Stress Testing with Multi-faceted Liquidity

The Central Bank Collateral Framework as a Financial Stability Tool

Angelo Cuzzola
angelo.cuzzola@santannapisa.it

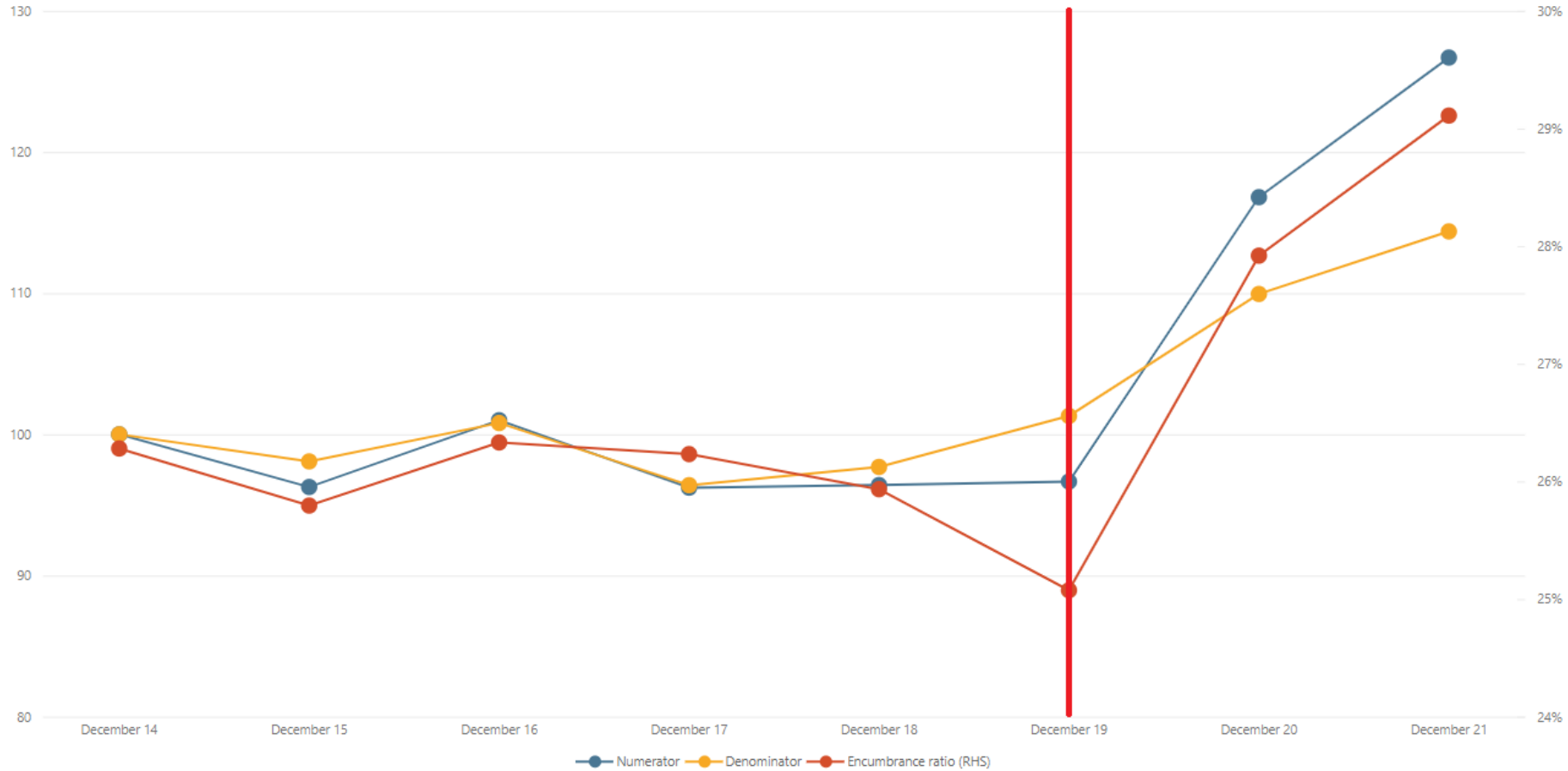
Joint with:
Claudio Barbieri (SSM, DG-HOL)
Ulrich Bindseil (ECB, DG-MIP)

Working Group on Stress Testing
2022 Research Workshop - Frankfurt - September 29, 2022

Motivation, background and contributions

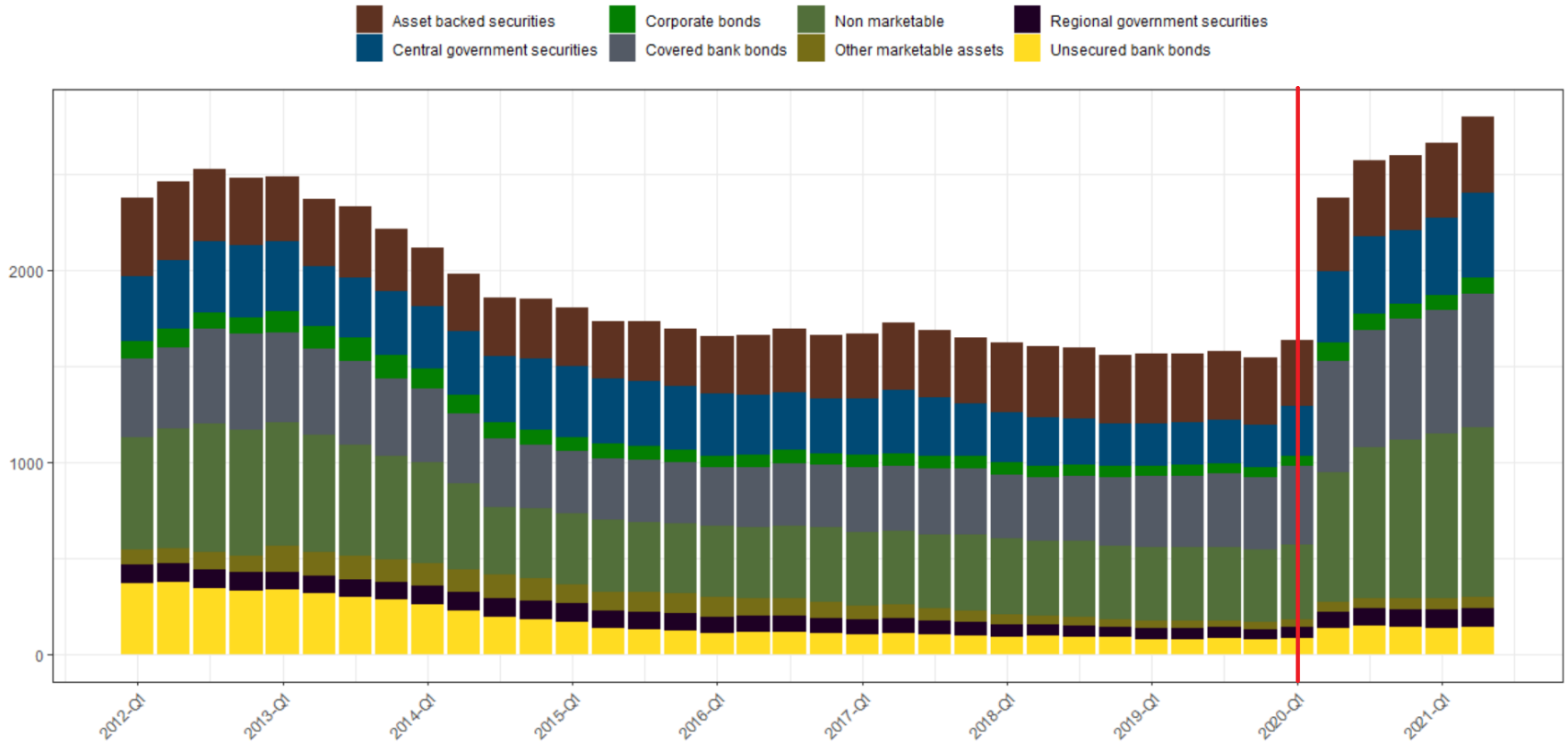
Motivation and background

"The encumbrance ratio continued the upward trend initiated in 2020 and reached 29.1% in 2021." (EBA Encumbrance Report 2022)



Motivation and background

"Central bank funding increased its relevance as the main source of encumbrance." (EBA Encumbrance Report 2022)
From 13% in Dec. 2019 to 27.6% in Dec. 2021 as relative source of encumbrance.



Motivation and background

Since the outbreak of the great financial crisis, stress tests have become fundamental tools for **banking supervision**.

More recently, the circumstances of the COVID19 crisis required the ECB to step in as an **essential liquidity provider**.

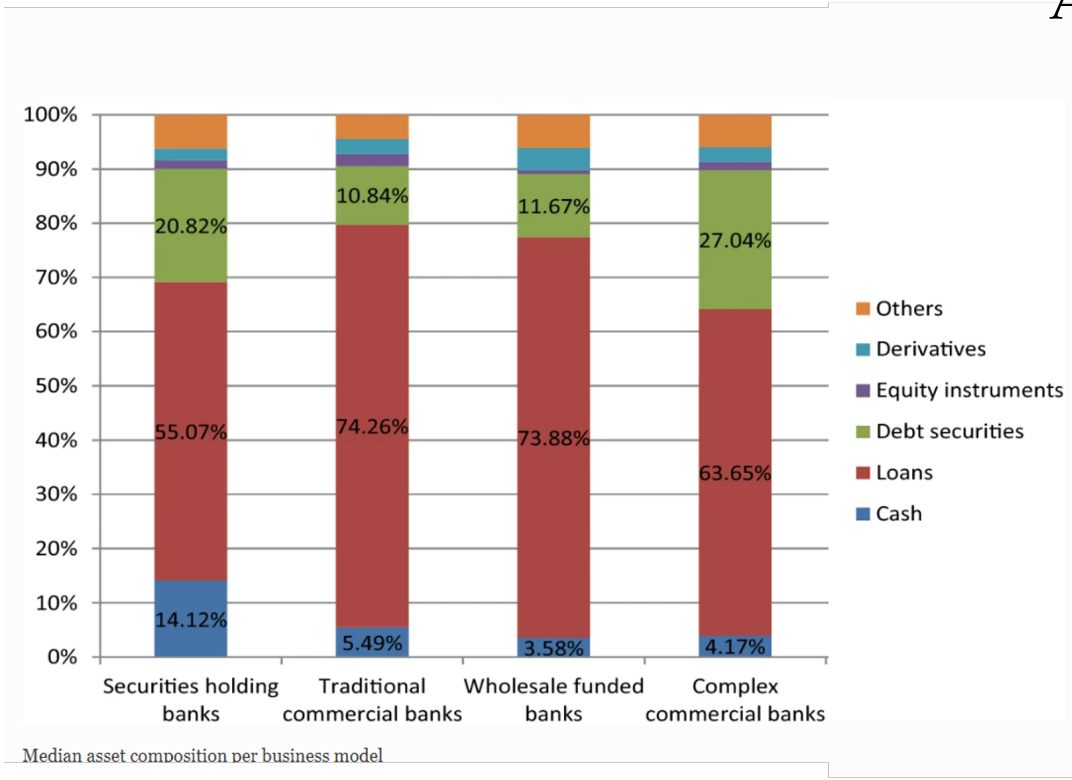
Banks interact strategically with ECB policies:

- Monetary policy affects quantity of high-liquid collateral Grandia et al. (2019)
- Impact of LCR regulation on demand for CB reserves Kedan and Veghazy (2021)

We aim to investigate the link between the effects of the ECB credit policies, with a focus on the design of the collateral framework, and banks' performances in a stress test.

Motivation and background
The stress outcomes under multi-faceted liquidity

Banks with less liquid assets and lower liquidity buffers can naturally appear riskier in a stress test



Source: Farnè & Vouldis (2021), p. 36

During a crisis, however, banks can resort to the ECB credit upon collateralization.

A stress test model should

- represent the assets to account for the variety in the eligibility spectrum of the collateral framework (CBCF);
- explain changes in the risk profile of the banks induced by the CBCF;
- capture the multi-faceted nature of liquidity: the asset have different liquidity prospects on different channels.

A summary of the extant stress testing models analyzed along four fundamental modelling dimensions

	Active/Passive behavior of banks	Single/multi financing channel(s)	Contagion	Liquidity-solvency interaction
Greenwood et al., 2015	Active	Single-channel	✓	✗
Cont and Schaanning, 2017	Active	Single channel	✓	✗
Cont et al., 2020	Active	Multi-channel	✗	✓
BEAST (Budnik et al. 2020)	Active	Two channels	✓	✓
Sydow et al. 2021	Active	Multi-channel	✓	✓
SSM regulatory ST (bottom-up)	Passive	-	✗	-

Contributions

- Design a stress test model with four key features: active behaviour of banks, multiple financing channel, implicit contagion effects and liquidity-solvency interactions.
- Liquidity is modelled as a multi-faceted property of assets providing a quantitative framework to study the implications of different collateral framework designs (beyond its risk-protection function).
- The model is used to analyze the effects of the CB collateral framework on banks' performances in a dynamic stress test.
- We apply the framework to a simulated financial system and to a dataset of European financial institutions, constructed integrating two different sources: FINREP and AnaCredit.
  - Properties in line with previous studies (e.g. threshold for systemic triggers,"robust-yet-fragile")
  - New insights on the liquidity/solvency interaction and on the post-shock adjustment process

The operational stress-test model

The operational framework

We extended existing stress models integrating and enriching their main characteristics in one operational framework.

- Cont and Schaanning (2017) and Coen et al. (2019): models with fire sales and indirect contagion through common exposures, based on theoretical (Shleifer and Vishny, 2011) and empirical studies on fire sales (Greenwood et al., 2015; Duarte and Eisenbach, 2021)
- Cont et al. (2020), a structural framework for the joint stress testing of solvency and liquidity
  - liquidity and solvency risk interact as the liquidity shortfalls are induced by the run-off of credit sensitive fundings -> **modelling liabilities run-off probabilities**
  - Banks respond to the liquidity shocks undertaking various mitigating action -> **modelling banks beahviour in a complex liquidity landscape**

Model items

An operational model featuring a population of financial institutions with a granular balance sheet representation

Assets side		Liabilities side	
$A^{M,enc}_{\mu,i}, A^{M,une}_{\mu,i}$	Marketable	e_i	Equity
$A^{N,enc}_{\nu,i}, A^{N,une}_{\nu,i}$	Non-marketable	l^u_i	Unsecured credit
c_i	Cash	l^{rp}_i	Repo credit
o_i	Other assets	l^{cb}_i	Central Bank credit
		l^{ot}_i	Other credit
		$\{l^d_{ik}\}_{k\in\mathcal{D}_i}$	Short-term deposits

Table: Balance sheet representation for bank i, with $\mathcal{D}_i$ defining the set of depositors of the bank.

Model dynamics and interactions

With a given balance sheet representation the dynamics of the stress test is determined by this set of interactions

Asset value shocks. Exogenous when prompted as the starting point of the stress test or endogenously generated by mark-to-market price mediated contagion.

Liquidity shocks. Induced by the run-off of credit sensitive fundings due to the deterioration of banks fundamentals.

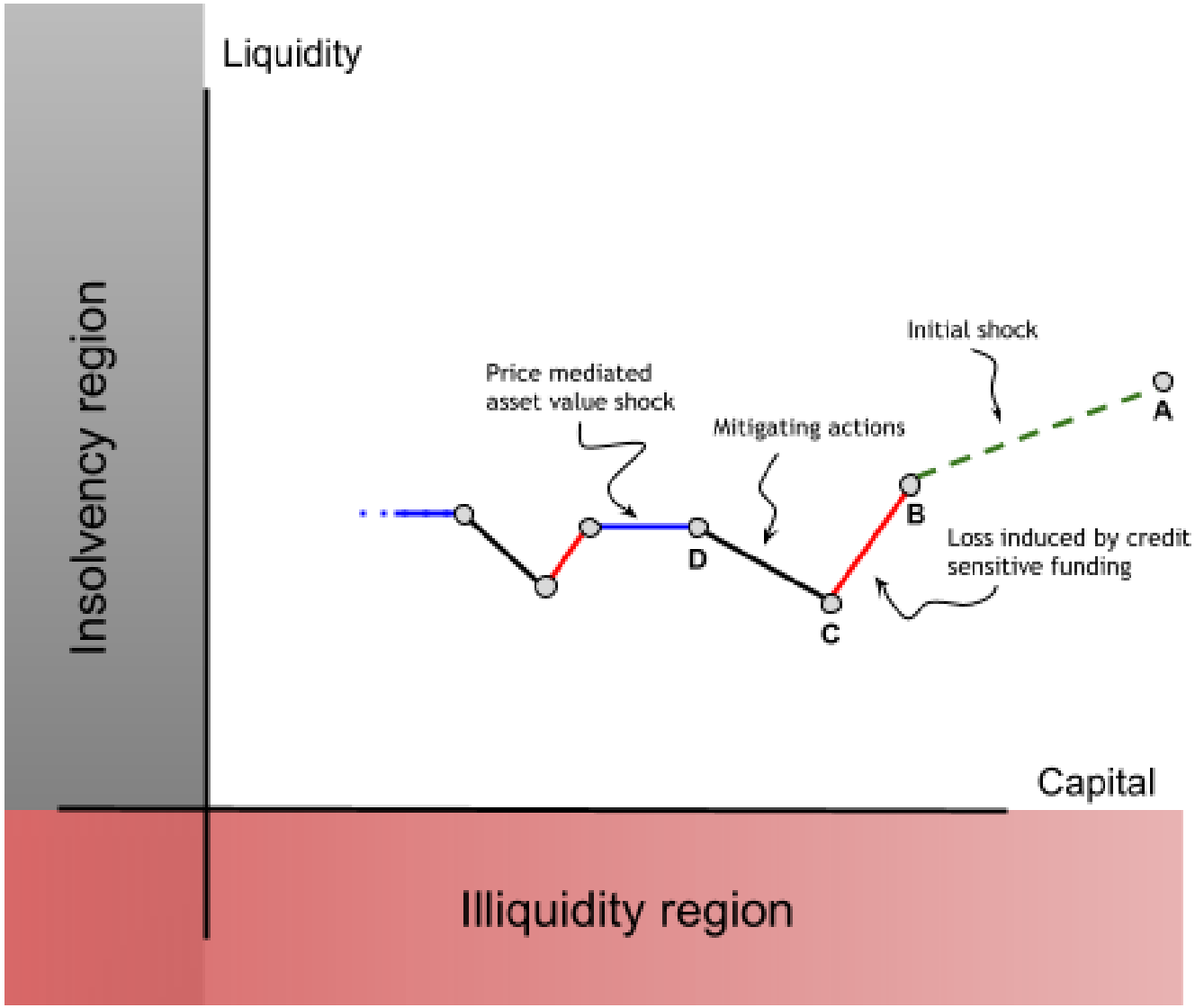
Banks' mitigating action. Banks compensate the liquidity shortfall accessing four different channels: i) unsecured credit (distance to default as in Cont et al. (2020)), ii.1) Repo credit, ii.2) Central Bank credit, ii.3) assets sales.

Price mediated contagion. Banks actions may affect assets' prices determining assets values shifts that are transferred to banks balance sheets as endogenous shocks.

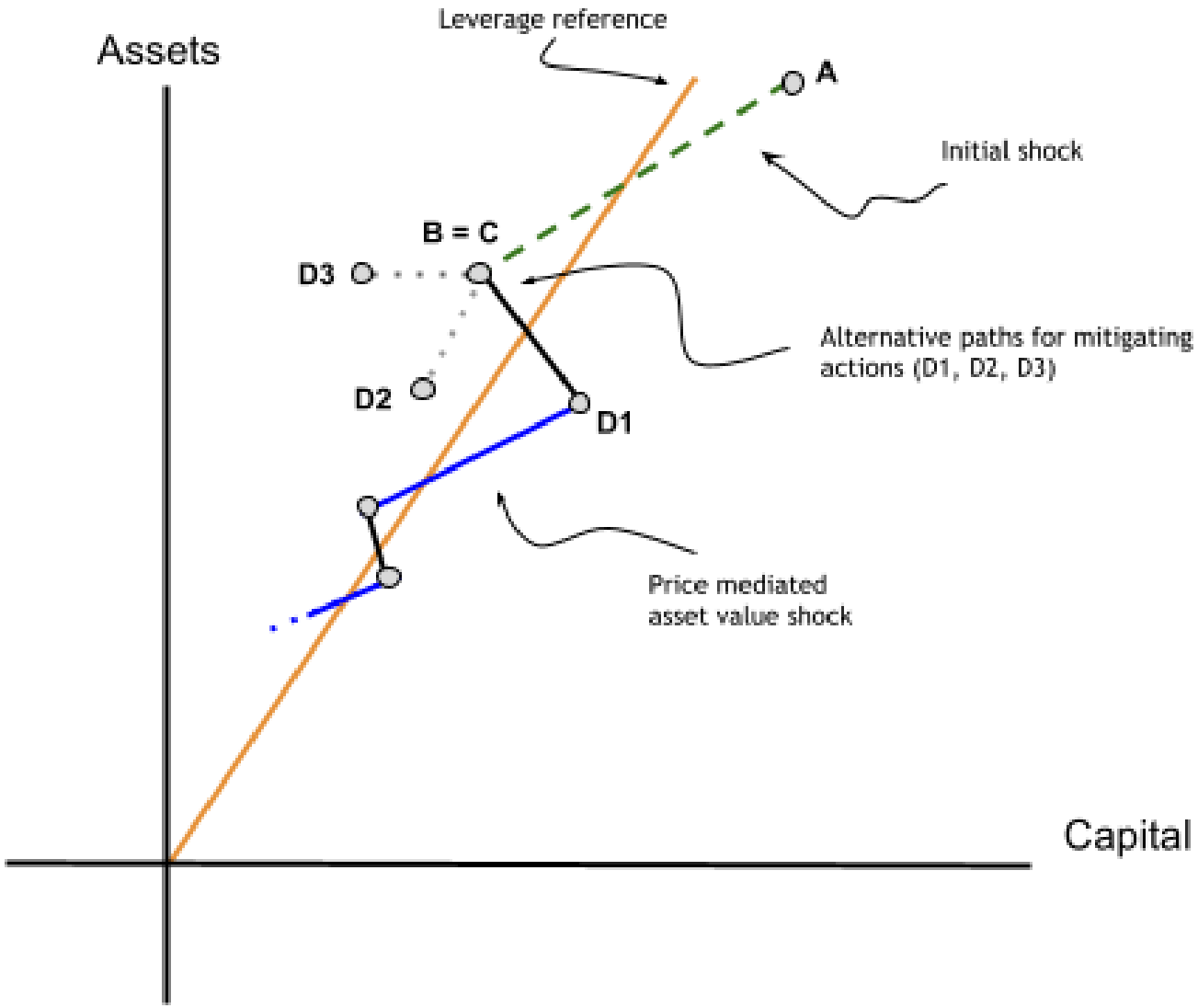
Model timeline

1. An exogenous shock hits the value of the assets. Banks' fundamentals change accordingly.
2. Credit sensitive fundings respond to the banks' balance sheets changes, possibly inducing bank-specific liquidity shortfalls.
3. All the banks in the financial system are called to action, initially they deal with liquidity shortfalls or use the available funding sources to restore the possibly deteriorated fundamentals. They access the various channels according to their objective and collateral availability.
4. Banks that are not able to cover the liquidity shortfall default for illiquidity, banks that, after repaying, cannot face the costs of the compensating financing operations default for insolvency.
5. The mark-to-market losses mediated by assets prices are transferred to banks' balance sheet items in the form of assets value shock as in step 1. The cycle restarts.

Model timeline
Liquidity solvency-diagram



Model timeline
Leverage-ratio diagram

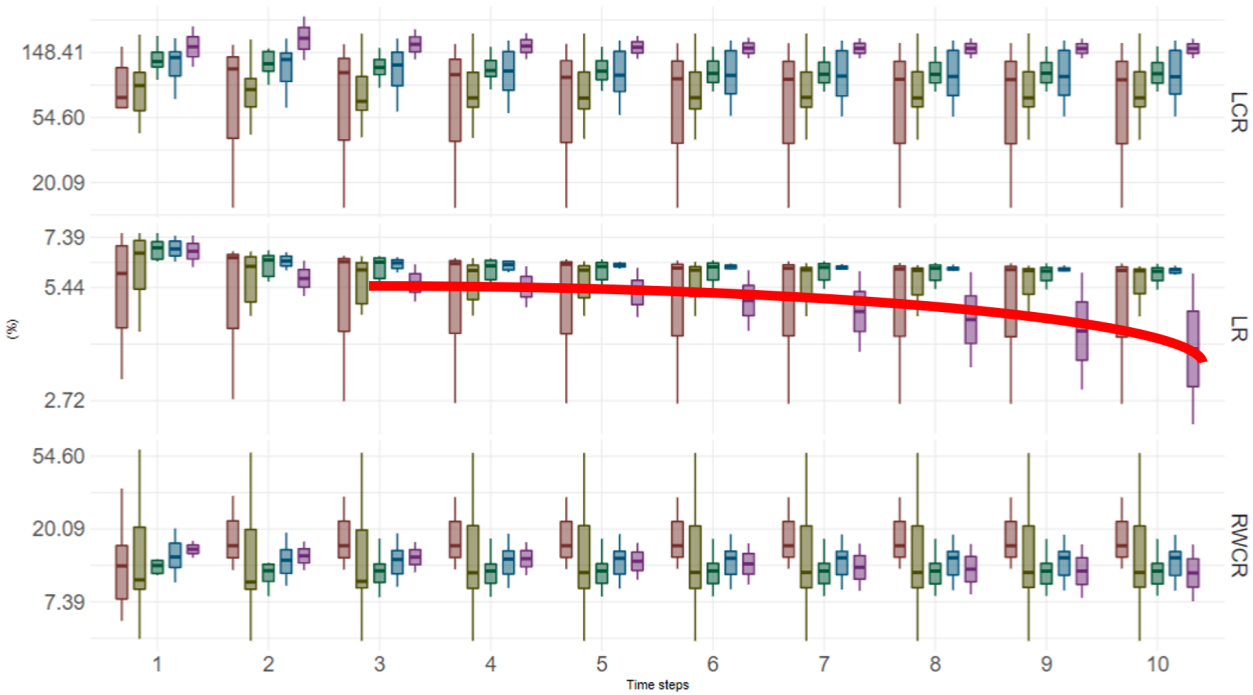


Model applications and results

Asset classes and liquidity categories

Model applications and results
Russia and eastern countries scenario

- Shocks affects the distributions of the regulatory ratios of banks by country
- Immediate and mild impact on liquidity coverage ratio and capital ratio
- Longer term impact on leverage ratio: long lasting liquidity adjustment process



(b) Eastern countries scenario (I5).

Outlook

Next steps

- We are currently refining the comparison between with/without collateral framework scenarios.
- The assets classification can be further exploited for the definition of other scenarios (e.g. sectoral shock).
- Checking the robustness of the encumbered/unencumbered classification and extending to all asset types (at start) in the empirical application.

Thanks for your attention!

Questions and comments are welcome

Selected references I

BUDNIK, K. B., M. BALATTI, I. DIMITROV, J. GROSS, M. KLEEMANN, T. REICHENBACHAS, F. SANNA, A. SARYCHEV, N. SIŅENKO, AND M. VOLK (2020): "Banking euro area stress test model," .

COEN, J., C. LEPORE, AND E. SCHAANNING (2019): "Taking Regulation Seriously: Fire Sales Under Solvency and Liquidity Constraints," *Bank of England Working Paper*.

CONT, R., A. KOTLICKI, AND L. VALDERRAMA (2020): "Liquidity at risk: Joint stress testing of solvency and liquidity," *Journal of Banking & Finance*, 118, 105871.

CONT, R. AND E. SCHAANNING (2017): "Fire sales, indirect contagion and systemic stress testing," *Indirect Contagion and Systemic Stress Testing (June 13, 2017)*.

DUARTE, F. AND T. M. EISENBACH (2021): "Fire-Sale Spillovers and Systemic Risk," *The Journal of Finance*, 76, 1251–1294.

FARNÈ, M. AND A. T. VOULDIS (2021): "Banks' business models in the euro area: a cluster analysis in high dimensions," *Annals of Operations Research*, 1–35.

Selected references II

GRANDIA, R., P. HÄNLING, M. LO RUSSO, AND P. ÅBERG (2019): "Availability of high-quality liquid assets and monetary policy operations: an analysis for the euro area," *ECB Occasional Paper*.

GREENWOOD, R., A. LANDIER, AND D. THESMAR (2015): "Vulnerable banks," *Journal of Financial Economics*, 115, 471–485.

KEDAN, D. AND A. V. VEGHAZY (2021): "The implications of liquidity regulation for monetary policy implementation and the central bank balance sheet size: an empirical analysis of the euro area," *ECB working paper series*.

SHLEIFER, A. AND R. VISHNY (2011): "Fire Sales in Finance and Macroeconomics," *Journal of Economic Perspectives*, 25, 29–48.

SYDOW, M., A. SCHILTE, G. COVI, M. DEIPENBROCK, L. DEL VECCHIO, P. FIEDOR, G. FUKKER, M. GEHREND, R. GOURDEL, A. GRASSI, ET AL. (2021): "Shock amplification in an interconnected financial system of banks and investment funds," .