Bank Capital in the Short and in the Long Run

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Introduction

- Since the global financial crisis min TCRs rose from 8% in Basel II to 10.5% in Basel III
- Opposing views on effects of higher capital ratios (CRs)
  - Needed to strengthen soundness of banks and improve incentives
  - Concerns of cutting credit provision to an already weak real economy
- This paper discusses the issues that determine how the above trade off should be resolved

Main Questions

Main question: **how far** and **how quickly** should capital requirements be raised in order to ensure a strong and resilient banking system **without** imposing undue costs on the real economy?

How the (transition) costs and (long-run) benefits of capital requirement policies are affected by...

- the **conduct of monetary policy**
- the **degree of fragility of the banking sector**

Approach

- In order to understand the effects of changes in capital regulation we build a **quantitative macro-banking model** featuring both nominal and financial frictions.
- The financial side of the model features **borrowers default** (in a CSV setting), **bank default** and **capital regulation** as in Clerc et al, 2015 and Mendicino et al (2016a)
- Introduce **monetary policy**, **nominal debt contracts** and **nominal price stickiness**
- To provide **quantitative results**, the model is calibrated to match **Euro Area** empirical regularities in macro, financial and banking variables.

Main Conclusions

Tighter Bank Capital Regulation:

- **potential long-run benefits**: Higher bank capital ratios reduce excessive bank leverage, defaults and their social/fiscal costs
- **short-run/transition costs**: Increases in CR resemble a negative demand shock

- In some circumstances (e.g. when the ZLB binds) short-run costs can offset the long-run welfare benefits! Then a more **gradual** and **less sizable** implementation of higher CRs more appropriate

- Benefits of higher CRs are larger and costs are smaller when bank risk is high.

Related literature

- Macroprudential policy to correct pecuniary externalities
  Lorenzoni (2008), Bianchi and Mendoza (2011, 2015), Korinek and Jeanne (2010)
- Capital requirements in a macro-banking framework
  Van den Heuvel (2008), Martinez-Miera and Suarez (2014), Nguyen (2014), Clerc et al (2015), Kiley and Sim (2015), Christiano and Ikeda (2017)
- Macroprudential-monetary policy interactions in DSGE
  De Paoli and Paustian (2017), Collard et al (2017)
- Impact of policies at the ZLB
  - Fiscal policy: Christiano, Eichenbaum, Rebello (2011), Erceg and Linde (2014)
  - Structural reform: Eggertson, Ferrero and Raffo (2014)

Model players: Households

- Three different types of household members
  - **Workers**: supply (insured and uninsured) deposits to banks and labor to the production sector
  - **Entrepreneurs**: provide equity financing to good-producing firms
  - **Bankers**: provide equity financing to banks
- Household provides *risk-sharing* to their members (against defaults on deposits)

Model players: Entrepreneurial firms and banks

- **Entrepreneurial firms**:
  - The representative entrepreneurial firm gets equity from entrepreneurs
  - Borrow funds from banks under limited liability
  - Risky investment in physical capital (default risk)
  - firm defaults on its loans when the gross return on its assets (logN distributed iid shocks) is insufficient to repay its debt obligations.
- **Banking sector**:
  - Competitive 1 period banks that supply (risky) loans to entrepreneurial firms
  - Use deposit funding and equity funding
  - Subject to capital regulation
  - Borrowers riskiness + iid portfolio return shock (logN distributed) $\Rightarrow$ banks default risk (*limited liability on deposits*)

Model players: Households

- **(Standard) Goods and Capital producing firms** (*price stickiness*)
- **Macroprudential Authority** : sets capital requirements for banks
- **Monetary Policy Authority** : sets the short-term policy rate - Taylor Rule

Key Distortions

1. **Individual bank default risk is not priced efficiently**
   - Part of bank debt = insured deposits (pays back promised interest rate)
   - Uninsured bank debt priced according to average (rather than individual) bank risk

   $\Longrightarrow$ *banks have an incentive to take excessive risk (benefits of Higher CRs)*

2. **Limited participation in the equity market**
   $\Longrightarrow$ *equity more expensive than debt (cost of Higher CRs)*

3. **Nominal debt and nominal price rigidities** *(important for short term costs of Higher CRs)*

Calibration

- Based on quarterly data for the Euro area (1992:1-2016:4)
- Reproduces salient features of macro, financial and banking data
- Implemented in two stages:
  1. Parameters fixable by convention
  2. Rest of parameters found so as to match targeted moments (by minimizing equally weighted sum of distances between empirical model-based moments)

Model fit

Table: Model fit

Targets	Definition	Data	Model
Real risk-free rate	$(\beta^{-1}-1)\times 400$	2.32	2.32
Inflation	$(\overline{\pi}-1)\times 400$	1.77	1.77
Capital requirements	ϕ	0.08	0.08
Share of insured deposits	κ	0.54	0.54
NFCs' default	$F_f(\overline{\omega}_f)\times 400$	2.646	2.675
NFC loans to GDP	$b_f\,/\,GDP$	1.897	1.868
Spread NFC loans	$(R^f-R)\times 400$	1.215	1.244
Banks' default	$F_b(\overline{\omega}_b)\times 400$	0.665	0.664
Equity return of banks	$(\rho_b-1)\times 400$	7.066	7.138
Banks price to book ratio	ν_b	1.148	1.148
Capital share of households	$K_s\,/\,K$	0.22	0.219

Long-run Effects of Higher CR

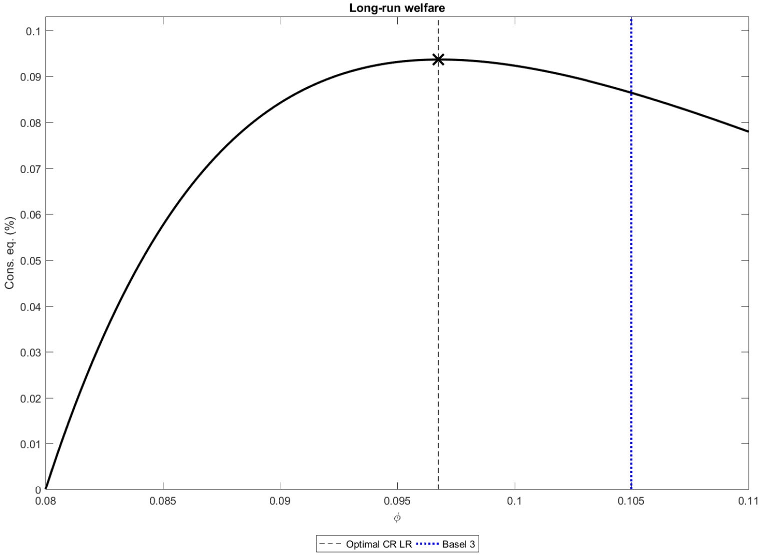
We use our quantitative model as a laboratory to explore the **long-run** real and welfare effects of a permanent change in TCRs (between 8 and 11 percent).

Higher CRs affect **bank funding costs/credit supply** in two off-setting ways:

- the implied reduction in the probability of bank default, lowers the **cost of deposit funding** (deposit spread): no negative implications for credit supply $\Rightarrow$ dominates when bank prob. default high
- **larger share of more expensive equity**: tightening in credit supply $\Rightarrow$ dominates for low bank prob. default

Hump shape in welfare reflects the changing nature of the above trade off.

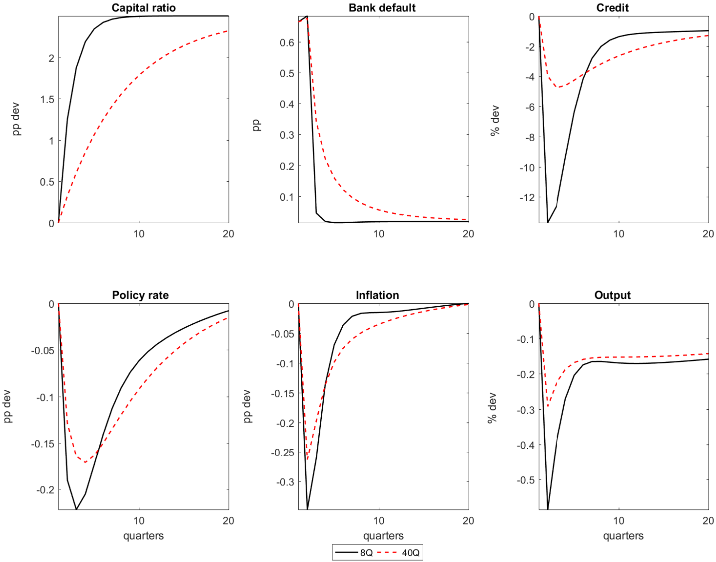
Long-run welfare impact



Experiment

- Design:
  - t=1 economy at deterministic steady state
  - t=2,3,... **2.5 pp permanent change in CR**, implemented gradually (perfect foresight)
- Alternative Environments
  - **Speed of implementation**
    - Provide a macroeconomic rationale for gradual phase-in of general increases in capital requirements (as for Basel III)

Different speeds: 8Q vs 40Q



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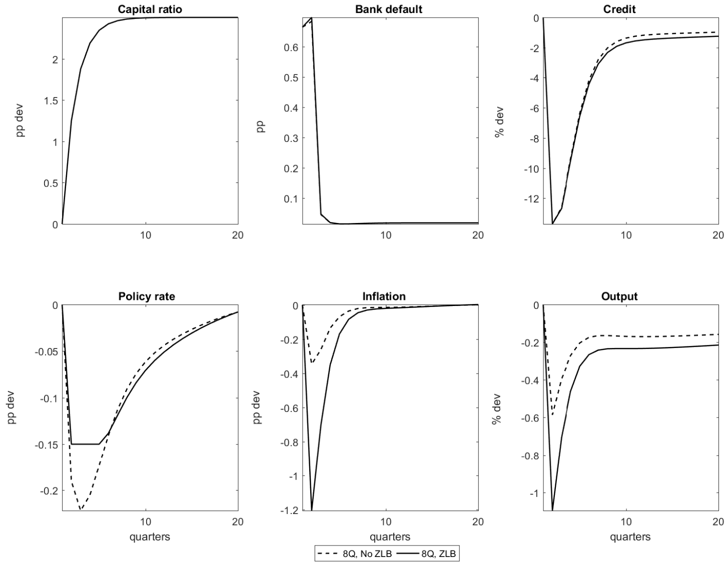
  - **Conduct of Monetary Policy**
    - Short-term costs particularly large when monetary policy is constrained (e.g. ZLB for interest rate policy)

Impact of the ZLB



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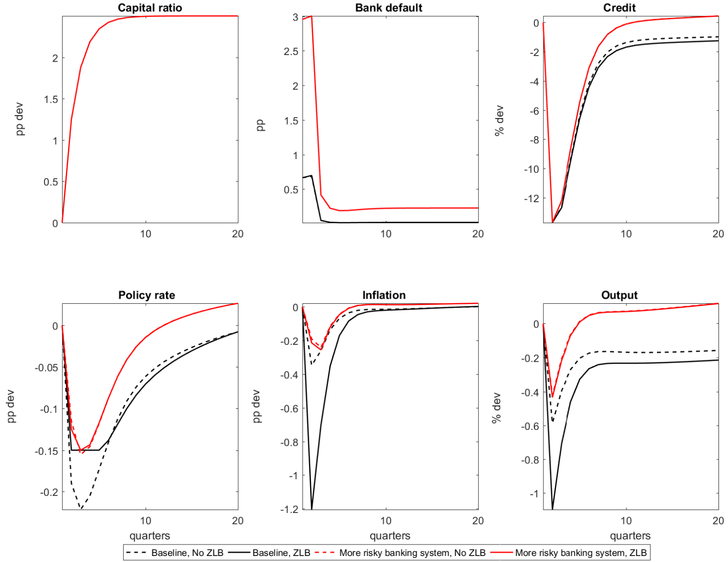
  - **Conduct of Monetary Policy**
    - Short-term costs particularly large when monetary policy is constrained (e.g. ZLB for interest rate policy)
  - **Degree of Bank Distress**
    - There is a level of fragility in the banking system above which swift aggregate recapitalisation may be justified

Transition costs under high financial distress

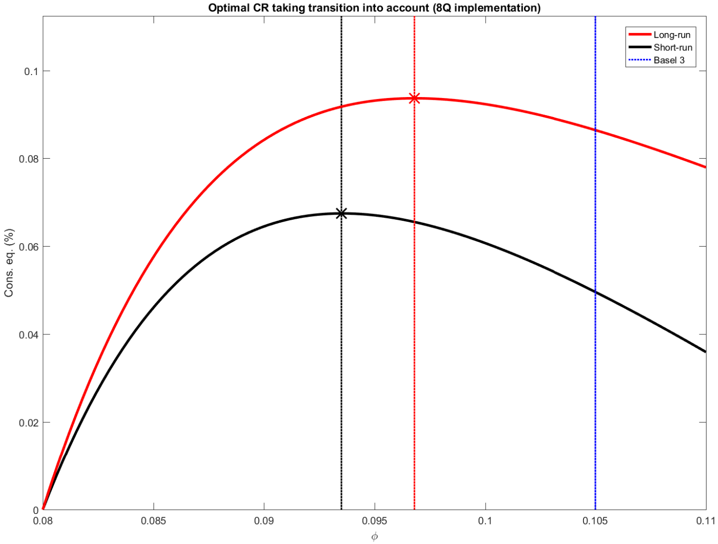


Social Welfare Max CR

Design of Optimal Capital Regulation:

- **Long run vs Long run + Transition**
  - Welfare costs during transition reduce the optimal CR wrt optimal long-run level: It is important to include transition costs when assessing the optimal CR increases!

Long-run vs Transition



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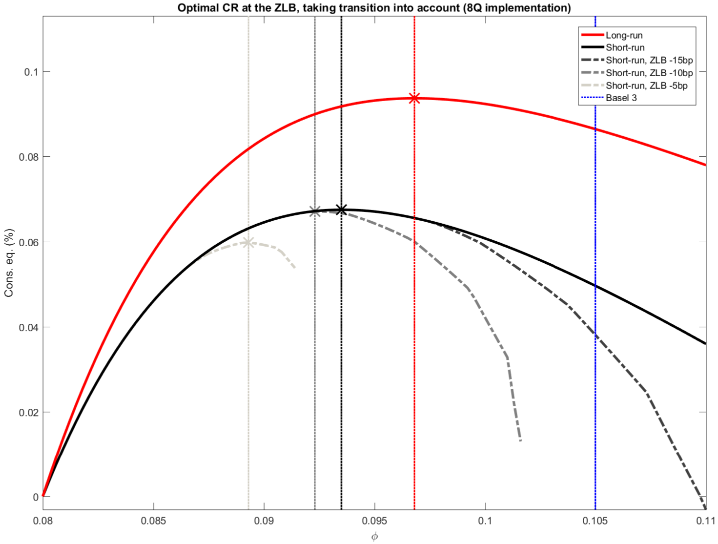
- **Normal Times (Taylor Rule) vs ZLB**
  - Being close to the ZLB further reduces the optimal CR

Impact of the ZLB

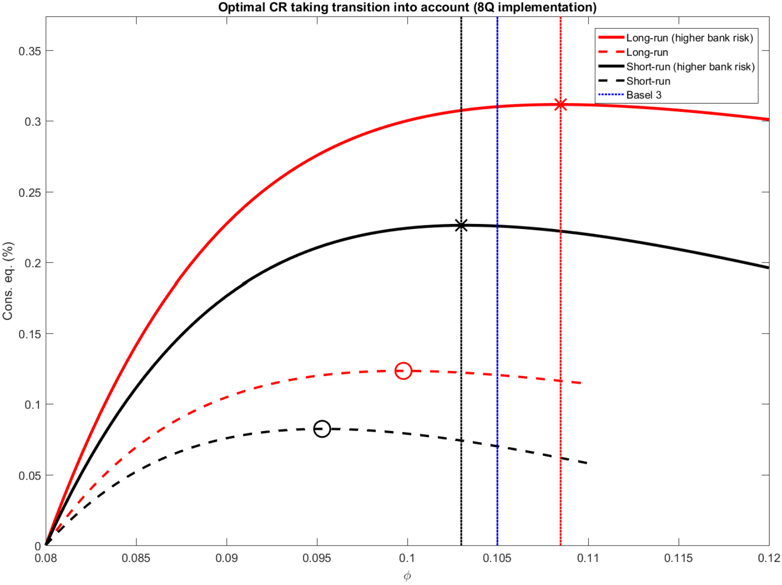


Social Welfare Max CR

Design of Optimal Capital Regulation:

- **Long run vs Long run + Transition**
    - Welfare costs during transition reduce the optimal CR wrt optimal long-run level: It is important to include transition costs when assessing the optimal CR increases!
- **Normal Times (Taylor Rule) vs ZLB**
    - Being close to the ZLB further reduces the optimal CR
- **Degree of Bank Distress**
    - The higher the degree of bank fragility the higher the optimal CR even with ZLB

High financial distress (comparison with normal times)



Main Conclusions

Capital requirement increases: **long-run benefits** BUT **short term costs** on the real economy

- Short-run real and welfare effects of higher CRs depend on the **speed of implementation**:
  - a slower speed of implementation can mitigate the short-run costs
- ... on the **conduct of monetary policy**:
  - smaller when monetary policy is accommodative
  - very large when the ZLB is binding $\Longrightarrow$ Slow implementation more appropriate
- ... and on the **fragility of the banking system**:
  - with more fragile banks the long term benefits of higher CRs are larger
  - ... while the short term costs reduced $\Longrightarrow$ Faster implementation optimal

Households

- Three different types of members
  - **Workers**: supply deposits to banks and labor to the production sector and transfer their wage income to the household
  - **Entrepreneurs**: provide equity financing to good-producing firms
  - **Bankers**: provide equity financing to banks [*limited participation*]
- Each period
  - Some entrepreneurs and bankers retire in each period and their wealth is shared among the dynasty members $\Rightarrow$ avoid over-accumulation of wealth,
  - Some workers become bankers and entrepreneurs (with some initial wealth endowment) $\Rightarrow$ constant size of the population.
- Household provides *risk-sharing* to their members (against defaults on deposits)

Households problem

$$E_t\left[\sum_{\tau=0}^{\infty}\beta^{t+\tau}\left[\log\left(C_{t+\tau}\right)-\frac{\varphi}{1+\eta}\left(L_{t+\tau}\right)^{1+\eta}\right]\right]$$

subject to the budget constraint:

$$\begin{gathered}P_tC_t+\left(Q_t+P_ts_t\right)K_{s,t}+D_t+B_t\leq\left(P_tr_{k,t}+\left(1-\delta_t\right)Q_t\right)K_{s,t-1}+\\ W_tL_t+\widetilde{R}_t^dD_{t-1}+R_{t-1}B_{t-1}-P_tT_{s,t}+P_t\Pi_t+P_t\Xi_t\end{gathered}\quad(1)$$

where:

C_t: consumption

L_t: hours worked

$\widetilde{R}_t^d$: Net of default return on deposits

D_t: portfolio of deposits

$K_{s,t}$ capital held by households, subject to a cost s_t

Q_t : nominal capital price

B_t : risk free asset (in zero net supply)

R_t : Risk free rate

T_t: lump-sum tax used to ex-post balance the DIA's budget

Π_t: aggregate net transfers from entrepreneurs and bankers

Ξ_t :dividends from firms that manage the capital stock on behalf of households

bank debt liability

- Fraction κ: **insured deposits** that always pay back the promised gross deposit rate R^d_{t-1}.

- Fraction $1-\kappa$: **uninsured bank debt** that pays back
  - the promised rate R^d_{t-1} if the issuing bank is solvent
  - $1-\kappa$ of the the average default loss (per unit of bank debt net recovery value of bank assets) in case of default [*Individual bank default risk not efficiently priced*]

$\Longrightarrow$ the gross return on bank debt is given by

$$\widetilde{R}^d_t = R^d_{t-1} - (1-\kappa)\Omega_t, \tag{2}$$

For $\kappa < 1$, bank debt is overall risky: $R^d_{t-1} \geq R_{t-1}$.

Banks

Competitive sector of banks supplying loans $B_{f,t}$ to entrepreneurial firms using deposit funding D_t and equity funding $E_{b,t}$.
Max expected equity pay-off:

$$\max_{B_{f,t},D_t,E_{b,t}} \quad E_t \Lambda_{b,t+1} \max \left[\omega_{b,t+1} \widetilde{R}^b_{t+1} B_{f,t} - R^d_t D_t, 0 \right]$$

$$\begin{array}{lll} \text{subject to:} & E_{b,t} + D_t = B_{f,t} & \text{balance sheet constraint} \\ & E_{b,t} \geq \phi_t B_{f,t} & \text{regulatory capital constraint} \\ & E_t \left[\rho_{b,t+1} E_{b,t} \right] \geq \overline{\rho}_{b,t} E_{b,t} & \text{bankers' participation constraint} \end{array}$$

where: $\omega_{b,t+1}$: idiosyncratic portfolio return shock (mean=1)

$\widetilde{R}^b_{t+1}$: realized return on well diversified portfolio of loans to entrepreneurs

$\overline{\rho}_{b,t}$: bankers' required rate of return on equity
$\Lambda_{b,t+1}$ is bankers' stochastic discount factor

Banks' willingness to invest in loans with returns $\widetilde{R}^b_{t+1}$ and subject to a capital requirement ϕ_t requires having

$$E_t \Lambda_{b,t+1} \left[1 - \Gamma_{b,t+1}(\overline{\omega}_{b,t+1})\right] \widetilde{R}^b_{t+1} \geq \phi_t v_{b,t}, \tag{3}$$

which explains the expressions for the participation constraints introduced in the borrowers' problem. Rate of return on banker equity is:

$$\rho_{b,t+1} = \frac{(1 - \Gamma_b(\overline{\omega}_{b,t+1}))\widetilde{R}^b_{t+1}}{\phi_t}.$$

where

$$\Gamma_b(\overline{\omega}_{b,t}) = \int_0^{\overline{\omega}_{b,t}} \omega_{b,t} f_b(\omega_{b,t}) d\omega_{b,t} + \overline{\omega}_{b,t} \int_{\overline{\omega}_{b,t}}^{\infty} f_b(\omega_{b,t}) d\omega_{b,t}$$

is the share of bank profits that accrue to depositors

Entrepreneurial Firms

The representative entrepreneurial firm gets equity A_t from entrepreneurs and borrow $B_{f,t}$ from banks to buy capital $K_{f,t}$ (return affected by an i.d.d. shock $\omega_{f,t+1}$ with mean 1).

- Can optimally default if net profits are negative, in which case the banks pay a bankruptcy cost and cease the underlying asset.
- The default decision depends on both iid and aggregate reasons:

$$\omega_{f,t} \leq \overline{\omega}_{f,t} = \frac{R^f_{t-1} \frac{B_{f,t-1}}{P_{t-1}}}{R_{K,t} K_{f,t-1}} \frac{1}{\pi_t} \tag{4}$$

where $R_{K,t} = \frac{(1-\delta_t)Q_t + P_t r_{k,t}}{Q_{t-1}}$ is the aggregate nominal return on capital.

Entrepreneurial firms

$$\max_{K_{f,t},R^f_t} E_t\left[\Lambda_{e,t+1}(1-\Gamma_{f,t+1}(\overline{\omega}_{f,t+1}))\left((1-\delta_{t+1})\frac{Q_{t+1}}{P_{t+1}}+r_{k,t+1}\right)\pi_{t+1}\right]K_{f,t} \tag{5}$$

subject to:

- Budget constraint: $B_{f,t} = Q_t K_{f,t} - A_t$
- Banks IC constraint:

$$E_t\left[\underbrace{\Lambda_{b,t+1}(1-\Gamma_b(\overline{\omega}_{b,t+1}))}_{\text{LEVERED RETURNS}}\underbrace{(\Gamma^f(\overline{\omega}_{f,t+1})-\mu_f G_f(\overline{\omega}_{f,t+1}))R_{K,t+1}}_{\text{NET RETURN ON A LOAN PORTFOLIO}}\right]q_t K_{f,t} \geq \overline{\rho}_{b,t}\phi_t B_{f,t}$$

where

$\Lambda_{e,t+1}$: the entrepreneurs' stochastic discount factor

$G_f(\overline{\omega}_{f,t+1})$:capital share that end up in default

$\overline{\rho}_{b,t}$: required expected rate of return on the equity

$B_{f,t}$ non-contingent debt with interest

μ_f: repossession cost

$\Gamma_f(\overline{\omega}_{f,t}) = \int_0^{\overline{\omega}_{f,t}} \omega_{f,t} f_f(\omega_{f,t}) d\omega_{f,t} + \overline{\omega}_{f,t}\int_{\overline{\omega}_{f,t}}^{\infty} f_f(\omega_{f,t}) d\omega_{f,t}$: share of total returns of levered asset that accrues to banks

Final good producers

The final good, Y_t, is produced by perfectly competitive firms using

- $y_t(i)$ units of each type of intermediate good i
- a constant return to scale, diminishing marginal product, and constant-elasticity-of-substitution technology:

$$Y_t \leq \left[\int_0^1 y_t(i)^{\frac{1}{1+\theta}} di\right]^{1+\theta}, \qquad (6)$$

  where θ is the price elasticity of demand.

Intermediary goods producers

The intermediate goods, $y(i)$, is produced by monopolistically competitive firms indexed by i using the following technology

$$y(i)_t = z_t \left(l(i)_t\right)^{1-\alpha} k(i)_{t-1}^{\alpha} \, , \tag{7}$$

where k is rented capital, l is labour supplied by households.

Price rigidities as in the New Keynesian literature. At time t each intermediate firm is allowed to revise its price with probability $(1-\xi)$ as in Calvo (1983), leading to the following New Keynesian Phillips curve:

$$\log\left(\frac{P_t}{P_{t-1}}\right) = \beta\left[E_t \log\left(\frac{P_{t+1}}{P_t}\right)\right] + \epsilon_\pi \log\left(\frac{X_t}{X}\right) \tag{8}$$

where $\epsilon_\pi = \frac{(1-\xi)(1-\beta\xi)}{\xi}$ and X_t represents the marginal cost of production. Intermediate firms are owned by the households.

Monetary and Macroprudential Authority

Monetary Policy Authority : sets the short-term policy rate - Taylor Rule

$$R_t = \rho_R R_{t-1} + (1-\rho_R)\left[\bar{R}\left(\frac{\pi_t}{\bar{\pi}}\right)^{\alpha_\pi}\left(\frac{GDP_t}{GDP_{t-1}}\right)^{\alpha_{GDP}}\right],$$

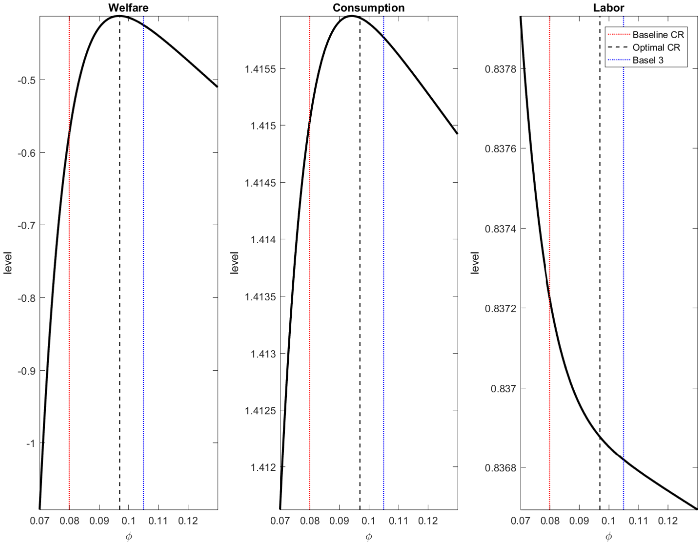
Macroprudential Authority : sets capital requirements for banks ϕ_t

Parameters

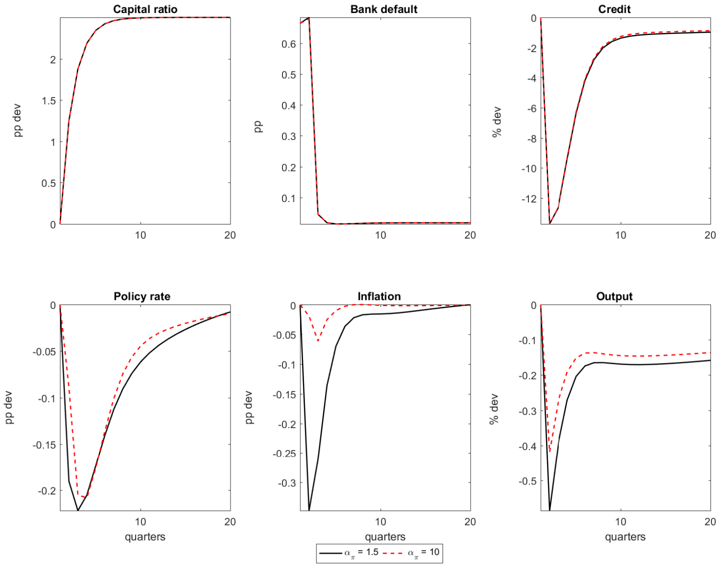
Table: Model parameters

Preset parameters					
Disutility of labor	φ	1	Banks bankruptcy cost	μ_b	0.3
Frisch elasticity of labor	η	1	Capital adjustment cost param.	ψ_k	4.567
Capital share in production	α	0.3	Price elasticity of demand	θ	1.005
Depreciation rate of capital	δ	0.03	Calvo probability	ξ	0.2
Population of entrepreneurs	n_e	1	Smoothing param. (Taylor rule)	ρ_R	0.75
NFC bankruptcy cost	μ_f	0.3	Inflation response (Taylor rule)	α_π	1.5
Survival rate of entrepreneurs	θ_e	0.975	Output growth response (Taylor rule)	α_{GDP}	0.1
Population of bankers	n_b	1			
Calibrated parameters					
Discount factor of consumers	β	0.994	STD iid risk for banks	σ_b	0.028
Capital requirement for banks	ϕ	0.08	Survival rate of bankers	θ_b	0.908
Share of insured deposits	κ	0.54	Transfer from HH to entrepreneurs	χ_e	0.001
Steady-state inflation	$\overline{\pi}$	1.004	Transfer from HH to bankers	χ_b	0.856
STD iid risk for entrepreneurs	σ_f	0.305	Capital managerial cost (coef.)	ς	0.006

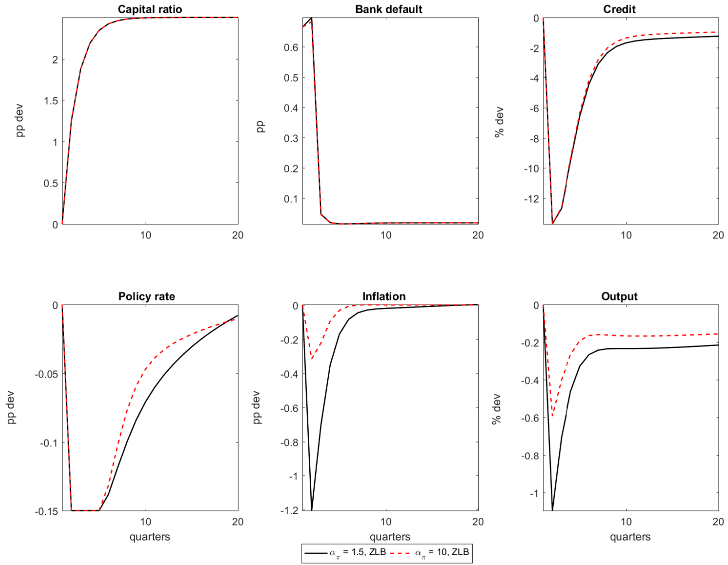
Appendix - Comparative statics



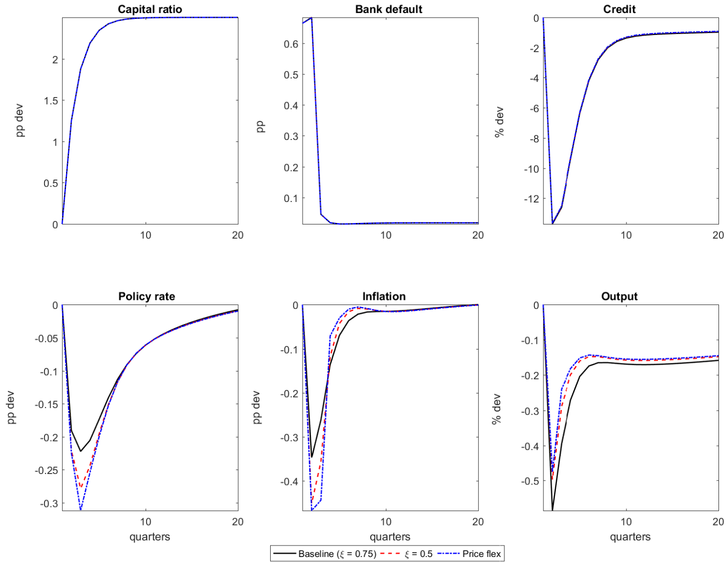
Appendix - Impact of monetary policy response



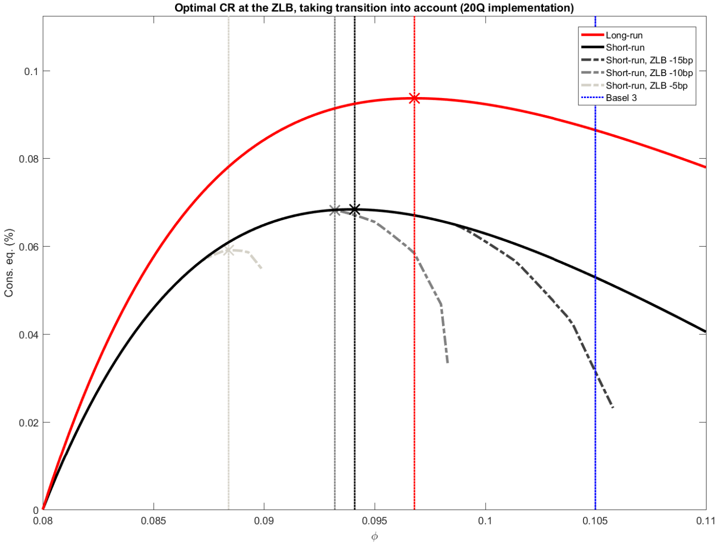
Appendix - Impact of monetary policy response, at the ZLB



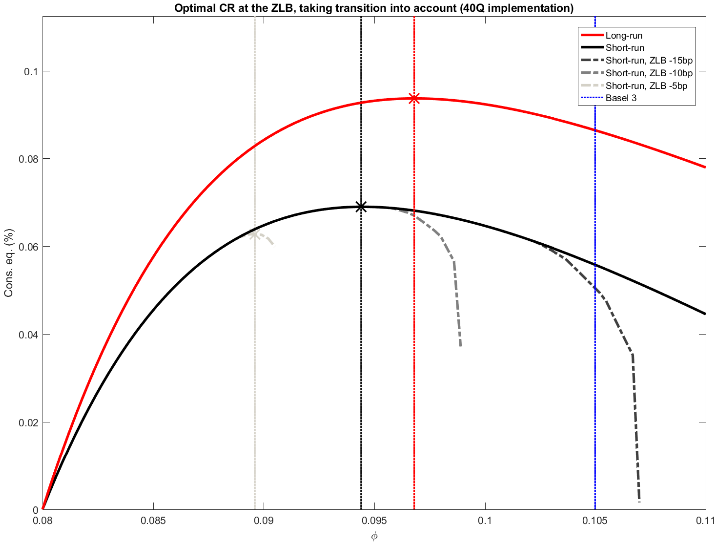
Appendix - Sensibility to price flexibility



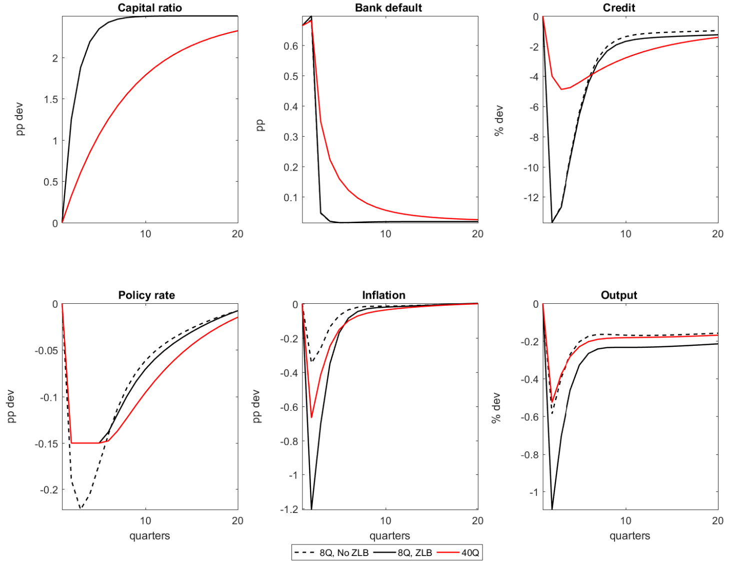
Appendix - Long-run vs Transition (20Q)



Appendix - Long-run vs Transition (40Q)



Lenght of implementation at the ZLB



High financial distress and the ZLB