Inflationary Shocks and the Financial Stability Trade-off

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6th Macroprudential Policy Group (MPPG) research workshop
16 October, 2023

Motivation

- Since the the spring of 2021, inflation increased rapidly and in a persistent manner, on the back of an unusual mix of demand and supply shock
- Major central banks reacted by increasing policy rates to bring inflation back under control
- Main questions:
  - How does higher than expected inflation affects financial stability risks?
  - What are the spillovers from monetary and macroprudential policy?

Framework

This paper illustrates cost and benefits of unanticipated changes in inflation through the lens of a quantitative macro-banking model featuring...

- Bank intermediation frictions
- Bank and borrower default risk
- New Keynesian features

$\longrightarrow$ Policy implications under this new environment for:

- Monetary Policy
- Macroprudential policy

Main Conclusions

Supply shocks

- increase inflation & weaken economic activity
- ...and give raise to financial stability risks!

Policy trade-offs

- Monetary Policy: Strict Inflation Targeting fully stabilizes inflation but amplifies financial stability risks
    - Trade-off btw Borrower and Saver Welfare
- Macroprudential Policy: no obvious benefits from releasing Capital Buffers – CCyB mitigates the impact on investment at the cost of higher default risk, especially when banks are less capitalized

Literature

Literature

- Effects of inflationary shocks in NK framework: Baqaee and Farhi [2022], Bilbiie and Melitz [2020], Blanchard and Gali [2007], Fornaro and Wolf [2023], Galí [2015], Gelain and Lorusso [2022], Guerrieri et al. [2022]

  $\Rightarrow$ Financial stability implications

- Interaction Monetary and Macroprudential: Angelini et al. [2014], Carrillo et al. [2021], Chen et al. [2020], Collard et al. [2017], de Paoli and Paustian [2017], Ferrero et al. [2018], Gersbach et al. [2018], Kiley and Sim [2017], Lambertini et al. [2013], Leduc and Natal [2018], Mendicino et al. [2020], Van der Ghote [2021], Espic et al. [2023]

  $\Rightarrow$ Focus on response to inflationary shocks

Model

Model Players

- **Households**
  - Borrowing(*) and Saving **Households**
- **Production**
  - Good Producing Firms(*)
  - Capital and Housing Production
- **Financial Intermediaries**(*)
  - raise **equity** and **deposits** from savers to extend **loans** to either borrowing households or firms
  - subject to **regulatory capital constraint**
- **Policy Interventions**
  - Macroprudential Authority sets capital requirements for banks
  - Monetary Policy Authority sets the policy rate (Taylor rule)

(*) All borrowers can default!

Model: Households

Two distinct dynasties of households ($\varkappa = s, m$) that differ in their discount factors ($\beta^m < \beta^s$):

- **Patient Household ("s")**: includes 3 members (constant mass 1)
  - **Savers**: supply labor to production sector and deposit to banks
  - **Entrepreneurs (E)** and **Bankers (B)**: inside equity providers (with limited net worth)
    - receive initial endowment from HH

- **Impatient Household ("m")**:
  - **Borrowers**: supply labor to production sector and **borrow** from the banks
    - buy housing and thier terminal housing value s.t. idiosyncratic risk
    - Individual borrower can optimally defaults if **terminal housing value** is insufficient to pay back its loan with bank
  - Dynasty pulls resources (takes into account the overall amount of mortgages and the fraction of defaulted loans every given period) and takes consumption decisions for all borrowers

Firms and Banks

- **Ex-ante** identical (to their own type)
- **Issues equity** among Entrepreneurs/Bankers (with limited net worth)⇒ External financing
- **Firms**
  - use **equity** and **loans** to buy capital and labor inputs to produce the final good $y_{t+1} = A_{t+1} k_t^{\alpha} (h_t)^{1-\alpha}$
  - Explicit contracting problem between bank and firm
    ⇒ banks price endogenously the default risk of borrowers
- **Banks**
  - use **equity** and **deposits** to give loans to firms/households
    $b_{f,t} = EQ_{b,t} + d_t$
    subject to **capital requirements**: $EQ_{b,t} \geq \phi_t b_{f,t}$
  - safety net guarantees (insured deposits) ⇒ risk profile of the individual bank not priced by depositors!

Borrowers

- **All borrowers** (households, firms and banks) operate under **limited liability** and can default on their debt obligations
  - HH and Firms $\Rightarrow$ bank loans
  - Banks $\Rightarrow$ deposits
- **Default** when: Value of the assets $<$ Liability to be repaid
  - Value of housing (borrowing HH) and capital (firms) insufficient to pay back the loan with bank
  - Banks: loan returns not enough to repay for deposits
  - Value of the assets depends on realization of both iid and aggregate shocks
- **Bankruptcy** imposes certain economic costs which are considered **deadweight losses** to the society

Monetary and Macro-prudential Authorities

Monetary Policy Authority : Taylor Rule or Strict Inflation Targeting

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

Macro-prudential Authority : sets capital requirements for banks ϕ_t

$$\phi_t = \bar{\phi} + \phi_{CCyB}\left(\frac{b_t^F + b_t^H}{\bar{b}^F + \bar{b}^H}\right)$$

When the CCyB is active, $\phi_{CCyB} > 0$, otherwise the coefficient is set to 0.

Key Distortions

(1) **Bank debt is not priced efficiently**
insured deposits: deposit rate independent of leverage of individual bank! $\Longrightarrow$
banks have an incentive to take excessive risk (benefits of Higher CRs)

(2)**Limited participation to the equity market**
$\Longrightarrow$ *equity more expensive than debt (cost of Higher CR)*

(3) **Nominal debt and nominal price rigidities**

Calibration

Calibration

- Based on quarterly data for the Euro area
- Reproduces salient features of macro, financial and banking data
  - HFCS, Flow of Fund, Supervisory data,Moody's EDF,...
- Implemented in two stages:
  - Parameters fixable by convention
  - Rest of parameters found so as to match targeted moments (by minimizing equally weighted sum of distances between empirical and model-based moments)
  - Model counterpart is the stochastic mean (defaults also driven by aggregate factors)

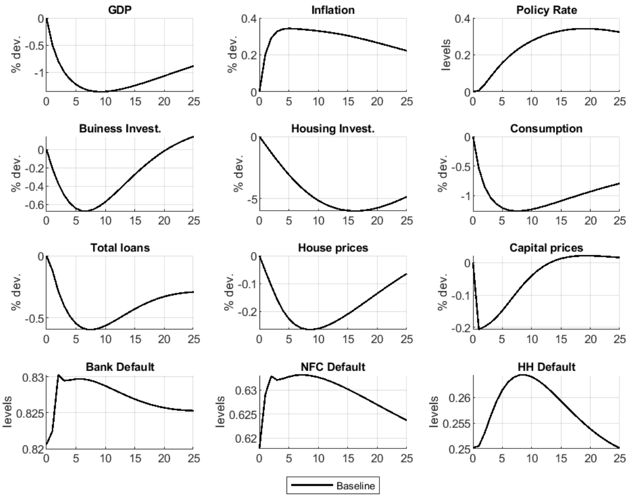
Calibration - Model parameters

Table: Model parameters

A) Preset parameters					
Disutility of labor for savers	φ_s	1	F banks bankruptcy cost	μ_F	0.3
Disutility of labor for borrowers	φ_m	1	M banks bankruptcy cost	μ_M	0.3
Discount factor for savers	β_s	0.9975	Entrepreneurs bankruptcy cost	μ_f	0.3
Housing weight in savers' utility	υ_s	1	Households bankruptcy cost	μ_m	0.3
Frisch elasticity of labor	η	1	Capital adjustment cost parameter	ψ_k	5
Capital share in production	α	0.3	Housing adjustment cost parameter	ψ_h	5
Depreciation rate of capital	δ_k	0.03	Calvo probability	ξ	0.95
Population of entrepreneurs	x_e	1	Smoothing parameter (Taylor rule)	ρ_R	0.86
Share of impatient households	x_m	0.90	Inflation response (Taylor rule)	α_π	2
Population of bankers	x_b	1	Output growth response (Taylor rule)	α_{GDP}	0.15
Habits formation	ϑ	0.5	Survival rate of entrepreneurs	θ_e	0.975
Share of insured deposits	κ	0.54	Survival rate of bankers	θ_b	0.951
Capital requirement on F banks	ϕ_F	0.133	Risk weight on M banks	rw	0.5
Transfer from HH to entrepreneurs	χ_e	0.2	Transfer from HH to bankers	χ_b	0.5974
Equity issuance cost parameter	ψ_0	1.5	Capital management cost - denominator	ϕ_K	2
CCyB coefficient	ϕ_{CCyB}	2			
B) Calibrated parameters					
Discount factor of borrowers	β_m	0.9729	STD iid risk for M banks	σ_M	0.0130
Housing depreciation	δ_h	0.0118	STD iid risk for F banks	σ_F	0.0552
Housing weight in borrowers' utility	υ_m	0.4274	STD iid risk for borrowers	σ_m	0.1003
Steady-state inflation	$\overline{\pi}$	1.005	STD iid risk for entrepreneurs	σ_f	0.3500
Capital management cost - numerator	ς	0.002			

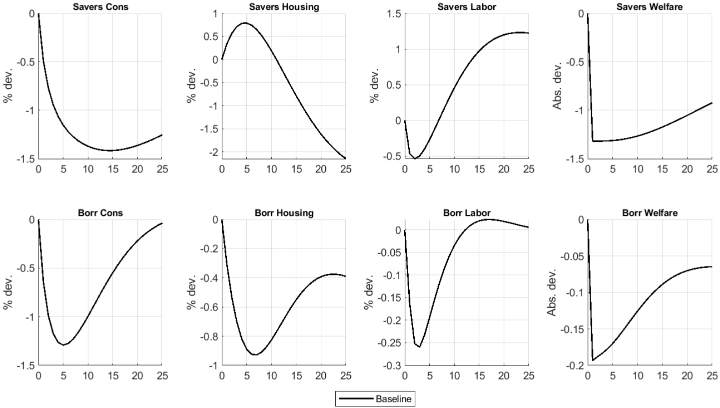
Results

Price Mark-up Shock: Baseline



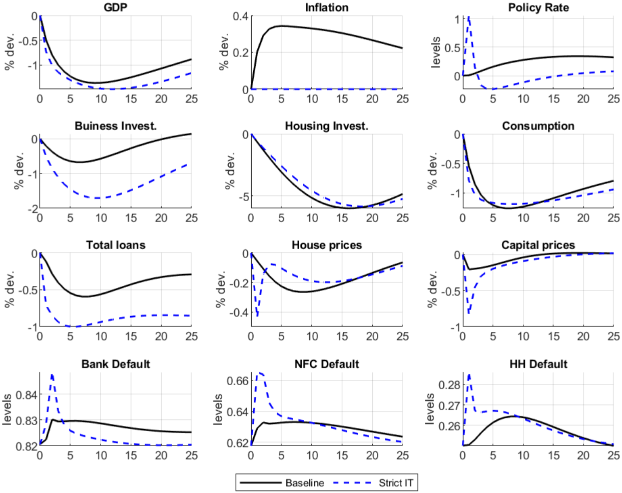
* Inflationary shocks lead to weaker economic activity.
* Banks face higher borrower default risk which increases their own default risk!

Price Mark-up Shock: Baseline (Borrowers vs Savers)



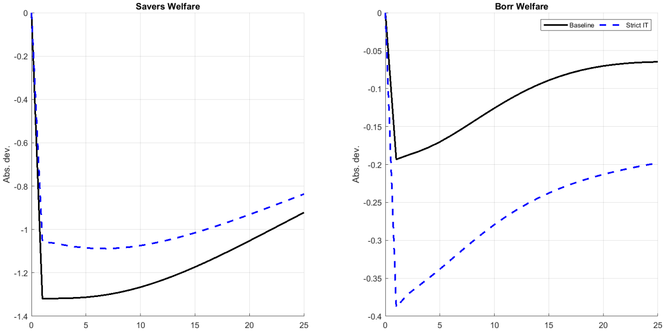
* Savers and Borrowers are both negatively hit by an unexpected increase in inflation

Baseline vs Strict Inflation Targeting



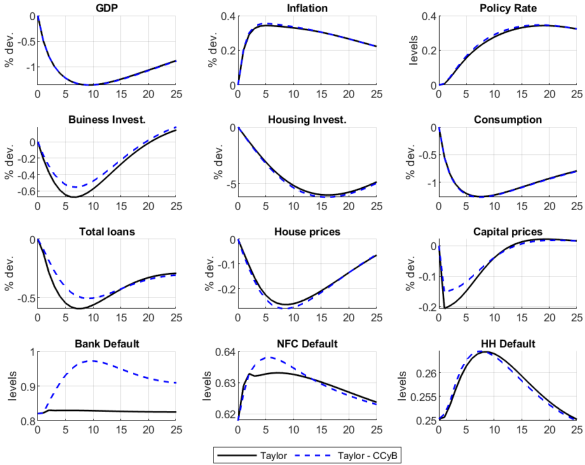
*Fully stabilizing inflation in the short-term further dampens economic activity and increases borrower and bank default risk

Baseline vs Strict Inflation Targeting (Welfare)



*Fully stabilizing inflation reduces the welfare cost for the savers at the cost of higher welfare losses for the borrowers

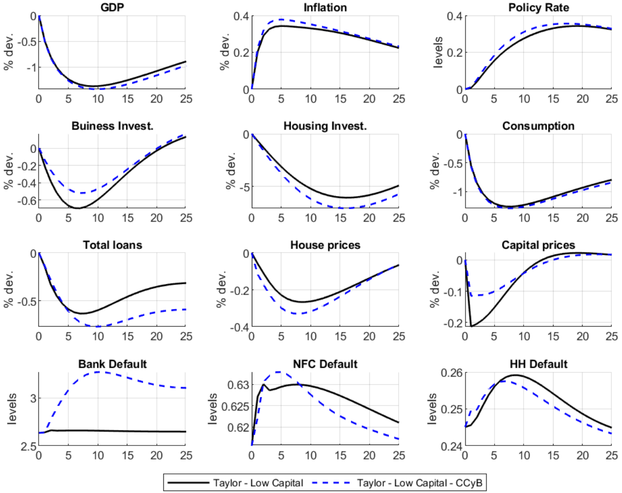
Baseline - CCyB vs No CCyB



*Releasing capital buffers to maintain credit limit the reduction in investment BUT further increases default risk

*Two counter-acting fources: overall no effects on GDP and inflation

CCyB vs No CCyB - Lower bank capital (-2pp)



*The default impact of releasing capital buffers are more sizable when bank capital levels are low (Strict IT would further amplify the negative effects on GDP)

Conclusions

- Inflationary shocks increase inflation and agents' default risk
  $\Rightarrow$ Trade off between inflation stabilisation and financial stability
- With strict inflation targeting, default risks increase in the short term and borrowers' welfare is lower wrt a standard Taylor Rule
- Releasing CCyB to mantain credit increases costs of default
- The default costs are larger when banks capitalisation is low and even larger when the central banks fully stabilizes inflation in the short term

Annex

Savers

Max discounted future stream of utility

$$\max \; E_t \left[\sum_{i=0}^{\infty} (\beta_{\varkappa})^{t+i} \left[\log\left(c_{\varkappa,t+i}\right) + v_{\varkappa,t+i} \log\left(h_{\varkappa,t+i}\right) - \frac{\varphi_{\varkappa}}{1+\eta} \left(l_{\varkappa,t+i}\right)^{1+\eta} \right] \right]$$

s.t.

$$c_{s,t} + q_{h,t} Ih_{s,t} + q_{k,t} Ik_{s,t} + s_t k_{s,t} + d_t + B_t \leq w_t l_{s,t} + r_{k,t} k_{s,t-1} + \frac{\widetilde{R}_t^d d_{t-1} + R_{t-1}^{rf} B_{t-1}}{\pi_t} + \Omega_{s,t} + \Pi_{s,t}$$

where

d_t: portfolio of deposits; B_t : risk free asset (in zero net supply)
$\widetilde{R}_t^d$: risky gross returns on deposits
$k_{s,t}$ capital held by savers subject to a cost s_t (to match the share of *non-intermediated capital*)
$\Omega_{s,t}$: lump-sum tax used to ex-post balance the DIA's budget
$\Pi_{s,t}$: aggregate net transfers from entrepreneurs and bankers + firms dividends

Bank debt liability

To capture bank liabilities in a broader sense:

- 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 net recovery value of bank assets in case of default

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

Firm Default

- Max the NPV of entrepreneurs' equity stake conditional on not defaulting s.t. **b.c.** and **banker's P.C.**
  - $R_{f,t}$ s.t. expected discounted bank profits are sufficient to compensate for the cost of equity required to provide the loan: function of the leverage choice by firm!

- Optimally **default** if **terminal assets value** is insufficient to pay back its loan with bank

$$\Pi_{i,j,t+1}(\omega_i) = \omega_i \left[q_{k,t+1}(1-\delta)k_t + A_{t+1}k_t^{\alpha}h_t^{1-\alpha}\right] - R_{f,t}B_{f,t} < 0$$

- for **aggregate** reasons $[A_{t+1}, q_{t+1}]$
- and **idiosyncratic reasons**: returns of levered asset (housing, capital and loan portfolio) affected by $\omega_{j,t}$: i.i.d shock (mean=1)

Bank Default

- Max the NPV of bankers' equity stake conditional on not defaulting s.t. **balance sheet** and **regulatory capital constraint**

- **Banks optimally default** when their loan returns are not enough to repay for deposits

$$[\omega_b \tilde{R}_{b,t+1} b_{f,t} - R_{d,t} d_t] < 0$$

- Standard assumption in **Reduce-Form** models of banks default risk (Merton type):
  DSGE models with bank default [Clerc et al. 2015, Begenau, 2016; Elenev, Landvoigt, Nieuwerburgh, 2018; Mendicino et al. 2019; Jermann, 2019,...]

- Advantage: Convenient for **tractability** (analytical solution)

Impatient Households

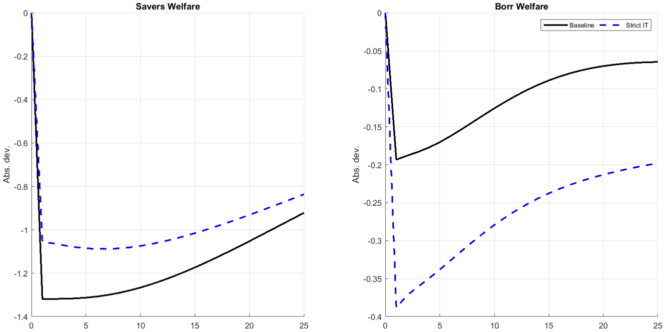
- Impatient workers receive consumption insurance from their dynasty and can individually default on their mortgages (non-recourse loans)

- Individual borrower optimally defaults if **terminal housing value** is insufficient to pay back its loan with bank

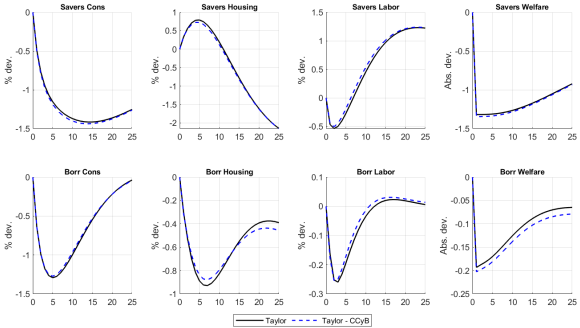
$$\Pi_{m,t+1}(\omega_m) = \omega_m q_{h,t+1}(1-\delta)\, h_{m,t} - R_{m,t} B_{m,t} < 0$$

- Household takes into account the overall amount of mortgages and the fraction of defaulted loans every given period $\Rightarrow$ max discounted future stream of utility s.t. **b.c.** and **banker's P.C.**

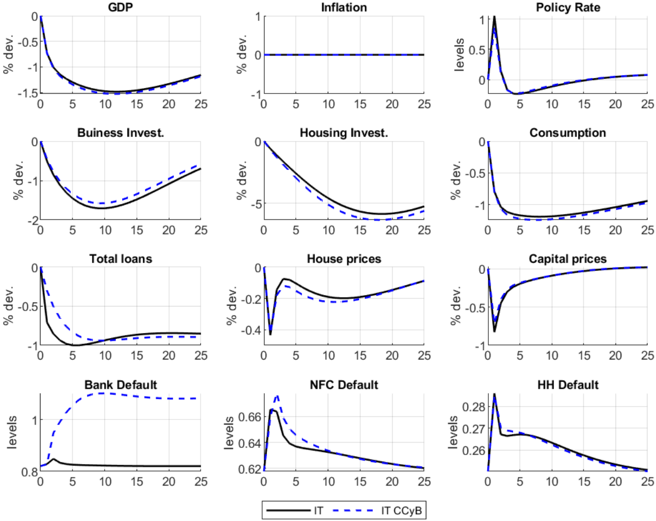
Supply Shock: baseline model vs IT 3D (Welfare)



Supply Shock - Taylor: CCyB vs No CCyB (Borrowers vs Savers)



Supply Shock IT: CCyB vs No CCyB



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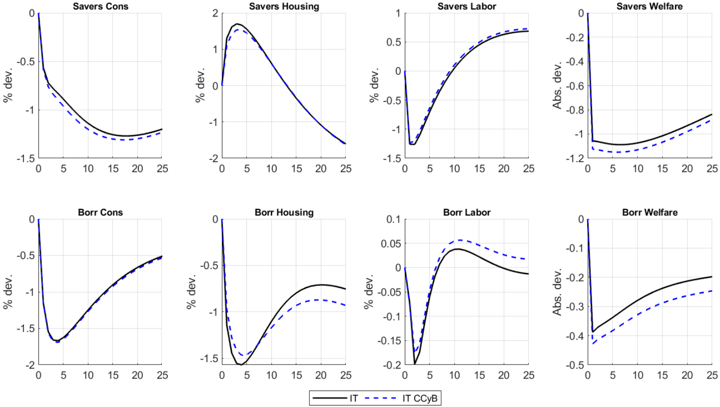
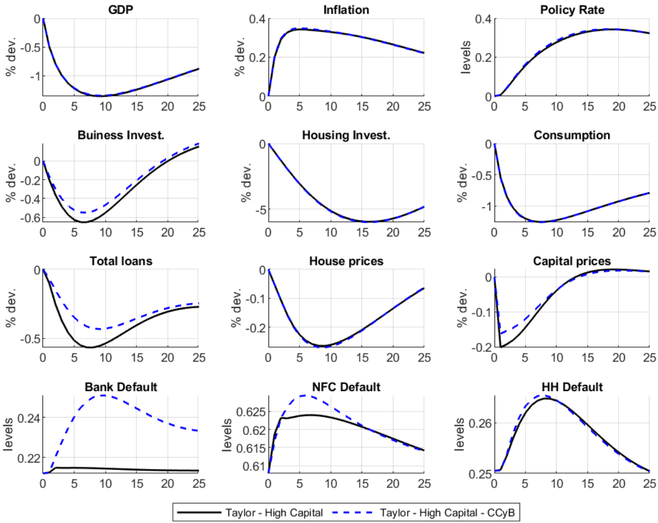
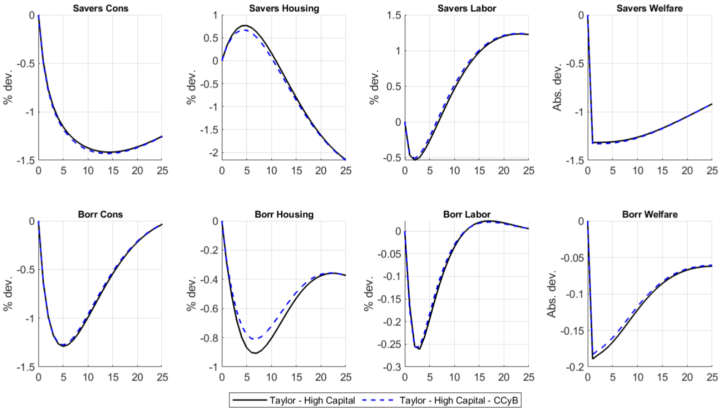


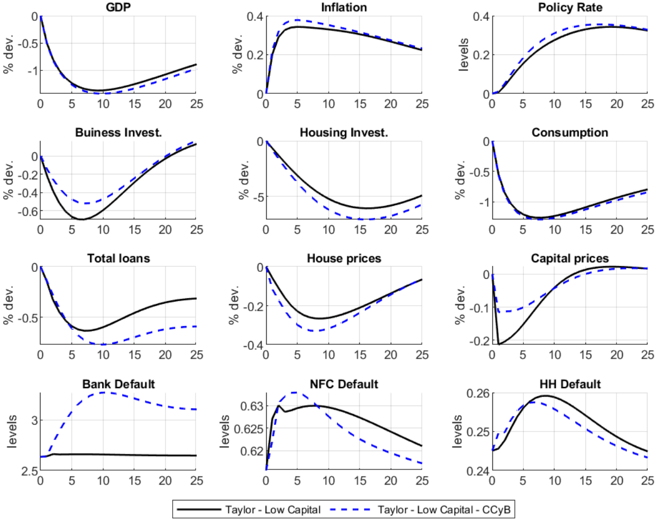
Supply Shock - Taylor: CCyB vs No CCyB - High Capital (+2pp)



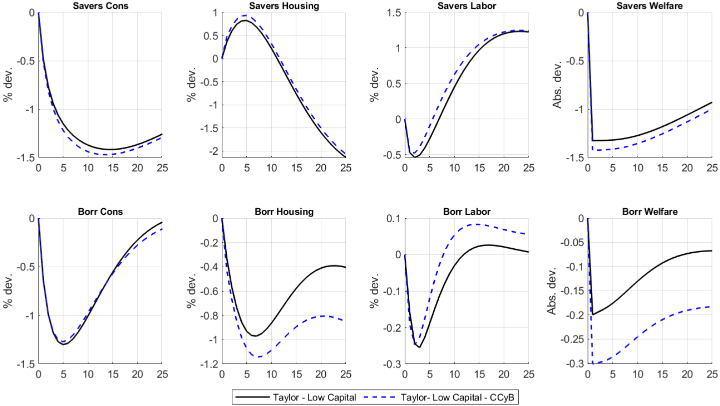
Supply Shock - Taylor: CCyB vs No CCyB - High Capital (+2pp) (Borrowers vs Savers)



Supply Shock - Taylor: CCyB vs No CCyB - Low Capital (-2pp)



Supply Shock - Taylor: CCyB vs No CCyB - Low Capital (-2pp) (Borrowers vs Savers)



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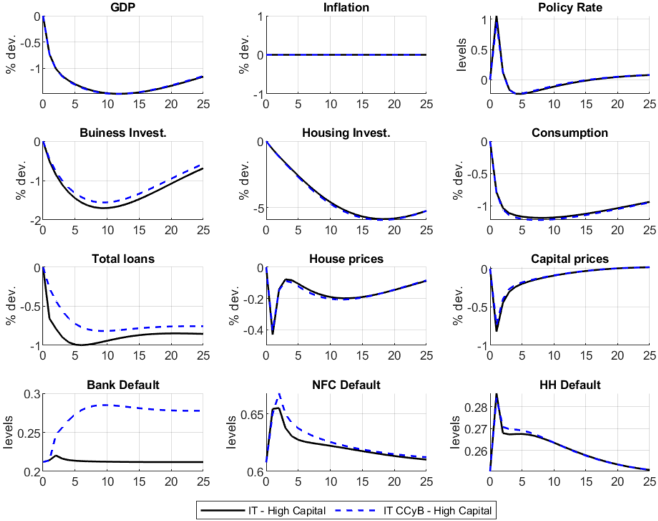
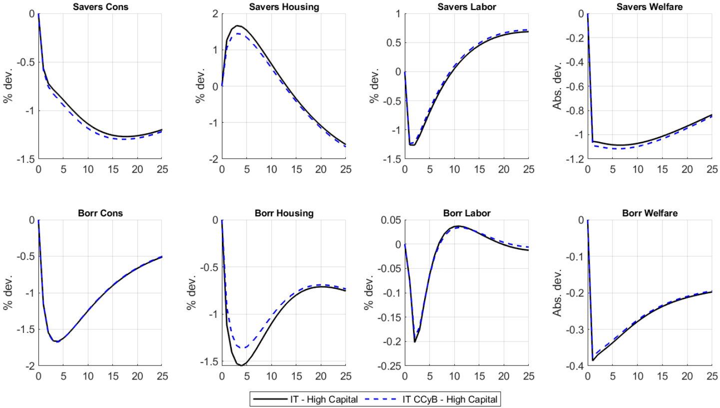
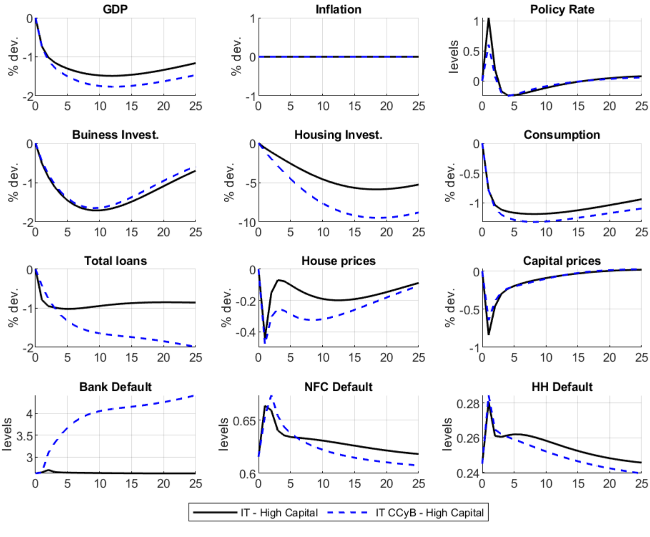


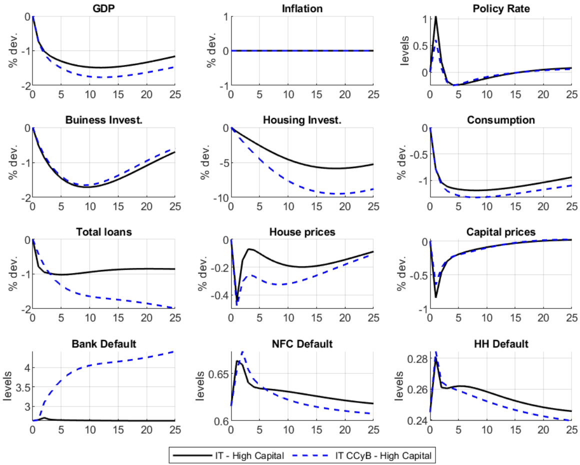
Supply Shock IT: CCyB vs No CCyB - High Capital (+2pp) (Borrowers vs Savers)



Supply Shock IT: CCyB vs No CCyB - Low Capital (-2pp)

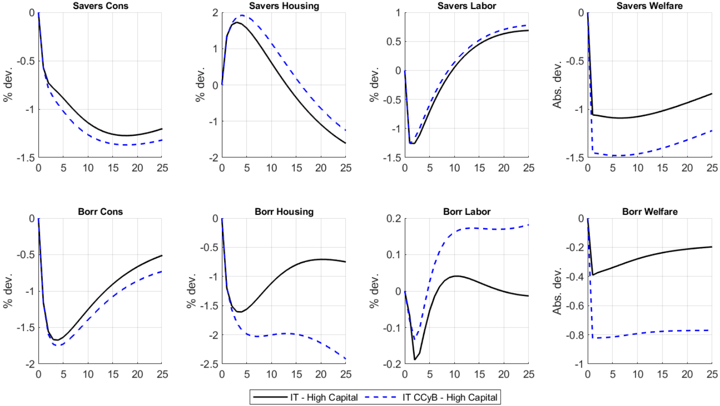


Price Mark Up Shock: CCyB vs No CCyB - Low Capital (-2pp) and IT



The default impact of releasing capital buffers are more sizable if bank capital levels are low and IT

Supply Shock IT: CCyB vs No CCyB - Low Capital (-2pp) (Borrowers vs Savers)



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