Debt sustainability and monetary policy: The case of ECB asset purchases

Enrique Alberola (BIS), Gong Cheng (BIS), Andrea Consiglio (University of Palermo),

Stavros Zenios (University of Cyprus, Cyprus Academy of Sciences, Bruegel)

DebtCon5, Florence, 25-26 May 2022.

Plan of the presentation

- Motivation and contribution
- Model and scenarios overview
- Results
- Conclusions

Introduction

Motivation

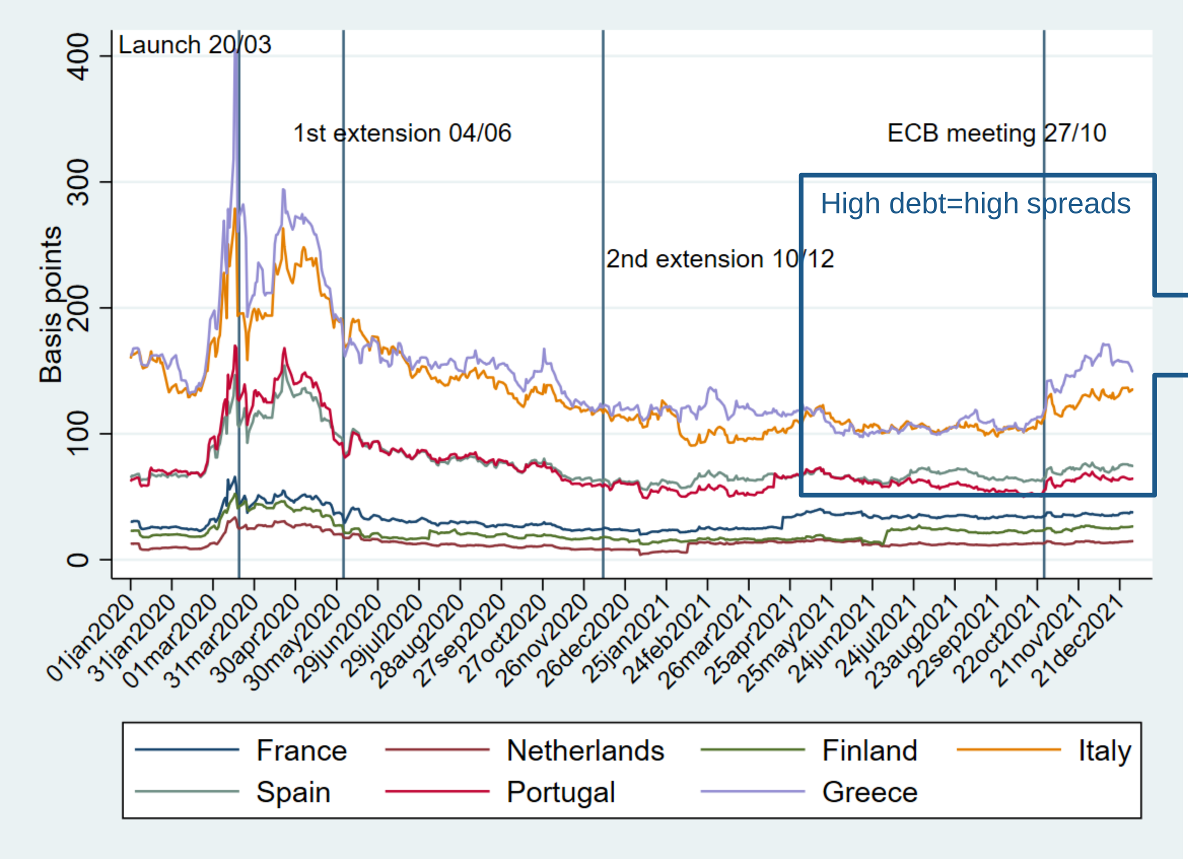
- Monetary and fiscal policy closely interacted to cushion the pandemic's economic fallout
- Central Banks deployed unconventional tools on an unparalleled scale
- Some EMEs have followed suite during the pandemic
- Financing conditions eased, giving leeway to very expansionary fiscal policy
- Announcements on asset purchases (launch, extensions, end, unwinding) affect spreads

➔ Need to rethink about debt sustainability in the context of

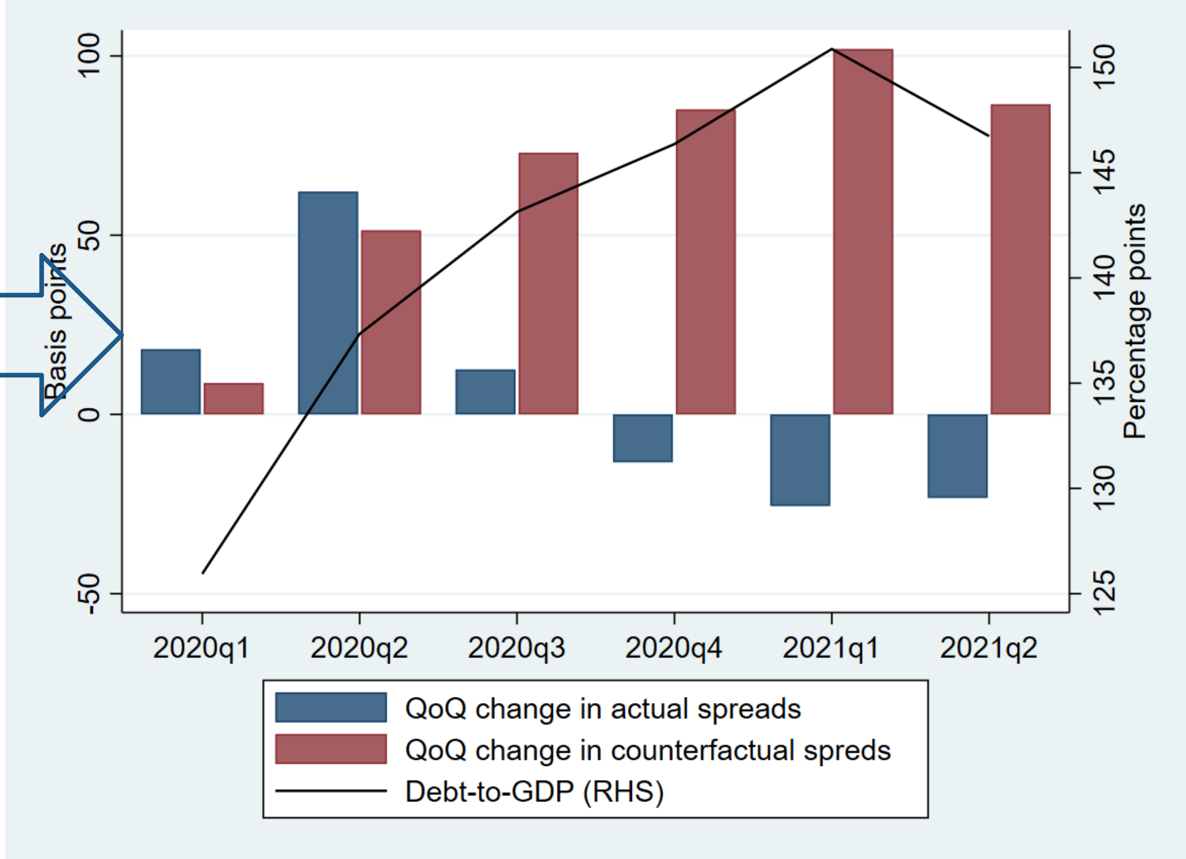
  - Unconventional monetary policy
  - tighter monetary-fiscal interactions: central bank actions impacting on debt dynamics

Motivation: looking into the counterfactual

Actual impact on sovereign spreads



Large impact for high-debt countries



Research question and contribution

- To what extent do central bank asset purchases, e.g. PEPP impact debt sustainability through its effects on credit spreads?
- What would happen
  - With no PEPP
  - When the ECB stops purchases and unwinds its portfolios?
  - If an inflation shock hits (like currently) and monetary policy:
    - looks through the shock
    - reacts with higher policy rates?
- How do governments adjust for debt management against the trade-off between financing costs and rollover risks given unconventional monetary policymaking?

Stochastic DSA
(Zenios, Consiglio, et al., *Op. Res*, 2021)

- Basic DSA with debt stock and flow dynamics
- Uncertainties with time/state-space **scenario trees**
- Risk management introduced with **Conditional VaR**
- Debt management optimisation:
  trade-offs between costs and rollover risks

\+

Macro framework
(≈Hofmann et al., BIS, 2021)

- IS and Phillips curves
- An active central bank setting
  - Conventional: Taylor rule
  - **Unconventional: PEPP**
- Affecting the yield curve through risk/term premia

↓

DSA simulations

- PEPP vs. no PEPP. Exit strategies. Inflation shock.
- Debt management strategies

Model overview

Stochastic DSA

- Basic debt dynamics equation (**stock**)

$$D_t - D_{t-1} = \left(\frac{r_t - \pi_t - g_t}{1+g_t}\right) D_{t-1} - \boldsymbol{PB_t}$$

- Basic gross financing needs equation (**flow**)

$$GFN_t = i_{t-1} D_{t-1} + A_t - PB_t$$

- Debt **financing** strategy

$$\sum_{j=1}^{J} X_t(j) = GFN_t$$

Debt stock and flow are expressed as ratio to **GDP** (Y_t) (lower case letters)

Optimisation model for Private Debt Management Offices (PDMOs):

- Minimise the cost of financing flows (gfn)
  - Subject to taking limited risks

$$\underset{X}{\text{Minimize}} \sum_{\substack{n \in N_t, \\ \text{for all } t=0,1,2,\ldots T.}} \text{Prob}^{(n)} \, \text{IP}_t^n$$

← Expected costs of debt (sum interest payments)

s.t. ← Debt flow bounded

$$\Psi(gfn) \leq \omega.$$

Debt sustainability

- Resolution maps debt trajectory with underlying probabilities
- Assessment on debt probability:

$$\frac{\partial d}{\partial t} \leq \delta.$$

- General criterion
  - $\delta \leq 0$ = declining debt
  - With a certain probability, at certain time horizon

Introduction of a macro framework and a central bank

- Phillips Curve:

$$\pi_t = \beta_\pi \pi_{t-1} + (1-\beta_\pi)E\pi_{t+1} + \gamma \hat{y}_t + \epsilon_{\pi,t}$$

- IS curve:

$$\hat{y}_t = \delta_y \widehat{y_{t-1}} + \left(1-\delta_y\right)E\widehat{y_{t+1}} - \alpha_y\left(i_{ft} - r^*\right) + \epsilon_{\hat{y},t}$$

- Taylor rule:

$$i_{ft} = \theta_i i_{t-1} + (1-\theta_\mathrm{i})[\pi_{t-1} + r_\mathrm{t}^* + \alpha_\pi(\pi_{t-1} - \pi_t^*)] + \alpha_i \widehat{y_{t-1}} + \epsilon_{i,t}$$

Monetary policy and risk premia

- The policy rate i_t plus term and risk premia $\rho_{t,j}$ affect debt financing costs at different maturities

$$r_t(j) = i_{ft} + \rho_{t,j}$$

- The premium is a function of debt levels ***and*** asset purchases

$$\rho\left(d_{i,t}, p_{i,t}, j\right) = \rho_C(d_{i,t}, j) \times (1 - \rho_{U_i}(p_{i,t}))$$

  - Under conventional monetary policy: $\rho_C\left(d_{i,t}, j\right)$, debt levels $d_{i,t} \rightarrow$ ↑ risk premia
  - Unconventional monetary policy suppresses spreads by the factor $\rho_U\left(p_{i,t}\right)$
    - PEPP purchases per country $p_{i,t} \rightarrow$ ↓ risk premia
  - The functional form $\rho_{U_i}(p)$ is estimated empirically:

$$\rho_{U_i}(p) = \begin{cases} \beta_{0,i} + \beta_{1,i} p + \beta_{2,i} p^2 & 0 < p < \overline{p}_i \\ \overline{\rho}_i & p_t \geq \overline{p}_i. \end{cases}$$

Cumulated PEPP purchases and spread suppression

- Risk premia estimation

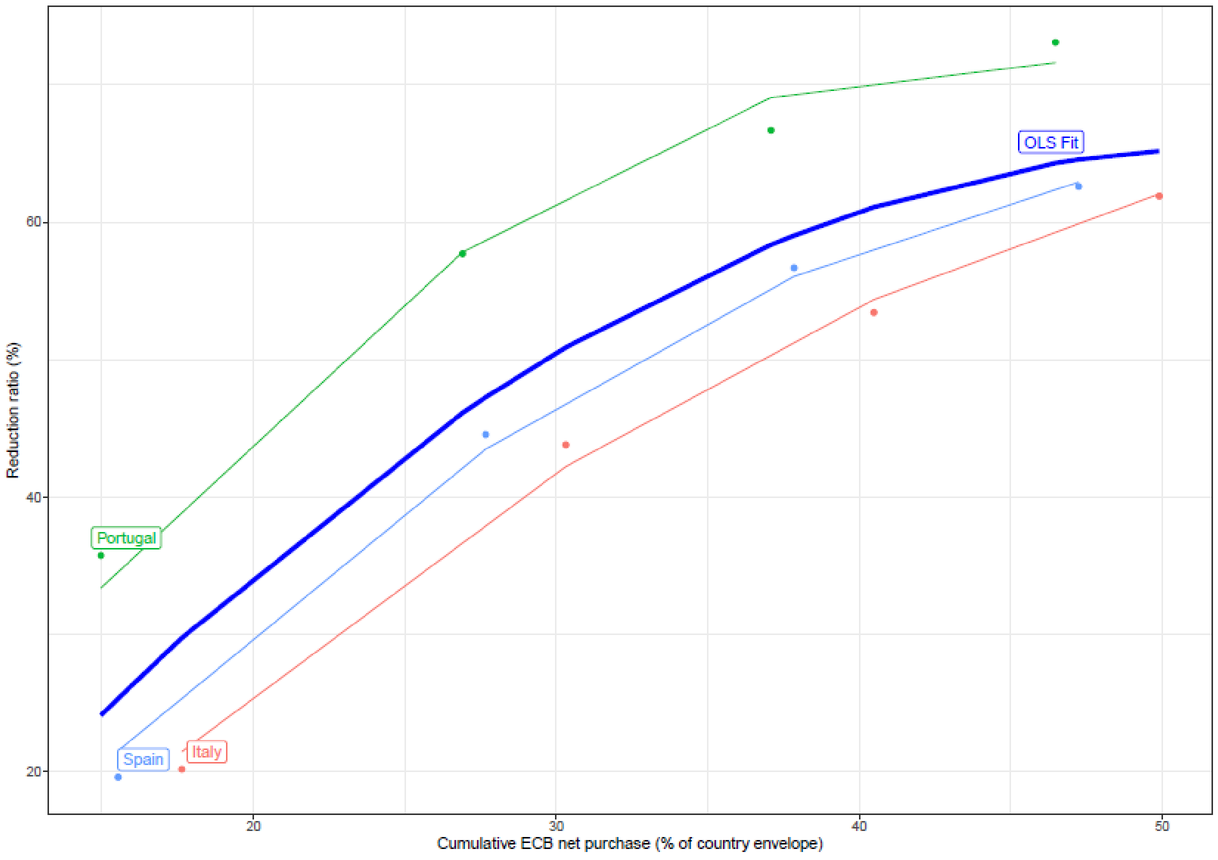
$$\rho(d_{i,t}, p_{i,t}, j) = \rho_C(d_{i,t}, j) \times (1 - \rho_{U_i}(p_{i,t}))$$

≈3bp x Δ 1 pp debt/GDP
Motivation slide

- Suppression function
  - Non linear estimation, country by country

$$\rho_{U_i}(p) = \begin{cases} \beta_{0,i} + \beta_{1,i}p + \beta_{2,i}p^2 & 0 < p < \bar{p}_i \\ \bar{\rho}_i & p_t \geq \bar{p}_i. \end{cases}$$

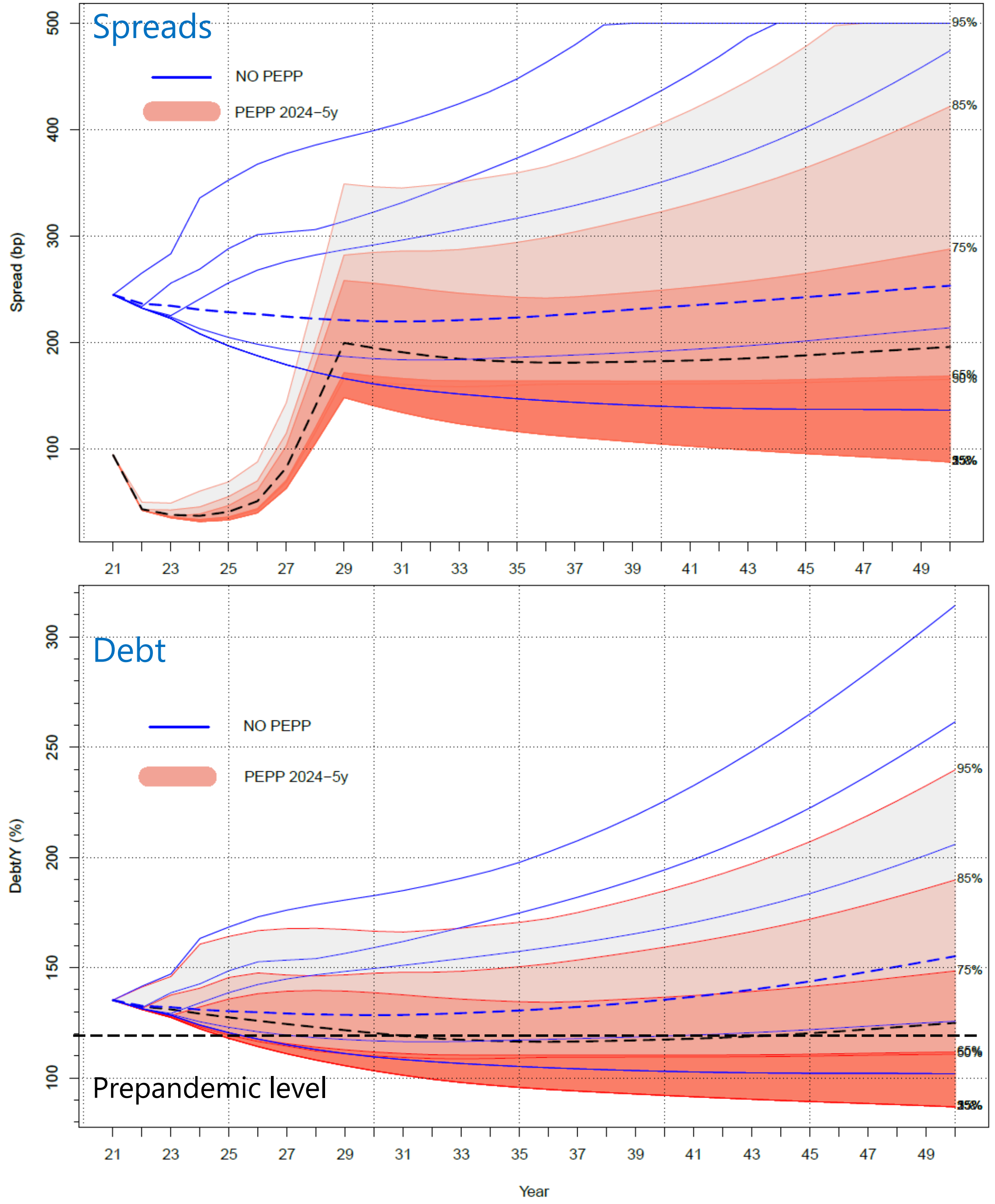
Figure 5 – PEPP-induced spread suppression



Main results

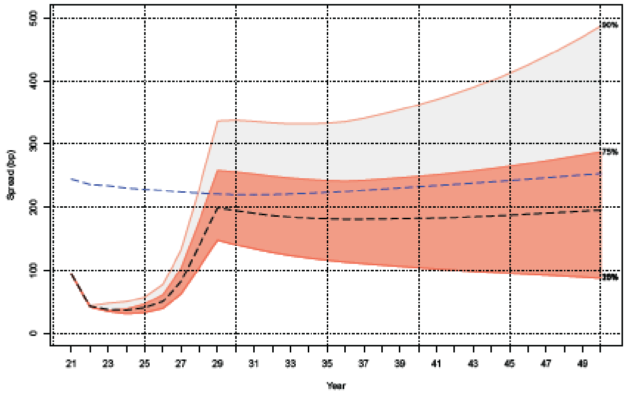
Asset purchases lowered financing costs and contributed to debt sustainability

- Fan charts on scenario tree
- **No PEPP (blue):** much higher spreads; Long-term debt rising up above pre-pandemic level; skewed towards higher risks
- **PEPP (red):** spreads depressed during PEPP
  - Unwinding (Early QTightening) gradually increases spreads before stabilising;
  - Long-term debt stabilises around pre-pandemic level; skewed towards lower risks

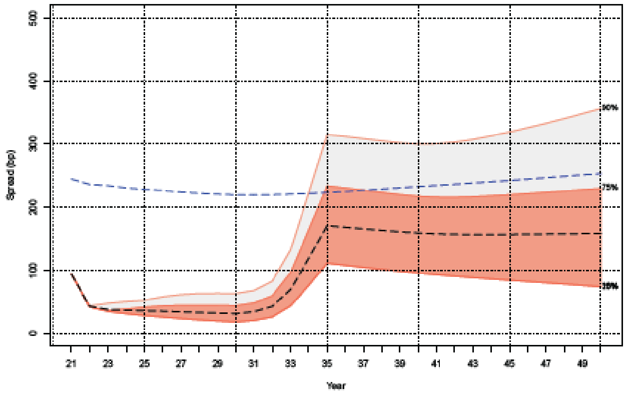


The more gradual the unwinding , the more favourable debt dynamics

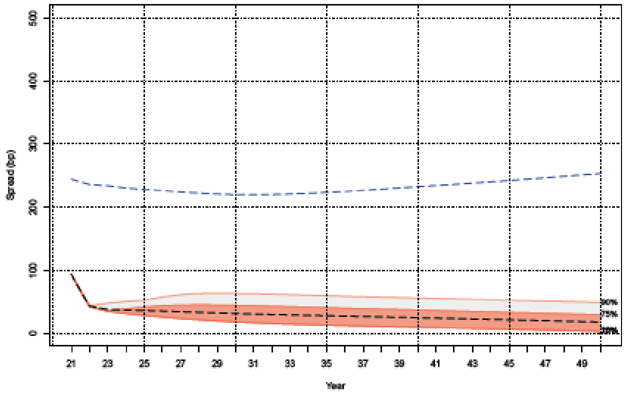
(A) Risk premia, EarlyQT



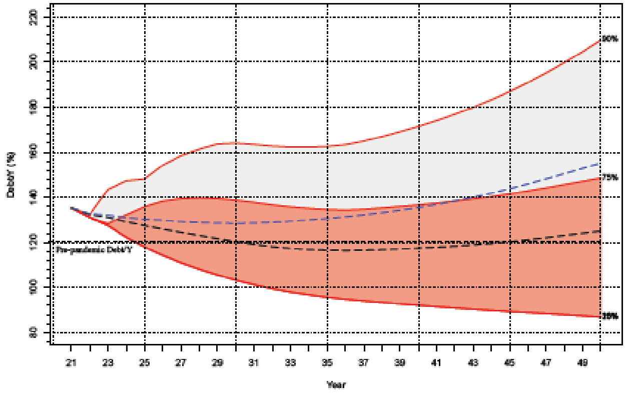
(B) Risk premia, LateQT



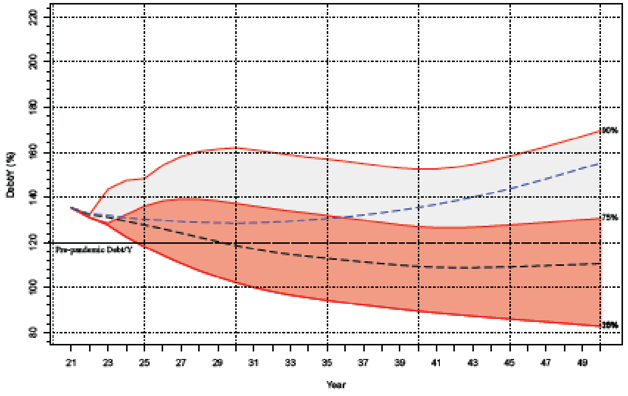
(C) Risk premia, QEternity



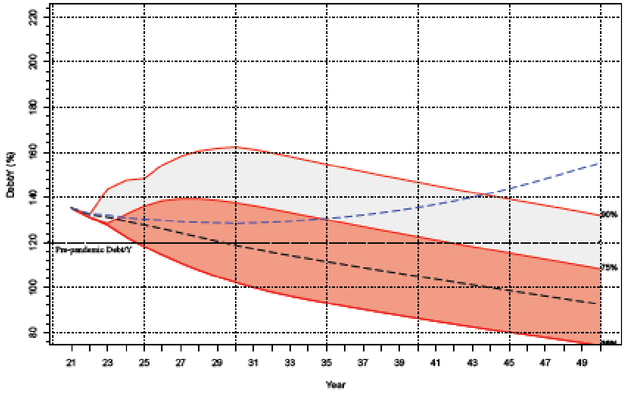
(D) Debt stock, EarlyQT



(E) Debt stock, LateQT



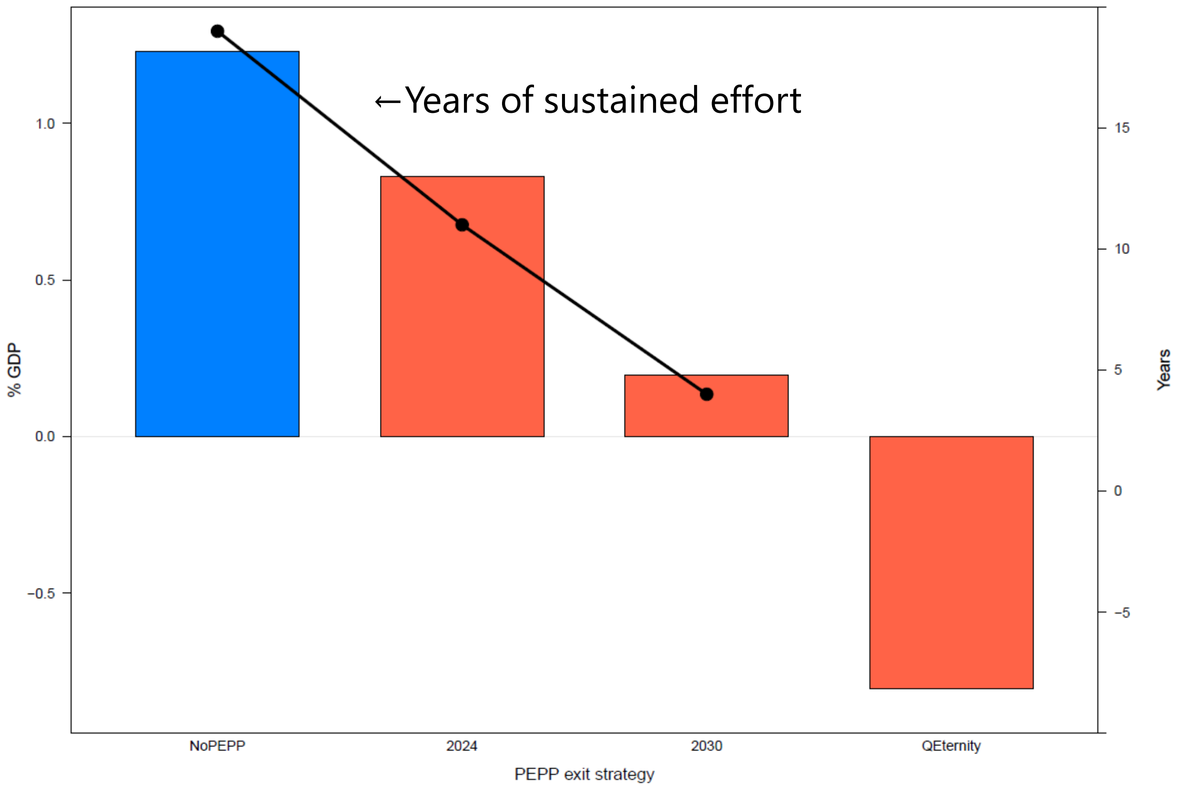
(F) Debt stock, QEternity



Unwinding (QT) and debt dynamics

- The earlier the start of unwinding, the larger extra fiscal effort and longer time are needed to stabilise debt.

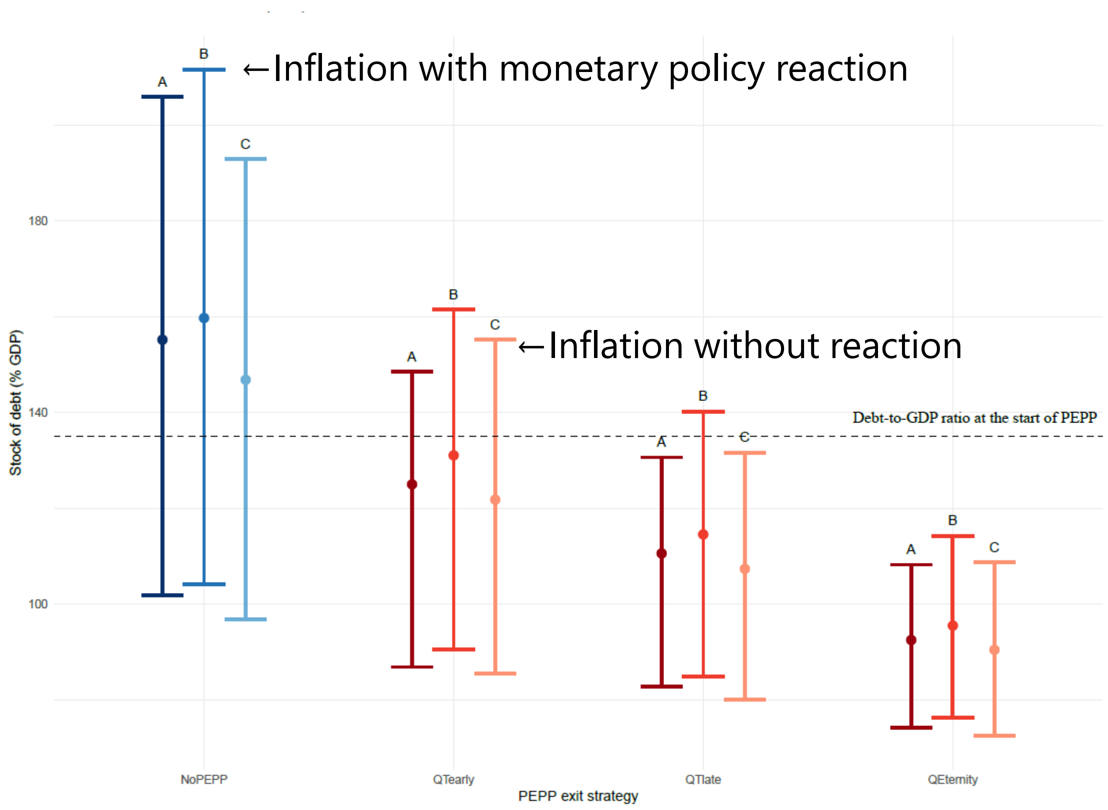
Extra fiscal effort to stabilize debt
(mean and interquartile range)



Implications of an inflation spike

- Dependent on the nature of the shock (short-lived or persistent) and the reaction of the central bank (interest hikes or not)
- Central bank hike rates (B bars): debt stock increases at the end of the horizon due to rising financing costs
- Central bank looks through the shock (C bars): debt dynamics improve slightly due to nominal effects
- Overall, the impact of inflation is small

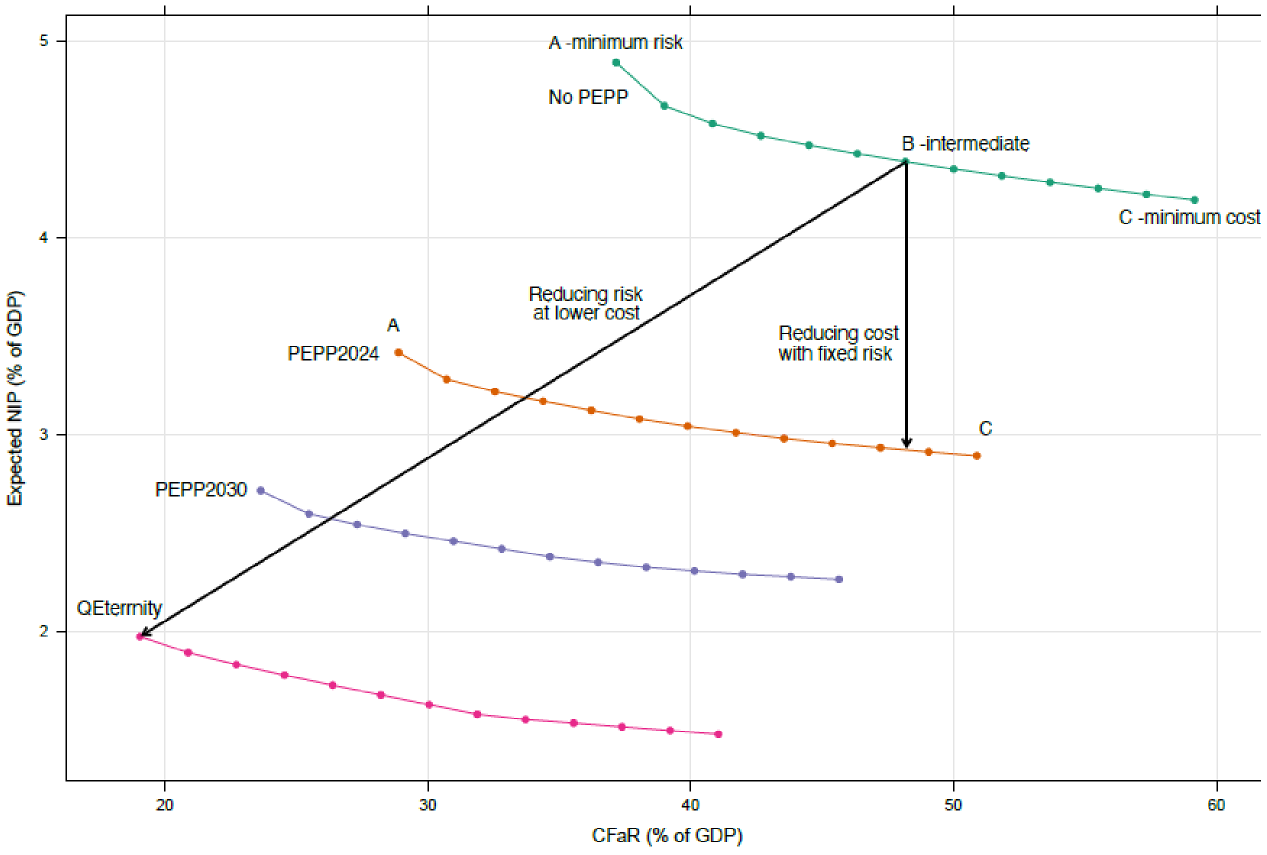
Debt levels under different scenarios
Interquartile ranges



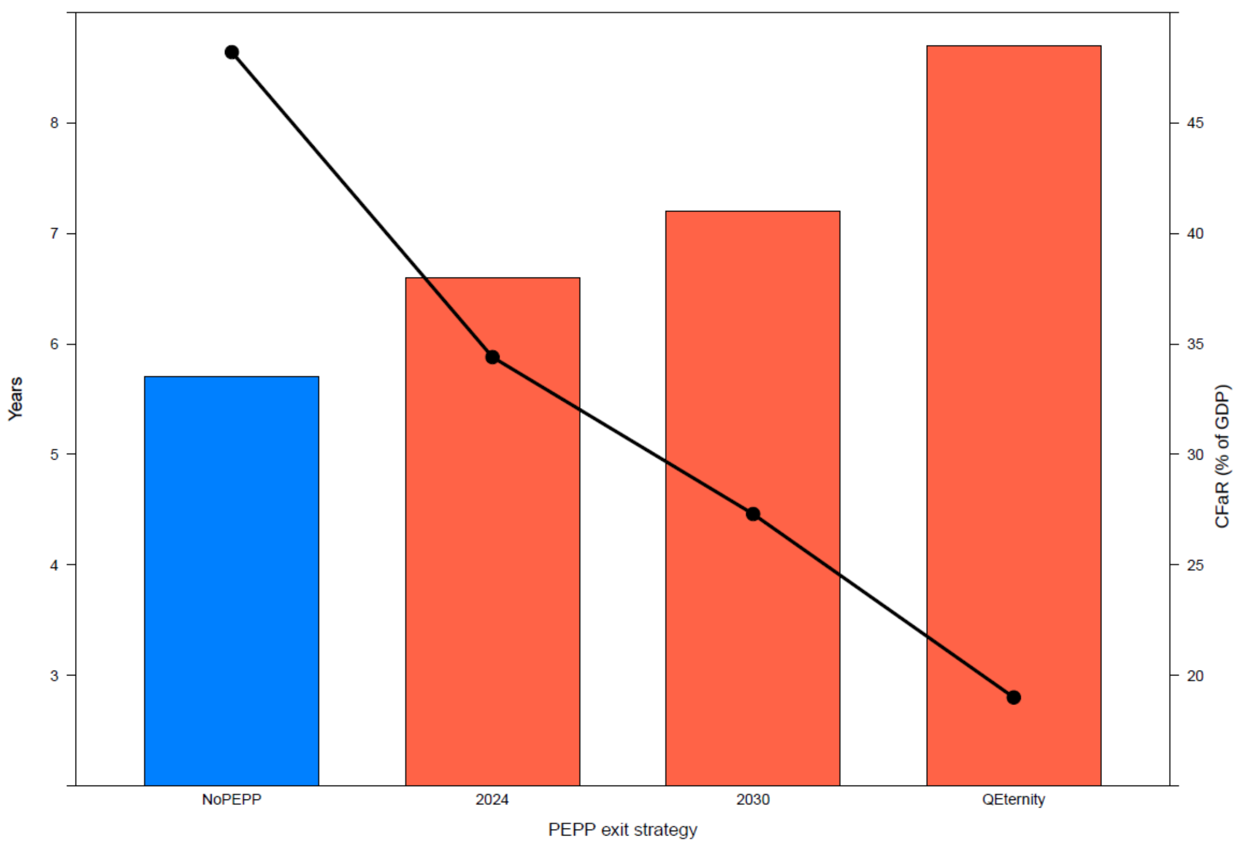
Optimal sovereign debt management

- Maturity lengthening compatible with risk reduction,
  - in line with empirically observed by Plessen-Matyas et al., ECB, 2021.

Expected cost and risk shift with PEPP



Debt maturity and risk under different scenarios



Conclusions

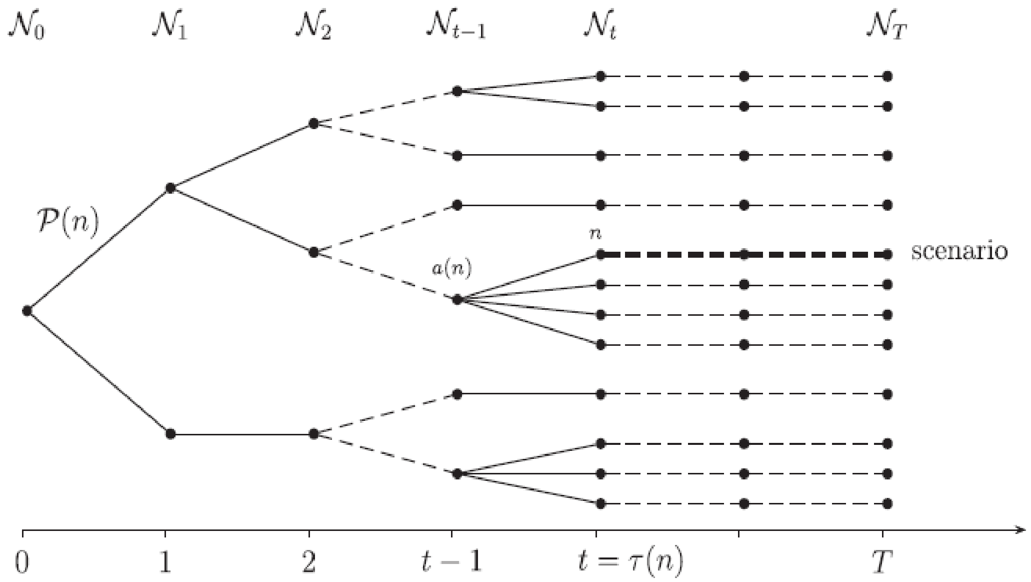
Conclusions

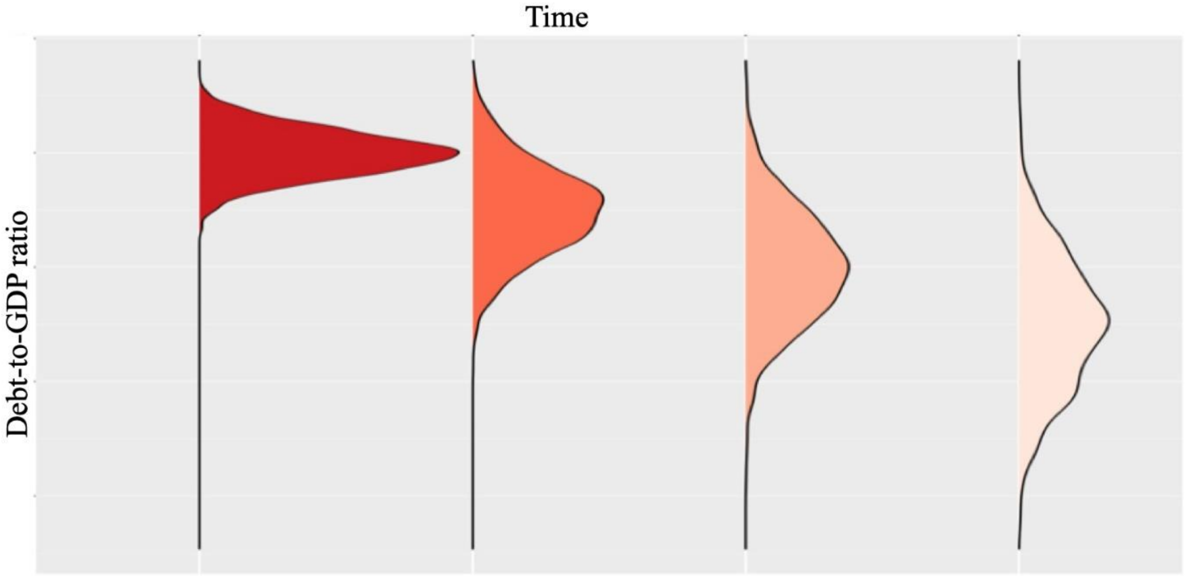
- Central bank asset purchases lower sovereign financing costs and contribute to debt sustainability
- Unwinding timing affects the debt level and the government's fiscal effort
- **Large positive impact, even with early unwinding: debt returns to pre-PEPP levels**
- The impact of inflation is relatively small. The magnitude and direction of the effect depends on how the central bank reacts with policy rates
- The government can optimally choose its financing strategies and achieve both lower costs or lower risks or both under PEPP. This effect has an impact on monetary policy transmission mechanism
- Future work/improvements:
  - Endogenise impact of spreads on activity in the projection horizon (iterative process)
  - Consolidated debt dynamics to account for the central bank maturity swap

- Paper highlights monetary fiscal-interactions: in contrast to conventional policies, unconventional greatly impacts on fiscal policy through debt dynamics

Scenario tree

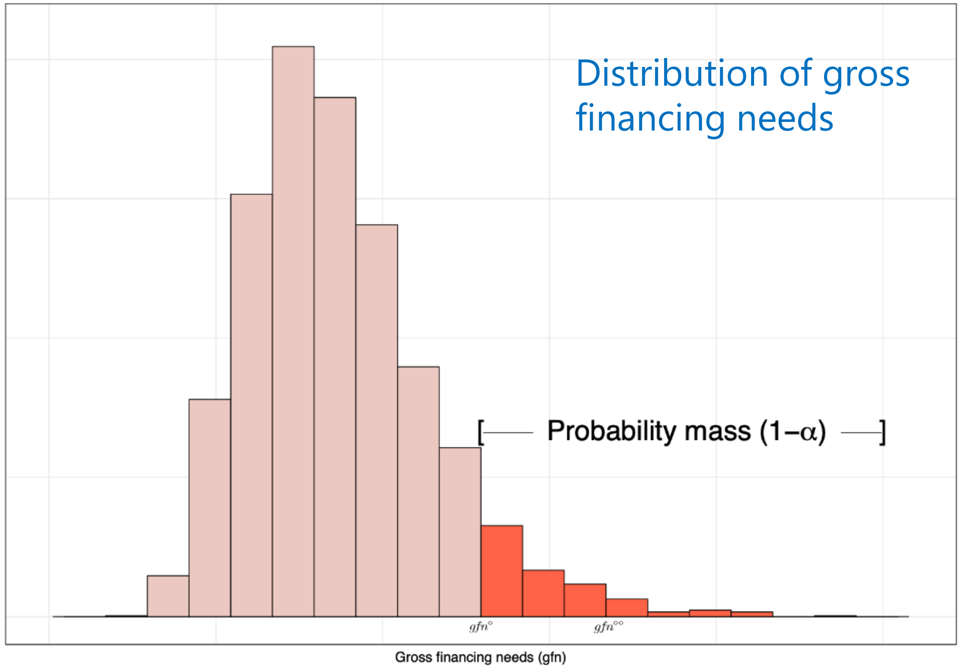
- Model uncertainty around a given path of expected future values
- Moment matching (Consiglio, Carollo and Zenios, *Quantitative Finance*, 16: 201-212, 2016)





Risk Measure: Conditional Value-at-Risk

$$\Psi(gfn) \doteq \mathbb{E}\left(gfn \mid gfn \geq gfn^{\diamond}\right)$$



Rockafellar-Uryasev (2000) linear program to shape risks

Calibration of the model economy

- Representative high-debt euro area country (Average legacy debt of Italy, Spain, and Portugal)
- With a debt-to-GDP ratio of 135% and risk premium of 250 bps
- Long-term steady states: output gap 0%, real GDP growth 1.4%, primary balance at zero, inflation 2%
- Key parameters from literature (Hofmann et al.)
- Matching scenario tree mean, with standard deviation and correlations from historical data

Variable	Value	Meaning
α_π	0.4	Coefficient of inflation in Taylor rule
α_i	0.25	Coefficient of output gap in Taylor rule
α_y	0.5	Coefficient of interest rate in output gap
γ	0.2	Coefficient of output gap in Phillips curve
β_π	0.3	Persistence of past inflation
$\delta_{\hat{y}}$	0.2	Persistence of past output gap
θ_i	0.2	Persistence of past interest rate
r^*	0	Natural interest rate
π^*	2	Target inflation rate

Calibrated scenarios

Path of state variables and monetary policy rate