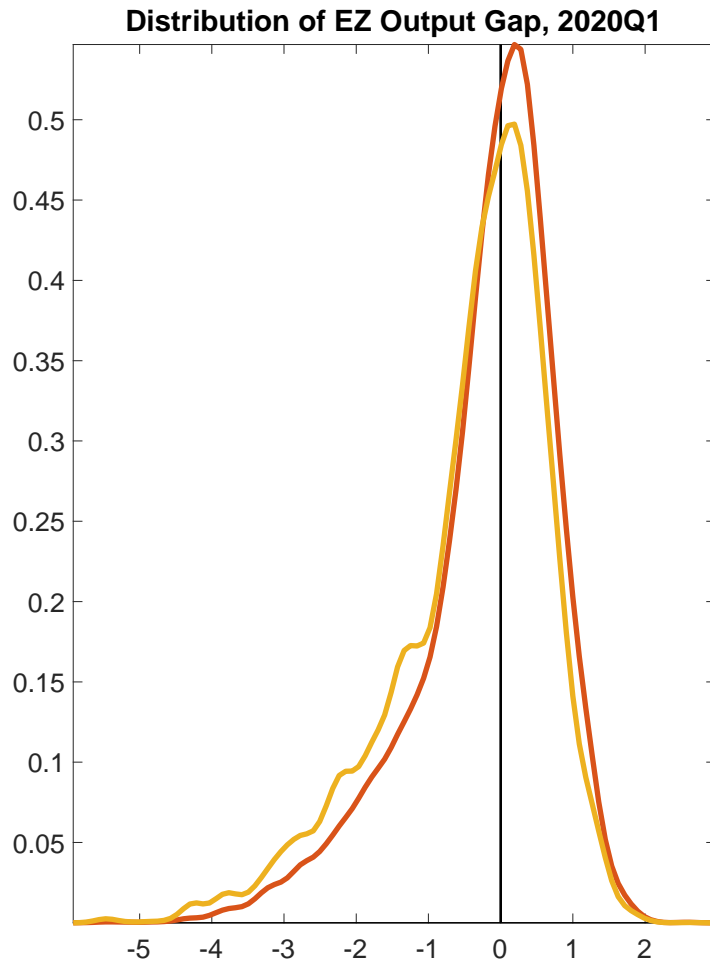
Eurozone



United States



Step 4: Scrutinize the Combined Forecast Results In Economic Terms



Takeaways

- Combine information from a multitude of empirical (reduced-form) models
- Use more robust quantile regression models to describe forecast densities
- Use exponential tilting and structural models to translate forecasts and scenarios into narratives and subject them to smell tests
- Structural Forecast Combination mitigates model risk by
 - Improving consistency of combined forecasts
 - Facilitating evaluation of the combined forecasts

Appendices



Our Systems Evolved to Include Checks against Model Uncertainty

Forecast combination remains the key model uncertainty mitigation technique

- Improve predictive performance
- Process information from broader data sets than any single particular model
- Indicate and handle structural breaks

What is Quantile Regression?

- Analogously to least squares regression, which estimates mean of the dependent variable, QR estimates chosen quantile of the dependent variable
- QR provides more complete picture about the distribution of the dependent variable
- More robust to outliers

What Are Structural Models?

- Derived from (economic) theory
- Explicit notions of demand and supply
- Elements of choice theory, expectations
- Unobserved components

What Is Exponential Tilting?

- Generalizes the concept of conditioning
- For a given model-implied predictive density, find a modified (“tilted”) density to satisfy extra conditions...
- ... while being as close as possible to the original density (in an entropy sense)