



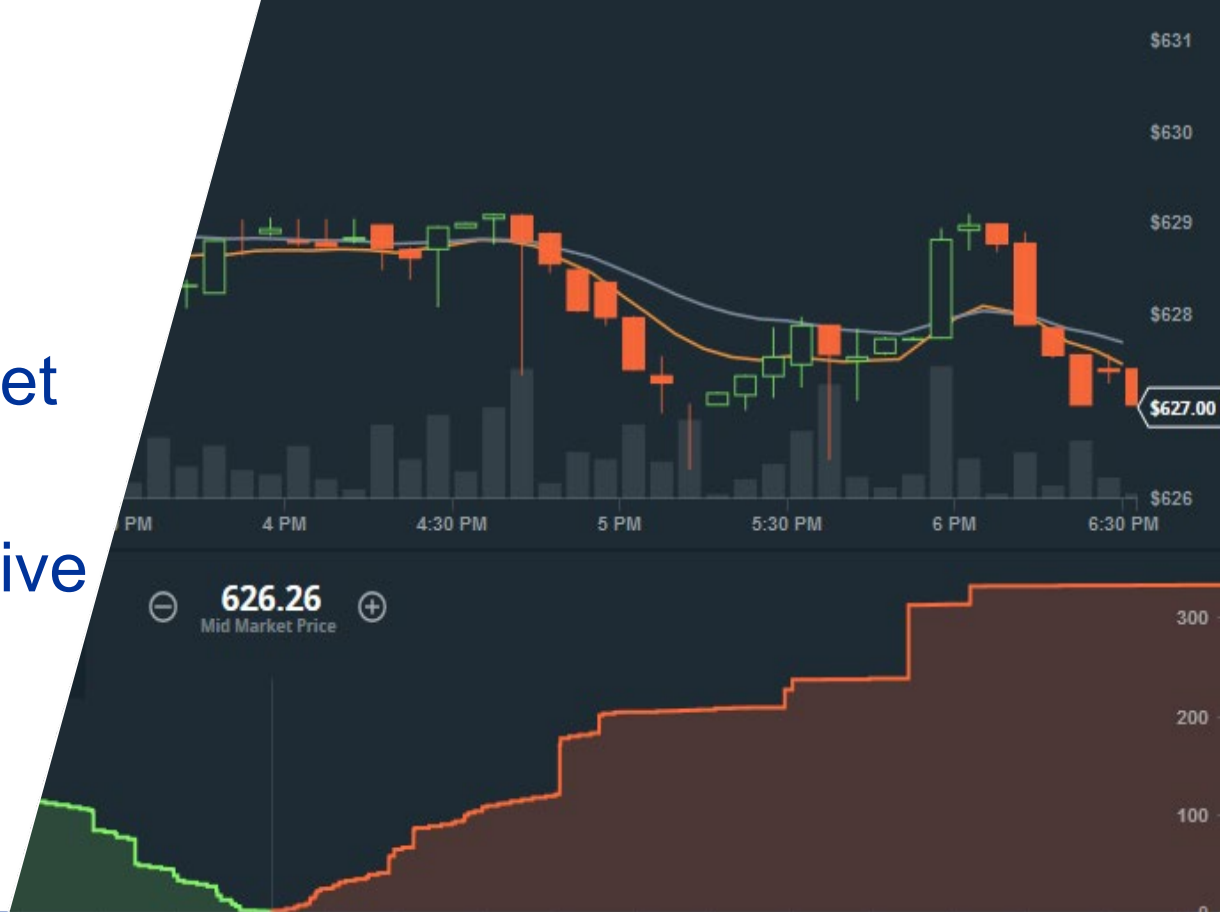
EUROPEAN CENTRAL BANK

EUROSYSTEM

# Contagion from market price impact: a price-at-risk perspective

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# Disclaimer

*The views expressed in this presentation are those of the authors and do not necessarily represent the views of the European Central Bank and the Eurosystem.*

# How to model price impact?

## Quantile regression

Expanding the exponential model: calibrate a wider range of impact severities levels, while keeping the converging nature of the exponential function.

$$R(v)^q = \beta_0^q (1 - \exp(-sV)) + \beta_1^q R_{sys}$$

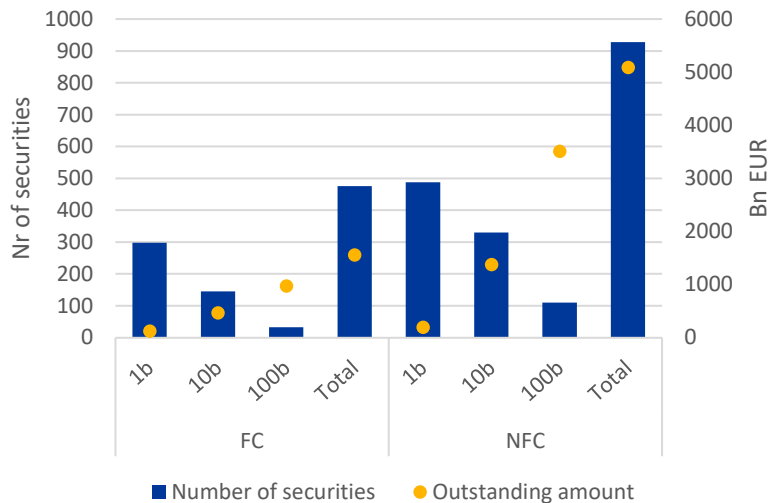
where  $s = \frac{\lambda}{\beta_0}$ , from which we can derive  $\lambda$ , and  $q$  is the estimated quantile.

Furthermore, a **system-level component**  $R_{sys}$  has been introduced to account for price changes due to changes in the market (can also be scenario-driven).

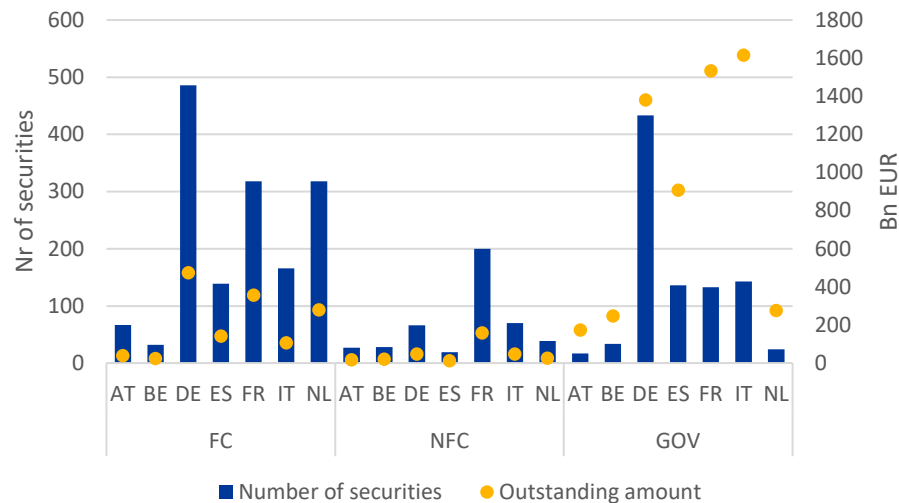
References: Adrian, Brunnermeier CoVaR (2016), Engle, Manganelli CaViaR (1999) and Fukker et al. Price-at-risk (2022), ECB Working Paper, No. 2692: <https://www.ecb.europa.eu/pub/pdf/scpwp/escb.wp2692~e290ddd247.en.pdf>

# Data coverage

## Equity security coverage



## Bond security coverage

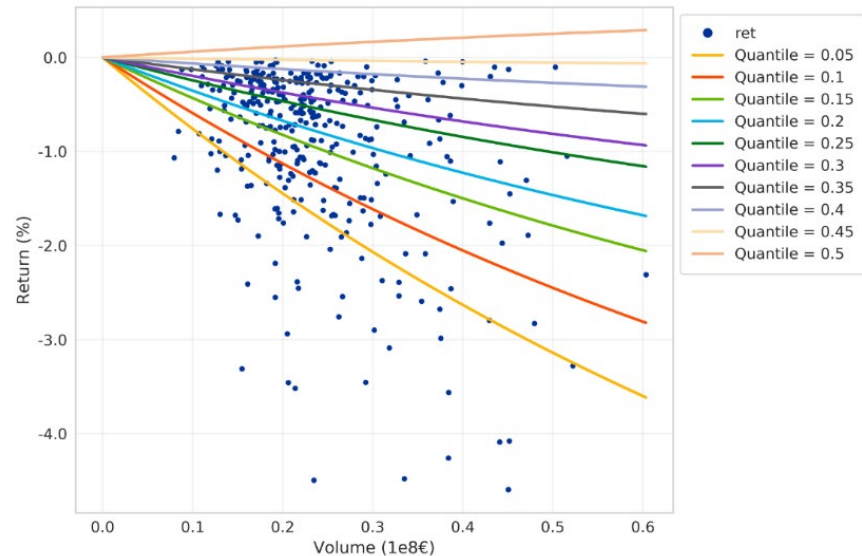
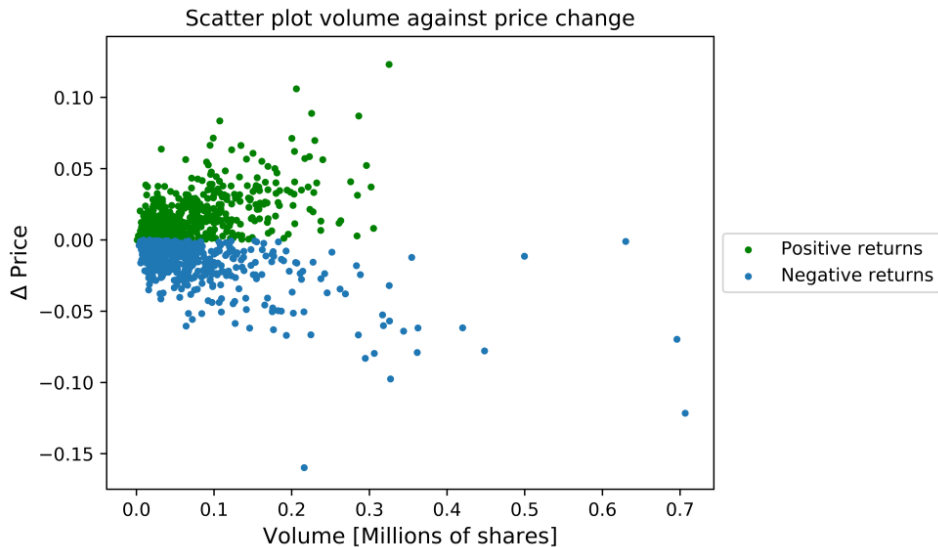


The dataset contains an as wide as possible range of equities and bonds, including different sectors, sizes, and euro area countries amounting to 7 trillion euro equities and 7.9 trillion euro bonds.

Source: Fukker et al. (2022).

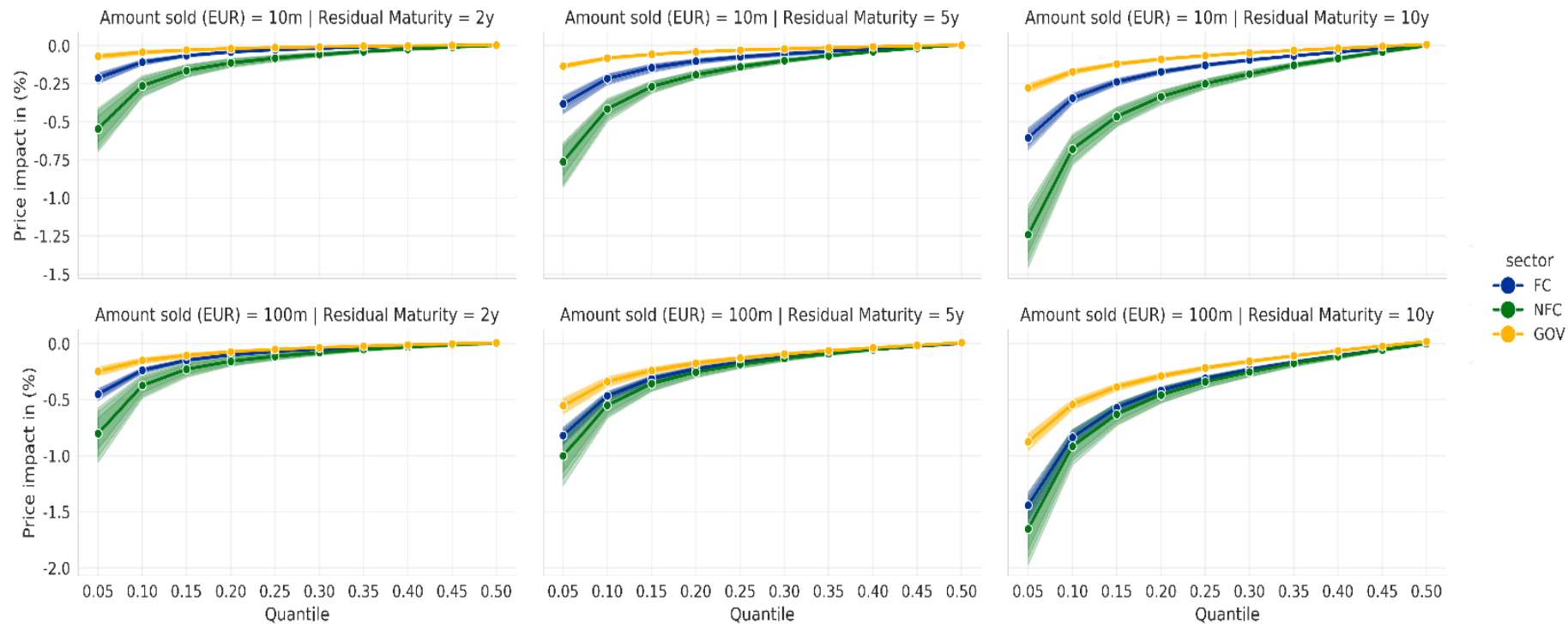
# Visualization of price calibration on empirical data

Empirical data shows that returns diverge as volumes increase (left hand side). The quantile regression approach on the negative impacts allows to evaluate risk at different intensity levels (right hand side)



# Security level impact size

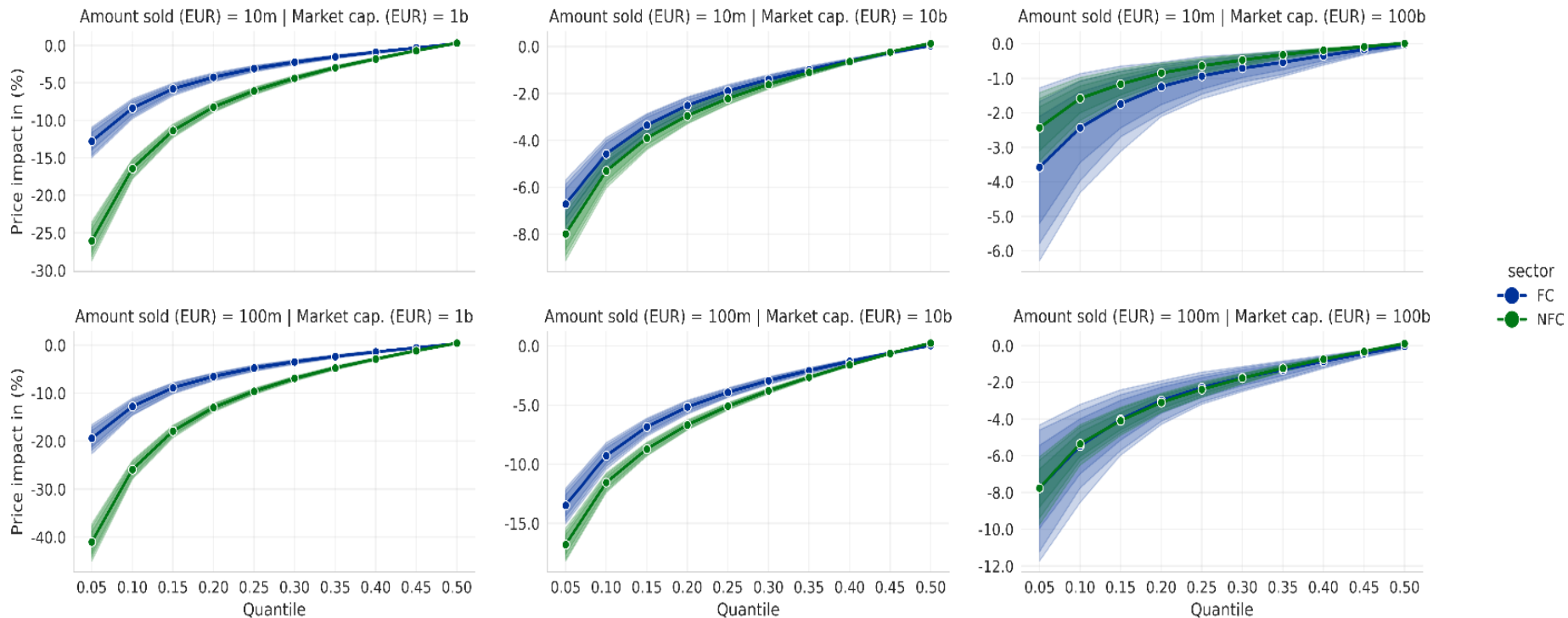
## Bonds - direct market price impact from fire sale of individual bonds



Source: Fukker et al. (2022).

# Security level impact size

## Equities - direct market price impact from fire sale of individual equity



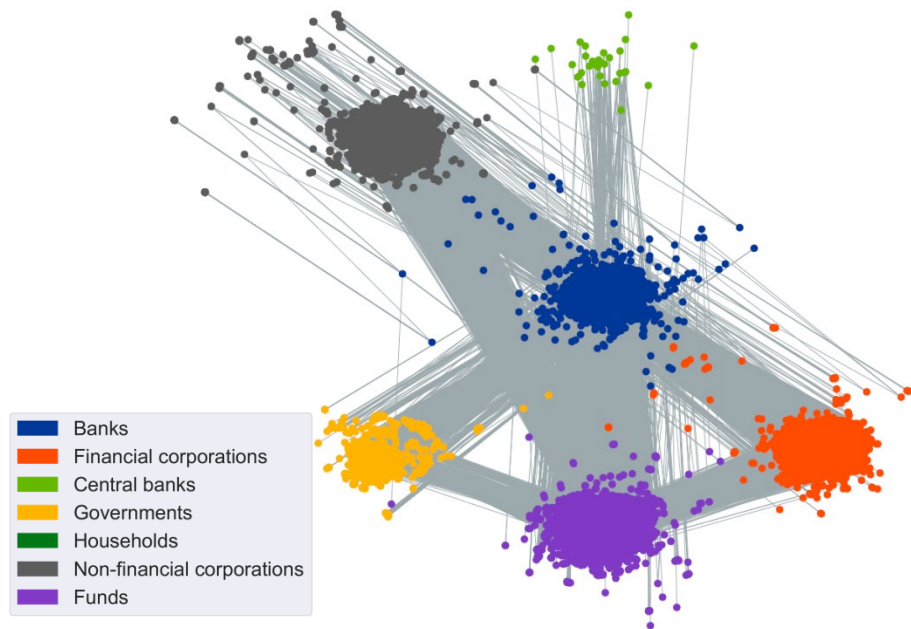
Source: Fukker et al. (2022).

# Fire sale simulations (I)

- **Using SWST model** (Sydow et al., 2021) for the system of banks and investment funds
- **Driven by liquidity shortfalls:** banks/funds cover their liquidity shortfalls by selling their tradable assets
- **Pro rata approach:** amounts sold are proportional for all securities held
- **Price equilibrium:** price impacts recalculated until no further change in market values of holdings

Reference: Sydow et al. (2021), ECB Working Paper, No. 2581 and Sydow et al. (2024), Journal of Financial Stability.

Securities holdings



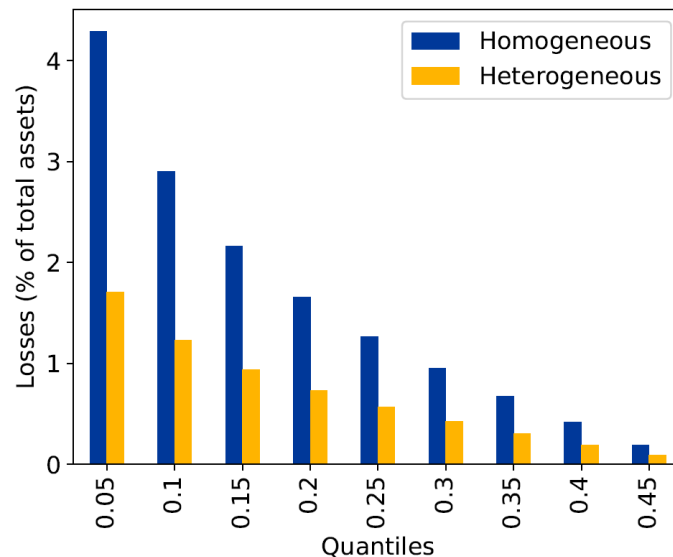
An edge shows that a bank/fund holds assets issued by another entity in a given sector. Granular securities data are covering 7% of total bank assets.



# Fire sale simulations (II)

- **Redemption shock** for investment funds to trigger fire sales of all securities in their portfolios
- **Banks and funds** suffer fire sale losses upon endogenous price drops
- Fire sale losses **largely depend** on the applied price impact parameters
- Heterogeneous impact parameters reveal **more limited risks** as opposed to homogeneous parameters

## Comparison to homogeneous price impacts

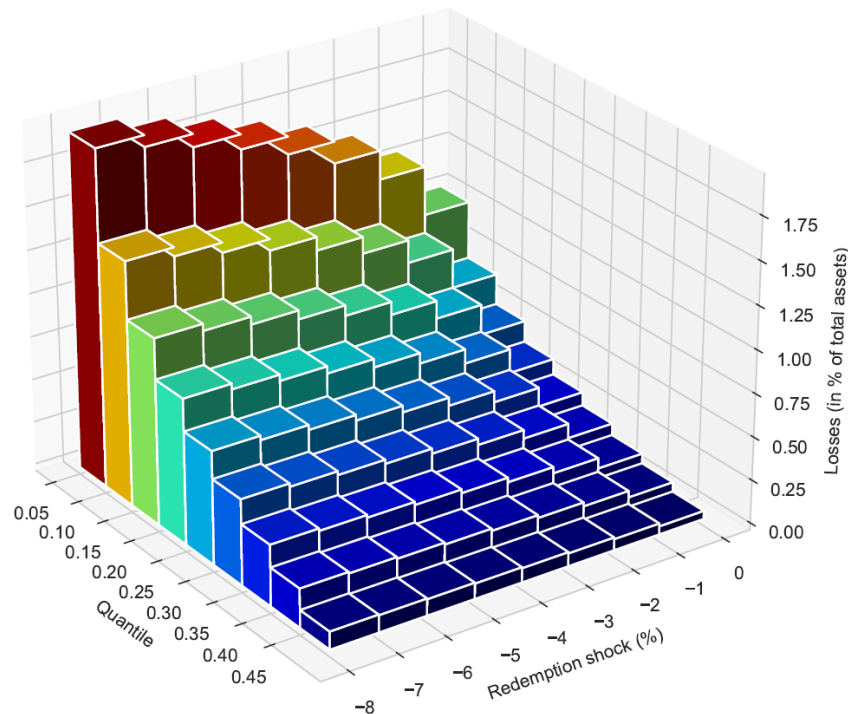


Assumed initial redemption shock for investment funds is -5%.

# Fire sale simulations (III)

**Sensitivity analysis** shows a sub-linear increase in system-level losses with the increase of redemptions for different price impact quantiles

Losses for different redemption shocks and quantiles



# Conclusion

- We estimated **security-level quantile price impact** parameters for different, arbitrary amounts sold, which is a useful complement to standard ‘average’ price impact parameters used in the literature
- Taking into account the **heterogeneity** across securities alleviates some of the risks shown by fire sale models that apply **homogenous** price impact parameters
- **Historical data** cannot explain the future, but former crisis episodes can provide an **indication** of the severity of **future** price movements affecting the liquidity of all agents in the financial system
- In addition to **sector-specific** stress testing exercises, it is important to conduct scenario-based **multi-sector, system-wide** stress testing exercises, with granular network information, to shed light on possible pockets of vulnerability in the financial system as a whole