Banking Dynamics and Capital Regulation

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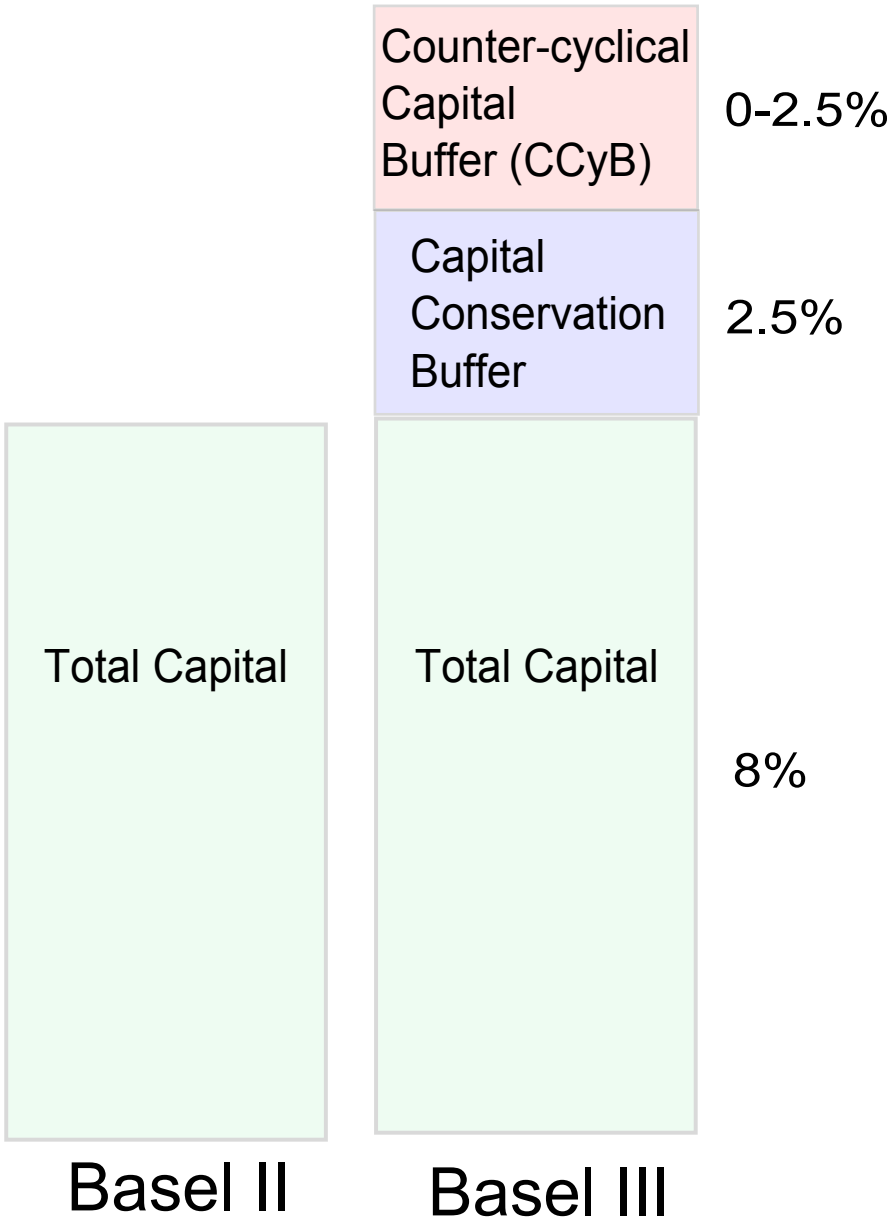
Preliminary

Motivation

- Recent development in banking regulations: Basel III
- Multiple layers of capital requirements make it difficult to analyze
  - No empirical guidance in Canada on how to adjust CCyB
- Need a structural model to quantify the implications of Basel III

Basel III capital regulations



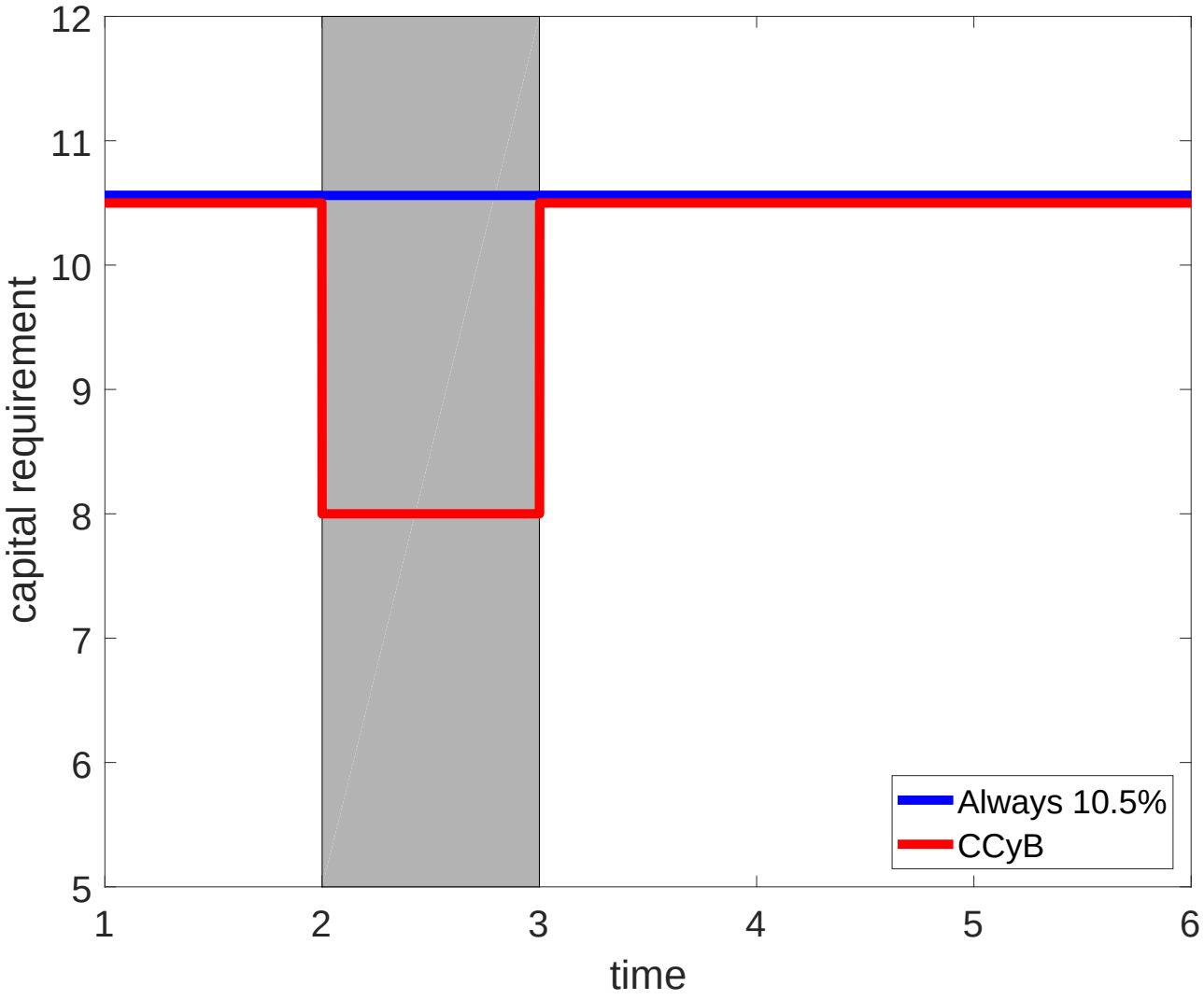
Questions

- How does CCyB impact the bank lending and the stability of banks relative to just raising the minimum capital requirement?
- How does CCyB affect banks of different sizes?
- How should CCyB be switch on and off along cycles?

What/how we do

- Develop a partial equilibrium heterogeneous banking model with
  - inefficiency from MH due to limited liability and deposit insurance
  - endogenous bank default that changes with regulation
    - wholesale borrowing depends on the default probability of banks
  - banks rationally anticipate policy changes and aggregate fluctuations
- Calibrate the model to Canadian banks: large vs small
- Simulate the model: crisis and recovery
- Today's focus:
  - model calibrated to large Canadian banks
  - non-contingent regulation vs CCyB

The analysis we do today



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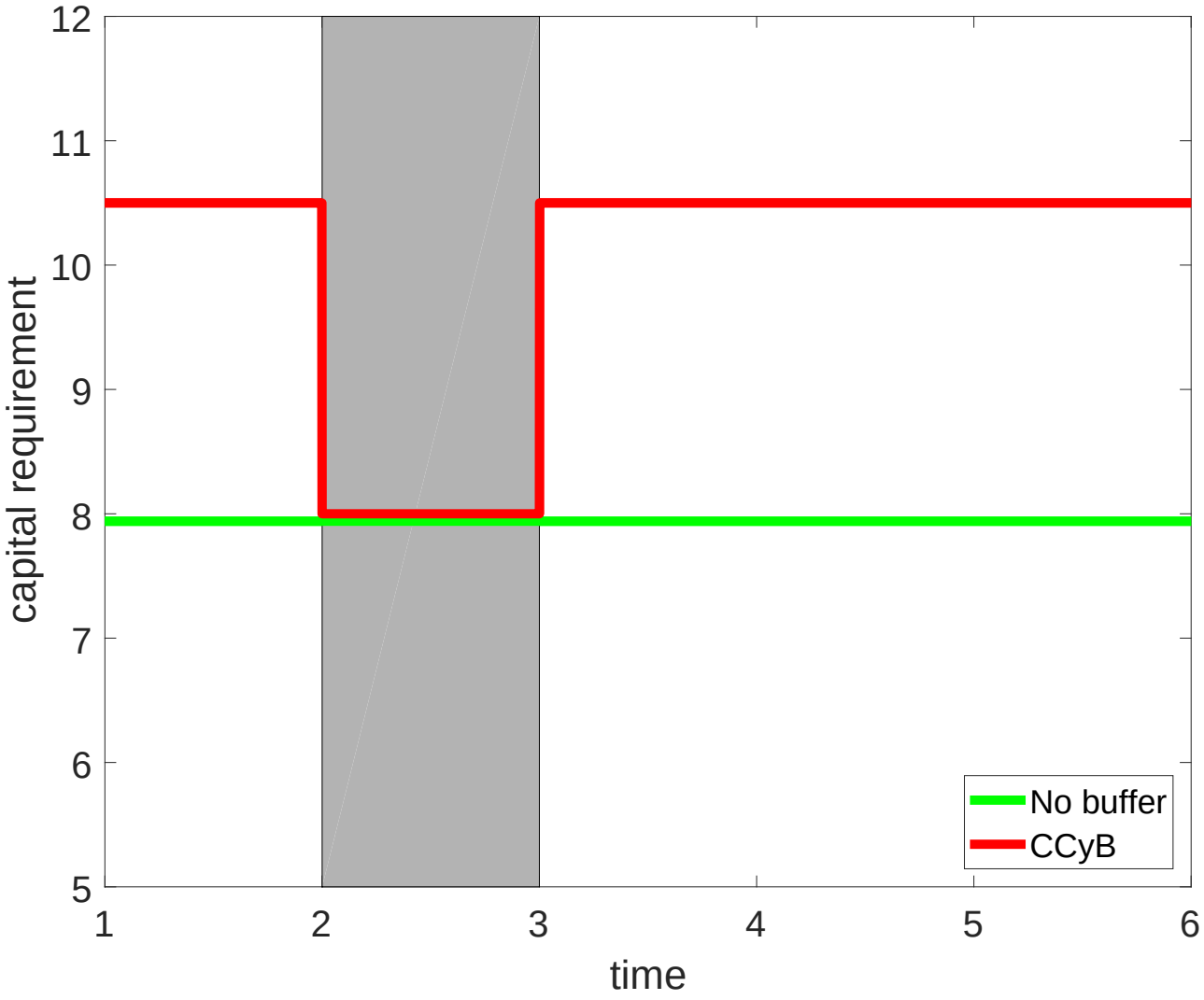
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capital requirement
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time
No buffer
CCyB

Main results

Relative to the non-state contingent capital regulation...

- CCyB attenuates bank failures during stressed periods
- However, CCyB increases bank failures during and after recovery
- CCyB contributes to more stable loan supply

$\Rightarrow$ Policy implication: potential trade-off associated with CCyB

Mechanism

The problem with a higher capital requirement during a crisis:

- recapitalization is costly for banks with diminished equity
- instead of raising capital, banks cut new loans
- besides, the cost of wholesale funding (WSF) increases

  $\because$ bank default increases when satisfying the requiremnt is harder

By turning off CCyB during a crisis,

- temporarily less stringent capital ratio $\Rightarrow$ support new loan issuance
- less likely to violate capital requirement

  $\Rightarrow$ less bank default & more favorable WSF rate
- trade-off: a higher bank default rate after crisis $\Leftarrow$ lower capital ratio

Literature

- Gertler and Kiyotaki (2010), Corbae et al. (2017), Bianchi and Bigio (2017)
- De Nicolo et al. (2014), Mankart et al. (2016), Corbae and D'Erasmo (2012, 2013)
- Our paper: heterogeneous banks with WSF priced by individual risks

Model: Bank balance sheet

ASSET	LIABILITY/EQUITY
Long-term Illiquid Loan	Insured Deposit
	Uninsured wholesale funding
	Equity

Capital regulation:

$$\frac{\text{Equity}}{\text{Risk Weghted Assets}} \geq \theta,$$

where θ is the capital requirement

Model: Sources of heterogeneity

- Loans shrink by idiosyncratic loan-failure shock
  - loan balance and cash-in-hand differ across banks
- Large banks and small banks have different business models:
  - the amount of deposit
  - the cost of loan issuance
  - the maturity of loans
  - the premium on borrowing
  - operation cost
  - the loan failure shock process

Model: Bank's default decision

a: cash-in-hand
ℓ: existing loans
z: aggregate states $(= G, B)$
φ: outside option

$$V(a, \ell, z) = \max\Big\{ \underbrace{\varphi}_{\text{default}}, \underbrace{W(a, \ell, z)}_{\text{operate}} \Big\}$$

Model: Bank's operation decisions

- If banks can satisfy the capital requirement:

$$W(a,\ell,z) = \max_{(n,c,b')\in\mathbb{R}^3_+} u(c) + \beta\mathbb{E}V\left(a'(\delta'),\ell'(\delta'),z'\right)$$

subject to

$$\ell' = (1-\lambda)\,(1-\delta')\,\ell + (1-\bar{\delta})n$$
$$a' = (\lambda+r)(1-\delta')\ell + r\,(1-\bar{\delta})n - \xi_d - b'$$
$$(1+\phi)c + n + \chi(n) \leq a + q(\ell,n,b',z)b' + \xi_d$$
$$\frac{e}{RWA} \geq \theta(z)$$

- Banks under supervision are further subject to $c = n = 0$.

Model: The discount price of wholesale funding

From the zero-profit condition of an investor,

$$q(\ell, n, b', z) = \frac{1 - \Pr\left(\delta' \geq \underline{\delta}(\ell, n, b', z') \mid z\right)}{1 + r_f + \rho},$$

where $\underline{\delta}$ is the endogenous default threshold, implicitly determined by banks' default decisions

The limiting distribution of banks

- The limiting distribution of banks is achieved when the normal state realizes every period ($z = G \ \forall t$)
- Note that banks' decisions assign a positive probability to the crisis state ($z = B$)
- We use the limiting distribution for calibration

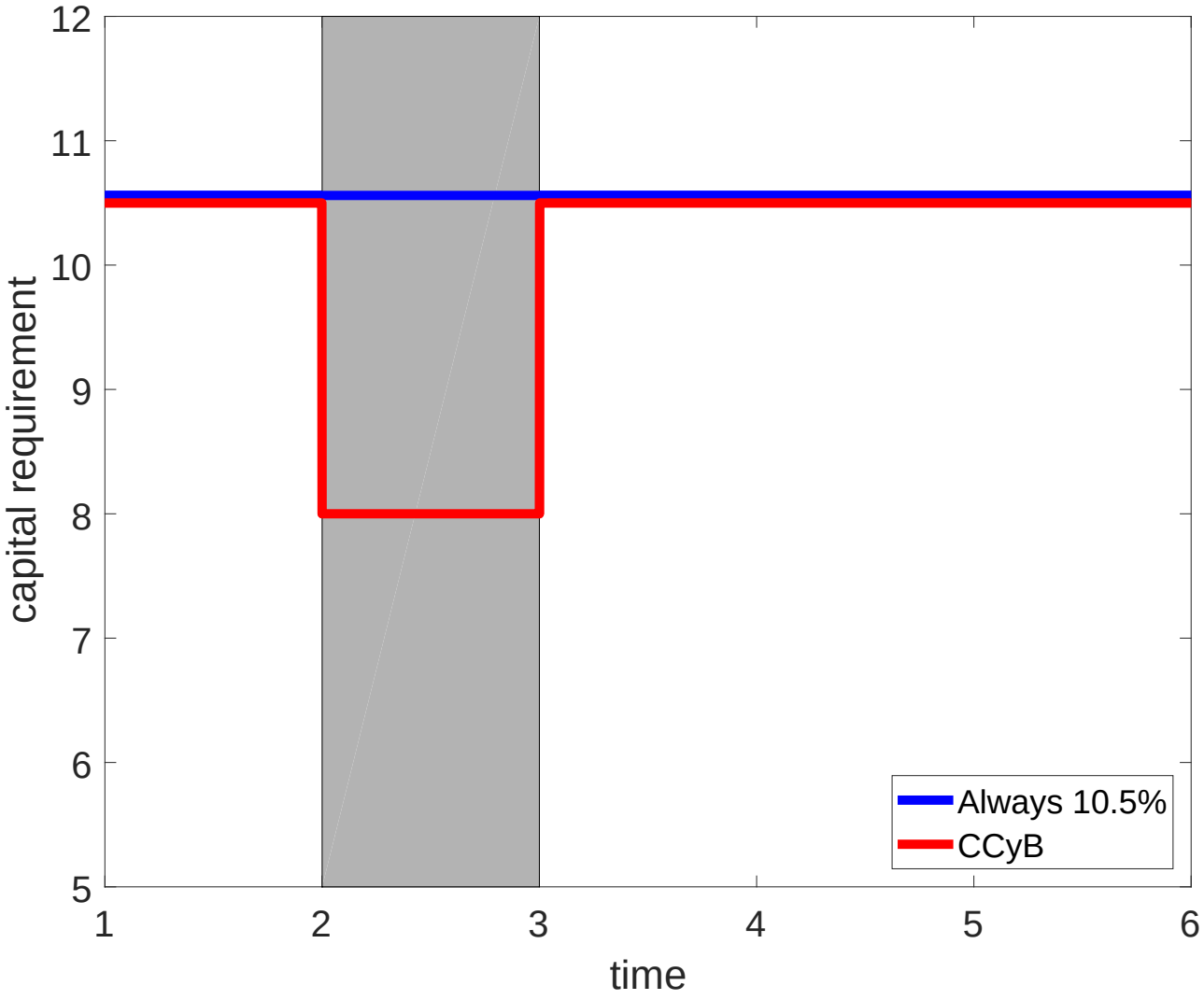
Calibration: Large Canadian banks

Parameter	Value	Description
$(\xi_{n,1}, \xi_{n,2})$	(0, 0.011)	$\chi(n, \xi_{n,1}, \xi_{n,2}) = \xi_n^1 \, n + 0.5 \, \xi_n^2 \, n^2$
ξ_d	11.76	Deposits
β	0.97	Subjective discount factor
λ	0.37	Maturity rate of long-term loans
r	0.04	Bank lending rate
$r_f + \rho$	0.001	Risk-free rate
σ	0.98	$u(c) = c^\sigma$
ω_r	0.9798	Risk weight on risky loans
$\Gamma_{z=G,z'=G}$	0.99	$\Pr(z' = G \vert z = G)$
$\Gamma_{z=B,z'=B}$	0.8	$\Pr(z' = B \vert z = B)$
$(\alpha_{\delta'}, \beta_{\delta'})_{z=G}$	(0.20, 43.6)	Loan write-off process in z=G
$(\alpha_{\delta'}, \beta_{\delta'})_{z=B}$	(2.45, 106.5)	Loan write-off process in z=B
φ	0	Outside option
$\underline{\theta}$	0	Default threshold
ϕ	0.016	Operation cost

Key banking industry moments: Large Canadian banks

	Data	Model	
		Non-contingent	CCyB
Bank failure rate	0.0%	0.016%	0.037%
Capital ratio	15.0%	17.2%	16.1%
New Loans/Deposit	0.91	0.88	0.87
Existing Loans/Deposit	2.44	2.33	2.32
WSF/Deposit	2.10	1.94	1.95
Equity/Deposit	0.22	0.60	0.57
Dividend/Deposit	0.035	0.066	0.066

What we are comparing



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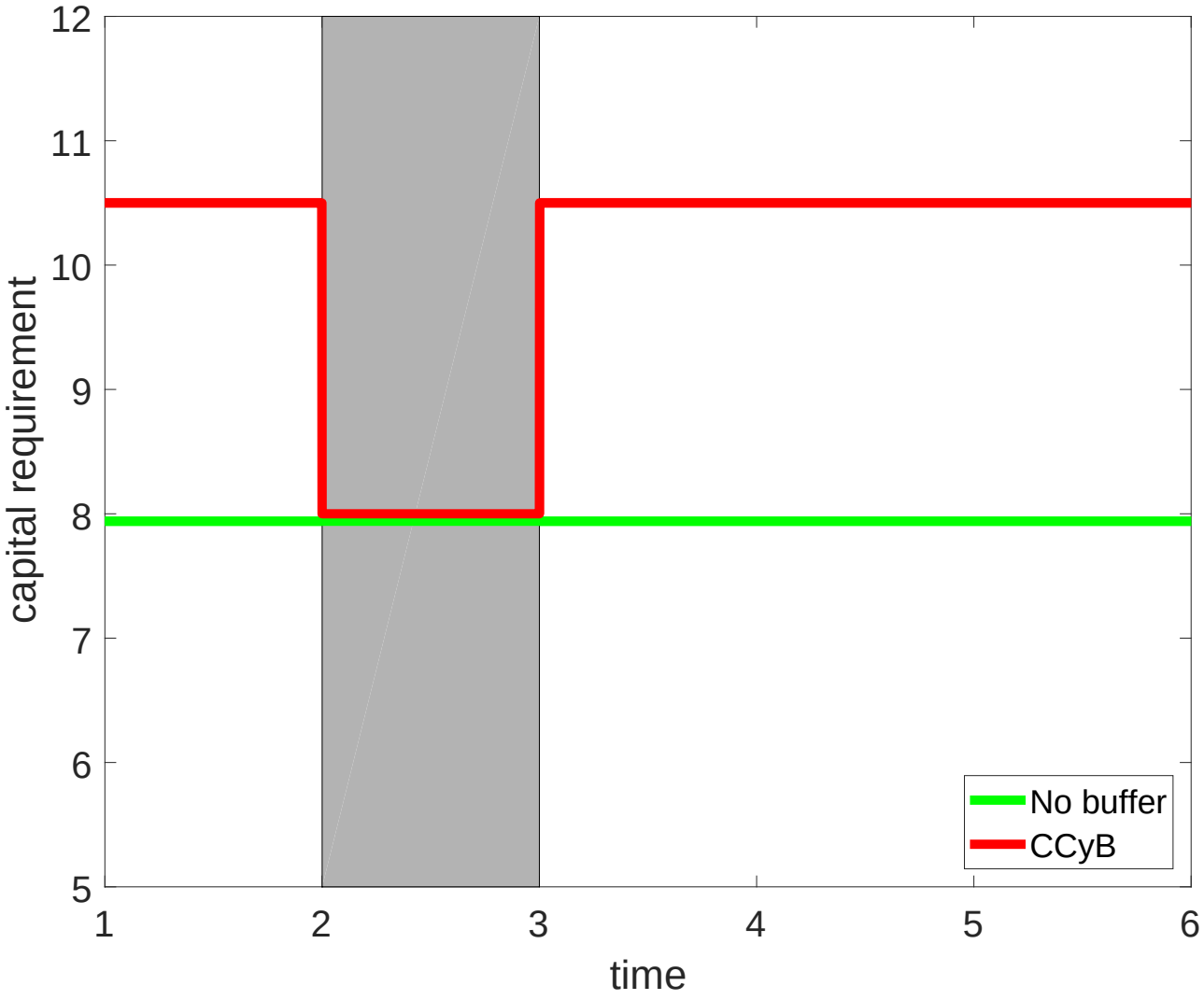
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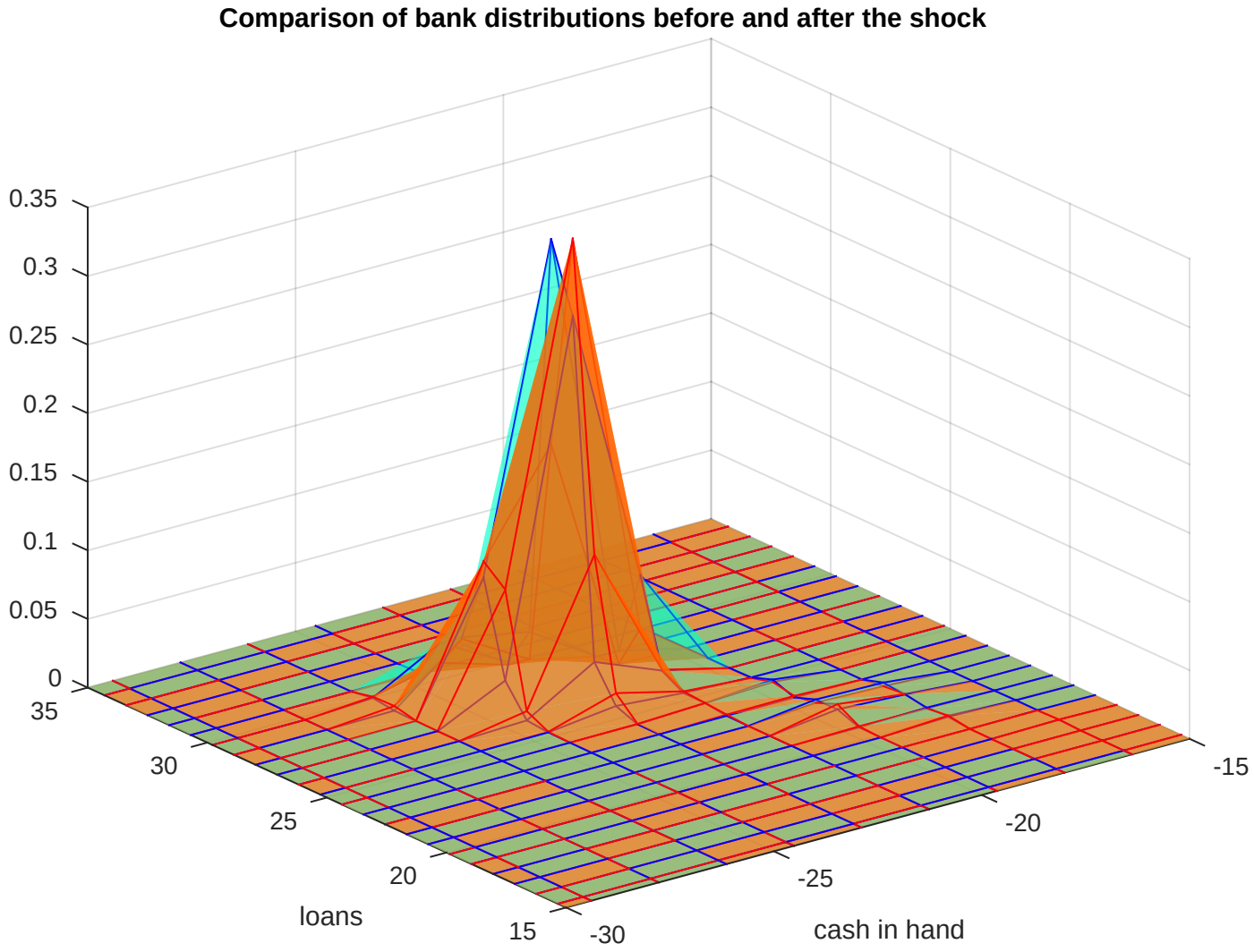
A crisis simulation

$t = 1, \ldots, 20$

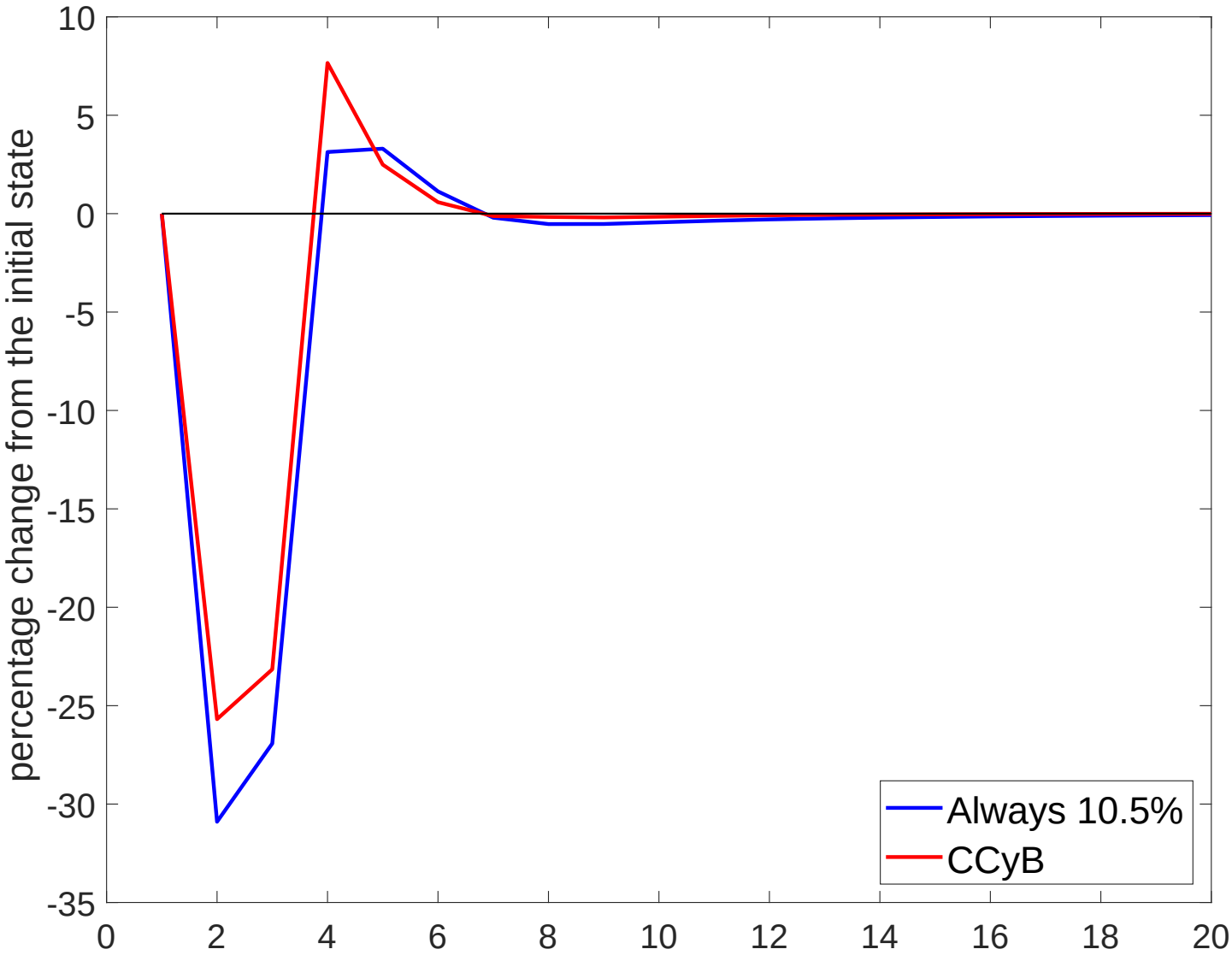
- The economy has been in the limiting state in $t = 1$.
- A crisis state realizes in $t = 2, 3$.
  - the average of loan failure rate is 5 times larger
  - the variance of loan failure rate is 2 times larger
- The aggregate state returns to the normal state in $t = 4, \ldots, 20$.

Compare " capital requirement is always 10.5%" vs "CCyB"

The distirubtion of banks one period after the shock



New loans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-5
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-20
-25
-30
-35
0
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6
8
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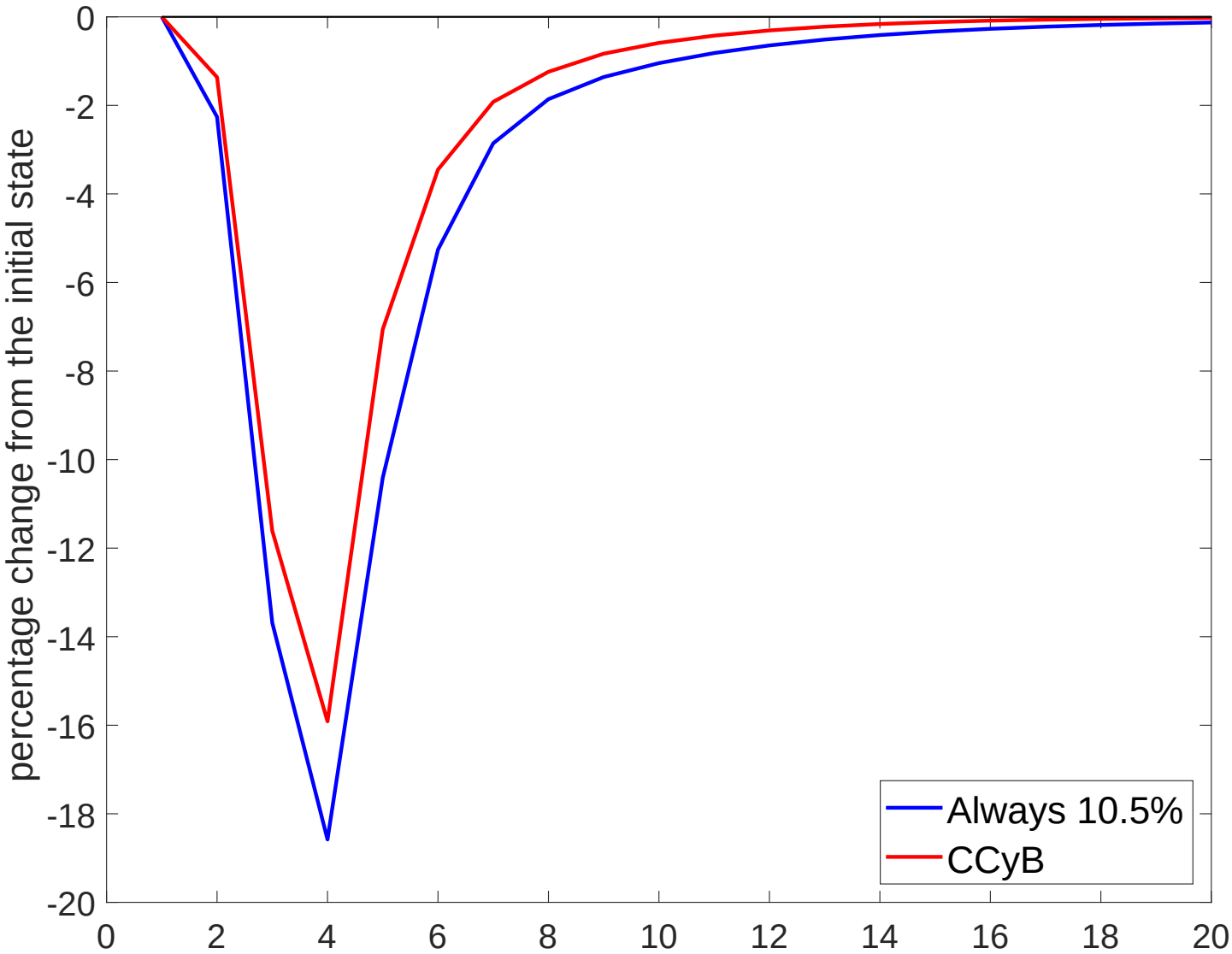
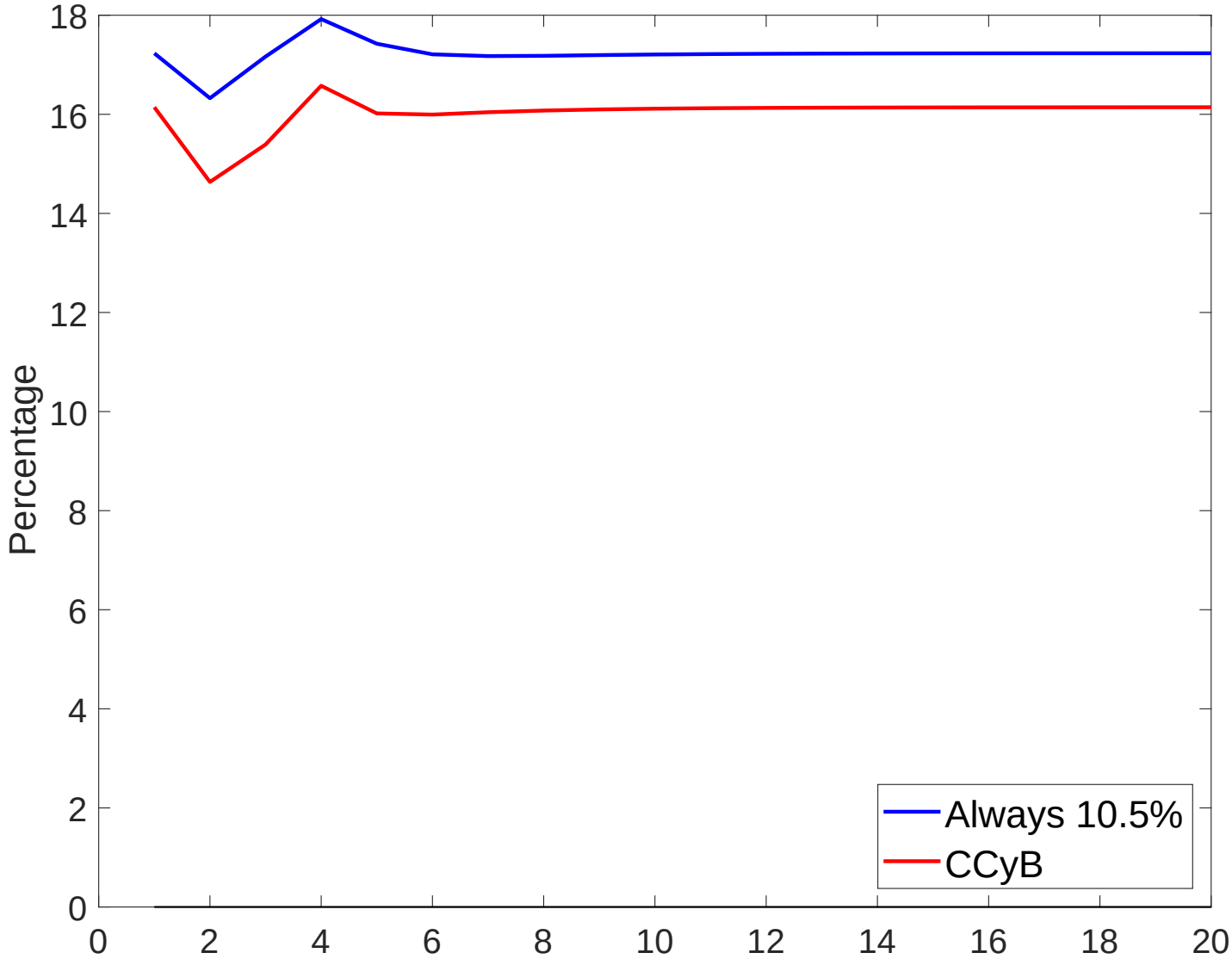
12
14
16
18
20
percentage change from the initial state
Always 10.5%
CCyB

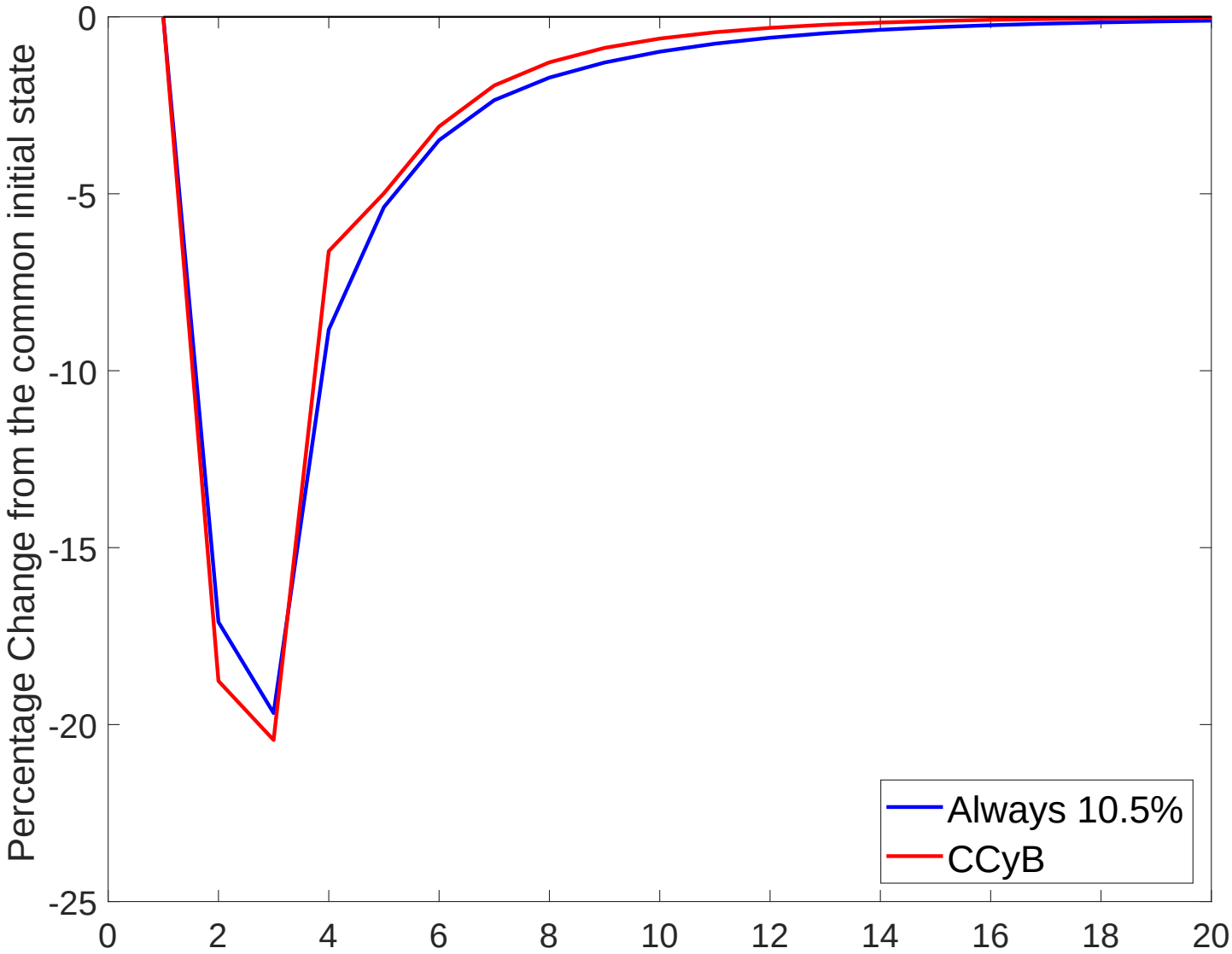
Existing loans



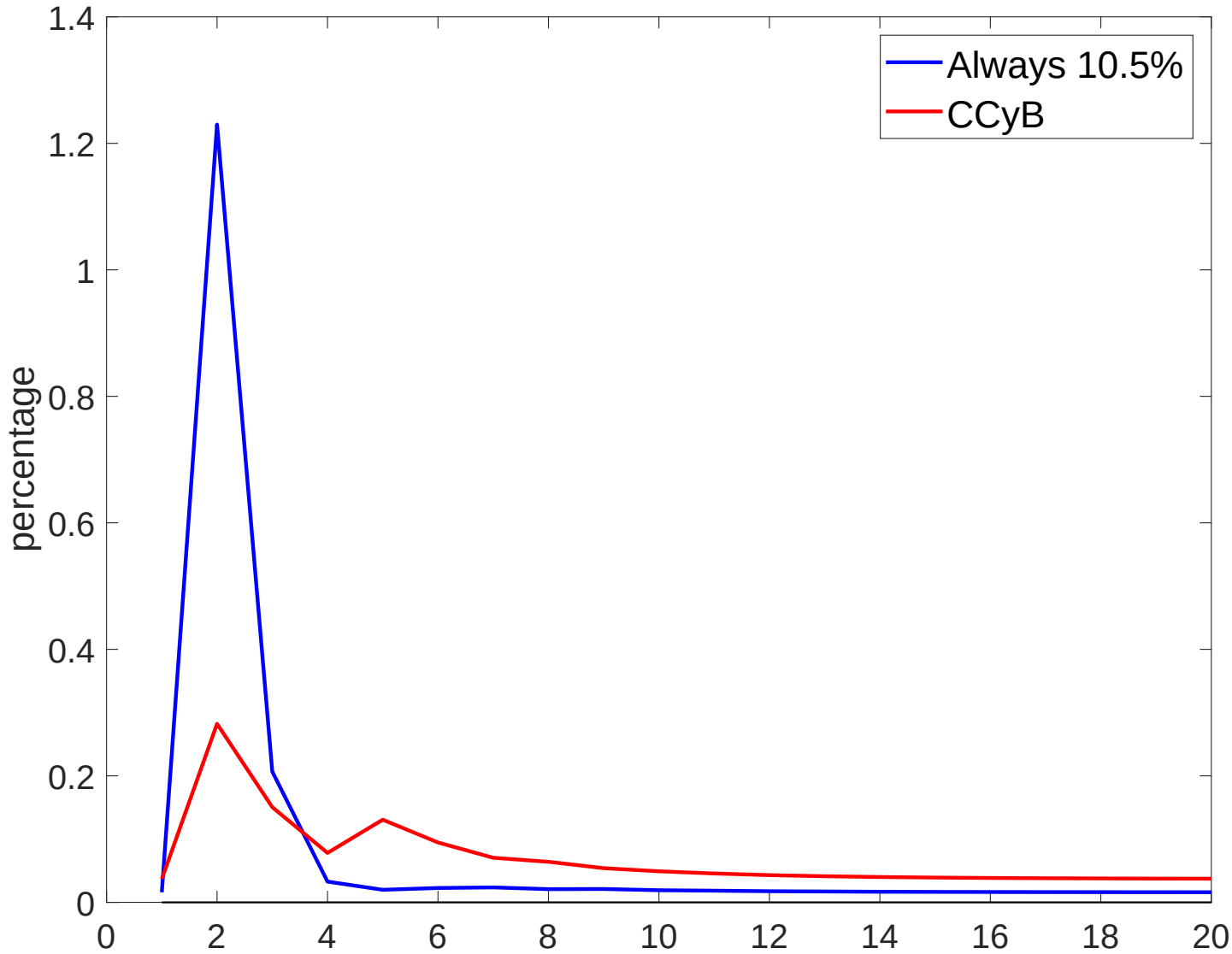
Capital ratio



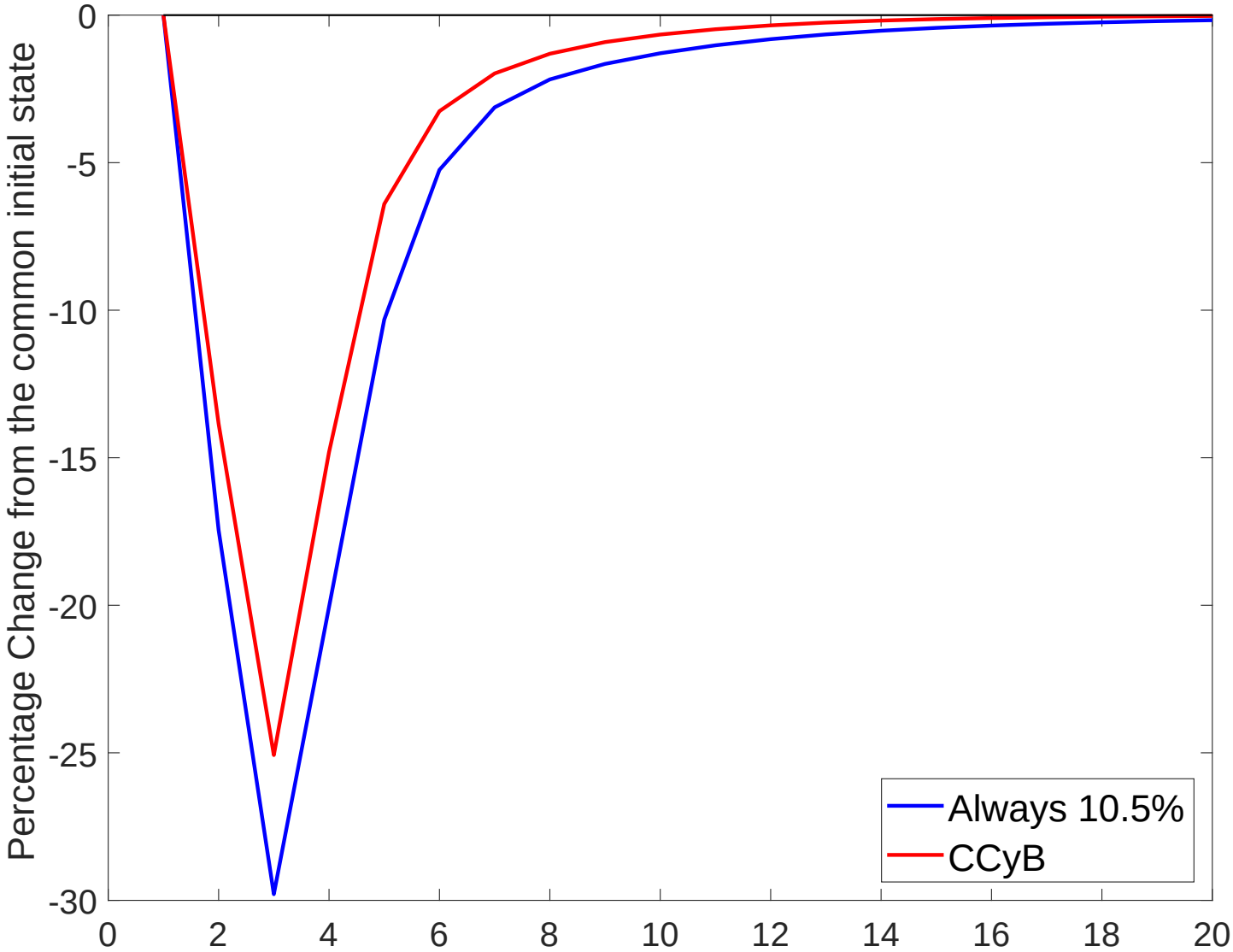
Equity


Percentage Change from the common initial state
0
-5
-10
-15
-20
-25
0
2
4
6
8
10
12
14
16
18
20
Always 10.5%
CCyB

Bank default probability



WSF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-30
0
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4
6
8
10
12
14
16
18
20
Always 10.5%
CCyB

Conclusion

Our model generates a trade-off associated with CCyB:

- Relative to a uniform increase in the capital requirement across aggregate states, CCyB supports smoother loan dynamics during distressed periods
- CCyB also attenuates bank loan failures during a crisis.
- However, CCyB comes at a cost of a higher bank default probability in normal times.

Plans going forward

- Calibration for small banks
- More layers of aggregate states: recessions in addition to crisis
- Comparison between CCyB and "No buffer"