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Empirical Estimation of GDP-at-Risk Models

CCBS Course for Central Bank of Egypt

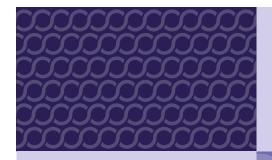**Simon Lloyd** (sites.google.com/view/splloyd/home)

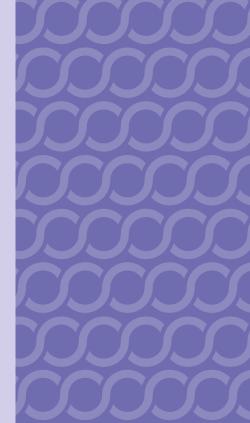Senior Research Economist, International and Financial Stability Strategy and Risk, Bank of England

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Plan for today

1. **An introduction to data and code to construct GDP-at-Risk model**

    *   Practical walk-through in MATLAB

2. **Discussion of modelling Egyptian GDP-at-Risk**

    *   What countries are most relevant to Egyptian macro-financial stability?

    *   What are the most relevant risk factors to focus on?

    *   Over what time span is data available for?

    *   Which results to focus on?

GDP-at-Risk Code: Overview

- The code is written in MATLAB and estimates a local-projection quantile regression model:

$$GDP\ growth_{i,t+h} = \alpha_i + \beta_1 \boldsymbol{X}_{i,t} + \beta_2 \boldsymbol{X}^*_{i,t}$$

LHS variable varies across different quantiles and horizons

Country fixed effects

Domestic indicators

Foreign indicators

- The code produces:
  1. Impulse Response Functions (IRFs) at 5th, 50th, 95th perc (& mean)
  2. Quantile Response Functions (QRFs)
  3. Historical Decomposition of GDP@R

GDP-at-Risk Code: Structure

- The code folder contains a "MASTER_GAR" file which is the only code that needs to be run to load the data, estimate the QR and obtain results

- Sub-codes are labelled "GO_*" and are also contained in "mfunctions" folder

- The "MASTER_GAR" file is structured as follows:
  - Preliminaries
  - Section 1: Load in data from Excel
  - Section 2: Transform data and set-up "X" and "y" matrices for the regression
  - Section 3: Estimate quantile-regression local projection – save coefficient estimates, standard errors and fitted values
  - Section 4: Produce charts to analyse results
  - Section 5: Save estimation

GDP-at-Risk Code: User Inputs

- User inputs (% ***) in order to run MASTER_GAR:

- Line 19: set user working directory where codes / subfolders are saved

- Lines 24-25: select whether to save results

- Line 48: select model to run (defined in "GO3_Switches")

- Lines 106 / 117 / 124-130: select which results you want to focus on

- User inputs in GO3_Switches

- Lines 10-16: define sample period and countries for estimation

- Lines 18-26: set LHS variable

- Lines 28-58 set RHS variables

- Lines 60-65: set bootstrap options for calculation of standard errors

- Lines 68-69: set quantiles and horizons to estimate

GDP-at-Risk Practicalities: Step 1

- Construct database and load in data

  - data saved in Excel files and loaded into MATLAB in GO1_LoadData

  - Should include GDP data, macro-financial data, linkages data (e.g. trade/financial weights)

TODAY:

Macro-financial dataset for advanced economies from Aikman et al. (2018) (extended by Lloyd et al. (2021)): covers data on circa. 20 variables for 22 countries (AEs and EMEs) 1972-2018

GDP-at-Risk Practicalities: Step 2

- Define specification to run - sample period and choice of covariates will depend on:

  - Data availability / degrees of freedom

  - Theory / previous studies

  - Country-specific knowledge (which variables matter most for GDP-at-Risk)

TODAY:

- 1980-2018 quarterly data for 11 advanced economies

- Domestic variables: Volatility, 3y change in Credit-to-GDP, GDP growth

- Global variables: None (for simplicity)

GDP-at-Risk Practicalities: Step 3

- Estimate QR and interpret results:

- Are the results in line with hypothesis?

- Do we see different effects across horizons and quantiles?

TODAY:

- Increase fin market vol. -> fall in GDP@R (*increased* tail risk) in near-term

- Increase debt-to-GDP -> fall in GDP@R (*increased* tail risk) in medium-term

- For credit, -ve effect at 5th perc = **2 x** effect at median

- Hist Decomp: at policy-relevant horizons, debt-to-GDP explains most of fluctuations in UK GDP@R

Discussion: Features of a CBE GDP-at-Risk model

- Data availability:
  - Length of time series
  - Panel vs. country-specific (is panel assumption reasonable?)

- Which risk factors?
  - Domestic financial conditions and credit growth
  - Domestic macroeconomic controls
  - Global factors?

- Results to focus on:
  - Impulse responses
  - Historical decomposition

Resources for Estimating GDP-at-Risk

Range of tools available:

- IMF (Excel / Python)

- CEMLA (R)

- BoE (MATLAB)