ESM DSA Analysis Using a Markov Switching Two Country EA DSGE Model

Assessing Debt Sustainability: Modelling Challenges and the Way Forward

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The views expressed are those of the presenter and do not necessarily reflect those of the European Stability Mechanism.

Motivation: Important Questions:

- what is missed by designing (off model) economic scenarios without endogenising the probability of stress might arise?
- would be wise to ignore the policy interactions (i.e. Francesco's work)?
- what happens when market participants' expectations decouple from those communicated by policy institutions
- are crises linear or nonlinear episodes (i.e. small changes can trigger large effects)?

ESM Debt Sustainability in General

- Highly sophisticated process given the number of tools employed and functions involved
  - Tools:
    - Traditional DSA spreadsheets combined with
    - Early Warning System analysis and
    - BVAR & Entropy simulation techniques
  - Guidance & Decision Steps:
    - EA baseline and adverse forecasts (EA team)
    - DSA horizontal guidance (DSA team)
    - Assessment of country specificities and shocks (Country teams)
  - Validation Stages:
    - Comments from the ERA Head
    - Comments from the Review Function
    - Comments from the Chief Economist

DSGE Stochastic Analysis

- It is an organising framework that allows us to:
  - ensure consistency by bringing together the output of all tools mentioned earlier
  - capture the feedback loop from the debt to the real economy (and vice versa)
  - capture how the (fiscal and monetary) policy mix affects the evolution debt dynamics
  - allow for market participants to have expectations that differ from those communicated by policy authorities
- Currently, the model is in a "learning mode" (i.e. we are learning a lot from the model)
- Some work is pending (i.e. probability thresholds) before the model becomes fully operational

Key Features of the Model

- **A Two Country Open Economy Model**
- **Standard New Keynesian Real and Nominal Frictions**
- **Financial Frictions**:
  - Government can (partially) default on public debt (Uribe (2006), Bianchi (2019), Kriwoluzky et al. (2019))
  - EA Debt (or ECB reserves) is perceived a more liquid or less risky than country-specific debt (Andres et al. (2004), Chen et al. (2012), Chin et al. (2022))
  - Default also erodes part of FIs' assets and impacts the households/corporates' effective interest rate (Smets and Wouters (2007), Fisher (2015), Corsetti et al. (2013))
- **Country Specific Fiscal Authorities**:
  - Revenues: consumption, labour and capital taxes
  - Expenditures: government consumption and transfers
  - All fiscal instruments are function of the debt to GDP ratio, transfers also respond to cyclical conditions (automatic stabilizers)
- **EA Authorities**:
  - Monetary policy via a Taylor Type rule (QE or/and TPI)
  - EA budget

Markov Switching: Default Expectations

- The linearised government budget constraint is given by:

$$\frac{b}{y}\hat{b}_t + \frac{\tau^K r^K k}{y}\left(\hat{\tau}_t^K + \hat{r}_t^K + \hat{k}_t\right) + \frac{\tau^L wl}{y}\left(\hat{\tau}_t^L + \hat{w}_t + \hat{l}_t\right) + \frac{\tau^C c}{y}\left(\hat{\tau}_t^C + \hat{c}_t\right)$$

$$= \frac{b}{y}\frac{1}{\beta}\hat{b}_{t-1} + \frac{b}{y}\frac{1}{\beta}\left(\hat{r}_{t-1}^G - \hat{\pi}_t - \hat{\gamma}_t\right) - \frac{b}{y}\frac{1}{\beta}\hat{d}_{s_t} + \frac{g}{y}\hat{g}_t + \frac{z}{y}\hat{z}_t + \frac{z^\Delta}{y}\hat{z}_t^\Delta$$

$$\hat{d}_{s_t} = \begin{cases} 0, \\ \chi B_t \end{cases}$$

- As in Corsetti et al. (2013) the amount of default $\frac{b}{y}\frac{1}{\beta}\hat{d}_{s_t}$ is transferred to households $\frac{z^\Delta}{y}\hat{z}_t^\Delta$ so no improvement after default (i.e. expectations about default)

- The evolution between **No Default** and **Default** regimes is controlled by the transition matrix $P_s = \begin{bmatrix} p_{NDF} & 1 - p_{DF} \\ 1 - p_{NDF} & p_{DF} \end{bmatrix}$

Markov Switching: Financial Frictions

- Liquidity frictions and default affect the funding cost for government and private sector, respectively:

$$\hat{r}^G_t = \hat{r}_t + \hat{d}_{s_{t+1}} + \hat{\varepsilon}^{rp}_{t+1} + \tilde{s}^B_{s_t}\left(\hat{b}^G_t + \widehat{\overline{p}}^{EA}_t - \hat{b}^{EA}_t\right)$$

$$\hat{r}^S_t = \hat{r}_t + \hat{\varepsilon}^{rp}_{t+1} + \tilde{s}^B_{s_t}\frac{B^G}{B^{EA}+B^G}\left(\hat{b}^G_t + \widehat{\overline{p}}^{EA}_t - \hat{b}^{EA}_t\right) + \vartheta_{s_t}\hat{d}_{s_{t+1}}$$

$$\vartheta_{s_t}, \tilde{s}^B_{s_t} = \begin{cases} 0 \\ \tilde{s}^B, \vartheta \end{cases}$$

- Similar to Corsetti et al. (2013) default has an impact on the real economy (unlike Uribe (2006))
- which then affects the evolution of debt and spreads (feedback loop)

Switching Between Low Inflation and High Debt Policy Regimes

- Monetary Policy

$$\hat{r}_t = \rho_r \hat{r}_{t-1} + (1-\rho_r)\, \phi^{\pi}_{m_t} \hat{\pi}^{EA}_t + (1-\rho_r)\, \phi^{y} \hat{y}^{EA}_t + u^r_t \tag{1}$$

- Fiscal Instruments

$$\hat{\tau}^J_t = \rho^J \hat{\tau}^J_{t-1} + \left(1-\rho^J\right) \gamma^J_{m_t} \left(\hat{b}_{t-1} - \hat{y}_{t-1}\right) \tag{2}$$

$$\hat{g}_t = \rho^G \hat{g}_{t-1} - \left(1-\rho^G\right) \gamma^G_{m_t} \left(\hat{b}_{t-1} - \hat{y}_{t-1}\right) \tag{3}$$

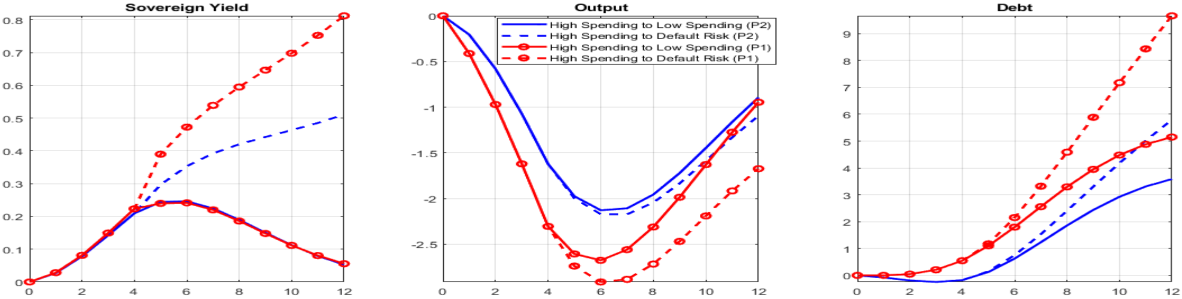
$$\hat{z}_t = \rho^Z \hat{z}_{t-1} - \left(1-\rho^Z\right) \gamma^Z_{m_t} \left(\hat{b}_{t-1} - \hat{y}_{t-1}\right) - \left(1-\rho^Z\right) \phi^Z \hat{y}_{t-1} \tag{4}$$

- Low Inflation Regime: i) $\phi^{\pi}_{m_{LI}} > 1$, ii) $\gamma^J_{m_{LI}} > 1/\beta$
- High Debt Regime: i) $\phi^{\pi}_{m_{HD}} < 1$, ii) $\gamma^J_{m_{HD}} < 1/\beta$
- The evolution of m_t is governed by the transition matrix $P_m = \begin{bmatrix} p_{LI} & 1-p_{HD} & 1-p_{NCC} & 0 \\ 1-p_{LI} & p_{HD} & 0 & 1-p_{NCC} \\ 0 & 0 & p_{NC} & 0 \\ 0 & 0 & 0 & p_{NCC} \end{bmatrix}$

Oil Adverse Shock & Risks of Default

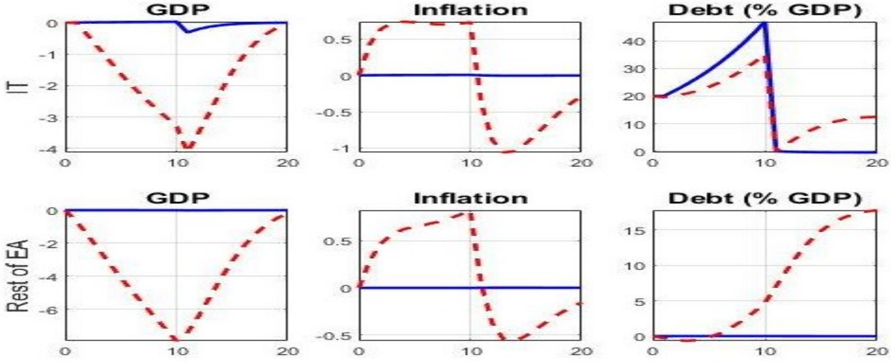
- Oil Shock increases inflation in period 1 for both IT and EA
- This leads to an increase of the policy rate
- IT switches to a high spending regime for the next 4 quarters (two scenarios):
  - IT switches back to a **low** spending regime
  - IT continues with a high spending regime but **expectations** about default **rise**
- This simulation is repeated for both $P_1 = \begin{bmatrix} 0.9 & 0.15 & 0.1 \\ 0.1 & 0.7 & 0.2 \\ 0.0 & 0.15 & 0.7 \end{bmatrix}$, $P_2 = \begin{bmatrix} 0.9 & 0.3 & 0.1 \\ 0.1 & 0.7 & 0.2 \\ 0.0 & 0.0 & 0.7 \end{bmatrix}$ matrices

Oil Adverse Shock & Risks of Default (cont.)



- A sequence of oil shocks hits the economy for the first four periods
- In response to the oil shocks, policymakers move to a high spending regime for four periods
- In period 5, we consider two scenarios. In the first scenario, policymakers move back to low spending (solid lines). In the second scenario, they keep with high spending, raising concerns about the possibility of a default (dashed lines)
- For each scenario, we analyse the case of a high-reputation country (blue lines with no circles) and a low-reputation country (red lines with circles)

Debt Crisis: The Role of Policy Uncertainty



- **Sequence of Regimes:** No Policy Co-Operation (NCC), Default (DF), Low Inflation (LI)
- **Two Cases:** No Policy Uncertainty (blue-line) $P_{NU} = \begin{matrix} NCC \\ DF \\ LI \end{matrix} \begin{bmatrix} 0.9 & 0 & 0 \\ 0.1 & 0 & 0 \\ 0 & 1 & 1 \end{bmatrix}$ (blue-line), Policy Uncertainty

$$P_U = \begin{matrix} NCC \\ DF \\ LI \\ HD \end{matrix} \begin{bmatrix} 0.9 & 0 & 0 & 0 \\ 0.05 & 0 & 0 & 0 \\ 0 & 1 & 1 & 0 \\ 0.05 & 0 & 0 & 1 \end{bmatrix}$$

, where HD stands for High Debt regime

Day to Day Use

- Tailored/calibrated to each country
- Features of the model are switched on/off depending on the state of the economy
- A MATLAB/Excel toolkit allows country teams to simulate alternative scenarios
- Understand how market participants view the evolution of debt depending on:
  - state of the economy
  - evolution of risks
  - policy mix

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