A DSGE model to assess the post crisis regulation of universal banks

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Outline

Introduction

- The last financial crisis has led to a multiplication of new regulations
  - Volcker rule
  - Liikanen proposal
  - Basel III new requirements
    - ↪ Reinforcement of the capital requirement
    - ↪ Introduction of liquidity requirements
- The calibration of liquidity requirements still under discussion
  - As well as their impacts on the economy
- The consistency of these reforms is under investigation
- Our approach : a general equilibrium model that proposes a suitable framework for both capital and liquidity constraints
  - taking into account several features, such as
    - More than 1 period maturity assets
    - Several types of assets
    - Distinction between SMEs and large corporate firms

Related Literature

- Plenty of papers on higher capital requirement.
- Little evidence on liquidity requirements impacts
- Several outstanding issues

Related Literature

- Plenty of papers assessing the costs of higher capital requirement
  - Empirical studies : Sutorova and Teply (2013), Bridges et al. (2015) ...
  - DSGE Models : Angelini and Gerali (2012), Mendicino et al. (2015) ...

    Main results :
    Large consensus that higher capital requirement results in higher banks funding costs and imposes costs in terms of lending and ultimately economic activity.

    LT effects after 1pp increase in the capital requirement :
    - Relatively small impact on lending spreads : from 2 to 20 bp
    - Similar results for the GDP : -0.30% to -0.04%

    $\Longrightarrow$ *Models that do not take into account the new liquidity requirements*

- Little evidence on liquidity requirements impacts
- Several outstanding issues

Related Literature

- Plenty of papers on higher capital requirement.
- Little evidence on liquidity requirements impacts.
  - Empirical Studies : Banerjee and Mio (2015) on UK data, Bonner (2015) on NL data
    ↪ *Studies based on liquidity requirements imposed in the UK and the Netherlands prior to Basel III*
  - Partial Equilibrium Models: De Nicolo et al. (2014)
    ↪ *Inhibiting prices dynamics, liquidity and capital requirements may have substantial impacts on credit and activity (Covas and Driscoll, 2010)*
  - General Equilibrium models: Roger and Vlcek (2010), Covas and Driscoll (2014) ...
    ↪ *But they all "adopt very simple definitions ... for the bank liquidity, **that are quite distant from the complex measures introduced by the new rules**". Angelini et al. (2011).*

    Main results :
    - High increase in HQLA (both empirical and DSGE models)
    - No significant changes in bank lending according to empirical studies

    Consistent with the EBA reports using QIS data.
    ↪ *Different from DSGE models simulations.*
- Several outstanding issues

Related Literature

- Plenty of papers on higher capital requirement.
- Little evidence on liquidity requirements impacts
- Several outstanding issues
  - Liquidity requirements calibration
  - Interaction between capital and liquidity requirements
  - Interaction between both liquidity requirements (LCR and NSFR)

Main Conclusions

- The implementation of liquidity regulation affects private consumption dynamics, and has a less persistent effect than solvency regulation that affects loans distribution as well as investment.

- The Liquidity Coverage Ratio may induce banks to substitute business credits for sovereign bonds. The dynamic of private investment may suffer from a crowding out effect from public debt.

  $\Longrightarrow$ Neglecting the sovereign bonds channel may underestimate the adverse effect of the introduction of the LCR on real variables.

- Implementing simultaneously liquidity and solvency regulations has compounded effects contrary to the view held before Basel III.

- The impact of the LCR is qualitatively similar to the impact of the NSFR, even if, quantitatively, the latter has a more moderate effect.

  $\Longrightarrow$ Strong substitution effects between the two liquidity ratios, more particularly in the financial sector.

Outline

The Model

- A large calibrated DSGE model extended with
  - Multi-period assets framework
  - Heterogeneity among producers
  - A bond market à la Gilchrist et al. (2010)

- Calibrated using euro area data

The Model

- A large calibrated DSGE model extended with
  - Multi-period assets framework as in Benes and Lees (2010), De Nicolo et al. (2014),
    geometric repayments of principal and interests scheme
  - Heterogeneity among producers
  - A bond market à la Gilchrist et al. (2010)
- An enriched banking sector
- Calibrated using euro area data

The Model

- A large calibrated DSGE model extended with
  - Multi-period assets framework
  - Heterogeneity among producers

    Making distinction between corporate firms (issue bonds) and SMEs (do not issue bonds)

  - A bond market à la Gilchrist et al. (2010)
- An enriched banking sector
- Calibrated using euro area data

The Model

- A large calibrated DSGE model extended with
  - Multi-period assets framework
  - Heterogeneity among producers
  - A bond market à la Gilchrist, Sim and Zakrajsek (2010)
    Idiosyncratic shock hitting the firms' production able to make firms' managers to default
    $\Longrightarrow$ A presence of a risk premia over riskless assets yield rate Details
- An enriched banking sector
- Calibrated using euro area data

The Model

- A large calibrated DSGE model extended with
  - Standard features
  - Multi-period assets framework as in Benes and Lees (2010)
  - Heterogeneity among producers
  - A bond market à la Gilchrist et al. (2010)
- An enriched banking sector
- Calibrated using euro area data

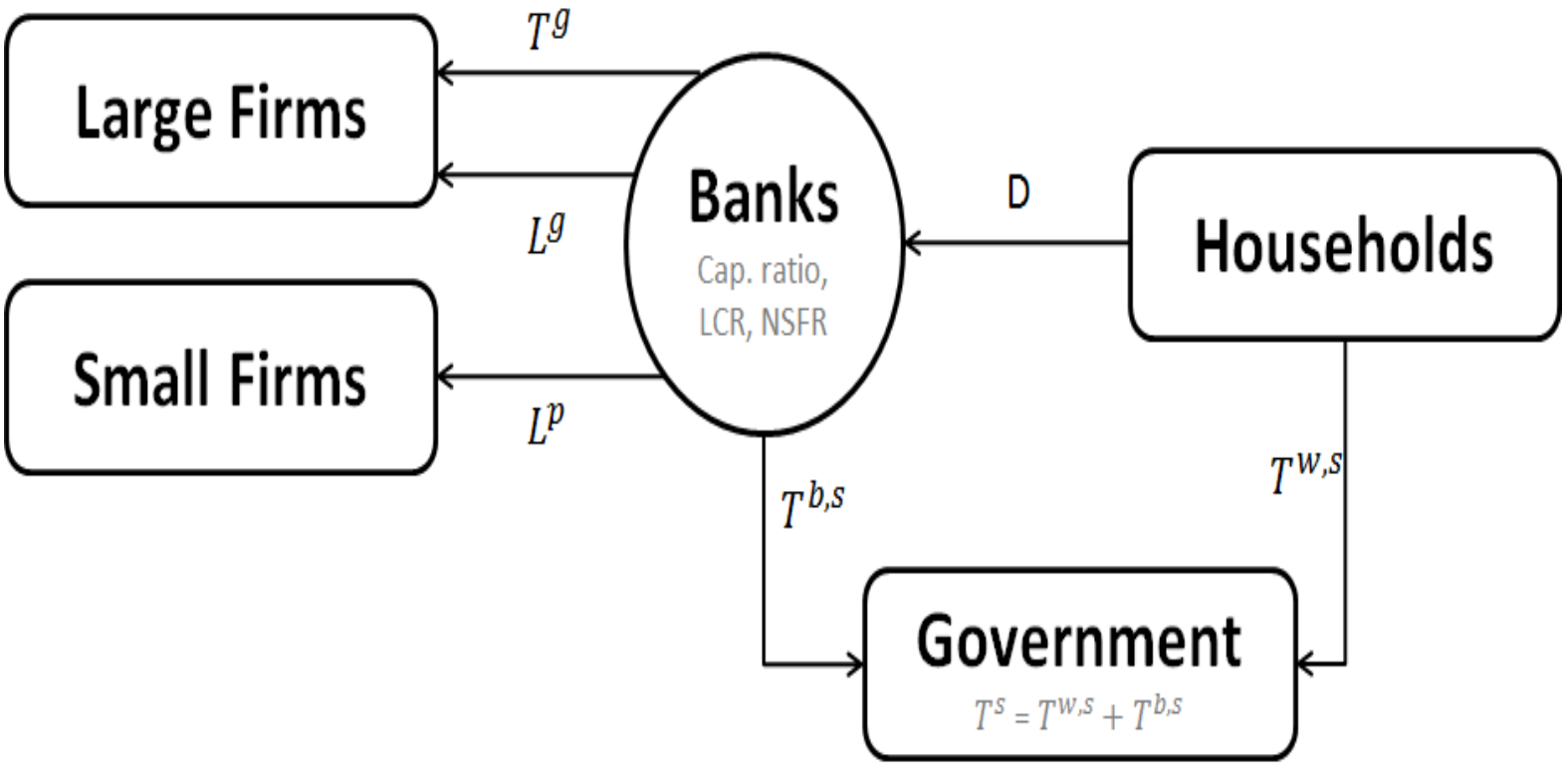


Figure : Financial Flows in the model

The Model

Modelling the banking sector :

1. A continuum of banks
2. In monopolistic competition
3. A simplified balance sheet :
   - Asset side: Loans to SMEs + loans to corporate + bonds to corporate + Bonds to sovereigns
   - Liability side : equity + deposit + interbank funds
4. Banks maximize cash flow net of adjustment cost of interest rates, intermediation cost and cost of deviation from target (regulation)
5. Regulation includes solvency and liquidity (LCR and NSFR) constraints

The Model

- A large calibrated DSGE model extended with
  - Standard features
  - Multi-period assets framework as in Benes and Lees (2010)
  - Heterogeneity among producers
  - A bond market à la Gilchrist et al. (2010)

- An enriched banking sector

- Calibrated
  - To match some Euro Area aggregate ratios
  - Using (EA model by) Gerali et al.(2010) estimation
  - Using French supervisory data to calibrate the regulatory constraint coefficients

Details

Outline

The Main Findings

- Quantitatively, results in the range of the literature results

Long-term Impact of capital and liquidity requirements*

	Capital requirement			LCR requirement		
Paper	Bank Loans	GDP	Spread BLR	Bank Loans	GDP	Spread BLR
de Bandt and Chahad - EA	**-1.75% (SMEs) -1.98% (large corporates)**	**-0.31%**	**+5.8bp (SMEs) +2.6bp (large corporates)**	**-0.0% (SMEs) -0.0% (large corporates)**	**-0.00%**	**0.0bp (SMEs) 0.0bp (large corporates)**
Angelini & Gerali (2012) - EA	-1.96%	-0.36%	+31bp	-	-	-
Covas & Driscoll** (2014) - USA	-0,8%	-0.1%	+4bp	-3.1%	-0.3%	+11bp
Sutorova & Teply (2013) - UE	-0.03%	-	+18.8bp	-	-	-
MAG (2010) - 17 OECD	-	-0.09%	12.2bp	-	-0.15%	+25bp

*1pp increase in the capital ratio and 25pp increase in the LCR
**6pp increase in the capital ratio

- Lending to the economy is almost not affected by the imposition of the LCR (Banerjee and Mio (2015) and EBA reports using QIS data).

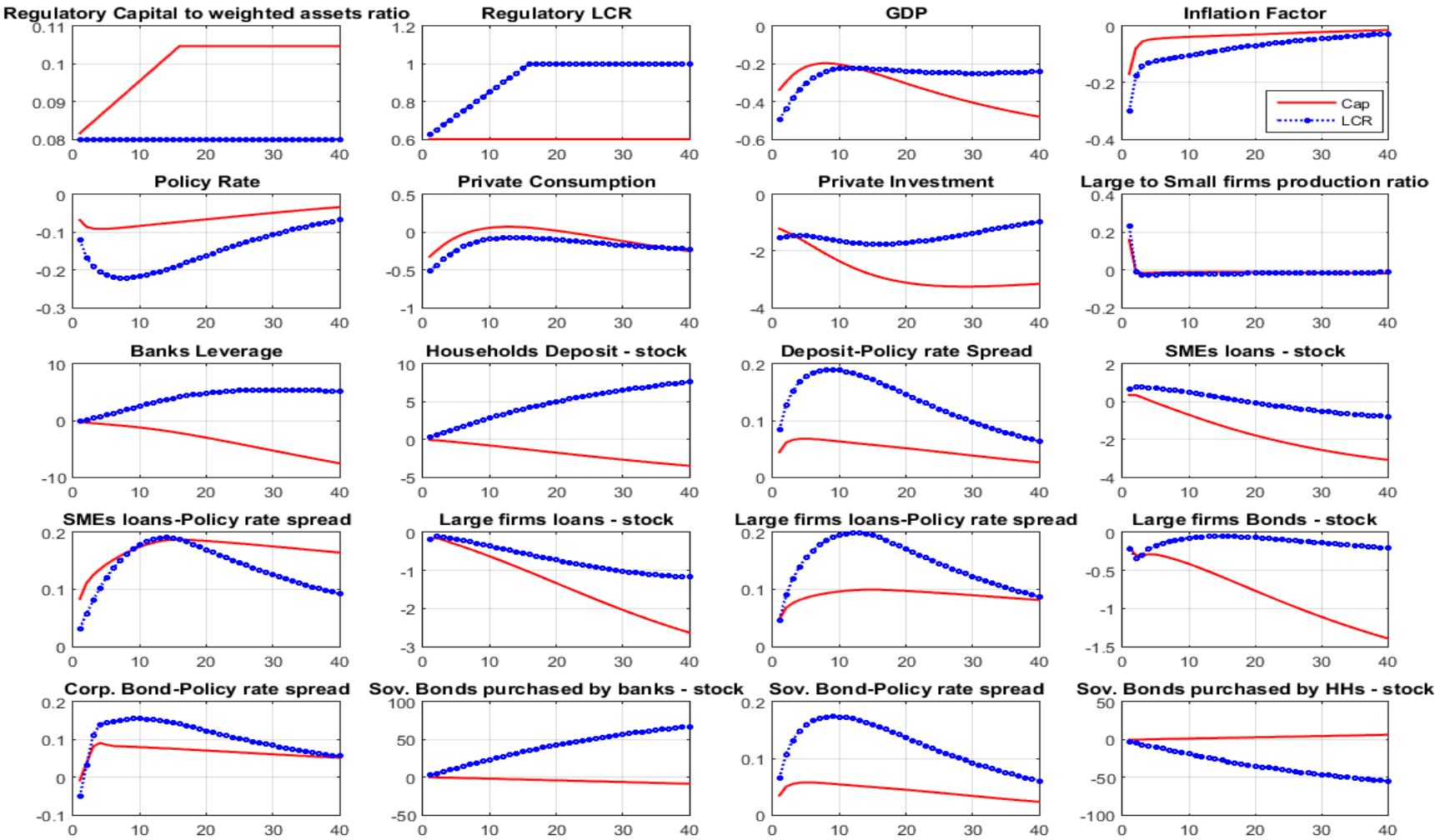
The Main Findings

- Quantitatively, in line with the literature
- Negative impact on output

  Through mainly

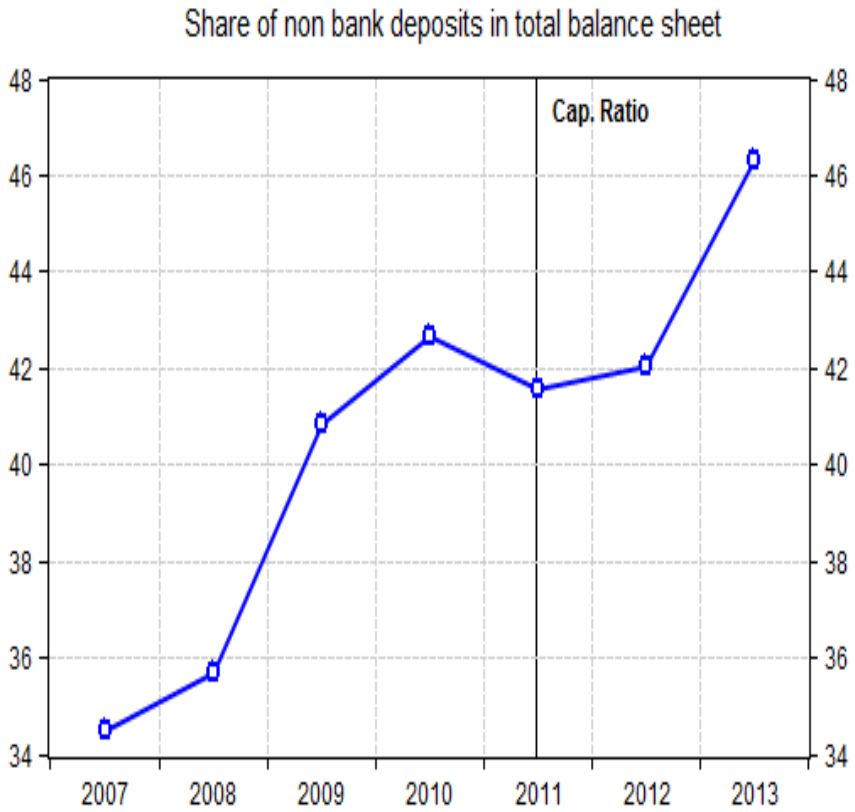
  - Investment (Capital ratio) due to a sharp deleveraging process triggered by the constraint
  - Consumption (LCR) due to the HHs deposit channel
    - Banks are strongly encouraged to increase their holding of non-bank deposits
    - Since the LCR cost of holding 1 additional euro of HHs deposit is much lower of the LCR benefit of holding 1 additional euro of (HQLA) sovereign bonds.

1- Capital or liquidity requirements



2- HHs deposits in banks

In the last few years, deposits increase, more than loans

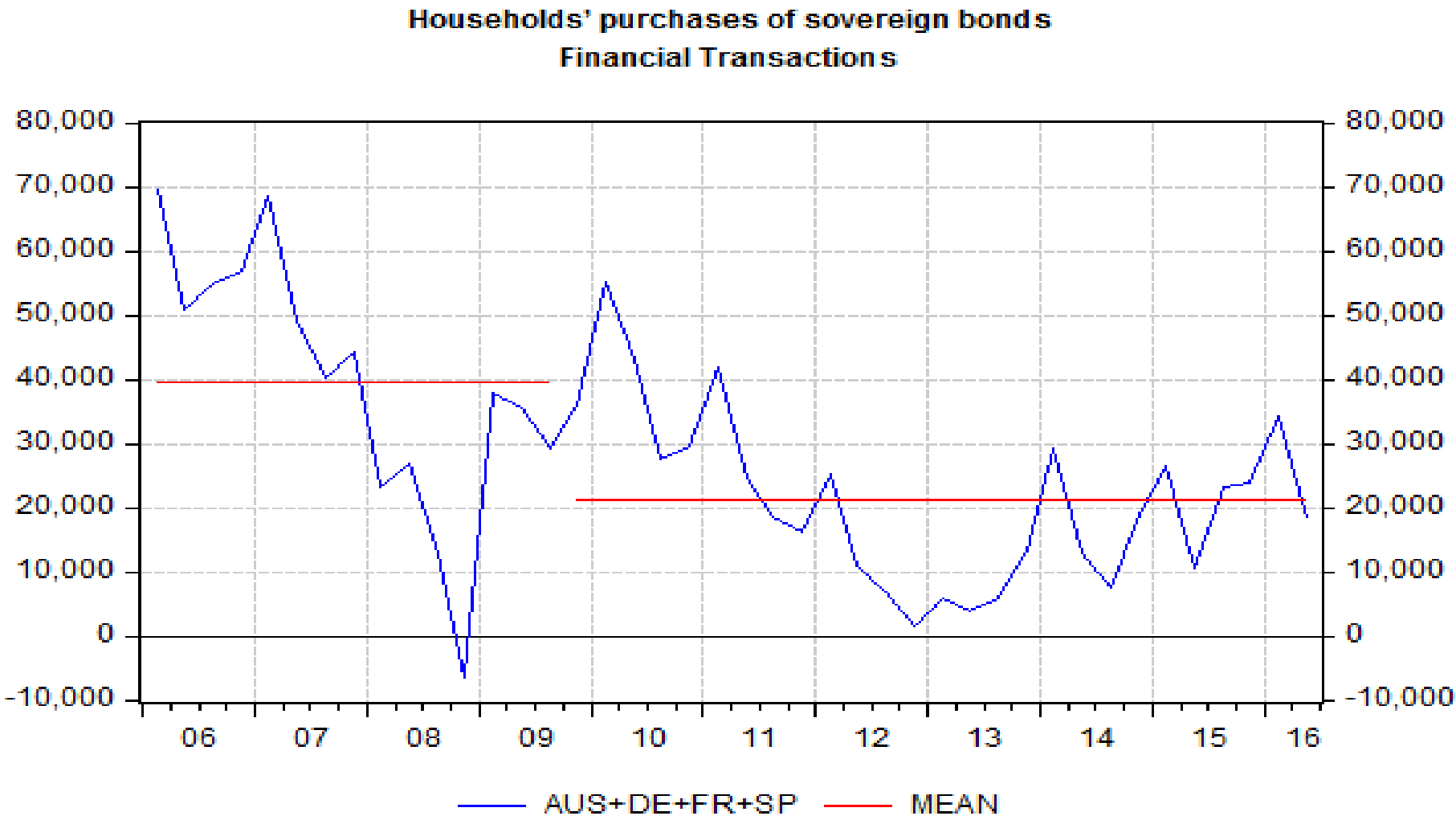


The Main Findings

- Quantitatively, in line with the literature
- Negative impact on output
- High incentives for holding sovereign bonds to reach the LCR

  "*It is not desirable that the prudential regulation leads to shift the banks' investments primarily toward the public sector financing needs, since we saw during the year 2010 that some of the sovereign bonds could suffer from sudden liquidity shocks.*" Christian Noyer's new year address to the ACPR, 2011.

3'- Decrease in Households' purchases of sovereign bonds (euro area)



The Main Findings

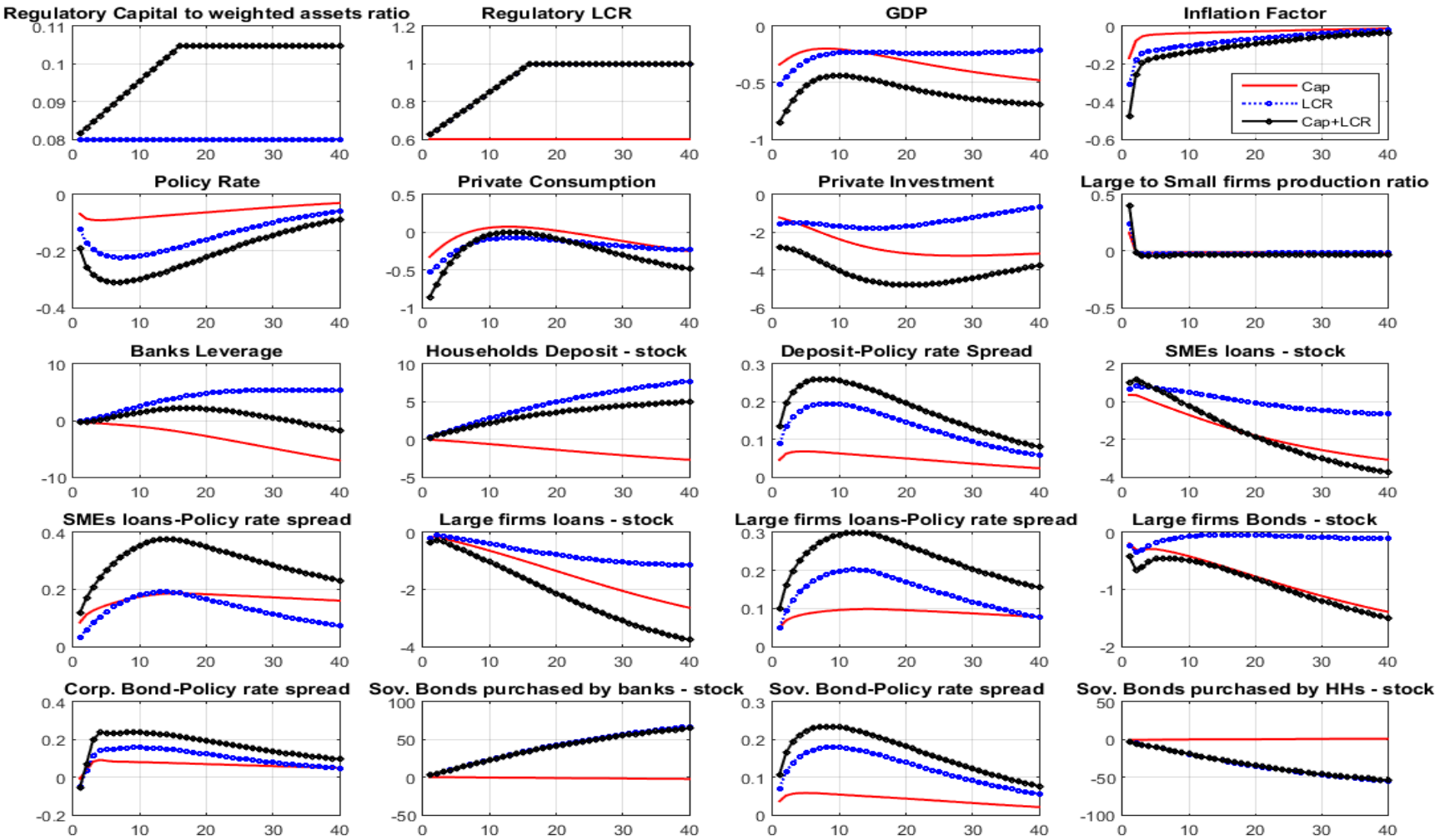
- Quantitatively, in line with the literature
- Negative impact on output
- High incentives for holding sovereign bonds to reach the LCR

$\Longrightarrow$ Neglecting the sovereign bonds channel may underestimate the adverse effect of the introduction of LCR on real variables.

The Main Findings

- Quantitatively, in line with the literature
- Negative impact on output
- High incentives for holding sovereign bonds to reach the LCR
- Implementing simultaneously liquidity and solvency regulations has compounded effects

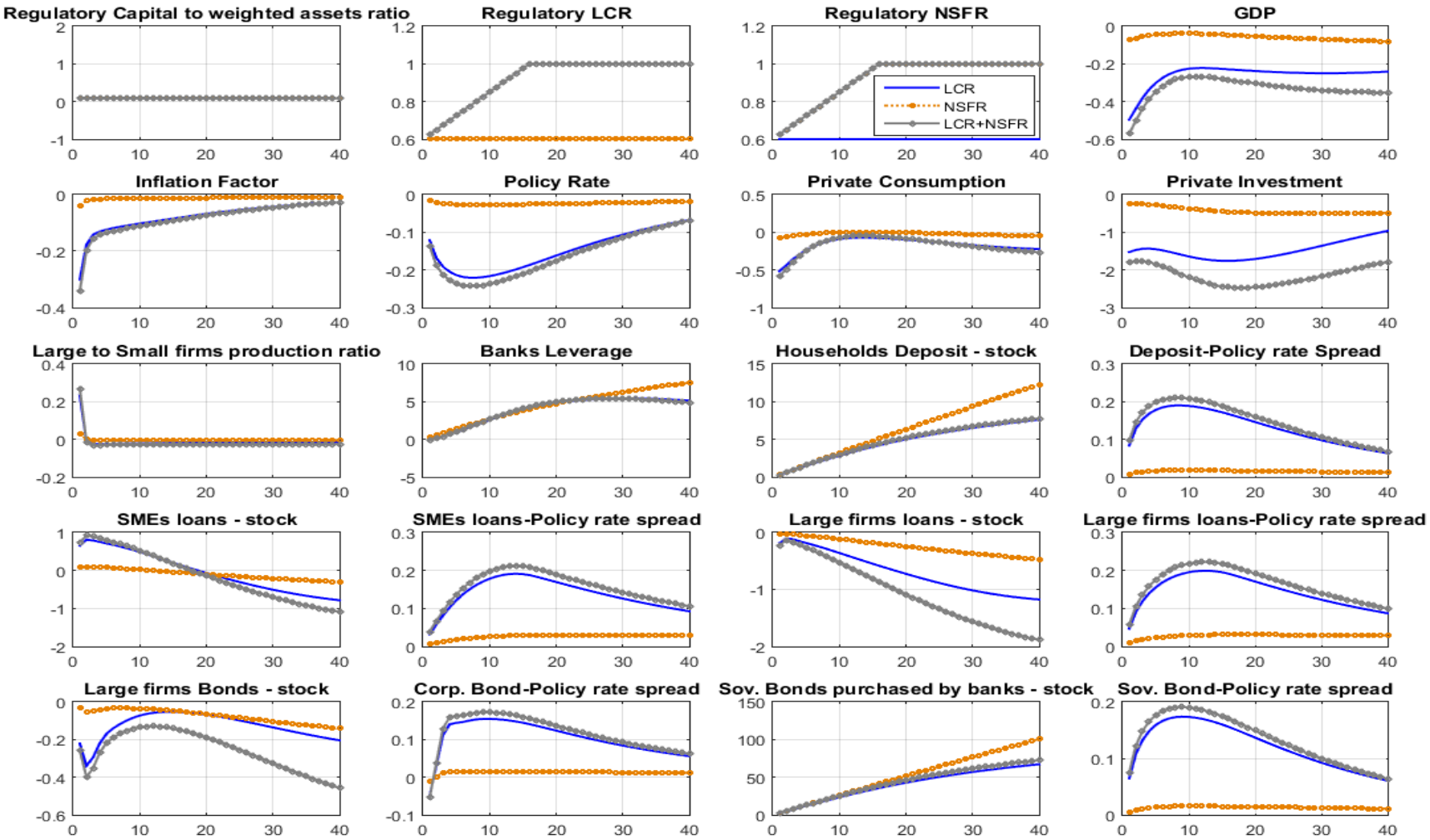
4- Joint effect of capital and liquidity requirements



The Main Findings

- Quantitatively, in line with the literature
- Negative impact on output
- High incentives for holding sovereign bonds to reach the LCR
- Implementing simultaneously liquidity and solvency regulations has compounded effects
- Positive externalities when implementing the two liquidity constraints (LCR and NSFR)

5- LCR vs NSFR


Regulatory Capital to weighted assets ratio
Regulatory LCR
Regulatory NSFR
LCR
NSFR
LCR+NSFR
GDP
Inflation Factor
Policy Rate
Private Consumption
Private Investment
Large to Small firms production ratio
Banks Leverage
Households Deposit - stock
Deposit-Policy rate Spread
SMEs loans - stock
SMEs loans-Policy rate spread
Large firms loans - stock
Large firms loans-Policy rate spread
Large firms Bonds - stock
Corp. Bond-Policy rate spread
Sov. Bonds purchased by banks - stock
Sov. Bond-Policy rate spread

Outline

Conclusion

- The implementation of Basel III regulatory constraints comes with a medium term dampening in output
- We highlight the role of the channel of accumulation of sovereign bonds, making the issue more relevant for the Basel committee, in terms of consistency of the different reforms.
- We conclude to the substitutability between LCR and NSFR, but, (very) low degree of substitutability between capital and liquidity constraints.
- This offers a partial explanation of a few stylized facts.
- The model can be useful to assess the calibration of microprudential and macroprudential regulation (to study variants of current policies).

Thank you for your attention

Long term maturities

- Each period, a constant proportion $(1-\delta^x)$ of the existing stock of assets SX_t is required.

Thus :

- The stock of assets held at time t is of the form :

$$SX_t = \sum_{k=0}^{\infty} \left(\delta^X\right)^k X_{t-k} \frac{P_{t-k}}{P_t} \iff SX_t = \frac{\delta^X}{\pi_t} SX_{t-1} + X_t \tag{1}$$

- the sum of all repayments (in real terms) related to due at time 't'

$$J_t^X = \frac{\delta^X}{\pi_t} J_{t-1}^X + (1 - \delta^X + R_t^X) X_t \tag{2}$$

- The collateral constraint can be written as :

$$FJ_t^L \leqslant \theta_t \left(q_{t+1}^K \pi_{t+1} \iota K_t (1-\delta)\right) \tag{3}$$

when FJ_t^L represents the residual value of interests and principal that has to paid on the bank credit borrowed until time t. $FJ_t^{L^p,i}$ can be written recursively as :

$$FJ_t^L = \frac{\delta^L}{\pi_t} FJ_{t-1}^L + \left(1 + \frac{R_t^L}{1-\delta^L}\right) L_t \tag{4}$$

Back

Main Basel III ratios

- Capitalisation Ratio

$$BCAP_t^n = \frac{SK_t^{B,n}}{\gamma_t^{LP} SL_t^{P,n} + \gamma_t^{LG} SL_t^{G,n} + \gamma_t^{Tg} ST_t^{G,n} + \gamma_t^{TS} ST_t^{S,n}} \tag{5}$$

- Liquidity Coverage Ratio

$$BLCR_t^n = \frac{\mu^{NTg} ST_t^{Tg,n} + \mu^{NTs} ST_t^{Ts,n}}{\underbrace{\mu^D SD_t^n + \mu^{JD} J_t^D + \mu^{IB} (1 + R_t) IB_t^n}_{\text{potential cash outflows}} - \underbrace{\left(\mu^{Lp} J^{LP,n} + \mu^{Lg} J^{LG,n} + \mu^{Tg} J^{TG,n} + \mu^{Ts} J^{TS,n} \right)}_{\text{cash inflows}}} \tag{6}$$

- Net Stable Funding Ratio

$$BNSFR_t^n = \frac{\gamma^{NK} K_t^{B,n} + \gamma^{D1} SD_t^n \left(1 - \delta_{1-4}^d\right) + \gamma^{D2} SD_t^n \delta_{1-4}^d}{\gamma^{TS} ST_t^s + \gamma^{TG} ST_t^g \gamma^{LP} SL_t^p \delta_{1-4}^{LP} + \gamma^{LG} SL_t^g \delta_{1-4}^{LG} + \gamma^{OthA} OtherAssets} \tag{7}$$

with : $\delta_{1-4}^x = \prod_1^4 (1 - \delta^x)^j$

Back

Assessing corporate bonds rates

From an investor point of view, the net-worth of a large firm is defined as :

$$\begin{aligned}\mathcal{W} = z_t \left[p_t^{e,g} Y_t^{e,g}\right] + T_t^g + L_t^g + (1-\delta) q_t^K K_{t-1}^G - q_t^K K_t^G - w_t N_t^g - \frac{J_{t-1}^{L^g}}{\pi_t} - \frac{J_{t-1}^{T^g}}{\pi_t} \\ + \underbrace{\iota^g \left(1-\theta^g\right) q_t^K K_{t-1}^G (1-\delta)}_{\text{the resale value of installed capital}} - F J_t^{T^g} \text{ where } z_t = exp(\epsilon^z) \text{ and } \epsilon^z \sim \mathcal{N}(-\frac{\sigma^2}{2}, \sigma^2)\end{aligned} \tag{8}$$

Large firm manager will choose to default if :

$$\begin{aligned}\mathcal{W} < \overline{\mathcal{W}} = \overline{z_t} \left[p_t^{e,g} Y_t^{e,g}\right] + T_t^g + L_t^g + (1-\delta) q_t^K K_{t-1}^G - q_t^K K_t^G - w_t^e N_t^g \\ - \frac{J_{t-1}^{L^g}}{\pi_t} - \frac{J_{t-1}^{T^g}}{\pi_t} + \iota^g \left(1-\theta^g\right) q_t^K K_{t-1}^G (1-\delta) - F J_t^{T^g} < \frac{J_{t-1}^{T^g}}{\pi_t}\end{aligned} \tag{9}$$

The trade-off equation for the investor can be written as :

$$\mathbb{P}_t = \underbrace{E_t \left\{ \frac{J_t^S \left(1-\Delta^s\right)}{\pi_{t+1}} \right\}}_{\text{Expected repayments from sovereign debtors}} \tag{10}$$

with :

$$\mathbb{P}_t = E_t \left\{ \int_{-\infty}^{\overline{\epsilon_z}} (1-\mu) \left[\mathcal{W}_{t+1}\right] dF(\epsilon_z) + \int_{\overline{\epsilon_z}}^{+\infty} \frac{J_t^G}{\pi_{t+1}} dF(\epsilon_z) \right\} \tag{11}$$

Back

Assessing corporate bonds rates

The trade-off equation (10) for the investor can then be written as :

$$\frac{J^G_{t-1}}{\pi_t} - \frac{J^S_{t-1}\left(1-\Delta^s\right)}{\pi_t} = \int_{-\infty}^{\overline{\epsilon_z}} \underbrace{\frac{J^G_{t-1}}{\pi_t} - (1-\mu)\,\mathscr{W}}_{>0} dF\left(\epsilon_z\right) \tag{12}$$

After some simplifications, we can rewrite $\mathbb{P}_t$ as follows:

$$\begin{aligned}\mathbb{P}_{t-1} = (1-\mu)\Bigg[\mathcal{F}\left(\frac{\overline{\epsilon_{z,t}}+\sigma^2/2}{\sigma}\right)\left(\overline{\mathscr{W}}+\frac{J^{Tg}_{t-1}}{\pi_t}\right)+\left(\mathcal{F}\left(\frac{\overline{\epsilon_{z,t}}-\sigma^2/2}{\sigma}\right)-exp(\overline{\epsilon_{z,t}})F\left(\frac{\overline{\epsilon_{z,t}}+\sigma^2/2}{\sigma}\right)\right)p^{e,g}_t Y^{e,g}_t\Bigg] \\ +\left[1-F\left(\frac{\overline{\epsilon_{z,t}}+\sigma^2/2}{\sigma}\right)\right]\frac{J^{Tg}_{t-1}}{\pi_t}\end{aligned} \tag{13}$$

Back

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Thus :

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- the sum of all repayments (in real terms) related to X due at time 't'

$$J_t^X = \frac{\delta^X}{\pi_t} J_{t-1}^X + (1 - \delta^X + R_t^X) X_t \tag{15}$$

- The collateral constraint can be written as :

$$FJ_t^L \leqslant \theta_t \left(q_{t+1}^K \pi_{t+1} \iota K_t (1-\delta)\right) \tag{16}$$

when FJ_t^L represents the residual value of interests and principal that has to paid on the bank credit borrowed until time t. $FJ_t^{L^p,i}$ can be written recursively as :

$$FJ_t^L = \frac{\delta^L}{\pi_t} FJ_{t-1}^L + \left(1 + \frac{R_t^L}{1-\delta^L}\right) L_t \tag{17}$$

Back

Calibration

- Discount factors and banks loan demand elasticities calibrated to match the bank lending and deposit rates
- LTV parameters θ^p and θ^g at 0.47 and 0.70 resp., with a resalable part of capital at 0.8
  $\Longrightarrow$ To ensure a steady-state values of SMEs and corporate firms banks loans to GDP about 10% (resp. 30%).
- δ^x calibrated in a way to get Macaulay's maturities about 4, 5, 7, 10 and 15 years for respectively SMEs bank loans, large firms bank loans, large firms bonds, risk-less (sovereign) bond and households deposits.
- We set the steady state SME's part in the global production volume at 0.33 (French data)
- The weights in the capitalization ratio : loans to SMEs (Stock) = 0.81, loans to large firms (Stock) = 0.46, Corporate Bonds (Stock) = 0.33 and Sovereign Bonds (Stock) = 0.04.
- For the LCR

$$\begin{array}{lcl} \mu^{NT^G} & = & 0.11 \\ \mu^{T^S} & = & 1/3\left(1-\mu^{NT^G}\right) \\ \mu^{L^G} & = & 0.5/3 \end{array} \qquad \begin{array}{lcl} \mu^{NT^S} & = & 0.8 \\ \mu^{D} & = & 0.2 \\ \mu^{L^P} & = & 0.5/3 \end{array} \qquad \begin{array}{lcl} \mu^{T^G} & = & 1/3\left(1-\mu \right. \\ \mu^{JD} & = & 1/3 \\ \mu^{IB} & = & 1/3 \end{array}$$

- and the NSFR

$$\begin{array}{lcl} \zeta^{NK} & = & 1 \\ \zeta^{TS} & = & 1+(0.05-1)\,\mu^{NT^S} \\ \zeta^{LG} & = & 0.5 \end{array} \qquad \begin{array}{lcl} \zeta^{D1} & = & 0.52 \\ \zeta^{TG} & = & 0.45 \\ \zeta^{OthA} & = & 1 \end{array} \qquad \begin{array}{lcl} \zeta^{D2} & = & 0 \\ \zeta^{LP} & = & 0.5 \end{array}$$

Basel 3 main ratios

- Capital requirement

$$\frac{\text{Bank Capital}}{\text{Risk-Weighted Assets}} > (\text{Minimum regulatory capital})$$

- LCR

$$\frac{\text{High-Quality Liquid Assets (HQLA)}}{\text{Total net cash outflows over the next 30 calendar days}} > 100\%$$

- NSFR

$$\frac{\text{Available amount of stable funding(>1 year)}}{\text{Required amount of stable funding (>1 year)}} > 100\%$$

- The denominators are based on stressed scenarios

Back

Deposits Spreads