Designing QE to overcome the lower bound constraint on interest rates in a fiscally sound monetary union

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\textsuperscript{1}The views expressed in this paper do not necessarily reflect those of the ECB.
Overview of the presentation

1. Motivation
2. The model
3. Results
4. Conclusion
Main points of the paper

- Consider a tractable model of a monetary union (with potentially asymmetric member countries) in which the single short-term rate reaches the lower bound constraint.
- How to design EA QE? (Portfolio composition? Risk Sharing?)
- Goal: replicate the allocations and welfare levels that would have prevailed under an unconstrained Taylor-type interest rate rule.
- Results:
  - Clear-cut results if MU has a sound fiscal structure.
  - Complexities arise if fiscal structure is not sound. (needs future work in a strategic setting)
Theory: No obvious theoretical reference point

(Standard) Dimension 1: Single economy
“The problem with QE is it works in practice but it doesn’t work in theory” (Ben Bernanke)

(Extra) Dimension 2: Monetary union
“... Usually, the fiscal implications are dealt with easily within a one-country framework, between the central bank and the treasury. But in the euro area, there is no European treasury...” (Mario Draghi)

→ What is lacking?
Monetary union models which reconcile Eggertsson/Woodford with 1) Tobin and 2) Mundell (non-strategic issues) and Chari/Kehoe (strategic issues)
**Reality** (2014): Monetary Policy

Inflation at risk to be too low for too long, while MP close to the effective lower bound

What to do?

- **Standard QE recipe** (of stand alone economies)?
  
  CB to support aggregate demand by purchasing longer-term gov’t debt (**portfolio rebalancing**) plus **forward guidance** (**signalling**)
**Reality (2014): Many fiscal policies**

**Fiscal policies suffer from dysfunctional framework and no appetite for a fiscal union**

- Very uneven distribution of fiscal space (and since 2010 loss of market access as a reality)
- Unclear notion of riskiness of national debt
- Absence of area-wide safe (parts of) gov’t debt
- Treaty logic (“no bail out”): government budget constraints are separate; MP has no mandate to facilitate bail out of gov’ts via CB balance sheet
EA QE: starting points

**Reality** (2014): Many fiscal policies

Spirit of no bail-out idea got modified in the course of IMF-type conditional support:

- Logic for programme countries follows Farhi/Tirole (2016), i.e. if fiscal positions of member countries are very different, **ex post solidarity** is reasonable, but this is different from unconditional ex-ante risk sharing
Motivation of EA QE is clear: area-wide inflation outlook

Yet, design of **QE in a (fiscally) incomplete MU is non-trivial,**
→ it touches inevitably on the **critical intersection of MP and FP** since the **Eurosystem takes outright sovereign risk on its balance sheet in** in order to satisfy its **primary objective**

How to settle the tensions between **Stimulus vs. Incentives?**
→ **Brunnermeier et al (2016) ”The euro and the battle of ideas”**
EA QE: Challenges and design issues

How to settle the tensions between **Stimulus** vs. **Incentives**?

- **Stimulus-camp**: QE needed to boost demand in order to avoid losses from missing the inflation objective
  
  *Avoidance of these losses is particularly important in a MU, since nominal anchoring is key*

- **Incentives-camp**: QE to be avoided since it invites for detrimental free-riding of governments
  
  *Erosion of fiscal framework is particularly costly in a MU*

(see: Chari/Kehoe, 2008)
Effective compromise is possible

Eurosystem has exploited that **QE in a MU is a multidimensional tool** and has been **mindful of incompleteness of EMU**

**Key parameters** (in addition to standard ones, known e.g. from US) carefully calibrated at the boundary of MP and FP

- Degree of **(strongly limited) risk sharing**
- **Portfolio weights** (purchases according to **capital key**)
- **Issuance limits** (avoidance of strategic role in debt restructuring)
- **Issuer limits** (123-related concerns)
→ **EA QE** complements a broad range of other non-standard tools

- **OMT**: country-specific support, risk-shared, conditionality
- **TLTRO’s**: long-term provision of liquidity to banks
- **ELA**: provision of emergency liquidity, no risk sharing
- **NIRP**
- **Forward guidance**
- Moreover: **ABSPP, CBPP, CSPP**
Research agenda:

Role of **key parameters** to be assessed by model-based work which
→ recognises current trade-offs (*recall: Stimulus vs. Incentives*)
→ allows for **feasible changes of EA architecture over time**

→ Moreover, **5PR as a reference point for long-term outcomes:**

"...Progress will have to follow a sequence of short- and longer-term steps, but it is vital to establish and agree the full sequence today. The measures in the short-term will only increase confidence now if they are the start of a larger process, a bridge towards a complete and genuine EMU.” (5PR)
Our approach

→ Analytics of such agenda are tricky
→ Proceed stepwise, use backward induction

Step 1 (Current paper: ”Designing QE to overcome the lower bound constraint on interest rates in a fiscally sound monetary union”)

- Assume, counterfactually, MU has a complete fiscal framework
- How to design EA QE in an extended 2-country monetary union model à la Benigno (2004) with
  i) portfolio balance channel (s.t. QE works!) and
  ii) (occasionally) binding lower bound constraint but maintain iii) standard and stable fiscal feedback rules

Step 2 (work in progress: strategic issues)

- Relax iii) and reconsider design of EA QE in an incomplete fiscal set-up
- Idea: consider variation à la Chari/Kehoe (2008) and allow for Nash vs optimal outcomes, i.e. expansionary effects of EA QE to be weighted against adverse incentive effects under non-cooperative FP’s
Our approach

**Step 3 (work in progress: non-strategic issues)**

- Use **country-specific QE in normal times** even when interest rates are not constrained.
- Idea: create sufficient country-specific instruments in a monetary union, **opposing the shortage of instruments** as described by Mundell.
- Questions: how to **optimally** design QE in a monetary union above the lower bound? Is the **same welfare level as in a single economy** for all member states possible?
How to design QE to reduce or even eliminate the welfare-reducing effects of the lower bound constraint in a monetary union?

Particularly relevant benchmark in a monetary union:

- Outcomes that would have been realised if there had been no lower bound constraint on the common short-term interest rate
Key features

- Analytical starting point: 3-equation New Keynesian model delivers ineffectiveness result of QE at the ZLB

- We embed this model as a parametric special case in a 2-country monetary union model with banks, extending Benigno (2004)

- HH accumulate wealth via deposits (with banks) and real balances, and consume differentiated goods from both countries \((N, S)\) with home bias

- Banks, acting like mutual funds, invest in short- and long-term government bonds of both countries

- Passive fiscal policy: short- and long-term bonds follow well-behaved feedback rules
**Real effects of QE**

- **Issue:** *irrelevance proposition* of Wallace (1981) and Eggertsson and Woodford (2003)
  → QE is ineffective at the lower bound constraint

- Tobin and Brainard (1963) observe *imperfect substitution*:
  positive relationship between relative portfolio shares and asset returns

We model the **portfolio balancing channel** via:

1. imperfect substitutability between bonds of *different maturities* due to
   **portfolio adjustment costs** (Harrison, 2012; Andrés et al., 2004), e.g.:
   - preferences ("preferred habitat" à la Vayanos und Vila, 2009)
   - regulation requirements
   - transaction costs

2. further imperfect substitutability between *domestic* and *foreign*
   long-term bond holdings due to *home bias*
Deposits are claims against the bank’s portfolio of short- and long-term bonds issued in both countries subject to portfolio adjustment costs and home bias in long-term holdings.

→ Rates of return on deposits are **weighted averages** of short-term and long-term rates and thus **heterogeneous** across the union:

\[
\hat{R}_{D,t} = \frac{1}{1+\delta} \hat{R}_{S,t} + \frac{\delta}{1+\delta} \left[ \omega_N \hat{R}_{L,t+1} + (1 - \omega_N) \hat{R}_{L,t+1} \right]
\]

Compared with New Keynesian benchmark, **non-negativity of deposit rates replaces ZLB constraint on short-term interest rates.**
Stylised balance sheet of the central bank in our monetary union:

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short-term bonds</td>
<td>Money in circulation</td>
</tr>
<tr>
<td>Short-term bonds</td>
<td>$\alpha B_{SC}^N$</td>
</tr>
<tr>
<td></td>
<td>$(1 - \alpha) B_{SC}^S$</td>
</tr>
<tr>
<td>Long-term bonds</td>
<td>$\alpha Q_N^N$</td>
</tr>
<tr>
<td></td>
<td>$(1 - \alpha) Q_S^S$</td>
</tr>
</tbody>
</table>

- **Conventional MP**: short-term Taylor-type interest rate rule (reacting to union-wide inflation rate and output gap)
- Short-term bonds are perfect substitutes to ensure same short-term rate across countries
- **Unconventional MP**: (potentially) country-specific purchases of long-term bonds (“QE”)
- Monetary union allows (via TARGET-balances): $B_{SC}^N + Q^N \neq M^N$
  $\rightarrow$ Additional funding channel for $c^N \neq y^N$
Risk sharing

- Current assumption:
  Regular CB income on short-term bond holdings: shared
  QE-related CB income on long-term bond holdings: not shared

- Deeper analysis of risk sharing requires strategic setting
Symmetric monetary union

- $N = S$
- Model consists of

\begin{align*}
\hat{c}_t^N &= \hat{c}_{t+1}^N - \sigma \left[ \hat{R}_{D,t}^N - \hat{\pi}_{c,t+1}^N - \hat{r}_{n,t}^N \right] \\
\hat{\pi}_{c,t}^N &= \beta \hat{\pi}_{c,t+1}^N + \frac{\varepsilon - 1}{\chi} (\psi + \frac{1}{\sigma}) \hat{c}_t^N \\
\hat{R}_{St} &= \rho_R \hat{R}_{St-1} + (1 - \rho_R) \left[ \phi_\pi \hat{\pi}_{c,t}^N + \phi_y \hat{c}_t^N \right] + \varepsilon_{R,t}
\end{align*}

and

\begin{equation}
\hat{R}_{Dt}^N = \hat{R}_{St} + \tilde{\nu}_1 \left[ \hat{b}_{LP,t}^N - \hat{b}_{SP,t}^N \right]
\end{equation}

and further equations

**Special case:** In the absence of portfolio adjustment costs ($\tilde{\nu}_1 = 0$), model is isomorphic to New Keynesian 3-equation model:

$\rightarrow$ Eggertsson/Woodford: QE is ineffective, while forward guidance is not
Symmetric monetary union

General case ($\tilde{v}_1 > 0$):

- **Unconstrained interest rate rule outcomes** can be **replicated via** QE-augmented policy rule

- **Caveat**: Initial shock is not too large (such that unconstrained deposit rates remain non-negative: $R_{D,t}^N \geq 1$)

- **QE remains effective** until **yield curve becomes flat** (leading in the limit to zero deposit rates)

Intuition for Replicability:

- deposit rates drive dynamics in consumption Euler equation

- use appropriately scaled QE purchases to replicate unconstrained deposit rates and, hence, **unconstrained outcomes of all welfare relevant variables**

→ see: **Proposition 1**
Symmetric monetary union

**Proposition 1:** Consider the equilibrium allocation \( A^{N*} = \{ \hat{c}_t^{N*}, \hat{h}_t^{N*}, \hat{m}_t^{N*} \} \) of welfare relevant variables in a symmetric monetary union that results from an unconstrained interest rate rule consistent with \( R_{D,t}^{N*} \geq 1 \), leading to a welfare level \( W^{N*} \). If the lower bound constraint on short-term interest rates makes it not feasible to implement this allocation with a conventional policy rule, then there exists a QE-augmented policy rule which respects the lower bound and replicates \( A^{N*} \) and, thus, \( W^{N*} \).

**Corollary 1:** Features of the QE-augmented policy rule:
1. If \( R_{S,t}^* \geq 1 \), set \( R_{S,t} = R_{S,t}^* \) and if \( R_{S,t}^* < 1 \), set \( R_{S,t} = 1 \)
2. For \( t < t_1 \), set \( q_t^N = 0 \), while for \( t \geq t_1 \) set \( q_t^N \geq 0 \)
Symmetric monetary union

Experiment 1: **MU with symmetric shocks and symmetric structures**
Symmetric monetary union

**Comment 1:** QE augmented policy rule preserves standard assignments of active MP and passive FP even if short-term rate reaches lower bound.

**Comment 2:** For large shocks (s.t. $R_{D,t}^{N*} < 1$), QE becomes ineffective, but forward guidance remains effective (see appendix).
Asymmetric monetary union

- $N \neq S$ in terms of a) shocks or b) structures

- Additional features: Current account imbalances (financed by CB via TARGET-balances or privately by integrated financial markets; see appendix)

- QE: CB has two instruments ($q^N_t$, $q^S_t$) for asymmetric monetary union: 
  → **Proposition 1** can be extended to **Proposition 2**:
Proposition 2: Consider the equilibrium allocation of welfare relevant variables, consisting of the pair $A^{N*} = \{\hat{c}^{N*}_t, \hat{h}^{N*}_t, \hat{m}^{N*}_t\}_{t=0}^{\infty}$ and $A^{S*} = \{\hat{c}^{S*}_t, \hat{h}^{S*}_t, \hat{m}^{S*}_t\}_{t=0}^{\infty}$, that results from an unconstrained interest rate rule consistent with $R^{N*}_{D,t} \geq 1$ and $R^{S*}_{D,t} \geq 1$, leading to welfare levels $W^{N*}$ and $W^{S*}$. If the lower bound constraint on short-term interest rates makes it not feasible to implement this allocation with a conventional policy rule, then there exists a QE-augmented policy rule which respects the lower bound and replicates $A^{N*}$ and $A^{S*}$ and, thus, $W^{N*}$ and $W^{S*}$.

Corollary 2: Features of the QE-augmented policy rule:
1. If $R^*_S,t \geq 1$, set $R_S,t = R^*_S,t$ and if $R^*_S,t < 1$, set $R_S,t = 1$
2. For $t < t_1$ set $q^N_t = q^S_t = 0$, while for $t \geq t_1$ set $q^N_t \geq 0$ and $q^S_t \geq 0$
Motivation Model Results Conclusion Background

Asymmetric monetary union

Experiment 2: **MU with asymmetric shocks, but symmetric structures** *(here: homogeneous transmission channel)*

Shock realises only in N:

\[ y^N \quad \text{cpi}^N \]

\[ y^S \quad \text{cpi}^S \]

\[ R^N_\text{D} \quad R^N_\text{L} \]

\[ R^S_\text{D} \quad R^S_\text{L} \]

\[ q^N \quad q^S \]

→ purchases with **symmetric** portfolios (= “capital key”): \( q^S = q^N \)
Asymmetric monetary union

Experiment 3: **MU with symmetric shocks, but asymmetric structures** *(here: heterogeneous transmission channel)*

Larger home bias in LT bonds in S ($\omega_S > \omega_N$):

→ purchases with **asymmetric** portfolios *(≠ “capital key”)*: $q^S > q^N$
Asymmetric monetary union

How to read Experiment 2 vs. 3?

- Lower bound applies symmetrically if structures are symmetric
  → QE according to capital key

- Asymmetric structures create asymmetric private demand patterns for long-term bonds which do not fully realise due to the lower bound
  → Asymmetric QE needs to make up for the asymmetric patterns

Recall: no scope for opportunistic behaviour by assumption!
→ capital key becomes a crucial margin for QE design in a strategic setting

→ Paper is consistent with the ECB offering a range of distinct facilities, e.g.:
  QE: unconditional area-wide stimulus, according to capital key, to lift inflation
  OMT: conditional support for structural reforms, country-specific
New Keynesian 3-equation model extended to a 2-country monetary union model with banks

Effectiveness of QE at the lower bound via portfolio adjustment costs?
Idea: non-negativity of deposit rates replaces the non-negativity of short term policy rate

Sound fiscal governance structure:
QE portfolio of CB can be adjusted to replicate unconstrained outcomes resulting from a standard Taylor-like interest rate rule

Key challenge: incorporate strategic trade-offs arising from fiscal incompleteness of EMU
Thank you for your attention!
Experiment 4: **Approximating** unconstrained outcomes with QE and FG

![Graphs showing various economic indicators with different scenarios: no ZLB, ZLB no QE, ZLB with QE & FG.](image)
The representative household in $N$ obtains utility from overall consumption ($c^N$) and real money balances ($\frac{M^N}{P^N_c}$), and disutility from hours worked ($h^N$). The country-specific CPI is given by $P^N_c$.

The lifetime utility function is:

$$\max \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \phi^N_t \left[ \frac{(c^N_t - c^N_{t-1})^{1-\sigma}}{1-\sigma} - \frac{(h^N_t)^{1+\psi}}{1+\psi} + \frac{\chi_m^{-1}}{1-\sigma_m^{-1}} \left( \frac{M^N_t}{P^N_{c,t}} \right)^{1-\sigma_m^{-1}} \right]$$

subject to

$$D^N_t + M^N_t + P^N_{c,t} c^N_t = R^N_{D,t-1} D^N_{t-1} + M^N_{t-1} + W^N_t h^N_t + \Gamma^N_t$$

- Variables denoted in per-capita terms (sizes of $N$ and $S$ are $\alpha$ and $1 - \alpha$).
- Nominal variables are deflated with the country-specific consumer price.
- Only $N$ equations are shown. Those for $S$ look symmetrical (with the exception that the terms of trade $T_t$ take the opposite sign).
BACKGROUND: Households (2)

The optimality conditions in log-linear terms are:

\[
(1 - \varsigma \beta) \hat{MUC}_t^N = -\frac{1}{\sigma (1 - \varsigma)} \left[ \hat{c}_t^N - \varsigma \hat{c}_{t-1}^N \right] + \frac{\varsigma \beta}{\sigma (1 - \varsigma)} \left[ \hat{c}_{t+1}^N - \varsigma \hat{c}_t^N \right] + \varsigma \beta \hat{r}_n,t+1
\]

\[
\hat{MUC}_t^N = \hat{MUC}_{t+1}^N + \left[ \hat{R}_D,t - \hat{R}_{c,t+1}^N - \hat{r}_n,t \right]
\]

\[
\hat{h}_t^N = \hat{w}_t^N + \hat{MUC}_t^N
\]

\[
\hat{m}_t^N = -\sigma_m \hat{MUC}_t^N - \frac{\sigma_m \beta}{1 - \beta} \hat{R}_D,t
\]

where the natural rate of interest is defined as \( \hat{r}_n,t \equiv -(\hat{\phi}_{t+1}^N - \hat{\phi}_t^N) \) and follows an exogenous AR(1) process:

\[
\hat{r}_n,t = \rho r \hat{r}_{n,t-1} + \epsilon_{n,t}
\]

- \( \sigma > 0 \) elasticity of intertemporal substitution
- \( \psi > 0 \) wage elasticity of labor supply
- \( \sigma_m > 0 \) interest elasticity of money demand
- \( \varsigma \in [0, 1] \) habit formation in consumption
The consumption bundle $c^N$ is assumed to be given by a CES function that consists of domestic $c^N_D$ and foreign goods $c^N_F$:

$$c^N = \left[ \lambda_N \left( c^N_D \right)^{\eta-1} + (1 - \lambda_N) \left( c^N_F \right)^{\eta-1} \right]^{\eta/(\eta-1)}$$

- $\lambda_N \in [0, 1]$ share of domestic goods in the consumption basket consumed by the household (a natural index of openness)
- $\eta > 0$ elasticity of substitution between Domestic and Foreign goods.

Aggregate demand in $N$ (log-linearised already):

$$\hat{y}_t^N = \lambda_N \hat{c}_t^N + (1 - \lambda_N) \hat{c}_t^S + \eta (1 - \lambda_N) (\lambda_N + \lambda_S) \hat{T}_t$$

- Consumer prices are: $\hat{\pi}_{c,t}^N = \lambda_N \hat{\pi}_{p,t}^N + (1 - \lambda_N) \hat{\pi}_{p,t}^S$
In each country, a continuum of monopolistically competitive firms sell their differentiated goods in the domestic and foreign market. Only labour enters the production function (in log-linear terms):

$$\hat{y}_t^N = \hat{h}_t^N$$

The NK Phillips curve features nominal price rigidity à la Rotemberg:

$$\hat{\pi}_{p,t}^N = \beta \hat{\pi}_{p,t+1}^N + \frac{\varepsilon - 1}{\chi} \left[ \hat{\pi}_{s,t}^N + (1 - \lambda_H) \hat{T}_t \right]$$

with law of motion for the terms of trade

$$T_t \equiv \frac{P_{p,t}^S}{P_{p,t}^N}$$

$$\hat{T}_t = \hat{T}_{t-1} + \hat{\pi}_{p,t}^S - \hat{\pi}_{p,t}^N$$
BACKGROUND: Banks

In each country, banks accept deposits and invest in short- and long-term bonds of both countries, facing portfolio adjustment costs and home bias for long-term bonds. Short-term bonds are perfect substitutes.

- The profit maximisation is given by:

\[
\max \mathbb{E}_t [R_{S,t} B_{SP,t}^N + R_{L,t+1} B_{LD,t}^N + R_{L,t+1} B_{LF,t}^N - R_{D,t} D_t^N \\
- \frac{\nu_1}{2} \left( \delta \frac{B_{SP,t}^N}{B_{LP,t}^N} - 1 \right)^2 P_{P,t}^N - \frac{\nu_2}{2} \left( \frac{\omega_N}{1 - \omega_N} \frac{B_{LF,t}^N}{B_{LD,t}^N} - 1 \right)^2 P_{P,t}^N]
\]

s.t. \( D_t^N = B_{SP,t}^N + B_{LP,t}^N \)
\( B_{SP,t}^N = B_{SD,t}^N + B_{SF,t}^N \)
\( B_{LP,t}^N = B_{LD,t}^N + B_{LF,t}^N \)

The optimality conditions yield (in log-linear terms):

- **Deposit rate:** weighted average of short- and long-term rates

\[
\hat{R}_{D,t}^N = \frac{1}{1 + \delta} \hat{R}_{S,t} + \frac{\delta}{1 + \delta} \left[ \omega_N \hat{R}_{L,t+1}^N + (1 - \omega_N) \hat{R}_{L,t+1}^S \right]
\]

- **Maturity and regional spreads:** similarly proportional to portfolio shares
**BACKGROUND: Fiscal policy**

Fiscal policy requires to finance debt payments (interest+principal) and lump-sum transfers to domestic households using debt and seigniorage.

- Long-term bonds are modelled as consols $B^N_{consols}$ with value $V^N$ with no maturity and one nominal unit as return each period.
- Nominal outstanding long-term debt: $B^N_{LGt} = V^N_t B^N_{consols,t}$
- The return is given by: $R^N_{L,t} = \frac{1+V^N_t}{V^N_{t-1}}$

The government budget constraint is:

$$B^N_{SG,t} + B^N_{LG,t} + S^N_t = R^N_{S,t-1} B^N_{SG,t-1} + R^N_{L,t} B^N_{LG,t-1} + P^N_{c,t} \tau^N_t$$

The fiscal rules keep the real debt structure constant and determine lump-sum transfers as a stable feedback with $\theta > 0$ (log-linearised):

$$\hat{b}^N_{LGt} = \hat{b}^N_{SGt}$$

$$\frac{\delta}{\hat{b}^N_{LP}} \hat{\tau}^N_t = -\theta \left[ \hat{R}^N_{S,t-1} - \hat{\tau}^N_{c,t} + \hat{b}^N_{SG,t-1} \right]$$

Short-term debt is the clearing residual in the government budget constraint.
The central bank controls the short-term interest rate $R_S$ via a Taylor-like rule which responds to the union-wide aggregates

$$\hat{R}_{S,t} = \rho_R \hat{R}_{S,t-1} + (1 - \rho_R)(\phi_\pi \hat{\pi}_t + \phi_y \hat{y}_t) + \varepsilon_{R,t}$$

with $\alpha$ being the size of North and $1 - \alpha$ the size of South:

$$\hat{\pi}_{c,t} = \alpha \hat{\pi}^N_{c,t} + (1 - \alpha) \hat{\pi}^S_{c,t}$$

$$\hat{y}_t = \alpha \hat{y}^N_t + (1 - \alpha) \hat{y}^S_t$$

Standard monetary policy is symmetric, yet unconventional bond purchases can potentially be asymmetric with some functional form:

$$\tilde{q}^N_t = f^N(.) + \varepsilon^N_{q,t}$$

- Seigniorage and income/losses from bond purchases can be distributed according to country size or back to the country of origin.
BACKGROUND: Seigniorage and market clearing

Central bank balance sheet with $M_t = \alpha M^N_t + (1 - \alpha) M^S_t$:

$$M_t = \alpha \left( B^N_{SC,t} + Q^N_t \right) + (1 - \alpha) \left( B^S_{SC,t} + Q^S_t \right)$$

Aggregate seigniorage in $N$ is then determined by:

$$\alpha S^N_t = (1 - (1 - \alpha) \mu_1) (R_{S,t-1} - 1) \alpha B^N_{SC,t-1} + \alpha \mu_1 (R_{S,t-1} - 1) (1 - \alpha) B^S_{SC,t-1} + (1 - (1 - \alpha) \mu_2) (R^N_{L,t} - 1) \alpha Q^N_{t-1} + \alpha \mu_2 (R^S_{L,t} - 1) (1 - \alpha) Q^S_{t-1}$$

- $\mu_1 \in [0, 1]$ degree of income/loss sharing from regular seigniorage
- $\mu_2 \in [0, 1]$ degree of income/loss sharing from QE bond purchases

Market clearing on the bond markets implies in each country:

- Short-term bonds: $B^N_{SG,t} = B^N_{SD,t} + \frac{1 - \alpha}{\alpha} B^S_{SF,t} + B^N_{SC,t}$
- Long-term bonds: $B^N_{LG,t} = B^N_{LD,t} + \frac{1 - \alpha}{\alpha} B^S_{LF,t} + Q^N_t$
**Current account**  

\[ P_{p,t}^N \Omega_t^N = P_{c,t}^N c_t^N - P_{p,t}^N \{ y_t^N - \Xi_t^N \} \]

funded via five channels:

\[
\begin{align*}
P_{p,t}^N \Omega_t^N &= \frac{1 - \alpha}{\alpha} \left[ M_t^S - M_{t-1}^S - (B_{SC,t}^S - B_{SC,t-1}^S) - (Q_t^S - Q_{t-1}^S) \right] \\
&+ \mu_1 (1 - \alpha) (R_{S,t-1} - 1) \left[ B_{SC,t-1}^S - B_{SC,t-1}^N \right] \\
&+ \mu_2 (1 - \alpha) \left[ (R_{L,t}^S - 1) Q_{t-1}^S - (R_{L,t}^N - 1) Q_{t-1}^N \right] \\
&+ \frac{1 - \alpha}{\alpha} \left[ B_{SF,t}^S - R_{S,t-1} B_{SF,t-1}^S \right] - \left[ B_{SF,t}^N - R_{S,t-1} B_{SF,t-1}^N \right] \\
&+ \frac{1 - \alpha}{\alpha} \left[ B_{LF,t}^S - R_{L,t} B_{LF,t-1}^S \right] - \left[ B_{LF,t}^N - R_{L,t} B_{LF,t-1}^N \right]
\end{align*}
\]

1. new money holdings in S exceed new money creation in S
2. If CB income shared across union:
   a) more regular seigniorage generated in S than in N
   b) more QE income generated in S than in N
3. If financial markets integrated:
   a) Banks in S buy more new short-term debt issued in N than vice versa
   b) Banks in S buy more new long-term debt issued in N than vice versa
## BACKGROUND: Calibration

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha$</td>
<td>0.5</td>
<td>Relative country size of North</td>
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<tr>
<td>$\lambda_N$</td>
<td>0.8</td>
<td>Home bias of consumption in North</td>
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<tr>
<td>$\omega_N$</td>
<td>0.7</td>
<td>Home bias of bonds in North</td>
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<tr>
<td>$\eta$</td>
<td>1.0</td>
<td>Substitutability of domestic and foreign goods</td>
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<tr>
<td>$\beta$</td>
<td>0.9925</td>
<td>Household discount factor</td>
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<tr>
<td>$\sigma$</td>
<td>6.0</td>
<td>Elasticity of inter-temporal substitution</td>
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<td>$\zeta$</td>
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<td>Habit formation parameter in consumption</td>
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<tr>
<td>$\psi$</td>
<td>2.0</td>
<td>Frisch elasticity of labour supply</td>
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<tr>
<td>$\sigma_m$</td>
<td>1.0</td>
<td>Interest elasticity of money demand</td>
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<tr>
<td>$\epsilon$</td>
<td>5.0</td>
<td>Elasticity of substitution across goods</td>
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<td>$\chi$</td>
<td>28.65</td>
<td>Price adjustment cost parameter</td>
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<tr>
<td>$v_1$</td>
<td>0.0038</td>
<td>Short-long portfolio balance cost parameter</td>
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<tr>
<td>$v_2$</td>
<td>0.0127</td>
<td>Domestic-foreign portfolio balance cost parameter</td>
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<td>$\theta$</td>
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<td>Adjustment parameter in the fiscal transfer rule</td>
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<tr>
<td>$\mu_1$</td>
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<td>Degree of income sharing from seigniorage</td>
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<tr>
<td>$\mu_2$</td>
<td>0.0</td>
<td>Degree of income sharing from bond purchases</td>
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<td>$\phi_\pi$</td>
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<td>Inflation coefficient in the interest rate rule</td>
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<tr>
<td>$\phi_y$</td>
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<td>Output coefficient in the interest rate rule</td>
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<td>$\rho_R$</td>
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<td>Smoothing parameter in the interest rate rule</td>
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<tr>
<td>$\rho_n$</td>
<td>0.85</td>
<td>Smoothing parameter for the natural rate</td>
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<tr>
<td>$\bar{T}$</td>
<td>1.0</td>
<td>Steady state of the terms of trade</td>
</tr>
<tr>
<td>$\bar{m}_b$</td>
<td>0.2</td>
<td>Steady state ratio of money to short-term bonds</td>
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<tr>
<td>$\bar{b}_LP$</td>
<td>0.6</td>
<td>Steady state ratio of long-term bonds to output</td>
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<tr>
<td>$\delta$</td>
<td>3.0</td>
<td>Steady state ratio of long- to short-term bonds</td>
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</table>
BACKGROUND: Fiscal policy challenges

**Fiscal policies:** current framework lacks credibility
→ how to make architecture of EA more complete?

- Polar cases?
  a) re-nationalisation: to be avoided
  b) deep fiscal union: unrealistic for the time being

- Thus, recalibrate a **realistic mix** between
  i) rules-based behaviour for national FPs,
  ii) more reliance on market-based discipline, and
  iii) some role for a small euro area fiscal capacity, as a catalyst for future change
BACKGROUND: EA QE challenges

- EA QE has been key for achieving sustained adjustment of inflation towards below, but close to, 2% mark
- "Divine coincidence" of too low area-wide inflation and fragile sustainability of gov’t debt in some member countries unlikely to last forever
- Will macroeconomic deleveraging be sufficient (i.e. reduction of high debt levels via nominal growth)?
- Bridge to reform momentum to fix weak spots of EA governance via (grand) bargain?
Reforms to fix weak spots of EA governance via (grand) bargain?

- **Ingredients**: Steps towards **EA-wide fiscal capacity** cum completion of **Banking Union** cum **euro-area specific SDRM**?
- **role of ‘safe’ assets?**
  → need to mitigate i) bank-sovereign nexus and ii) destabilising cross-country safe haven flows
- **get clear on legacy issues vs new steady-state features**
- **use time axis** (phasing in of new features/regulations)
BACKGROUND: Alternatives to EA QE?

Single economy answers/adaptations → Problematic in view of EA specific features

Example: Proposal to switch to active fiscal policy, passive monetary policy (i.e. peg at $i = 0$)

“What is required is that fiscal policy be seen as aimed at increasing the inflation rate, with monetary and fiscal policy coordinated on this objective...In Europe it is harder to see how the necessary fiscal policy commitment could be arranged, because of the many fiscal authorities in the region. A Eurozone-wide moratorium on the Maastricht budgetary rules, to be kept in place until area-wide inflation reaches and sustains the target level, would be effective. Of course it is difficult to see how, in the Eurozone institutional framework, this could be arranged.”

(Chris Sims, Jackson Hole, 2016)

In any case, plausibility of FTPL is controversial