

# Who Is Afraid of Eurobonds?

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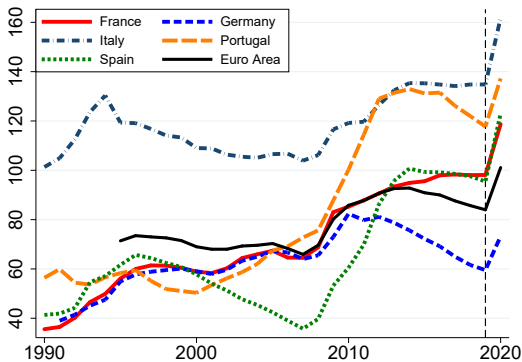
Sveriges Riksbank

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# Where Does the Euro Area Stand?

More countries in EA have now **elevated debt**

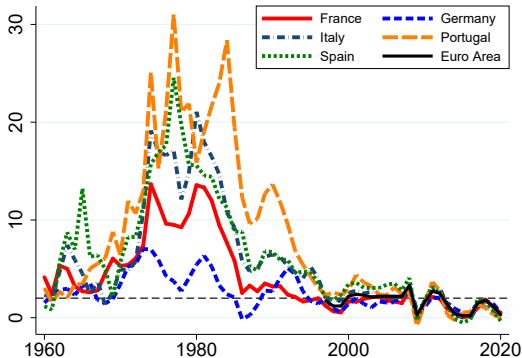
Figure: EA debt-to-GDP ratio



- Required fiscal adjustments likely to be persistent drag on economy

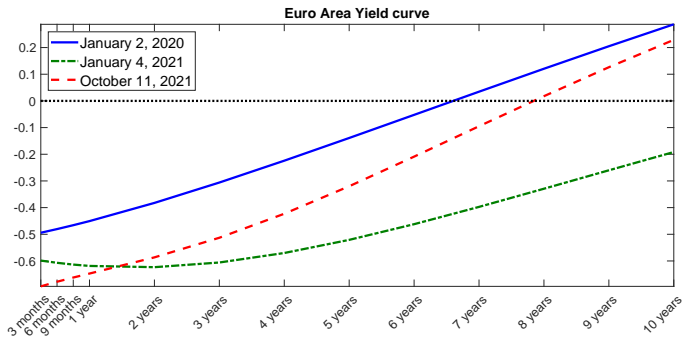
# Where Does the Euro Area Stand?

Figure: CPI inflation rate



- Low inflation rates constrain the ECB's ability to alleviate this drag

# Where Does the Euro Area Stand?



- Low and flat term structure considerably constrains monetary policy
- Limited space for the ECB to stabilize the EA economy in recession

## In Short...

With

1. Little fiscal space left due to **large public debt**
  2. **Limited** space of manoeuvre for **monetary policy**
- ... COVID19 pandemic found policymakers constrained

## What to Do?

# This Paper

- + A new monetary and fiscal framework that separates:
  - the need of **short-run** macroeconomic stabilisation...
  - ...from issue of **long-run** stabilisation of national debts.
  
- + EA authorities coordinate on policy response to EA recession:
  1. The fiscal authority issues **Eurobonds** to finance the fiscal stimulus
  2. Central bank **tolerates** inflation needed to stabilise increase in Eurobonds
  3. National governments fiscally responsible to **stabilise** national debt
  
- + Two-country monetary union model calibrated to EA to evaluate:
  1. New vs old framework based on unconditional monetary dominance
  2. Effects of a high-debt country refusing to comply with EA fiscal rules

# Main Findings

- + Monetary-led policy mix **not** the **best** strategy **unconditionally**
- + **Eurobonds-based** framework delivers **better** outcomes when **ZLB risk**
  1. Smaller recessions → lower national debt ratios → stronger recoveries
  2. Controlled reflation of EA → easing constraints on monetary policy
  3. Inflation increases modestly because of general equilibrium effects
  4. Welfare improves both in high-debt and low-debt countries
- + Defiant high-debt country may spark spiral of **inflation-recession-debt**



# A TANK Model of a Two-country Monetary Union

## ● Households:

- + savers and hand-to-mouth ▶ preferences
- + value public consumption as a complement to private consumption
- + if savers, wage setters subject to a Calvo lottery
- + if savers, invest in physical capital and rent a share to domestic firms
- + if savers, buy their national debt, Eurobonds, and have access to state-contingent securities ▶ bc hh

## ● Final goods firms:

- + combine domestic and imported good with CES aggregator
- + sell this good to domestic households ▶ final goods

## ● Intermediate goods firms:

- + hire labor and rent capital in competitive markets
- + price setters subject to a Calvo lottery
- + sell goods to domestic and foreign final goods firms ▶ interm. goods

## ● Labor packers:

- + assemble differentiated labor input supplied by households ▶ labor packers
- + sell homogeneous labor to domestic firms in competitive market



# Policy Authorities

- National governments

- + issue national debts with a maturity structure to domestic savers
- + levy distortionary taxes on domestic households
- + purchase goods and transfer resources to domestic households

$$P_t^B B_t + \tau_t^K R_t^K K_t + \tau_t^L W_t L_t + \tau_t^C P_t^C C_t = (1 + \rho P_t^B) B_{t-1} + P_t^C G_t + P_t^C Z_t$$

- EA fiscal authority

- + issues Eurobonds with a maturity structure to home and foreign country's savers
- + levies distortionary taxes on home and foreign country's households
- + transfers resources to home and foreign country's households

$$P_t^{B,EA} B_t^{EA} + \tau_t^{EA,K} (R_t^K K_t + R_t^K K_t^*) + \tau_t^{EA,L} (W_t L_t + W_t^* L_t^*) + \tau_t^{EA,C} (P_t^C C_t + P_t^{C*} C_t^*) = (1 + \rho_{EA} P_t^{B,EA}) B_{t-1}^{EA} + P_t^C Z_t + P_t^{C*} Z_t^*$$

- EA monetary authority

- + sets the interest rate of one-period risk-free bonds  $R_t = \frac{1}{E_t Q_{t,t+1}}$

# Fiscal Discipline

Fiscal authorities follow fiscal rules to stabilise their debts

+ National fiscal rules for  $i \in \{IT, DE\}$

$$\hat{\tau}_{i,t}^J = \rho_J \hat{\tau}_{i,t-1}^J + (1 - \rho_J) \gamma_{J_i} \hat{s}_{b_i,t-1},$$

$$\hat{g}_{i,t} = \rho_G \hat{g}_{i,t-1} - (1 - \rho_G) \gamma_{G_i} \hat{s}_{b_i,t-1}$$

$$\hat{z}_{i,t} = \rho_Z \hat{z}_{i,t-1} - (1 - \rho_Z) \gamma_{Z_i} \hat{s}_{b_i,t-1} - (1 - \rho_Z) \gamma_{ZY_i} \hat{y}_{t-1}$$

$J \in \{C, L, K\}$  and  $\hat{s}_{i,t} = \hat{b}_{i,t} - \hat{y}_{i,t}$  national debt-to-GDP ratio

+ EA fiscal rules

$$\hat{\tau}_{EA,t}^J = \rho_J \hat{\tau}_{EA,t-1}^J + (1 - \rho_J) \gamma_{J} \hat{s}_{bEA,t-1}$$

$$\hat{z}_{EA,t} = \rho_Z \hat{z}_{EA,t-1} - (1 - \rho_Z) \gamma_{Z} \hat{s}_{bEA,t-1} - (1 - \rho_Z) \gamma_{ZY} \hat{y}_{EA,t-1}$$

$J \in \{C, L, K\}$  and  $\hat{s}_{bEA,t} = \hat{b}_{EA,t} - \hat{y}_{EA,t}$  is EA debt-to-GDP ratio

# Fiscal Discipline

- + The EA monetary authority follows a Taylor rule

$$\hat{R}_t = \max \left\{ -\ln R^*, \rho_r \hat{R}_{t-1} + (1 - \rho_r) [\phi_\pi \hat{\pi}_{EA,t} + \phi_y \hat{y}_{EA,t}] \right\}$$

where  $\hat{\pi}_{EA,t} = \frac{1}{2} \hat{\pi}_{1,t} + \frac{1}{2} \hat{\pi}_{2,t}$  and  $\hat{y}_{EA,t} = \frac{1}{2} \hat{y}_{1,t} + \frac{1}{2} \hat{y}_{2,t}$  are at EA level

- + The Taylor principle is satisfied; i.e.,  $\phi_\pi > 1$
- + ZLB: sequence of anticipated shocks to unconstrained Taylor rule

# Emergency Budget

- + EA policy authorities **coordinate** on a response to EA recession
- + EA fiscal authority issues **Eurobonds** to finance the fiscal stimulus
- + Central bank **tolerates** increase in inflation to stabilise **that amount** of Eurobonds
- + National governments follow fiscal rules to **stabilise** national debts

# Emergency Budget

+ EA fiscal rules ( $J \in \{K, L, C\}$ )

$$\hat{\tau}_{EA,t}^J = \rho_J \hat{\tau}_{EA,t-1}^J + (1 - \rho_J) \left[ \gamma_J \hat{s}_{EA,t-1}^P + \gamma_J^A \left( \hat{s}_{EA,t-1} - \hat{s}_{EA,t-1}^P \right) \right]$$

$$\hat{z}_{EA,t}^P = \rho_Z \hat{z}_{EA,t-1}^P - (1 - \rho_Z) \left\{ \left[ \gamma_Z \hat{s}_{EA,t-1}^P + \gamma_Z^A \left( \hat{s}_{EA,t-1} - \hat{s}_{EA,t-1}^P \right) \right] + \gamma_{ZY} \hat{y}_{EA,t-1} \right\}$$

where  $\gamma_J \geq \beta^{-1} - 1 \geq \gamma_J^A = 0$

$\gamma_Z \geq \beta^{-1} - 1 \geq \gamma_Z^A = 0$

$\hat{s}_{EA,t-1}^P$  is Eurobonds to output ratio IF no symmetric recessionary shock

# Emergency Budget

- + EA monetary authority tolerates increase in inflation to stabilise amount of Eurobonds due to EA symmetric recession

$$\hat{R}_t = \max \left\{ -\ln R_*, \rho_R \hat{R}_{t-1} + (1 - \rho_R) \left[ \phi_\pi \hat{\pi}_{EA,t}^P + \phi_\pi^P \left( \hat{\pi}_t - \hat{\pi}_{EA,t}^P \right) + \phi_y \hat{y}_{EA,t} \right] \right\}$$

with  $\phi_\pi > 1 > \phi_\pi^P = 0$

- +  $\hat{\pi}_{EA,t} - \hat{\pi}_{EA,t}^P$  inflation increase necessary to stabilise  $\hat{s}_{EA,t-1} - \hat{s}_{EA,t-1}^P$

- + How do we pin  $\hat{s}_{EA,t}^P$  and  $\hat{\pi}_{EA,t}^P$  down?

# Emergency Budget

We construct a **counterfactual economy** where:

- + Symmetric recessionary shocks are shut down
- + The ZLB never binds
- + Policymakers follow Fiscal Discipline

# Calibration

## National fiscal parameters:

- + Steady state and persistence of tax rates: EC, DG Taxation and Customs Union
- + Steady-state and persistence of G and Z: Eurostat
- + Steady-state national debt-to-GDP: 60%
- + Debt response for fiscal instruments: high-country debt-to-GDP back to steady-state in 15 years

## EA fiscal parameters:

- + Steady-state of tax rates: 3%
- + Steady-state of Z: Eurostat
- + Steady-state EA debt-to-GDP: 7%

▶ table fiscal

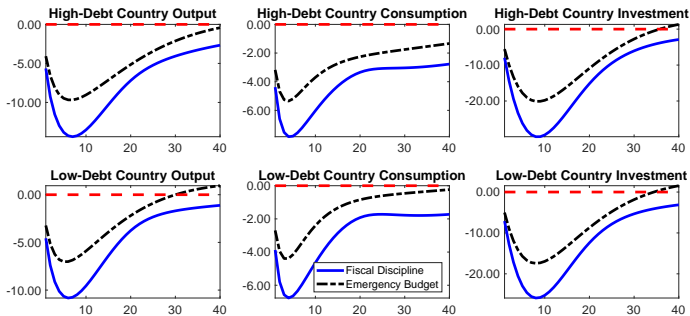
▶ table



# Our Exercise

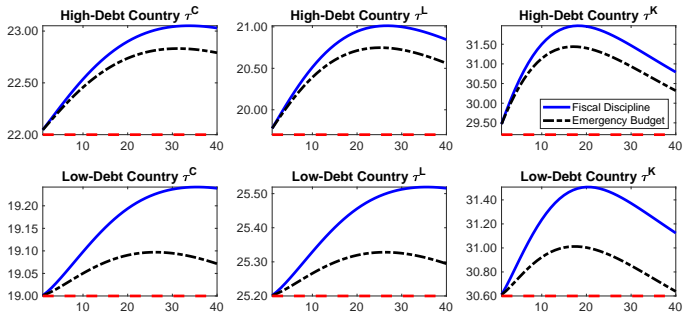
- + Recession induced through one standard dev. risk-premium shock
  - Persistence: Match average EABCN peak-to-trough
  - Volatility: Match output volatility over 1999Q1-2019Q4
  
- + Recessionary shock hits when debt-to-GDP away from steady state:
  - Country 1 (Italy): annual debt-to-GDP 134.8%
  - Country 2 (Germany): annual debt-to-GDP 61.9%
  
- + Compare:
  1. **Fiscal discipline**
  2. **Emergency budget**

# Facing a Recession



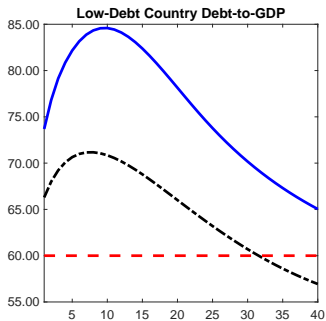
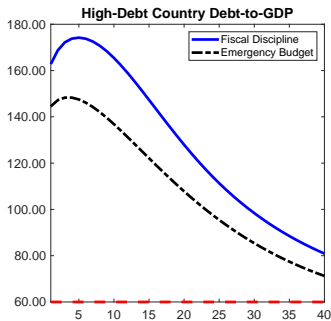
- Fiscal discipline in response to shock costly for both countries
- Using EA emergency budget mitigates recession in both countries

# Facing a Recession



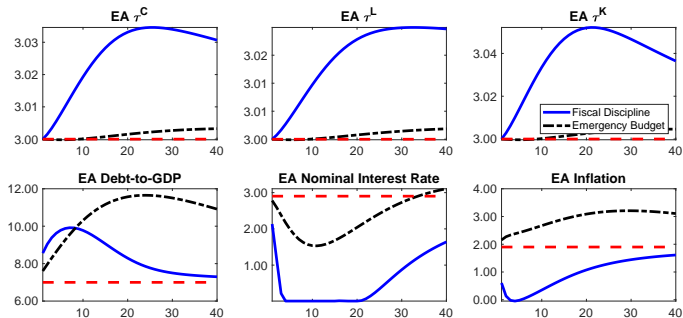
- Less fiscal adjustment at national level under emergency budget

# Facing a Recession



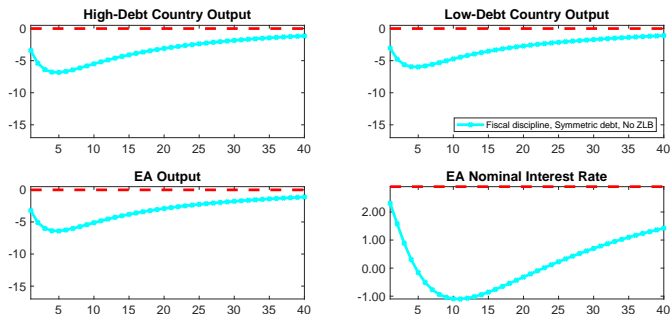
- Euro area emergency budget lowers national debt-to-GDP

# Facing a Recession



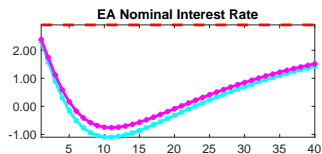
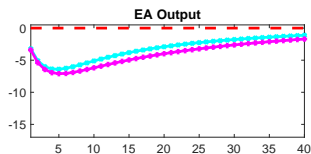
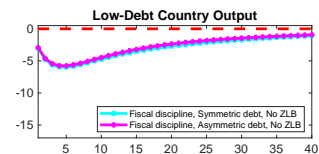
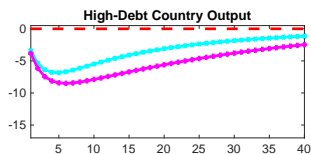
- Some increase in inflation
- Higher nominal rates lowers ZLB risk  $\rightarrow$  lower frequency of ZLB
- Central bank can escape ZLB

# Why Does the EA Need Monetary and Fiscal Coordination?



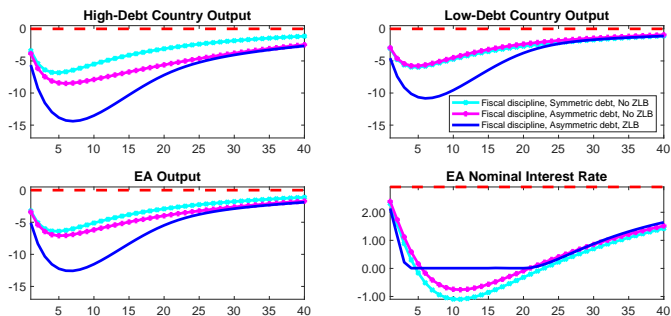
- When monetary policy unconstrained, it is effective stabilisation tool

# Why Does the EA Need Monetary and Fiscal Coordination?



- Large national debt matters somewhat for recovery under fiscal discipline

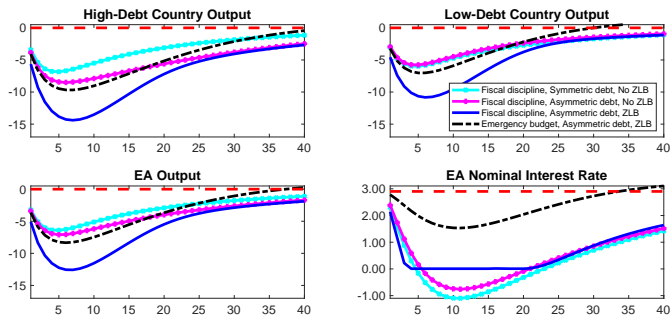
# Why Does the EA Need Monetary and Fiscal Coordination?



- If ZLB binds, no stabilisation tools for high-debt countries under fiscal discipline
- Very costly, also for low-debt countries because EA integrated



# Why Does the EA Need Monetary and Fiscal Coordination?



- Scope for Eurobonds as **stabilisation tool** if ZLB binds and large national debt

## Welfare Implications

Volatilities	Fiscal Discipline	Emergency Budget
Euro Area Output	16.797	11.707
Euro Area Inflation	0.617	0.427
High-Debt Country Output	18.103	12.273
High-Debt Country Inflation	0.640	0.426
Low-Debt Country Output	15.516	11.147
Low-Debt Country Inflation	0.640	0.426
ZLB Frequency	0.210	0.089

**Table:** Volatilities of Output and Inflation for 1000 simulations of 40 periods under *Fiscal Discipline* and *Emergency Budget*.

# What if the High-debt Country Abandons Fiscal Discipline?

- Conflict** between high-debt country fiscal authority & monetary authority  
+ 10-period conflict as Markov-switching model with fiscally-led resol.

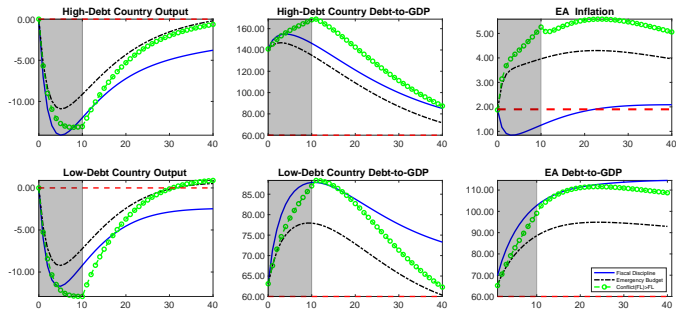
Parameter	Description	Fiscal Discipline	Emergency Budget	Conflict
$\phi_\pi$	Monetary response to $\pi_{EA}$	1.89	0.9	1.89
$\gamma_{J,IT}$	Fiscal response for IT	0.11	0.11	0.001
$\gamma_{J,DE}$	Fiscal response for DE	0.11	0.11	0.11
$\gamma_{J,EA}$	Fiscal response for EA	0.11	0.001	0.11

**Table:** Parameters of the monetary and fiscal rules under *Fiscal Discipline*, *Emergency Budget*, and *Conflict*.

- +  $J \in \{C, L, K, G, Z\}$
- +  $\gamma_J = 0.11$ , IT debt-to-GDP to SS in 15 years under fiscal discipline
- +  $\phi_\pi = 1.89$  as estimated in Coenen, Straub, & Trabandt (2013)
- + Transition probabilities across regimes as in Bianchi & Melosi (2019)

# What if the High-debt Country Abandons Fiscal Discipline?

Conflict between high-debt country fiscal authority & central bank



- Mounting inflationary pressure
- Monetary response worsens recession in low-debt country
- Monetary tightening exacerbates debt-to-GDP in high-debt country
- Spiral of growing inflation, deeper recession, and debt accumulation

# A New Monetary and Fiscal Framework for the EA?

- + Deterioration of fiscal positions put EA countries at **crossroads**:
  1. Keep following fiscal discipline **unconditionally**
  2. **Reform** EA policy framework to leverage synergy between monetary and fiscal policies
- + Overhaul current monetary/fiscal framework based on **Eurobonds**:
  1. To separate the need for **short-run** stabilisation from the issue of **long-run** fiscal sustainability
  2. To make **monetary policy** a more **effective** stabilisation tool to the advantage of all EA countries
- + Policies in one country affect outcomes in all countries, including the ones with more solid fiscal fundamentals
  - **coordination** required to maximize benefits.

# Appendix

# Literature

## + Monetary and fiscal policy in currency unions (CU)

- Beetsma and Jensen (2005), Galí and Monacelli (2008), Ferrero (2009), Nakamura and Steinsson (2014), Farhi and Werning (2017)

## + Fiscal theory of the price level

- Sargent and Wallace (1981), Leeper (1991), Sims, (1994), Woodford, (1994, 1995, 2001); Cochrane (1999, 2001), Bergin (2000), Schmitt-Grohé and Uribe (2020), Jarocinski and Mackowiak (2017), Bianchi and Melosi (2019), Bianchi, Faccini, and Melosi (2020)

**This paper:** Monetary-fiscal coordination in CU with Eurobonds

▶ Back

## Final Goods Firms

- + Final good produced combining  $C_t^H$  and  $C_t^F$  with technology

$$Q_t^C = \left[ (1 - \nu_c)^{\frac{1}{\mu_c}} C_t^H^{\frac{\mu_c - 1}{\mu_c}} + \nu_c^{\frac{1}{\mu_c}} C_t^F^{\frac{\mu_c - 1}{\mu_c}} \right]^{\frac{\mu_c}{\mu_c - 1}}$$

$\nu_c$  degree of openness &  $\mu_c$  elasticity of sub. between H & F goods

- Demand for H and F intermediate goods  $i$  and  $i^*$  by final consumption good firm:

$$C_t^H(i) = \left[ \int_0^1 C_t^H(i)^{\frac{1}{1+\eta_p}} \right]^{1+\eta_p} \quad C_t^F(i) = \left[ \int_0^1 C_t^F(i^*)^{\frac{1}{1+\eta_{p,x}}} \right]^{1+\eta_{p,x}}$$

$\eta_p, \eta_{p,x} > 0$  related to the intratemporal elasticities of sub. between the differentiated outputs supplied by the H and F intermediate firms

- Demand for H and F good bundles by final consumption good firm:

$$C_t^H = (1 - \nu_c) \left( \frac{P_t^H}{P_t^C} \right)^{-\mu_c} Q_t^C \quad C_t^F = \nu_c \left( \frac{P_t^F}{P_t^C} \right)^{-\mu_c} Q_t^C$$

▶ back

▶ price indices



# Intermediate Goods Firms

## + Intermediate goods firms

- Continuum of monopolistically competitive firms
- Use technology:  $Y_t(i) = K_t(i)^\alpha (A_t L_t(i))^{1-\alpha} - A_t \Omega$
- Calvo-price setters
- Price indexation:  $p_t^H(i) = (\pi_{t-1}^H)^{\chi_P} (\pi^H)^{1-\chi_P} P_{t-1}^H(i)$
- Face perfectly competitive factor markets for capital and labor

▶ back

# Wages

- Both savers and non-savers supply differentiated labor service
- Labor packer produces composite labor  $L_t = \left[ \int_0^1 L_t(l)^{\frac{1}{1+\eta_w}} dl \right]^{1+\eta_w}$
- Profit maximisation yields labor demand  $L_t(l) = L_t \left( \frac{W_t(l)}{W_t} \right)^{-\frac{1+\eta_w}{\eta_w}}$
- Wage set optimally by savers with prob  $\omega_w$
- Wage indexation  $W_t(l) = W_{t-1}(l)(\Pi_{t-1}e^\gamma)^{\chi_w}(\Pi e^\gamma)^{1-\chi_w}$

▶ back

# Households' Preferences

- + Savers
- + Hand-to-mouth

Same preferences

$$u_t = \left( (\ln C_t^*(j) - \tilde{C}_{t-1}^*) - \frac{L_t(j)^{1+\xi}}{1+\xi} \right),$$

where  $C_t^*(j) \equiv C_t(j) + \alpha_G G_t$

▶ back

# Households' Budget Constraints

- The nominal flow budget constraint for hand-to-mouth  $j \in [0, \mu]$

$$P_t^C (1 + \tau_t^C + \tau_t^{EA,C}) C_t^N(j) = (1 - \tau_t^L - \tau_t^{EA,L}) \int_0^1 W_t(l) L_t^N(j, l) dl + P_t^C Z_t^N(j)$$

- The nominal flow budget constraint for saver  $j \in (\mu, 1]$

$$\begin{aligned} P_t^C (1 + \tau_t^C + \tau_t^{EA,C}) C_t^S(j) + P_t^I I_t(j) + E_t \left( \underbrace{\frac{Q_{t,t+1} B_{s,t+1}}{\epsilon_t^{rp}}}_{\text{AD securities}} \right) + \underbrace{P_t^B B_t(j)}_{\text{national bond}} + \underbrace{P_t^{B,EA} B_t^{EA}(j)}_{\text{Eurobond}} \\ = B_{s,t}(j) + (1 + \rho P_t^B) B_{t-1}(j) + (1 + \rho P_t^{B,EA}) B_{t-1}^{EA}(j) \\ + (1 - \tau_t^L - \tau_t^{EA,L}) \int_0^1 W_t(l) L_t^S(j, l) dl \\ + (1 - \tau_t^K - \tau_t^{EA,K}) R_t^K v_t(j) \bar{K}_{t-1}^S(j) - \psi(v_t) \bar{K}_{t-1}^S + P_t^C Z_t^S(j) + D_t(j) \end{aligned}$$

▶ back

# Price Indices

$$P_t^C = \left[ (1 - \nu_c) P_t^H^{1-\mu_c} + \nu_c P_t^F^{1-\mu_c} \right]^{\frac{1}{1-\mu_c}}$$

$$P_t^{C*} = \left[ \nu_c P_t^{H*1-\mu_c} + (1 - \nu_c) P_t^{F*1-\mu_c} \right]^{\frac{1}{1-\mu_c}}$$

▶ Back

# Calibration I

Parameter	Description	Value	Target/Source
<b>Preferences</b>			
$\beta$	Discount factor	0.999	Annual SS real rate of 1.35%
$\xi$	Inverse Frisch elasticity	2	Coenen et al. (2013)
$\theta$	Habit in formation	0.59	Coenen et al. (2013)
$\alpha^G$	Substitutability of private vs. gov. consumption	-0.24	Leeper et al. (2017)
<b>Frictions and technology</b>			
$\mu$	Share of hand-to-mouth households	0.11	Leeper et al. (2017)
$\alpha$	Elasticity in production function	0.33	SS share of labour income in total output of 70%
$\delta$	Capital depreciation rate	0.025	Implies annual depreciation of 10%
$s$	Investment adjustment cost	5.56	Coenen et al. (2013)
$\psi$	Capital utilization cost	0.16	Leeper et al. (2013)
$\omega_p$	Price Calvo parameter	0.93	Coenen et al. (2013)
$\omega_w$	Wage Calvo parameter	0.78	Coenen et al. (2013)
$\chi_p$	Price indexation	0.38	Coenen et al. (2013)
$\chi_w$	Wage indexation	0.54	Coenen et al. (2013)
$\eta_p$	Price markup	0.163	Leeper et al. (2013)
$\eta_w$	Wage markup	0.286	Leeper et al. (2013)
$\nu_{C,IT}$	Degree of openness for IT	0.205	Albonico et al. (2019)
$\nu_{C,DE}$	Degree of openness for DE	0.261	Albonico et al. (2019)
$\mu_{C,IT}$	Elasticity of sub. between IT & DE	1.130	Albonico et al. (2019)
$\mu_{C,DE}$	Elasticity of sub. between DE & IT	1.300	Albonico et al. (2019)

▶ Back

# Calibration II

Parameter	Description	Value	Target/Source
Monetary authority			
$\phi_\pi$	Interest rate response to EA inflation	1.89	Coenen et al. (2013)
$\phi_y$	Interest rate response to EA output	0.16	Coenen et al. (2013)
$\rho_r$	Interest rate smoothing	0.88	Coenen et al. (2013)
Risk Premium Shock			
$\rho$	Persistence of shock	0.96	Match average EABCN peak-to-trough
$\sigma$	Volatility of shock	0.011	Match output volatility over 1999Q1-2019Q4

**Table:** Calibrated values for model parameters and steady-state targets.

▶ Back

# Calibration III

Parameter	Description	Value	Target/Source
Steady-state calibration targets			
$s_{b,IT}$	Quarterly debt-to-GDP in IT	2.4	Annualized 60%, Maastricht Treaty parameter
$s_{b,DE}$	Quarterly debt-to-GDP in DE	2.4	Annualized 60%, Maastricht Treaty parameter
$s_{b,EA}$	Quarterly debt-to-GDP in EA	0.28	Annualized 7%
$s_{gc,IT}$	Gov. expenditure-to-GDP ratio IT	0.187	Quarterly average in 2019, Eurostat
$s_{gc,DE}$	Gov. expenditure-to-GDP ratio DE	0.205	Quarterly average in 2019, Eurostat
$\tau_{IT}^L$	Steady-state tax rate on labor IT	19.7%	EC, DG Taxation and Customs Union, 2018
$\tau_{DE}^L$	Steady-state tax rate on labor DE	25.2%	EC, DG Taxation and Customs Union, 2018
$\tau_{EA}^L$	Steady-state tax rate on labor EA	3%	
$\tau_{IT}^K$	Steady-state tax rate on capital IT	29.2%	EC, DG Taxation and Customs Union, 2018
$\tau_{DE}^K$	Steady-state tax rate on capital DE	30.6%	EC, DG Taxation and Customs Union, 2018
$\tau_{EA}^K$	Steady-state tax rate on capital EA	3%	
$\tau_{IT}^C$	Steady-state tax rate on cons. IT	22%	EC, DG Taxation and Customs Union, 2018
$\tau_{DE}^C$	Steady-state tax rate on cons. DE	19%	EC, DG Taxation and Customs Union, 2018
$\tau_{EA}^C$	Steady-state tax rate on cons. EA	3%	
Debt maturities			
$\rho_{IT}$	Debt maturity decay rate IT	0.963	Target yearly average maturity of 6.87 in 2019
$\rho_{DE}$	Debt maturity decay rate DE	0.964	Target yearly average maturity of 5.94 in 2010
$\rho_{EA}$	Debt maturity decay rate EA	0.958	Target yearly average maturity of 6.6 in 2010

Table: Calibrated values for model parameters and steady-state targets.

[▶ Back](#)



# Calibration IV

Parameter	Description	Value	Target/Source
Fiscal authorities			
$\rho_{IT}^L$	Persistence of $\tau^L$ in IT	0.735	Estimated 2004-2020, EC, DG Taxation & Customs Union
$\rho_{DE}^L$	Persistence of $\tau^L$ in DE	0.735	Estimated 2004-2020, EC, DG Taxation & Customs Union
$\rho_{EA}^L$	Persistence of $\tau^L$ in EA	0.726	Estimated 2004-2020, EC, DG Taxation & Customs Union
$\rho_{IT}^K$	Persistence of $\tau^K$ in IT	0.606	Estimated 2006-2018, EC, DG Taxation & Customs Union
$\rho_{DE}^K$	Persistence of $\tau^K$ in DE	0.662	Estimated 2006-2018, EC, DG Taxation & Customs Union
$\rho_{EA}^K$	Persistence of $\tau^K$ in EA	0.502	Estimated 2006-2018, EC, DG Taxation & Customs Union
$\rho_{IT}^C$	Persistence of $\tau^C$ in IT	0.884	Estimated 2000-2020, EC, DG Taxation & Customs Union
$\rho_{DE}^C$	Persistence of $\tau^C$ in DE	0.833	Estimated 2000-2020, EC, DG Taxation & Customs Union
$\rho_{EA}^C$	Persistence of $\tau^C$ in EA	0.895	Estimated 2000-2020, EC, DG Taxation & Customs Union
$\rho_{IT}^G$	Persistence of G in IT	0.659	Estimated over 2007-2019, Eurostat
$\rho_{DE}^G$	Persistence of G in DE	0.365	Estimated over 2007-2019, Eurostat
$\rho_{IT}^Z$	Persistence of transfers rule	0.785	Estimated over 1996-2019, Eurostat
$\rho_{DE}^Z$	Persistence of transfers rule	0.636	Estimated over 2002-2019, Eurostat
$\rho_{EA}^Z$	Persistence of transfers rule	0.880	Estimated over 2002-2019, Eurostat
$\gamma^G$	Debt response for G	0.11	IT debt-to-GDP to SS in 15 years
$\gamma^Z$	Debt response for transfers	0.11	IT debt-to-GDP to SS in 15 years
$\gamma^L$	Debt response for $\tau^L$	0.11	IT debt-to-GDP to SS in 15 years
$\gamma^K$	Debt response, for $\tau^K$	0.11	IT debt-to-GDP to SS in 15 years
$\gamma^C$	Debt response for $\tau^C$	0.11	IT debt-to-GDP to SS in 15 years
$\phi_Y$	Automatic stabilizers	0.11	IT debt-to-GDP to SS in 15 years

▶ Back

Table: Calibrated values for model parameters and steady-state targets.

# What if High-Debt Country Abandons Fiscal Discipline?

Lack of stabilization tools in high-debt country leads national government of this country to refuse to comply with the common fiscal rules

Conflict:

- + Between high-debt country fiscal authority & monetary authority
- + Solved with Markov-switching model
- + Transition matrix  $Q$  between four regimes:
  1. Fiscal discipline
  2. Emergency budget
  3. Conflict with monetary-led resolution
  4. Conflict with fiscally-led resolution

$$Q = \begin{pmatrix} p^{MM} & 1 - p^{EB} & 1 - p^{CC} & 0 \\ 1 - p^{MM} & p^{EB} & 0 & 1 - p^{CC} \\ 0 & & p^{CC} & 0 \\ 0 & 0 & 0 & p^{CC} \end{pmatrix}$$