

How Should Public Debt Management Institutions Develop Medium-term Issuance Strategies?

An Optimal Debt Portfolio Model

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MOTIVATION & GOALS

- **Rationale for Modeling the Public Debt Portfolio**
 - Assessing all relevant costs and market risks: objective is to minimize both
 - Setting of strategic government debt portfolio targets (benchmarks)
 - Supports decision making
 - Mathematically supported strategies are accepted easier by policymakers
- **Model usage**
 - Macro-modeling provides yield curve forecasts (also for the shorter term financing plan)
 - Strategy formulation at the end of the year
 - Ad hoc runs for analysis purposes
 - Scenario analysis capabilities:
 - Budget deficit changes
 - Yield curve shifts
 - FX exchange rate trajectories
 - Borrowing constraints
 - New debt elements etc.

METHODOLOGICAL APPROACH

Two-Economy stochastic simulation model

- Hungary (small open economy) & Euro area (large economic block)
- Only one-way influence (EMU → Hungary)
- Medium term (5-year) simulation horizon
- Forecast of macroeconomic variables, future cash-flows, borrowing

1. Phase: model fitting

- Markov Regime Switching State-Space Model
 - Macroeconomic model (yield curves, FX exchange rate, inflation, CDS – implements 11 factors!)
 - Two economic states (normal growth periods vs. recession periods)
- Parameter estimation based on historical time series from 2008 in a Bayesian framework

2. Phase: scenario generation

- Forecast: simulation of trajectories (default: 1,000)
- Cost & risk calculation based on the generated scenarios

3. Phase: optimization

- Typically 25,000 possible financing compositions, 200 iterations of optimization
- Minimizing cost & risk factors (multi-objective optimization)
- Finding Pareto-optimal compositions of financing
- Issuance algorithm: monthly frequency, model instruments, issuance constraints

Results: Pareto-optimal compositions of financing, their cost & risk features, resulting debt structures

The model is based on the works of Bebes, Tran and Bebesi [1], [2]

COST AND RISK METRICS

Calculation of costs

- Interest cost
- Issuance price discount or premium
- Currency cost
- Liquidity premium
 - Cost of excess issuance

Risk metrics

- Volatility of costs
 - Standard deviation
 - Cost-at-Risk (CaR)
 - Conditional Cost-at-Risk (CCaR)
- Interest rate sensitivity
 - Average Time-to-Refixing (ATR)
 - Duration, Modified Duration
- Renewal risk
 - Average Time-to-Maturity (ATM)
 - Refinancing ratio (refinancing within 6 months, 1 year or 5 years)

FUNDING LIQUIDITY CONSIDERATIONS

- Liquidity constraint
 - Hard upper bound, no issuance above it
 - Exception: Discount T-bills (infinite demand, instrument of last resort)
- Liquidity threshold
 - Average historical issuance
- Liquidity premium
 - Extra cost of issuance between threshold and constraint
 - Only for local currency market instruments
- Treasury Single Account
 - Optimal cash buffer level

OPTIMIZATION

- Minimize costs and risks of the public debt portfolio
- Medium-term framework, 5-year horizon, monthly frequency
- Determine Pareto-optimal compositions of financing
 - Composition of financing: shares of model instruments we wish to attain in the long run
- Determine cost-risk efficient frontier
- Multiple risk measures
- Multi-objective Pareto-optimization
- 25,000 financing compositions analyzed simultaneously
- Optimal and diverse (200 iterations)

OBJECTIVE FUNCTIONS

Costs

- Minimize expected costs

Volatility of Costs

- Minimize standard deviation

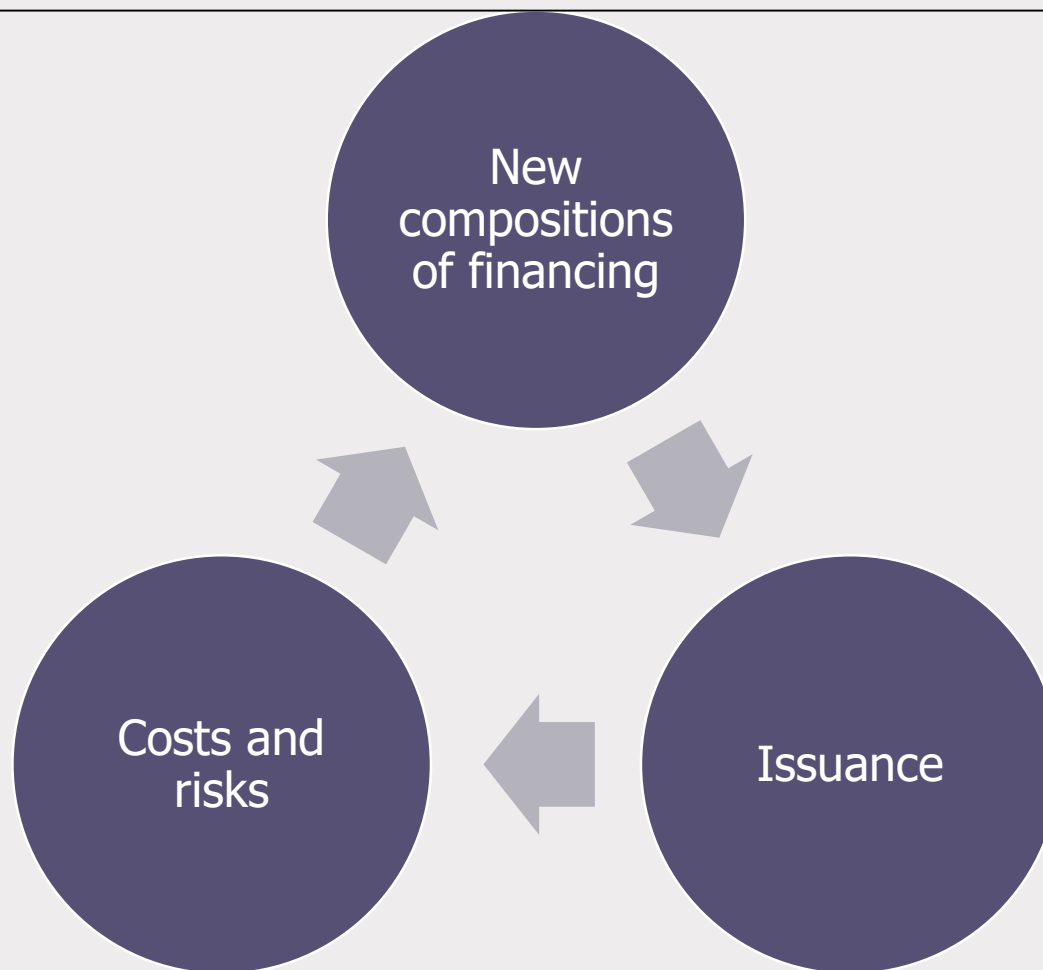
Interest Rate Sensitivity

- Maximize average time to re-fixing (ATR)

Renewal Risk

- Minimize share of 1-year refinancing

OPTIMIZATION PROCEDURE



ISSUANCE ALGORITHM

A typical optimization ~300 billion runs

1,000
realizations
of forecast
time series

25,000
financing
compositions

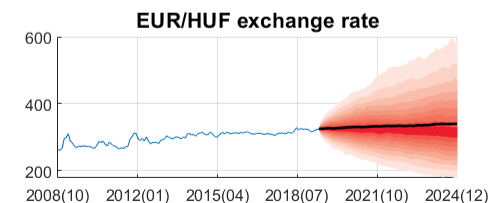
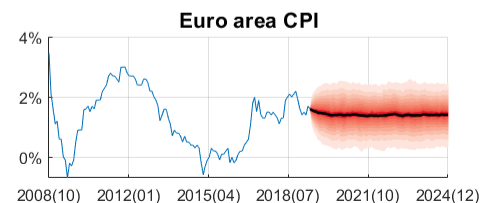
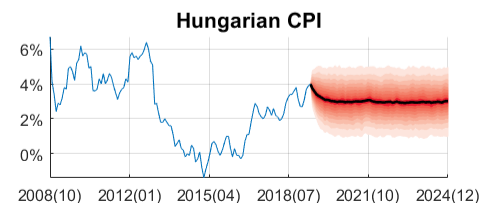
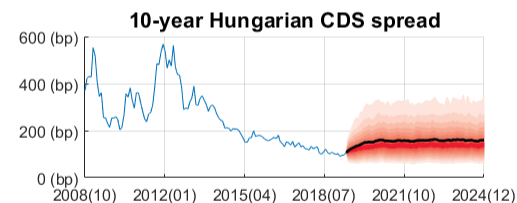
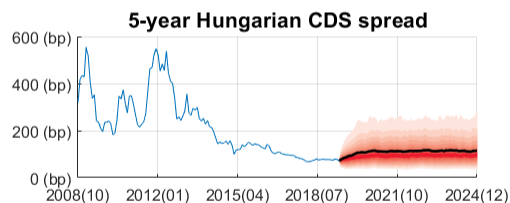
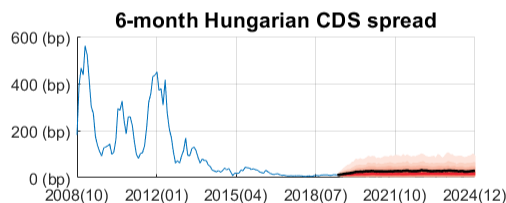
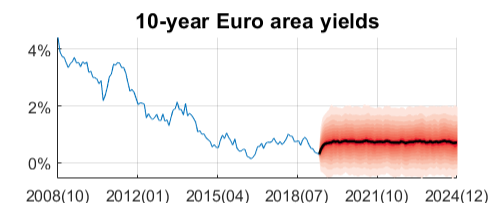
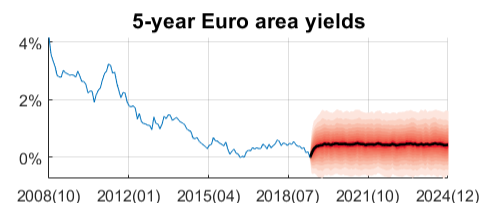
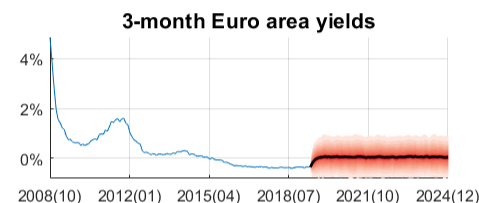
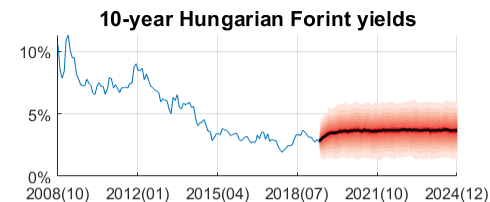
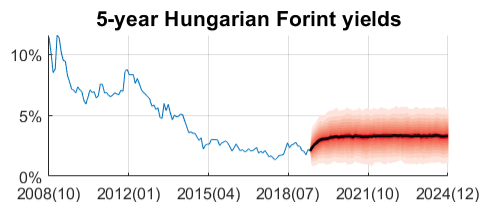
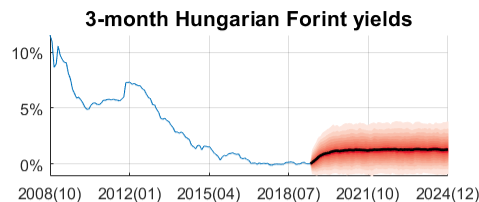
200
iterations

~60 months

MODEL INSTRUMENTS

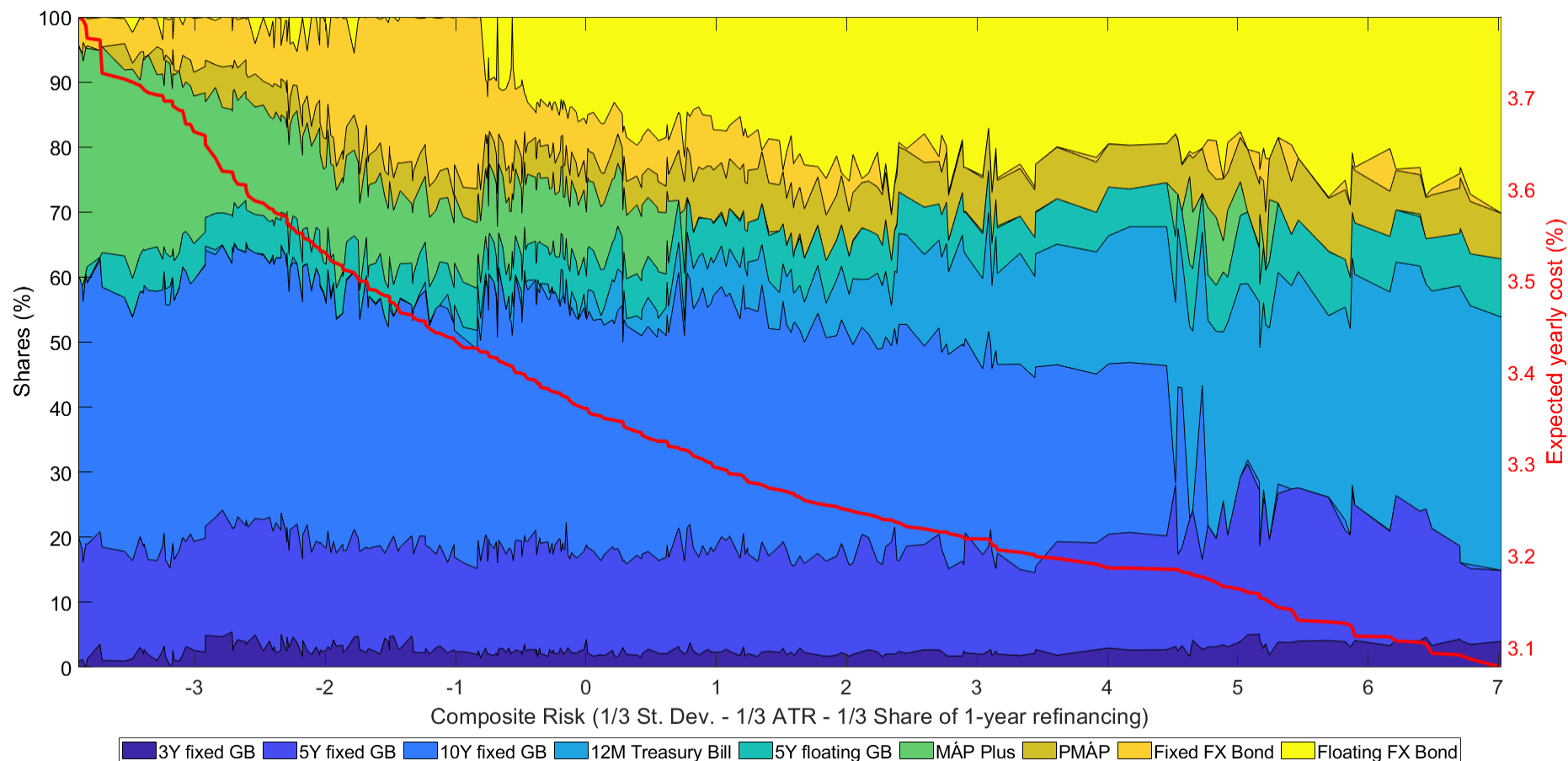
- Domestic market instruments
 - 3-, 5- and 10-year fixed rate Hungarian Government Bonds
 - 5-year floating rate Hungarian Government Bond
 - 12-month Discount Treasury Bill
- FX instruments
 - 5- and 10-year fixed rate FX bonds (Euro denominated)
 - 5- and 10-year floating rate FX bonds (Euro denominated)
- Retail instruments
 - 5-year Hungarian Government Security Plus (fixed rate)
 - 3- and 5-year Hungarian Premium Government Securities (floating rate, inflation linked)

FAN CHARTS



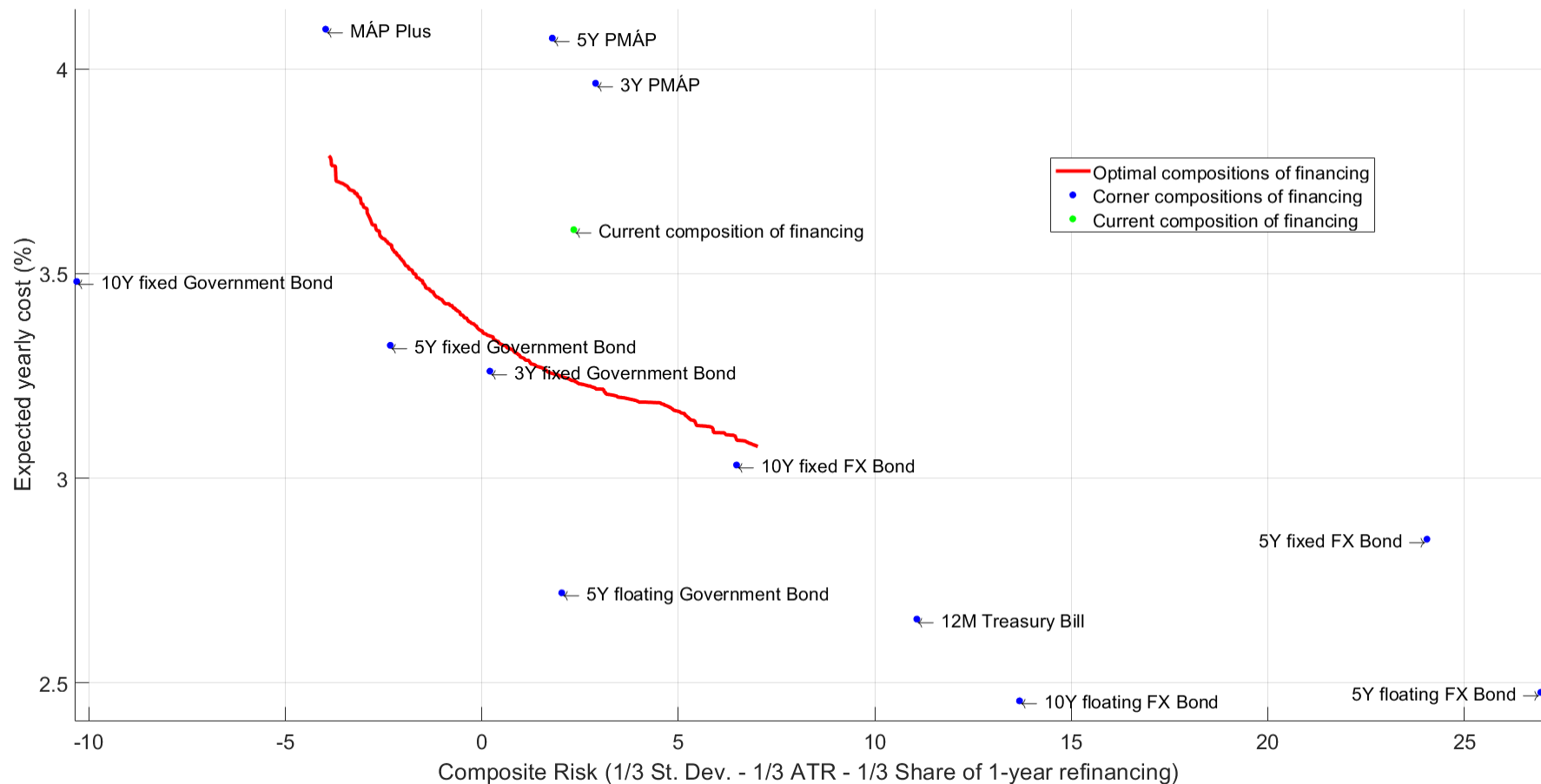
Example of recent simulation.

OPTIMAL COMPOSITIONS OF FINANCING



Example of recent simulation.

COST-RISK EFFICIENT FRONTIER



Example of recent simulation.

REFERENCES

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THANK YOU FOR YOUR ATTENTION!

