Evaluating Regulation within an Artificial Financial System

A Framework and its Application to the Liquidity Coverage Ratio Regulation

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https://www.econstor.eu/bitstream/10419/157842/1/886415047.pdf

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Introduction

Motivation

- The global financial crisis that started in 2007 has led to extensive new regulation around the world.
- In the EU alone, more than 50 regulatory measures that aim at stabilizing the financial system were proposed.
- We know little about how these measures individually will impact the financial system.
- We know almost nothing about the joint impact of the new regulation.

General Research Question

How can the impact of **new** financial regulation be evaluated?

- Empirical analysis of average effects:
  - It takes time for data to become available and problems will not be identified before it's to late.
  - Identification will be a nightmare.
- Develop theory to assess regulation:
  - Standard methodology works well for the purpose of isolating mechanisms. A holistic and detailed assessment including interdependencies is difficult.
- Both, standard theoretical and empirical analysis have a hard time dealing with rare (systemic) events.

Specific Research Question

The paper focuses on liquidity regulation. Specifically, it asks how the Liquidity Coverage Ratio (LCR) affects the structure and stability of the financial system?

- The LCR is part of the Basel III accord. It is designed to make sure that banks can endure **30 days of stress** without liquidity assistance.
- The LCR should be larger than 100%:

$$\text{LCR} = \frac{\text{high quality liquid assets}}{\text{net outflows within 30 days of stress}} \geq 100\%$$

- The LCR will be fully implemented in the EU in 2018 and in the US in 2019.

LCR Stress Scenario (example)

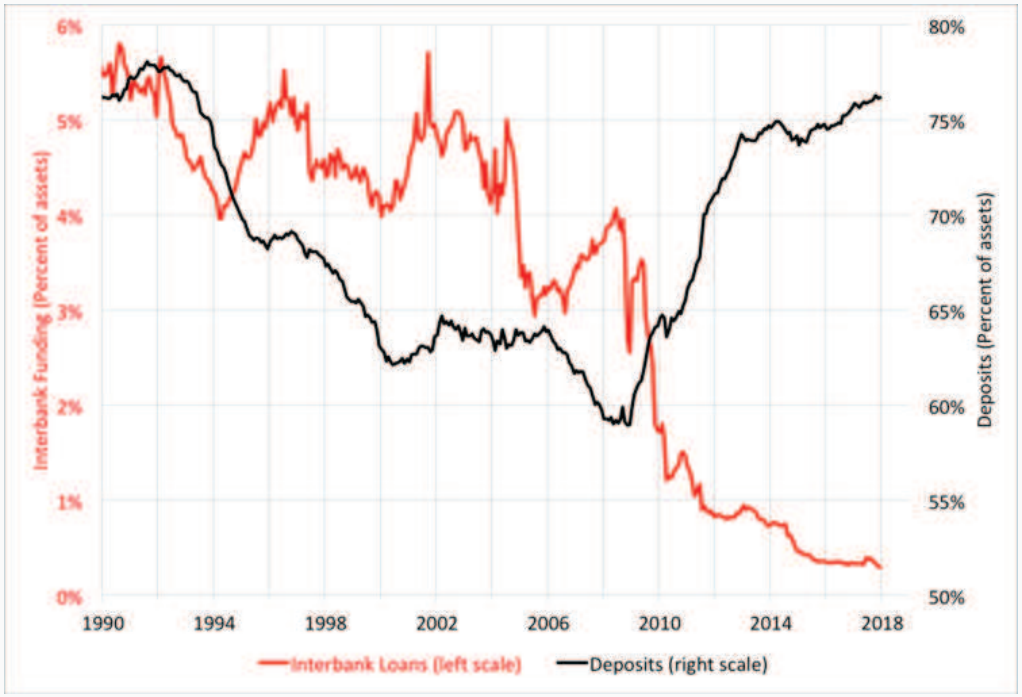
Stress is defined through specified **run-off rates** for liabilities, **inflow rates** for illiquid assets and **haircuts** for high quality liquid assets. For example:

- The run-off rate of **insured retail deposits** is **3%**, since they are deemed stable by the regulator. On the other hand, it is assumed that **unsecured wholesale debt** can not be rolled over in a stress scenario, i.e. the run-off rate for maturing wholesale debt is **100%**.
- The haircut assigned to **cash** is **0%**, while **common equity shares** are likely to lose value in a crisis and are therefore assigned a haircut of **50%**.
- The regulator assumes that maturing **reverse repos** of highly liquid assets (e.g. government bonds) will be rolled over, i.e. the inflow rate is **0%**. Amounts receivables from **retail counterparties** are assigned an inflow rate of **50%**.

Why Evaluate the LCR?

When binding, the LCR regulation will impact banks' choice of asset holdings, maturity structure and capital structure. Its repercussions may run deeper than expected.

- The funding structure of banks in the US has e.g. already shifted fundamentally (is the LCR to blame?):



Source: "Bank Financing: The Disappearance of Interbank Lending" (Cecchetti and Schoenholz's Blog: Money and Banking, March 05, 2018)

Contribution and Approach

Contribution to the Literature

- The paper provides a general framework for analyzing individual and multiple regulatory measures in detail.
- It evaluates the impact of the LCR on the balance sheet structure of banks and on financial stability. It produces testable implications.
- The model introduces important features such as maturity and asset liquidity that are often neglected in the related literature.

Related Literature

- The paper does not introduce a novel transmission channel of financial stress, but contributes to the literature by allowing well known mechanisms to interact within the model.
- Important contributions analyzing these mechanisms include Diamond and Dybvig (1983) on bank runs (runs in the model can occur on wholesale debt markets), Eisenberg and Noe (2001) on financial contagion through the interbank market, Greenwood et al. (2015) on fire sales, Bernanke and Gertler (1989) on the financial accelerator through collateralized borrowing (the repo market).
- The paper adds to a small but burgeoning literature that introduces adaptive behavior of agents in studies of contagion in interbank network models. Recent contributions include: Aldasoro et al. (2017) and Halaj (2017).

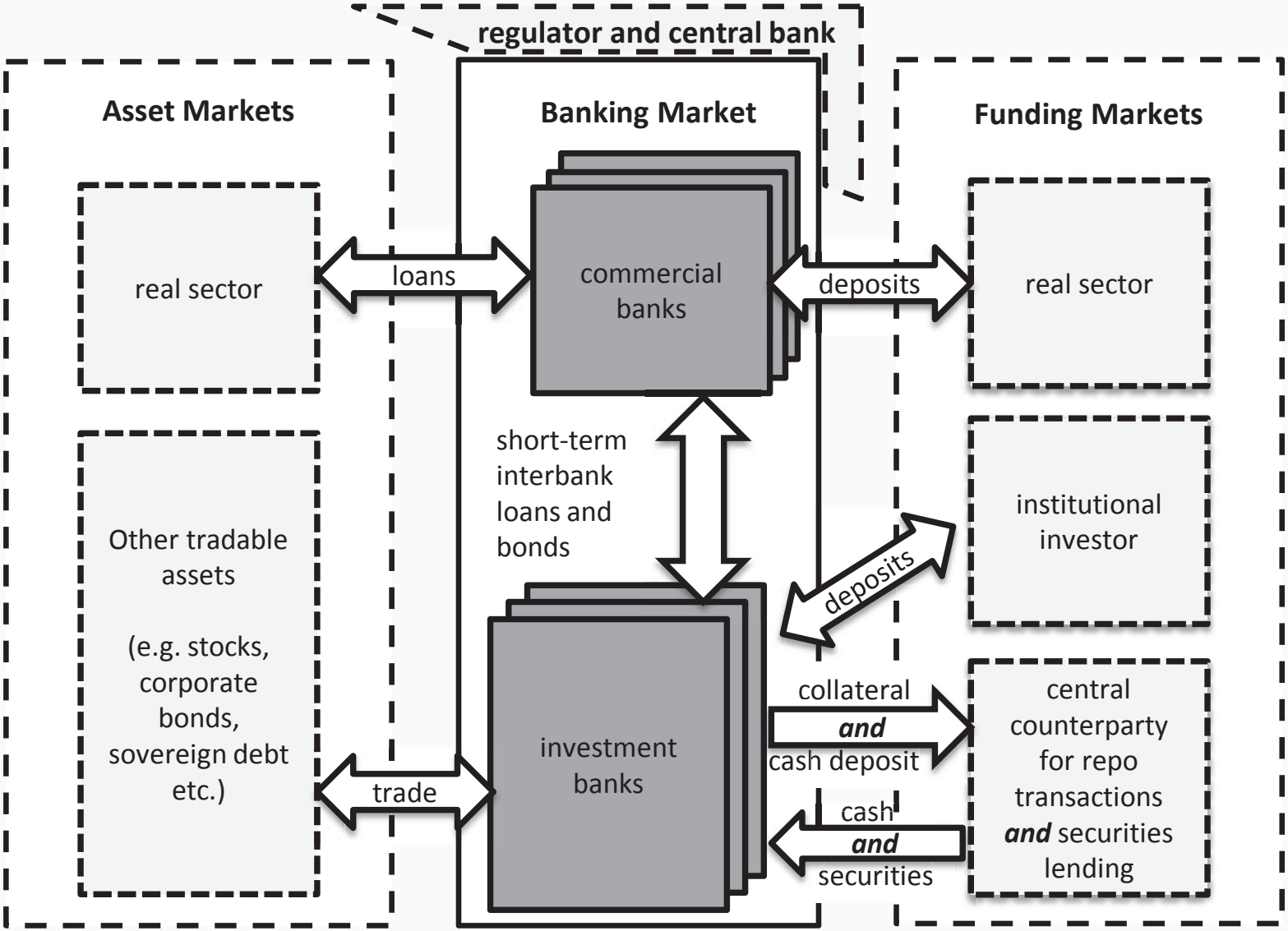
Contribution to Understanding Financial Stability

- Stress testing models typically used at central banks focus on the accounting dimension of economics. Feedback effects that are driven by banks' reactions to a stress scenario are mostly ignored.
- The model developed in the paper endogenizes the behavior of banks, which allows for feedback effects to emerge. This comes at the detriment of balance sheet (accounting) detail.
- Standard stress tests focus on commercial banks' balance sheets.
- The interaction between commercial banks and shadow banks can be the source of financial instability in the paper.
- Most of the stress testing literature looks at the current state of banks' balance sheet when conducting stress tests.
- The paper analyzes financial fragility conditional on changes to the underlying regulatory framework.

Model Components

- An artificial financial system (an agent-based model) is developed in which the LCR can be tested in detail.
- The model includes the agents and institutions that played a crucial role in the financial crisis:
  - Agents that adhere to one of two bank business models: traditional commercial banks and investment banks (or shadow banks).
  - Two unsecured wholesale funding markets that connect banks: an overnight interbank market and a long term wholesale funding market.
  - Asset markets for tradable assets.
  - A repo market for short term funding for investment bank agents.
  - A market for real sector loans.

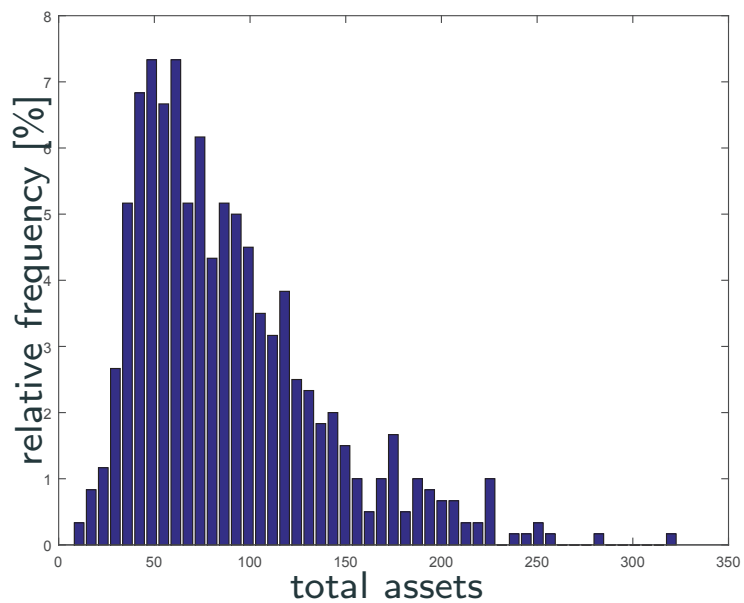
Model Overview

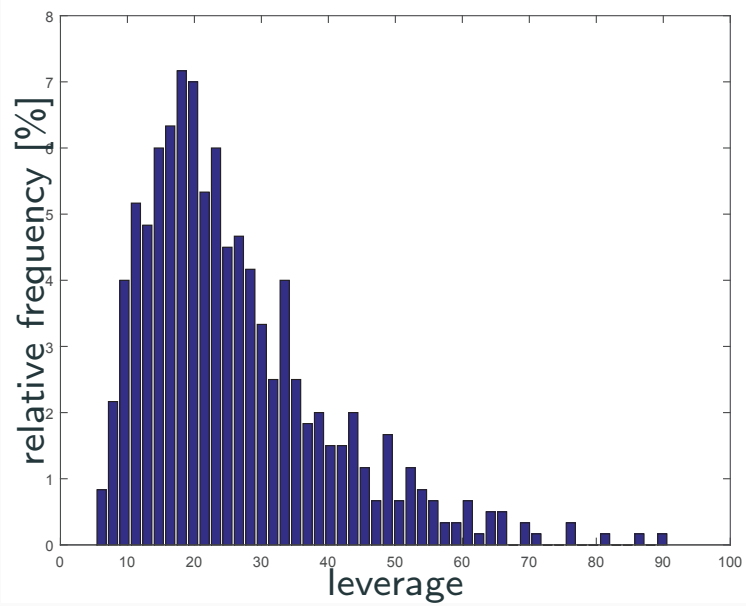


Some Model Features

Size and Leverage

Investment bank agents

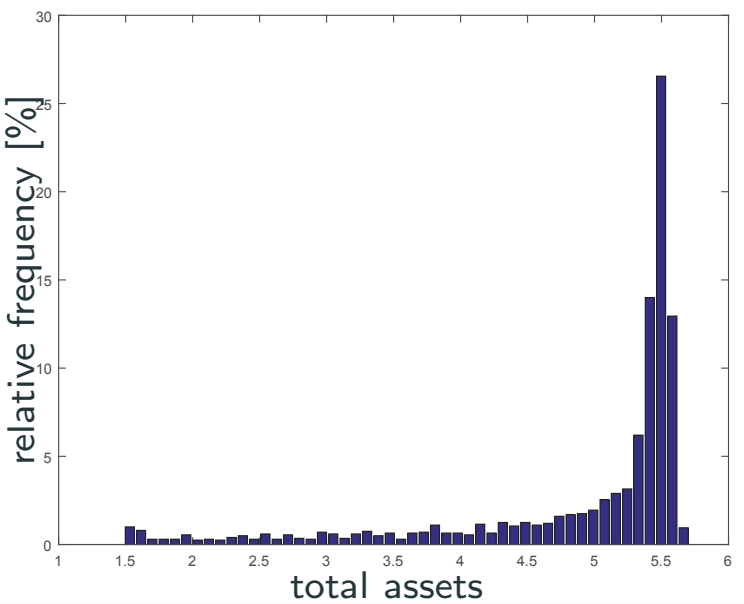


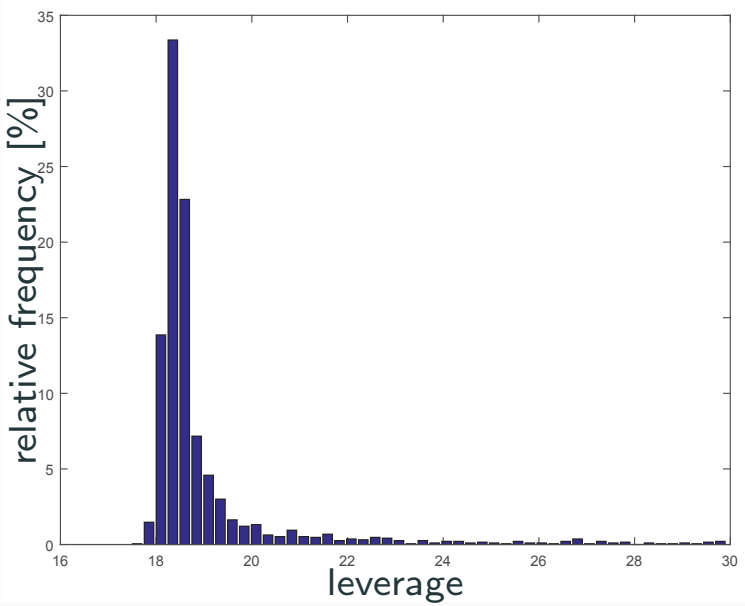


The relation between changes in size and changes in leverage tends to be procyclical for investment bank agents. This behavior, which is due to a predominately short term funding structure (through repos), is observed for investment banks and large broker dealer banks in reality.

Size and Leverage (2)

Commercial bank agents

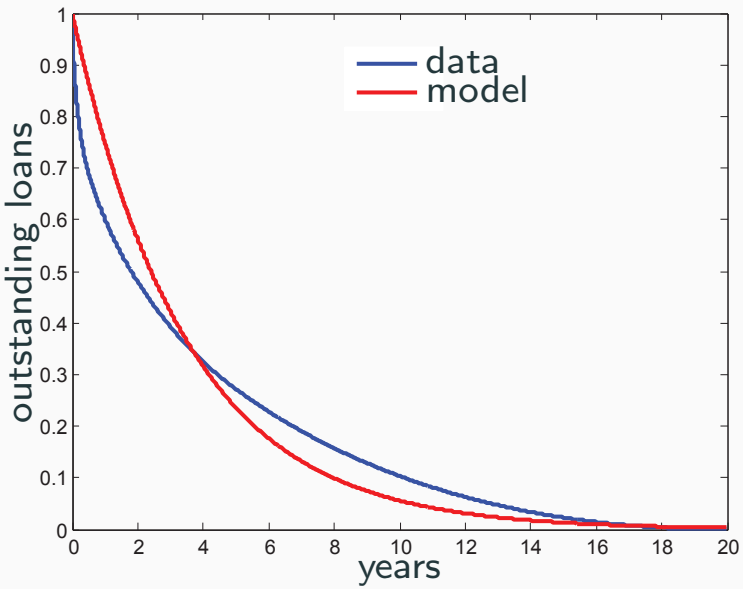


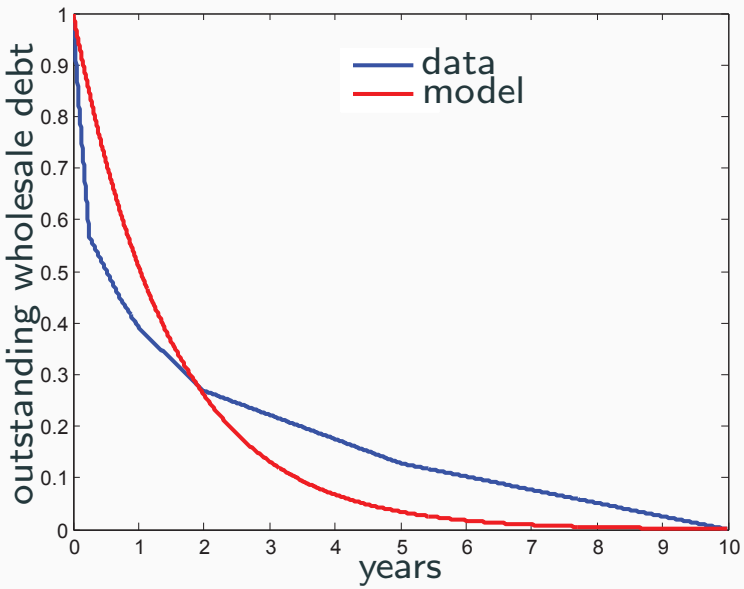


The relation between changes in size and changes in leverage is neutral most of the time. It is negative when agents are shocked. Long term wholesale funding and retail deposits prevent commercial banks from quickly deleveraging when shocked.

Maturity Structure

Fraction of outstanding assets and liabilities





The maturity structure of assets and liablities are crucial for financial stability, but mostly ignored in models. In the paper maturity is included through a constant repayment rate on portfolios of loans and other assets. *(exemplary data from Deutsche Bank annual report 2016)*

Risk Management

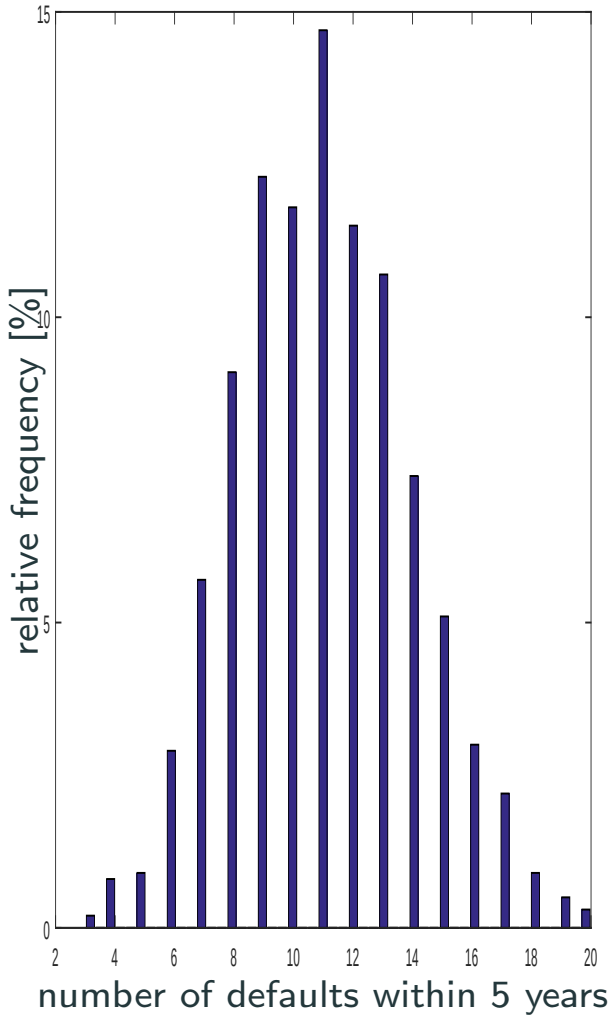
Agents are endowed with sophisticated risk management techniques:

Commercial banks

- Agents use a VaR-approach to control risk.
- Loss distributions of the loan portfolio are simulated within the simulation.

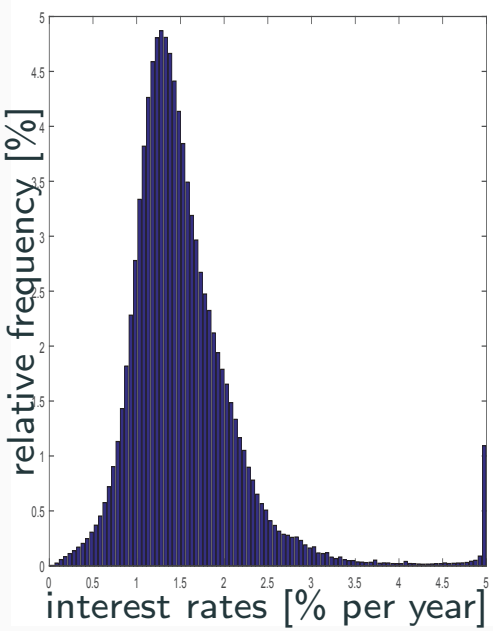
Investment/shadow banks

- Mean variance portfolio optimization.
- Counterparty default probabilities are considered.

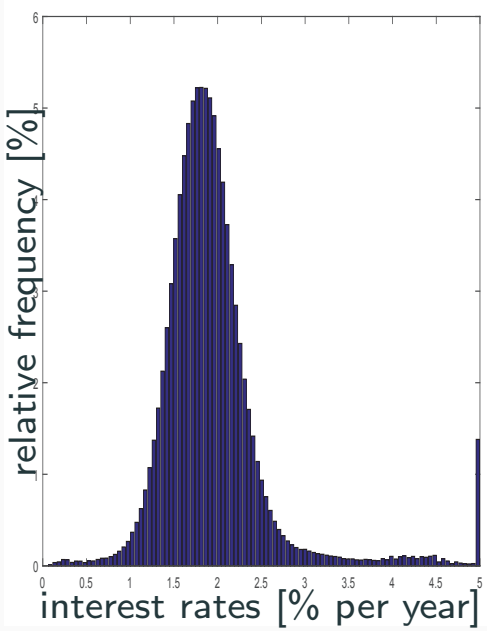


Refinancing Risk

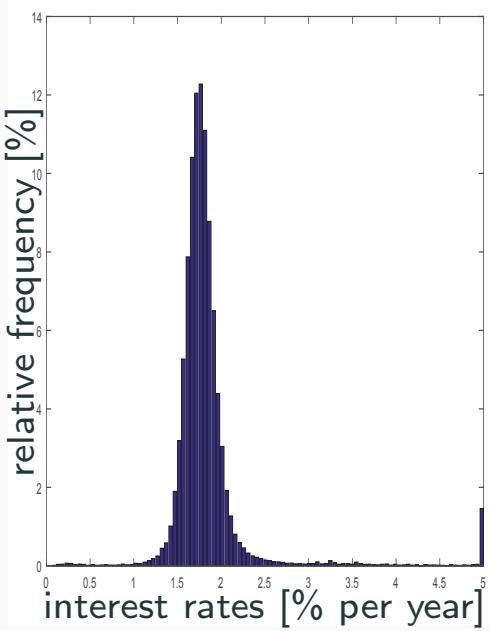
Funding costs



overnight interbank



long term bonds



wholesale funding

Commercial bank agents choose an optimal funding structure, taking into account the stability-cost trade-off between short term and long term debt. Long term bonds are typically more expensive than overnight interbank loans. However, their initial funding conditions apply until the bond matures.

Results

Average Impact

Commercial bank balance sheet

	without LCR [% total assets]	with LCR [% total assets]	change [% to benchmark]
loans	99.52	96.99	-2.14
cash	0.48	3.01	+540.71
equity	5.23	5.17	-0.75
deposits	30.46	30.33	0.00
short-term interbank	8.05	0.45	-94.41
long-term wholesale	56.27	63.83	+13.92
total assets	100.00	100.00	+0.41

Interest rates

	without LCR [% per year]	with LCR [% per year]	change [% to benchmark]
non-bank-securities	0.035	0.033	-5.714
short-term interbank	1.417	0.209	-81.779
long-term wholesale	1.806	1.948	+7.290

Explaining the Average Impact of the LCR (1)

The Loan Supply to the Real Sector Decreases

- There is a substitution effect: banks increase their volume of high quality liquid asset (cash), which crowds out loans to the real sector.
- The crowding out is slightly compensated by an increased balance sheet size. More cash on balance sheets reduces risk, which allows for lower equity ratios and larger balance sheets.

Explaining the Average Impact of the LCR (2)

The Overnight Interbank Market Collapses

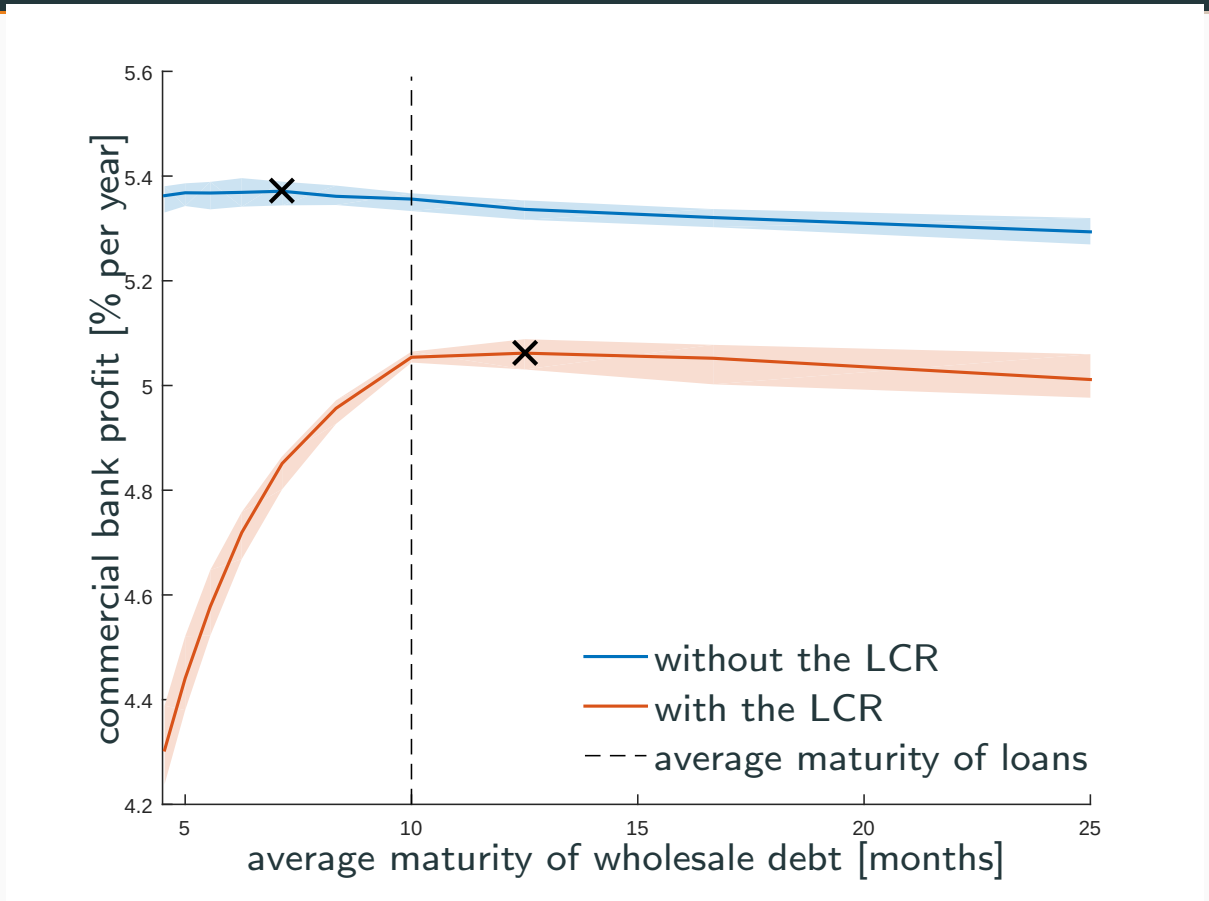
- At a binding LCR, any wholesale liabilities with a maturity below 30 days (the duration of the LCR stress scenario) will require an equal position of high quality liquid assets (HQLA).
- If the spread between the return of the HQLA and overnight interest rate is below transaction costs, using short term interbank loans seizes to be a viable business model.
- The model provides a potential explanation for the disappearance of short term interbank lending in the US (as shown in the introduction).

Explaining the Average Impact of the LCR (3)

Profitability of Commercial Banks Decreases

- Assuming that retail deposits are exogenous, overnight interbank funding is replaced by long term wholesale debt, which is more expensive (term premium).
- Higher demand for long term wholesale funding leads to an increase of long term interest rates.
- If banks do not increase interest rates for loans to the real sector (which would decrease demand for loans), higher funding costs lead to lower bank profitability and thereby contributes to lower loan supply.

Impact on the Optimal Maturity of Funding



In terms of profitability, the optimal average maturity (marked by the 'x') of wholesale debt increases with the LCR. While the optimal average funding maturity was below the average maturity of the loan portfolio without the LCR, this is no longer the case when the LCR is binding.

Explaining the Impact on the Optimal Maturity of Funding

- Without the LCR, banks could reduce their funding costs by reducing the maturity of wholesale funding. This was problematic in the crisis, as short term wholesale debt could not be rolled over.
- With the LCR, reducing the average maturity below the average maturity of the loan portfolio will require increased holdings of low yielding HQLA.
- As a consequence, banks will
  - increase the maturity of their funding, which will decrease their profitability or lead to higher interest rates on loans, or
  - they will decrease the maturity of loans, which will transfer the refinancing risk to households and firms.
- The LCR, when binding, interferes with the maturity transformation function of banks.

Recap. of the Average Impact

- The model developed in the paper suggests that the LCR regulation will:
  1. reduce the supply of loans to the real sector
  2. decrease the maturity of loans to the real sector
  3. increase wholesale funding costs for banks
  4. increase funding costs for the real sector
  5. lead to a strong decline in short term interbank lending
  6. increase the maturity of banks' wholesale funding
- Are these mostly detrimental effects compensated by a more resilient financial system?
- Remember, the purpose of the LCR is to stabilize the financial system.

Testing the Stability Impact of the LCR

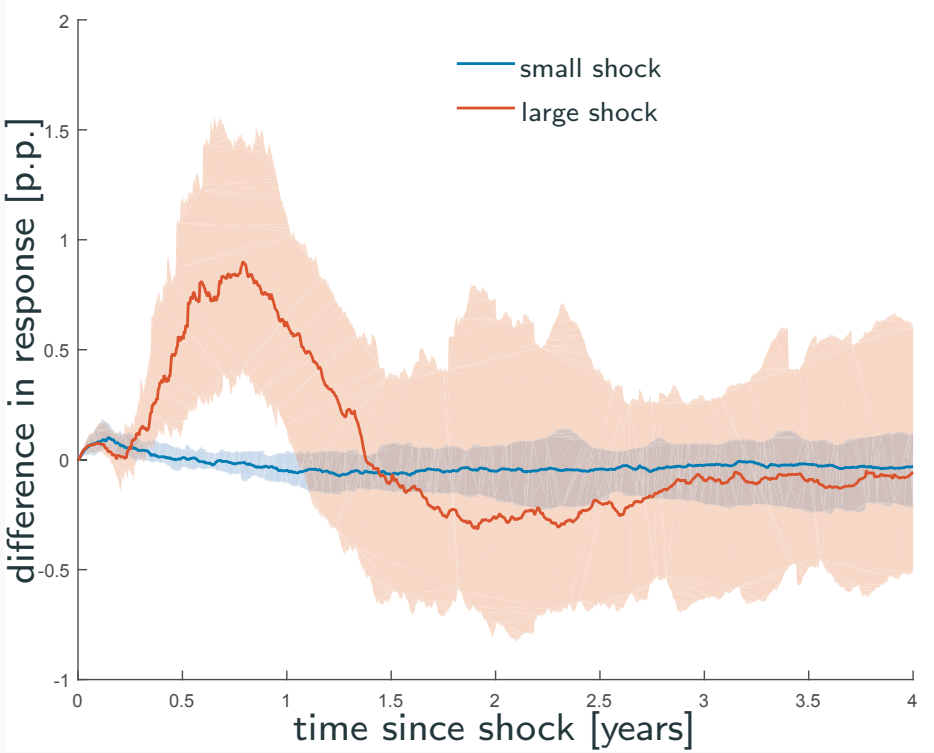
The paper introduces two types of shocks to test the LCR's impact on financial stability:

1. A confidence shock, which emulates the mutual loss of confidence in the banking sector after the collapse of Lehman Brothers in 2008.
   - For 30 days the unbiased expectations of counterparty default probabilities are multiplied by a factor.
   - The factor is 2 for a small confidence shock and 10 for a large confidence shock.
2. A solvency shock, in which an exogenously set portion of loans to the real sector default.
   - This is a one time shock.
   - A small shock entails a default of 1% of loans to the real sector and 2% for the large shock.

The impact of the LCR on the shock is tested by looking at the differences in responses to the shock with and without the LCR being active.

Unexpected Confidence Shock (1)

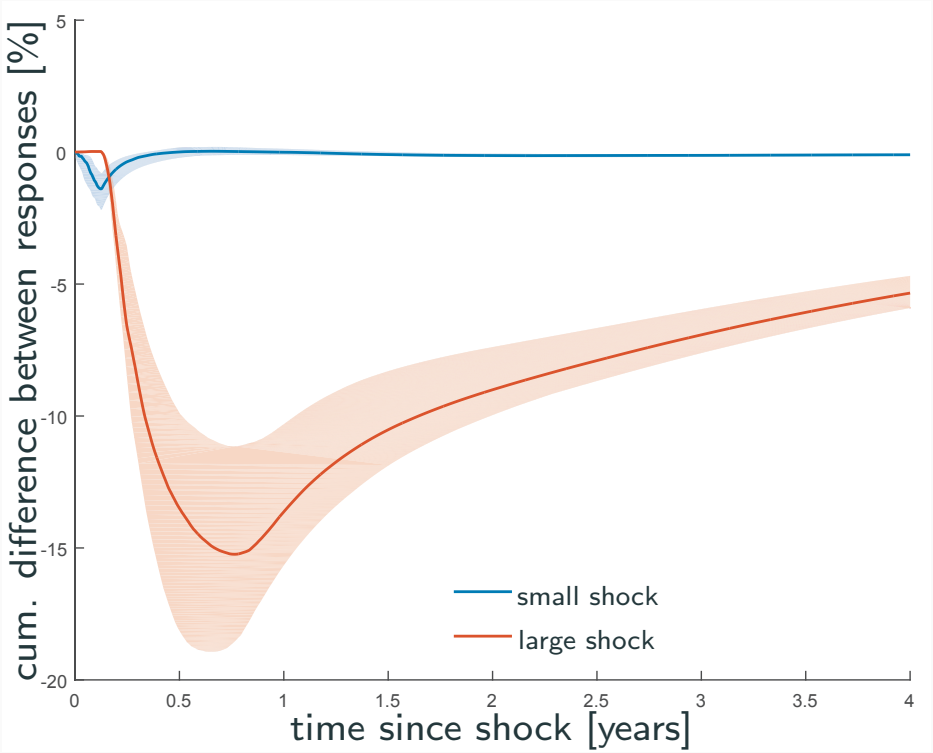
Impact on commercial banks' equity



The longer term funding structure triggered by the LCR regulation is beneficial to commercial banks in the presence of a confidence shock. In the first 1.5 years after the shock commercial banks have more equity when the LCR regulation is imposed. After that the impact of the LCR on banks' equity is slightly negative on average.

Unexpected Confidence Shock (2)

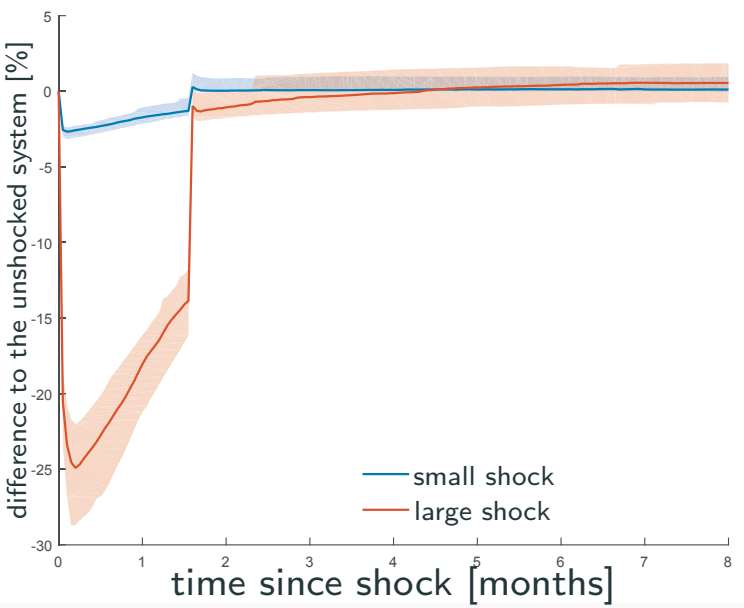
Impact on loan supply



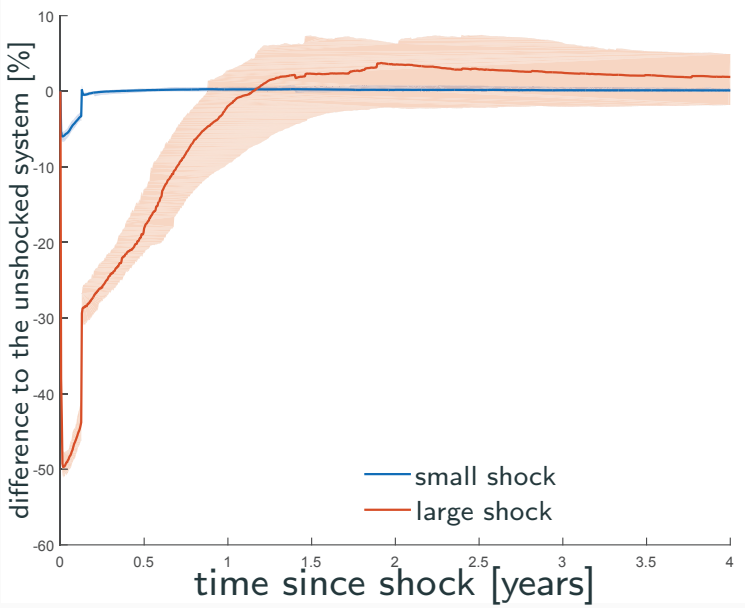
A large confidence shocks can lead to a severe credit crunch under the LCR regulation. One year after the shock, banks have provided about 15% less loans to the real sector when the LCR regulation is active. The recovery is very slow.

Unexpected Confidence Shock (3)

Impact on investment banks' equity



impact without the LCR



impact with the LCR

The creditors of commercial banks suffer valuation losses during a confidence crisis. These losses are more severe when the LCR is active and they are more persistent (note different time scales). The LCR has a destabilizing effect on the shadow banking sector.

Explaining the Impact of the Confidence Shock (1)

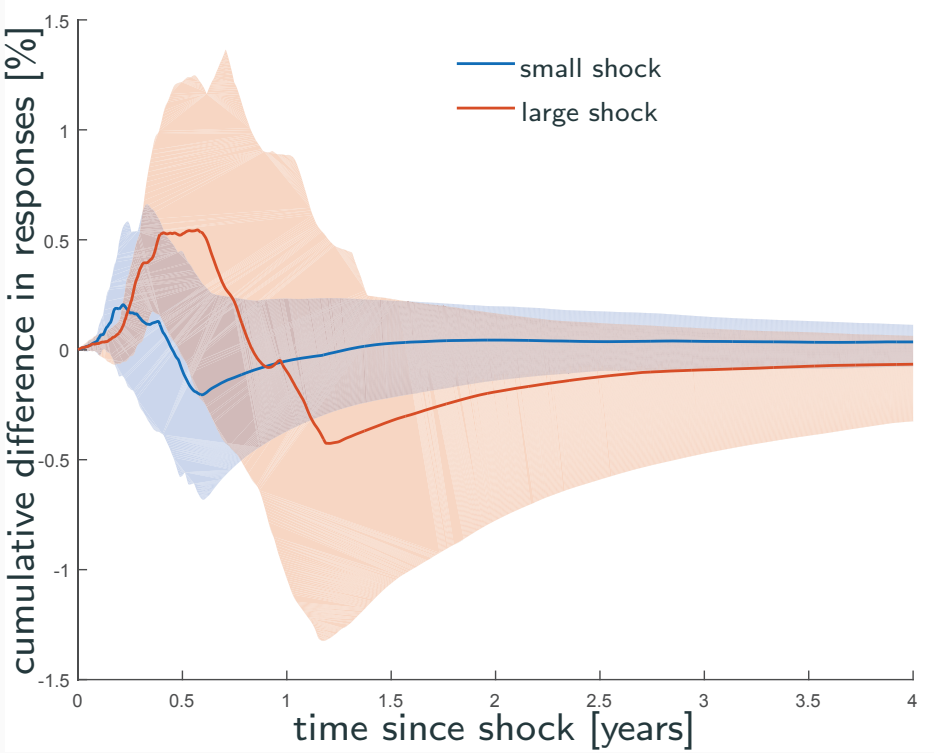
- Longer term funding under the LCR shield commercial banks from soaring short term interest rates that reflect the increase in perceived counterparty default probability during the confidence shock.
- When the average maturity of liabilities is higher than the average maturity of assets, banks can deleverage instead of refinance at high cost. This is beneficial to commercial banks' equity.
- The higher the maturity of an asset, the higher the probability that the asset will default within its lifetime (all else equal). Longer term assets therefore suffer greater valuation losses (price drop) during a confidence crisis than shorter term assets. Overnight assets do not have a price and therefore cannot suffer valuation losses.
- The drop in price of commercial bank bonds due to the confidence shock causes problems for creditor banks (investment banks in the model). Creditors will try to deleverage by selling asset, which leads to a further drop in prices. The ensuing fire sale spiral depletes the equity of creditor banks.

Explaining the Impact of the Confidence Shock (2)

- Until creditor banks recover from their losses, they will reduce their supply (and/or increase the interest rate) of wholesale funding to commercial banks.
- Since wholesale debt is a major funding source (about 60% of liabilities for large European banks on average) for commercial banks, the reduced supply will lead to a sustained credit crunch for the real sector.
- In essence, the LCR has stabilized commercial banks at the cost of destabilizing their creditors, with repercussions for the real sector.
- If the confidence shock is large enough, the LCR can have a severely detrimental effect on the financial systems ability to provide loans to households and firms.

Unexpected Solvency Shock (1)

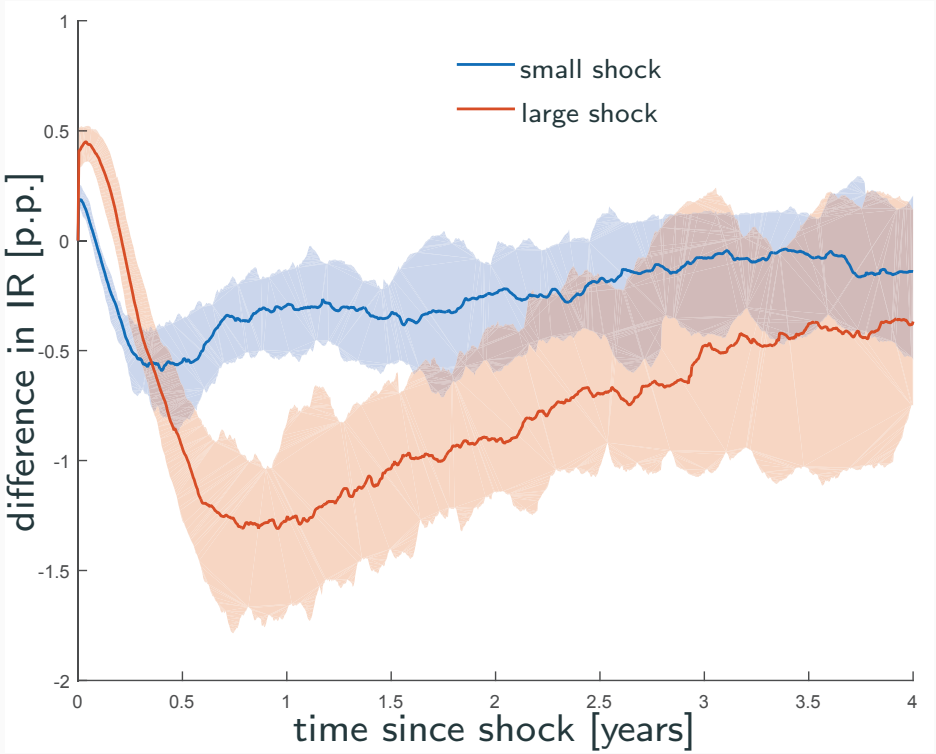
Impact on loan supply



An initial positive effect of the LCR regulation on the loan supply turns negative after some time.

Unexpected Solvency Shock (2)

Impact on commercial banks' equity



Lower profitability leads to a slower recovery of commercial banks.

Explaining the Impact of a Solvency Shock (2)

- Losses to banks' loan portfolios reduces their equity and increases their probability to default.
- A longer term funding structure when the LCR is active reduces their refinancing costs (compared to the case without the LCR) in the aftermath of the shock. The initial effect of the LCR on banks' equity is therefore positive.
- The long term impact of the solvency shock under the LCR regulation may nevertheless be negative.
- However, generally higher funding costs under the LCR regulation may lead to a slower recovery of the bank after the shock.
- The difference in impacts of a solvency shock with and without the LCR regulation is statistically significant (judging by the 90 confidence bands), but economically rather small. At their peak, the cumulative difference of the loan supply lies between -0.5% and 0.5% in a scenario where 2% of banks' loan portfolios default on a single day.

Conclusion

Conclusion

- A model is developed that allows for the analysis of financial stability conditional on changes to regulation.
- The paper shows that the LCR can have wide ranging impact on banks balance sheets. Among them, lower loan supply to households and firms and less maturity transformation by banks.
- The LCR stabilizes commercial banks (as intended) during a confidence shock, but destabilizes their creditors (unintended).
- The paper highlights the importance of taking a holistic (systemic) view of the financial system when developing regulation that is supposed to stabilize the system.