Key Points to Remember
STI Course on FX Interventions

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FX Interventions

- FX reserves come **with benefits and costs**
  - Buffer for intervention, building credibility, reducing risk premia, countercyclical policy
  - Cost of sterilization (liquidity management), valuation/duration risk on the balance sheet

- Choose the **right instrument** depending on the issue to address:
  - Excessive volatility: FX spot or forward
  - FX speculation witout endangering FX reserves: **non-deliverable forward**
  - Funding issue without risk transfer: **FX swaps**

- **Implementation**: pre-announced auctions **maximize signalling**, **reduce market distortions**

- Can operate rule-based interventions and discretionary interventions if necessary

Risk-Based FX Interventions

- For floating currencies, FX Interventions are about **managing risk at the macro level**
- **Central banks should model and anticipate risk**, both for discretionary and rules-based interventions
- Intervening through risk-based rules preserves exchange rate as **shock absorber** while strengthening financial stability
- The risk model can be used to benchmark FX interventions, even discretionary ones
- The VaR FXI spot rule can be **combined with other types of interventions**, for instance auctions on forward and NDF
- The risk tolerance can be dynamically ajusted as the hedging instruments are becoming more available

Statistics

- The mean, mode and median inform about the **central tendency**
- The variance informs about the **volatility/risk**, and the skewness about the BALANCE OF RISKS (asymmetry)
- **Density forecasts** are important for policymakers: think about risks and balance of risks, not just the central tendency
- Density forecasts: **uncertainty about the world**
- Confidence interval of the point forecasts: **uncertainty about the model**

Time Series Models

- Always check for **stationarity** before estimating models (ADF, KPSS): **differentiate** the data as necessary
- **Seasonality** and **trend** are generating non-stationarity
  - Seasonality can be dealt with Fourier terms (if regular), dummies (if irregular)
  - Trend can be addressed with detrending methods
- Partial autocorrelation purges out the effect of terms at shorter lags
- PACF: help selecting lag from AR, ACF helps on MA models
- Check that the residuals look like a white noise, for well-specified model

Volatility Modeling

- There is a difference between **realized volatility** (of realizations over time) and **conditional volatility** (probability of a future realization)
- GARCH models address most of the features of financial time series, yet are relatively simple too
- Very few models are able to outperform GARCH(1, 1). **GARCH(1,1) should be the benchmark model**
- GARCH embedds symmetric volatility shock. If you want **asymmetric shocks**: use **GJR-GARCH or EGARCH** instead.
- If you need more skewness and kurtosis to fit the data, change the distribution of the normalized residuals: SkewStudent, GED, etc.

Model Validation

- A model that performs well in-sample (R2, significant coefficients, etc.) does NOT necessarily forecast well: **risk of overfit**

- Crucial to measure the **out-of-sample performance**: backtest in **"real-conditions"**

- Use the right metric depending on the problem at hand:
  - For point forecast: RMSE, MSE, MAE (without outliers), MAPE. RMSE and MSE are sensitive to outliers
  - For density forecasts:
    - ⋆ Specification test: **Probability integral transform** (not too optimistic/pessimistic)
    - ⋆ Performance test: **logscore** (on average) or asymmetric logscore (for the tails)

- Hypothesis testing: "*Can not reject H0 doesn't mean we can accept HA*"

Python Programming

- Python is free and open-source and **can help the central bank for many tasks**, with thousands of packages:
  - Modeling and forecasting
  - Data management and data vizualization
  - Tasks automation

- You can use **Jupyter Notebooks** for coding, simple and efficient. Else Spyder for more advanced tools

- Create a new environment for each new project via Anaconda

- Import packages before using them, and set the working directory before running script

- **Lot of free online resources to learn Python**: encourage colleagues to use Python!

Thank You

- **Thank you very much for your enthusiasm and participation!**
- Thanks to STI and Alina for the spotless organization!
- We hope that this course will be helpful to you
  - Not only for FX interventions
  - Also for monitoring, research, forecasting, etc.
- Quantitative methods are more and more important, important for your central bank and your career !
- Interested in quantitative methods on other topics?
  - We are teaching **Forecasting Framework for Central Bank Systemic Liquidity in STI in 27 November - 01 December 2023 !**
  - Don't hesitate to register! FFCBSL: https://www-ins.imf.org/TAS/signon.aspx?pkey=ST23.30E