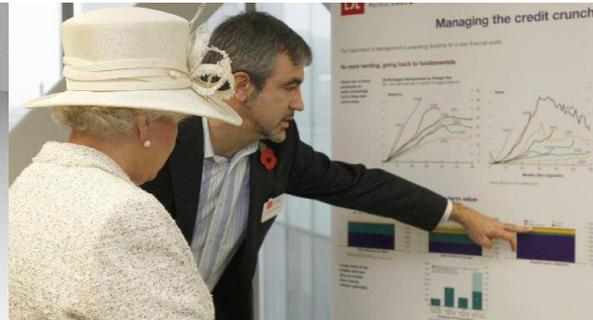


# Physics of banking system

Tomasz Gubiec  
University of Warsaw, Poland





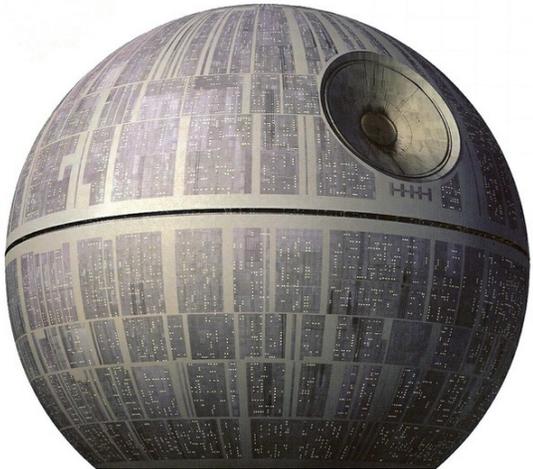
**Background.** On September 15, 2008, the Lehman Brothers bank announced its bankruptcy. This started a panic on the US stock exchange and the mortgage crisis that has spread throughout the world. The effects of these events are still visible today. On November 5, 2008, Queen Elizabeth II visited the London School of Economics under the British Academy Forum. At a meeting in the context of the financial crisis, the queen asked a simple question:

*If these things were so huge, how it is possible that all of them have been overlooked?*

The British Academy answered after almost half a year in the form of an open letter (<http://www.britac.ac.uk/events/archive/forum-economy.cfm>).

Let me quote a part of this answer:

*Everyone seemed to be doing their own job properly on its own merit. And according to standard measures of success, they were often doing it well. The failure was to see how collectively this added up to a series of interconnected imbalances... Individual risks may rightly have been viewed as small, but the risk to the system as a whole was vast.*



11.09054v1 [q-fin.GN] 29 Nov 2015

# It's a Trap: Emperor Palpatine's Poison Pill

Zachary Feinstein<sup>1</sup>

*Washington University in St. Louis*

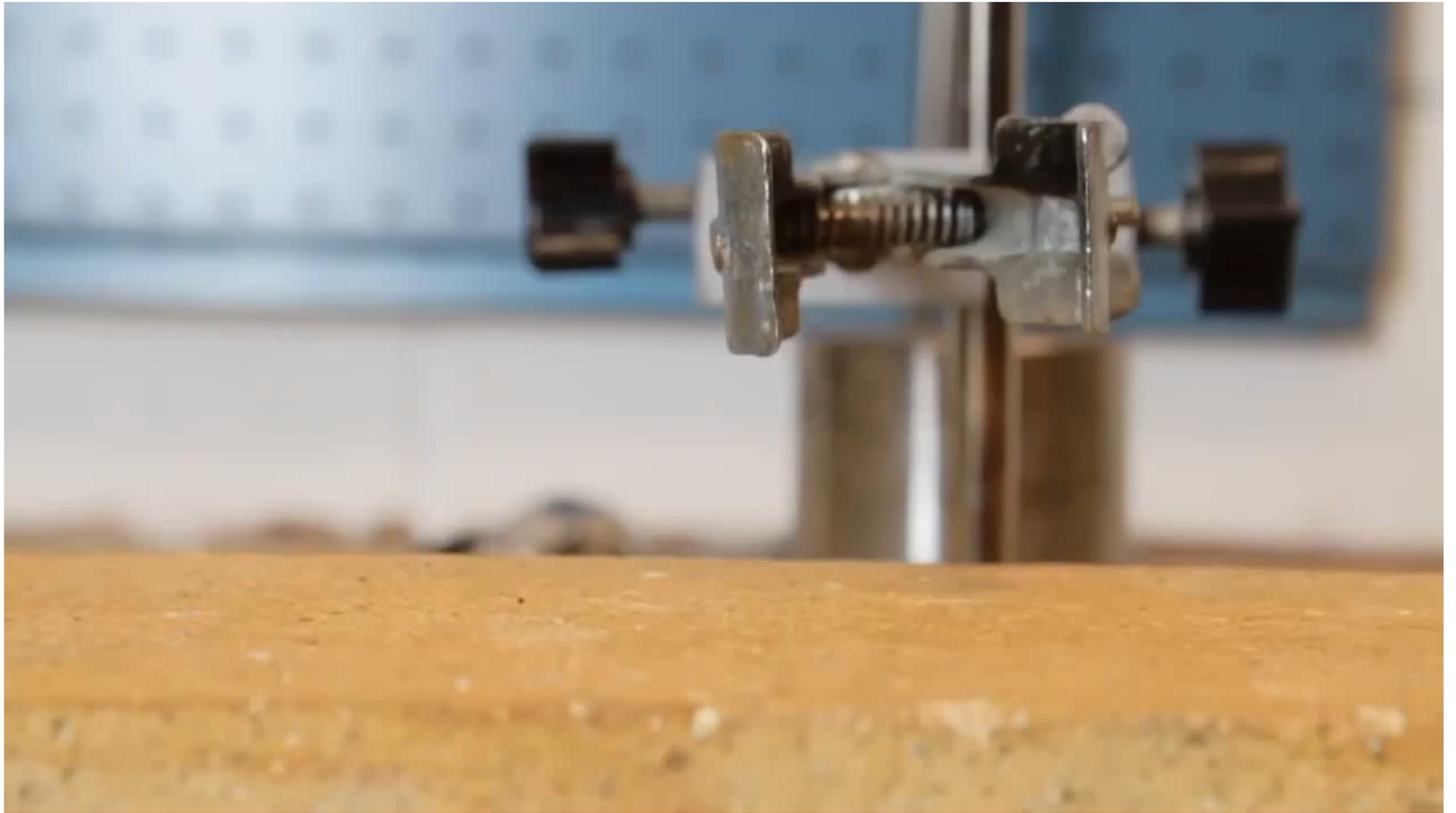
December 1, 2015

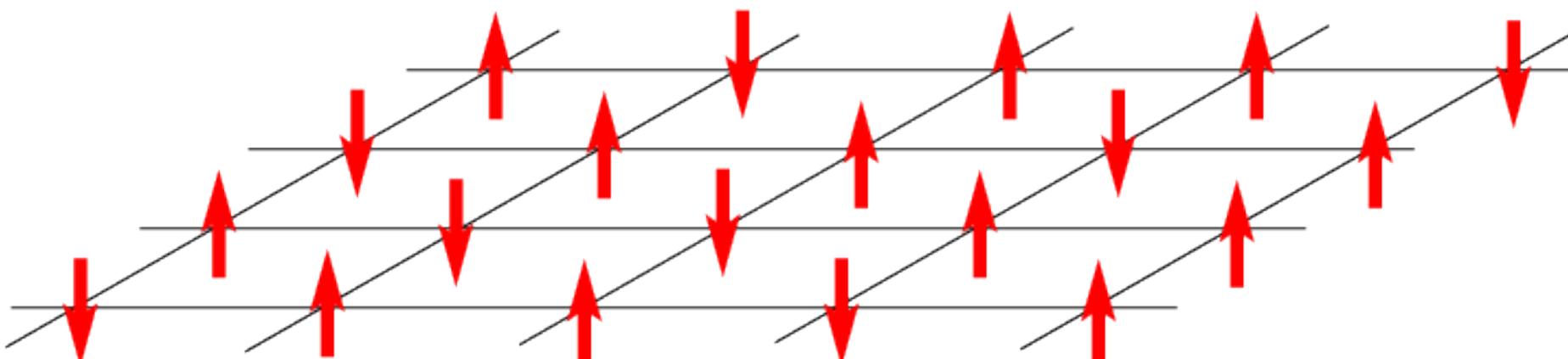
## Abstract

In this paper we study the financial repercussions of the destruction of two fully armed and operational moon-sized battle stations (“Death Stars”) in a 4-year period and the dissolution of the galactic government in *Star Wars*. The emphasis of this work is to calibrate and simulate a model of the banking and financial systems within the galaxy. Along these lines, we measure the level of systemic risk that may have been generated by the death of Emperor Palpatine and the destruction of the second Death Star. We conclude by finding the economic resources the Rebel Alliance would need to have in reserve in order to prevent a financial crisis from gripping the galaxy through an optimally allocated banking bailout. [\[2\]](#)

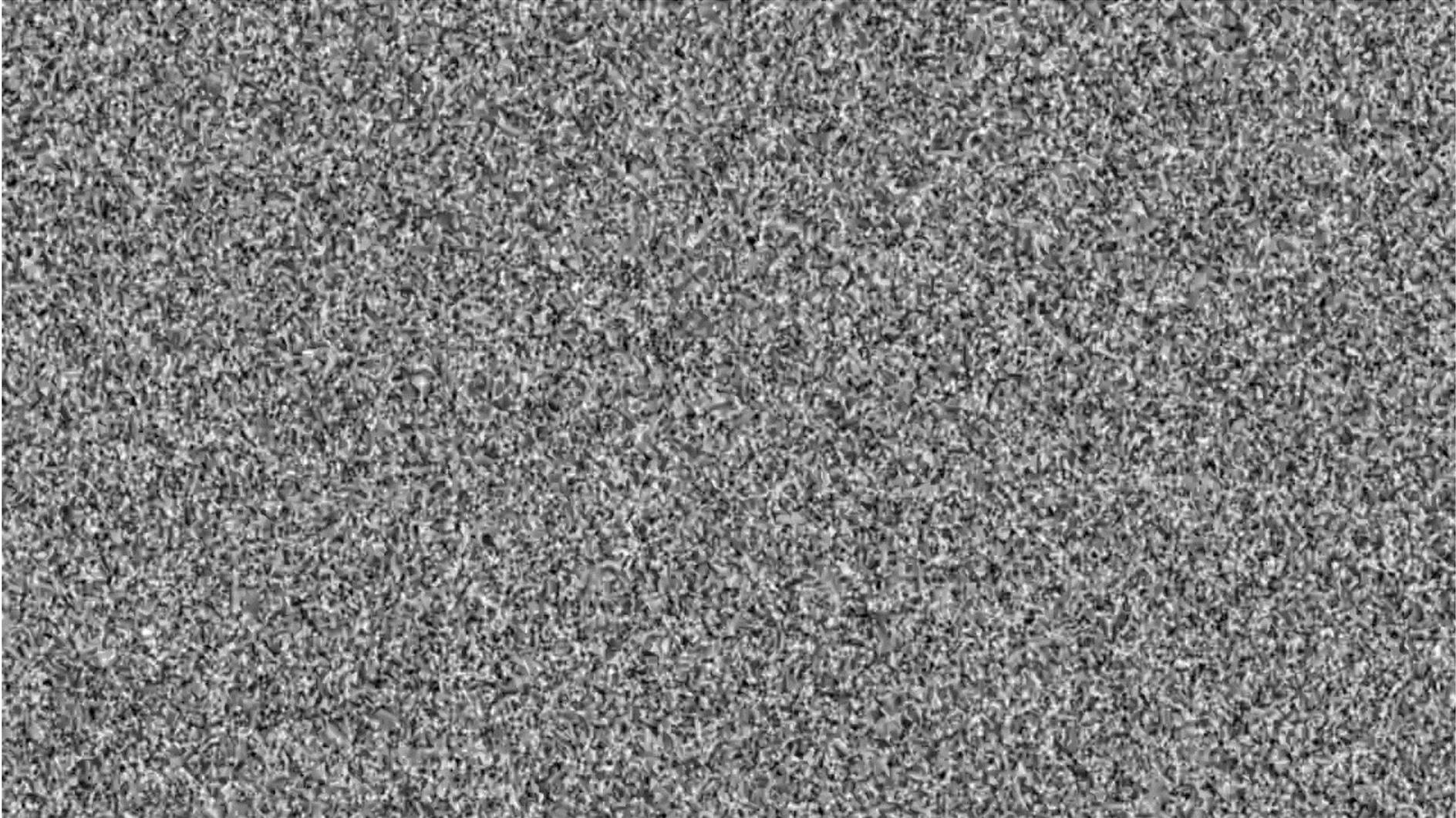
**Key words:** *Star Wars*; systemic risk; financial crisis; financial contagion; bailout allocation

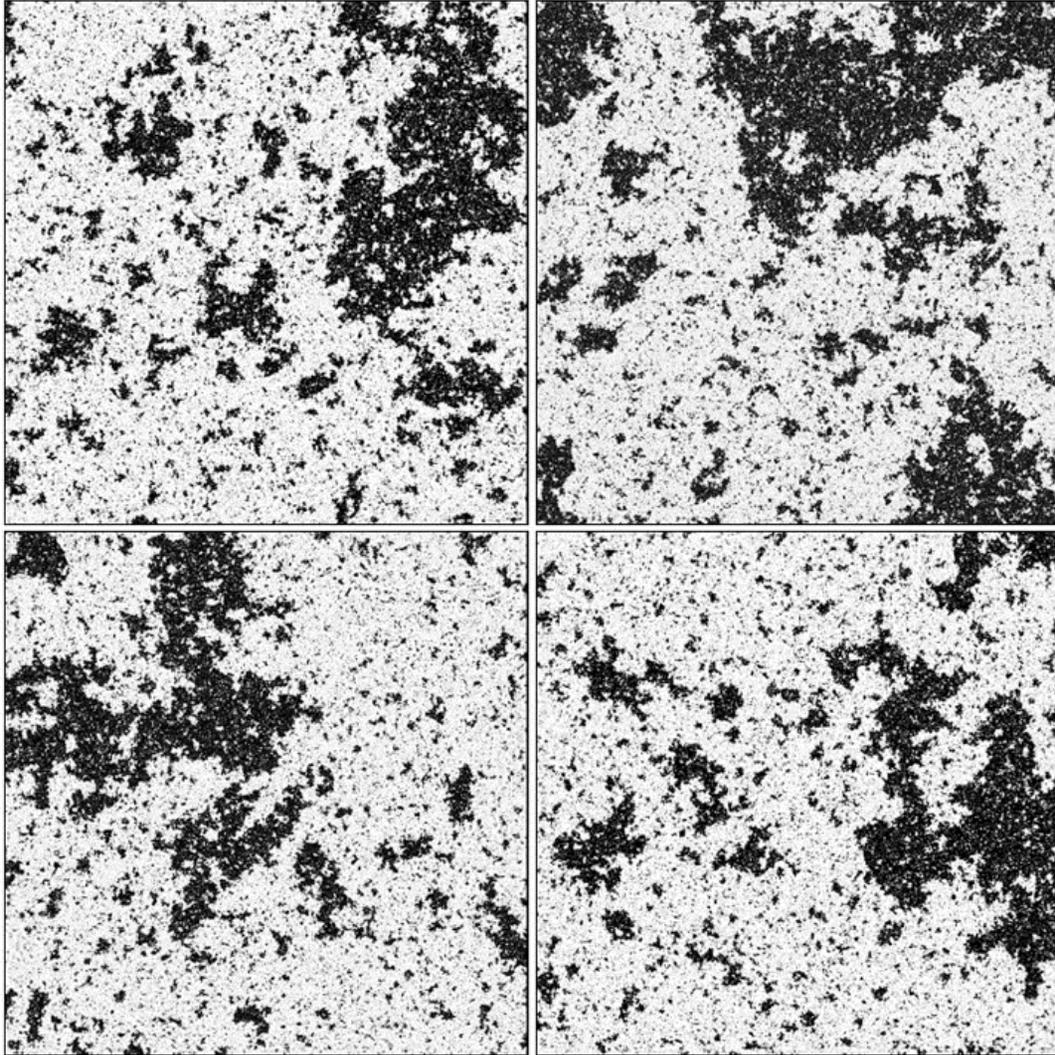
## 1 Introduction





2-D Ising Model



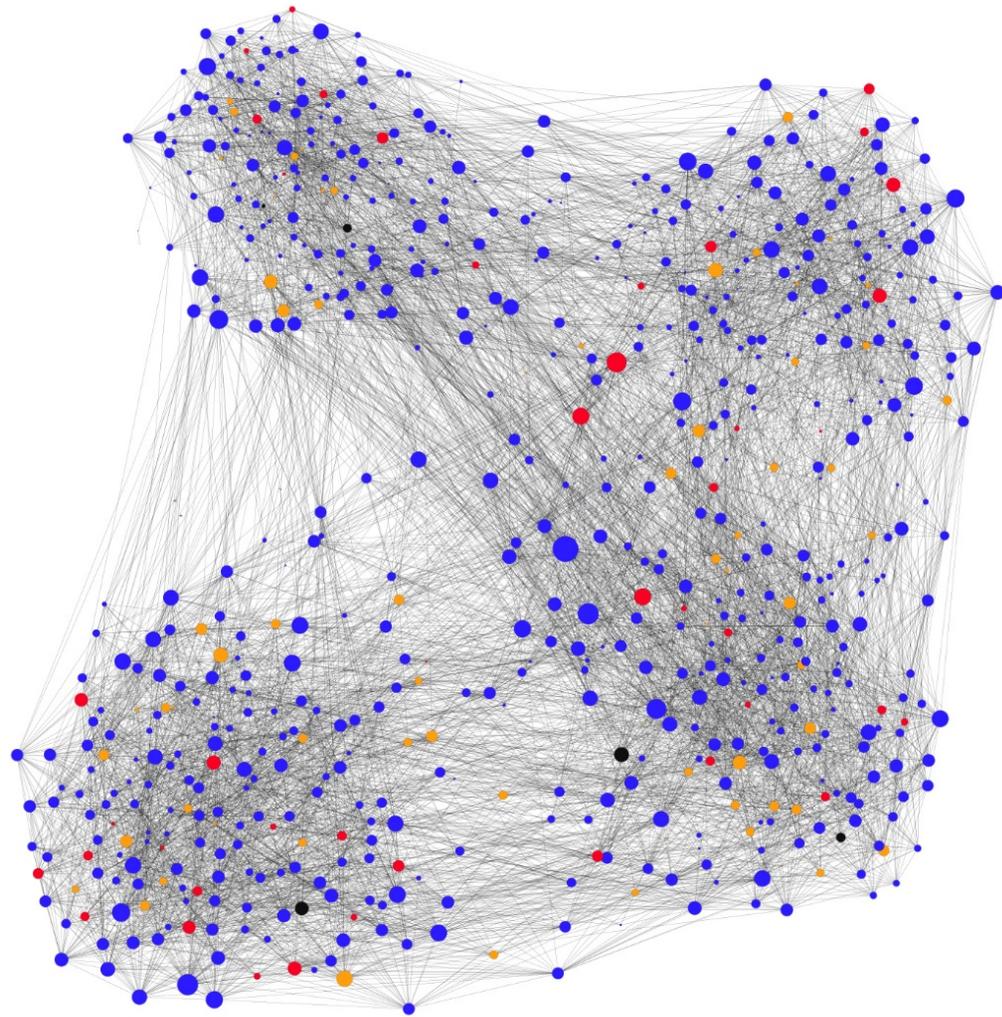




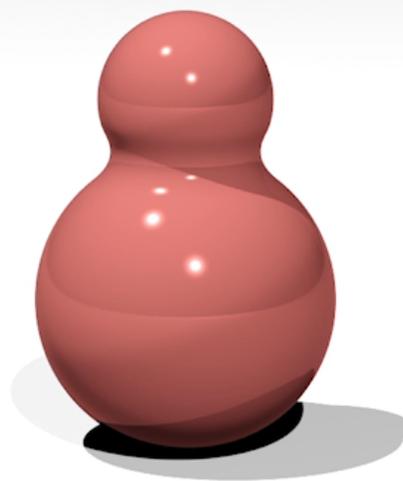


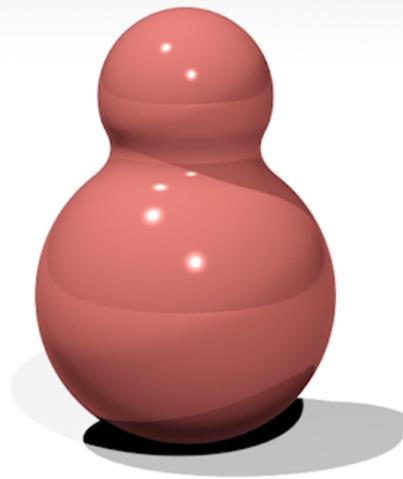


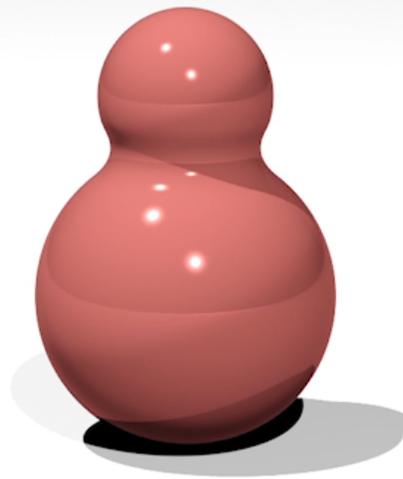


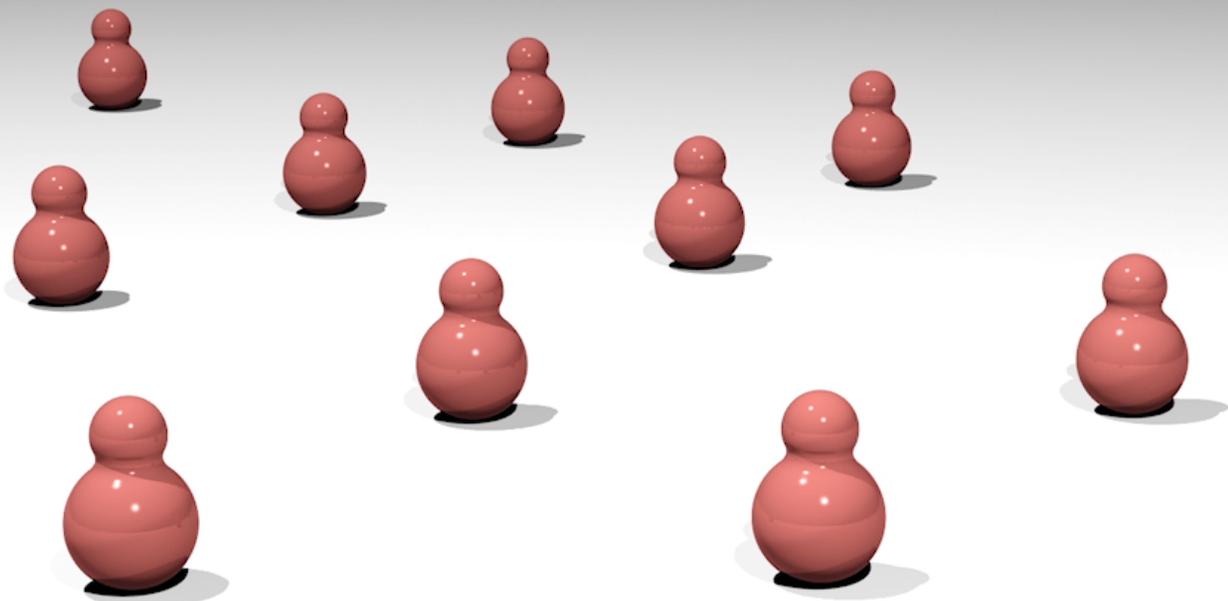


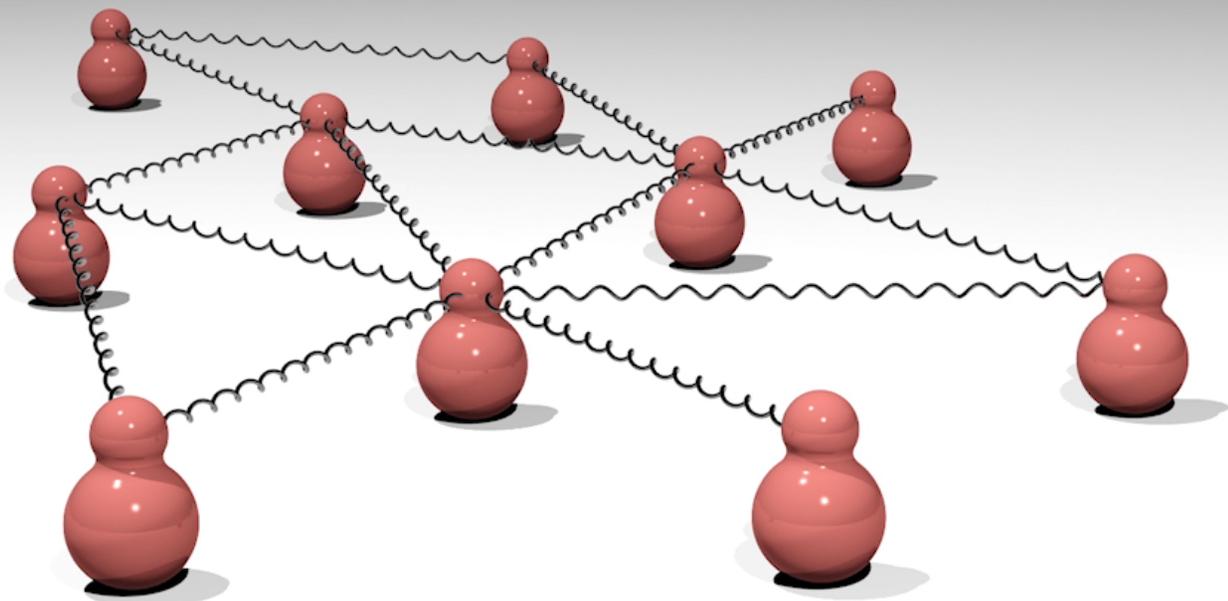


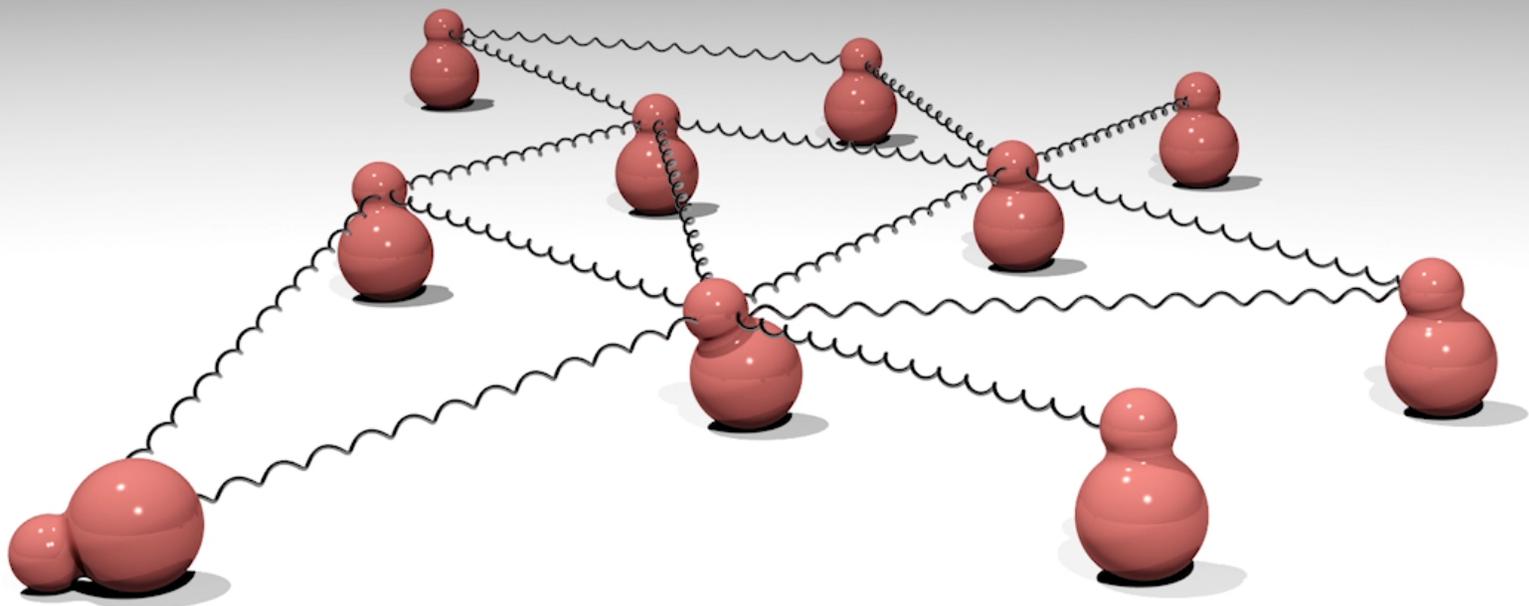


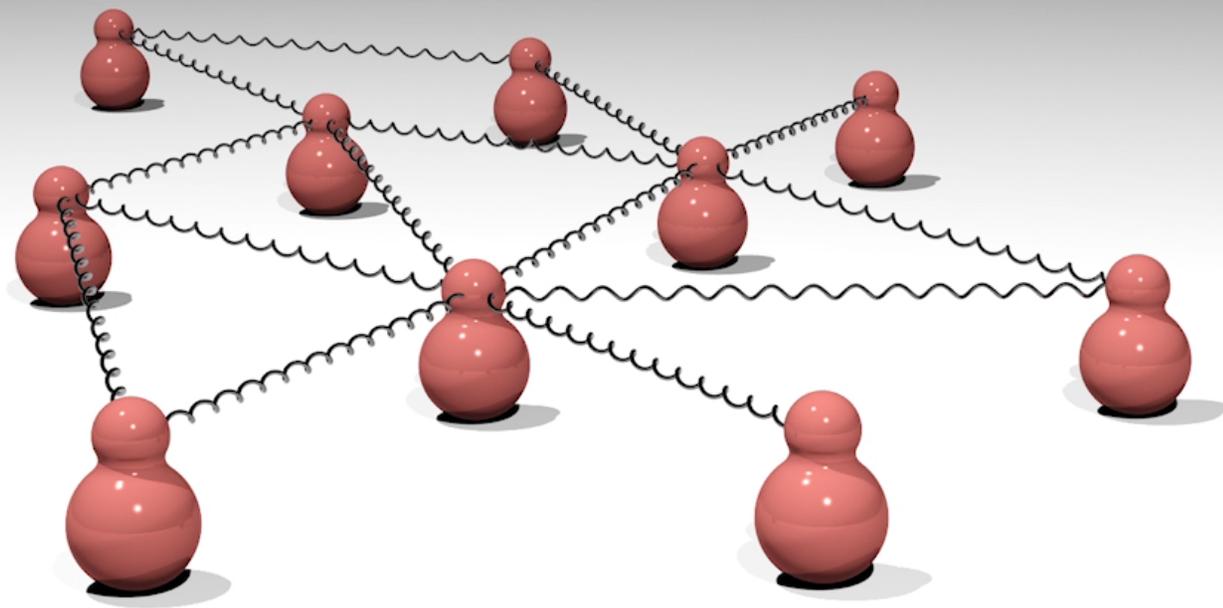


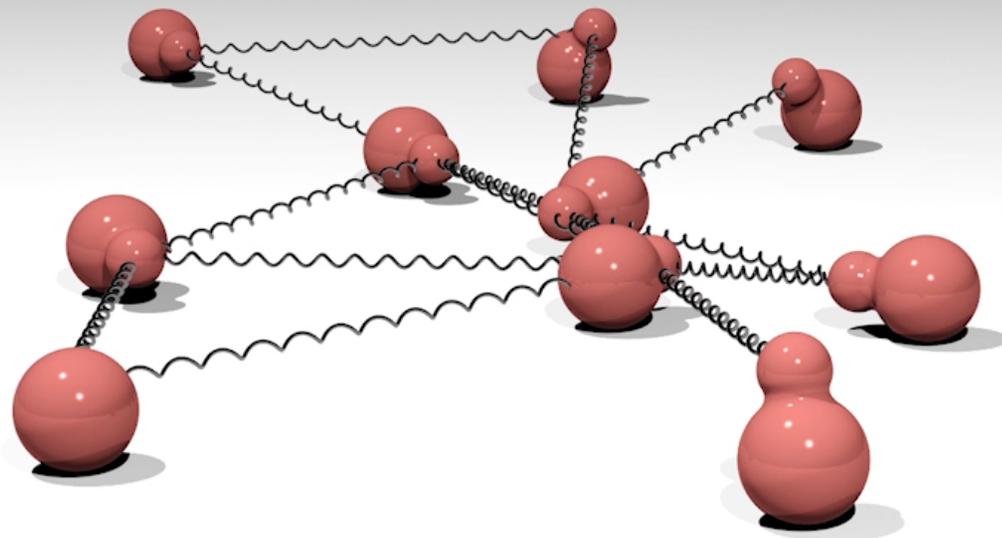




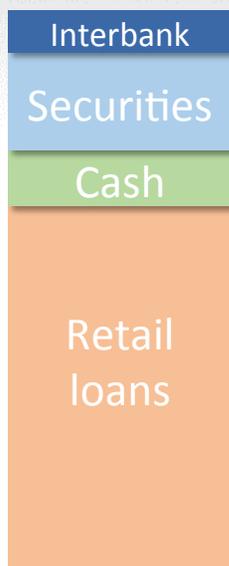








## Assets

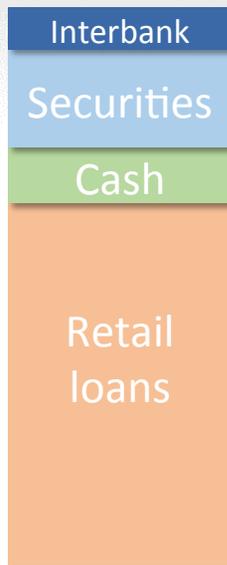


## Liabilities



Model

## Assets

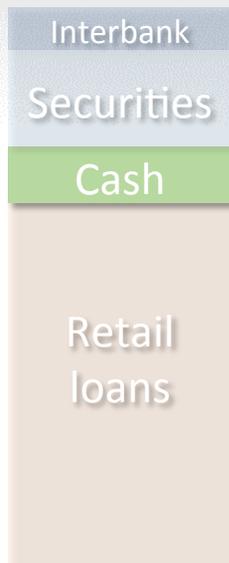


## Liabilities



Model

## Assets



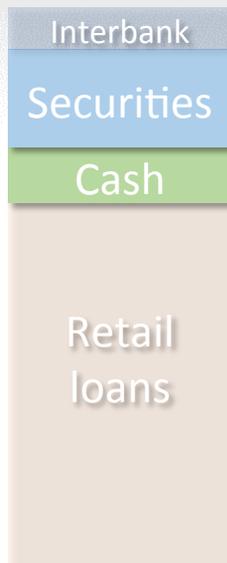
## Liabilities



## Reserve requirement

Cash/Deposits > 3.5%

## Assets



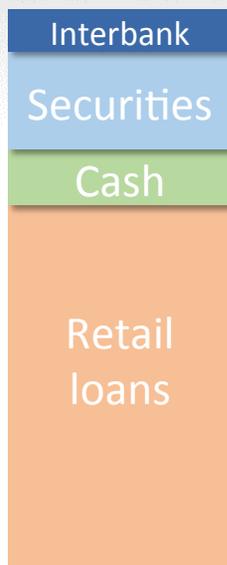
## Liabilities



## Liquidity Ratio

$$(Cash+Securities)/(0.3 \text{ Deposits}) > 1$$

## Assets



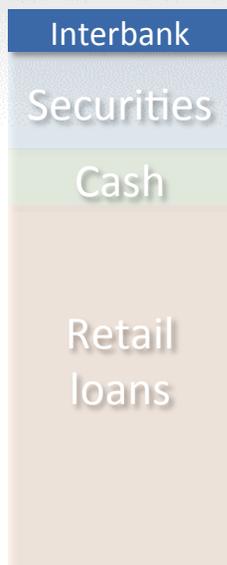
## Liabilities



## Leverage Ratio

$\text{Capital/Assets} > 5\%$

## Assets



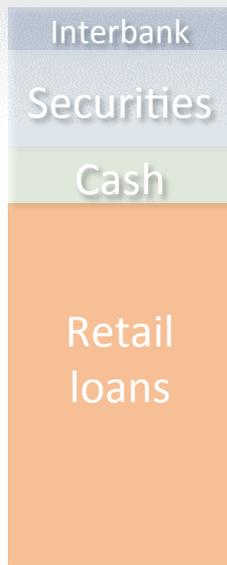
## Liabilities



## Big Exposure limit

$\text{Interbank Assets} / \text{Capital} < 25\%$

## Assets



## Liabilities



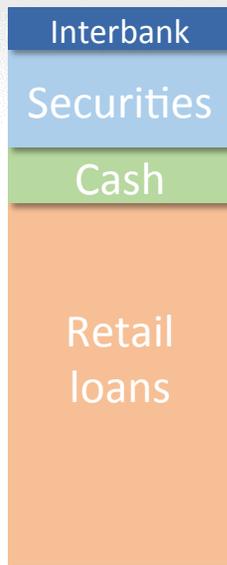
## Capital Adequacy Ratio

Capital/Retail loans > 8%

# Bank's possible actions

(one day timescale)

## Assets



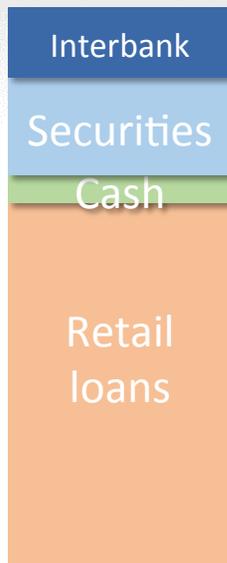
## Liabilities



# Interbank lending

(Liquidity Ratio↓, Capital Adequacy Ratio↓)

## Assets



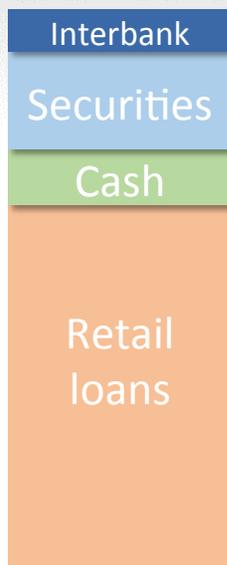
## Liabilities



# Interbank lending

(Liquidity Ratio↓, Capital Adequacy Ratio↓)

## Assets

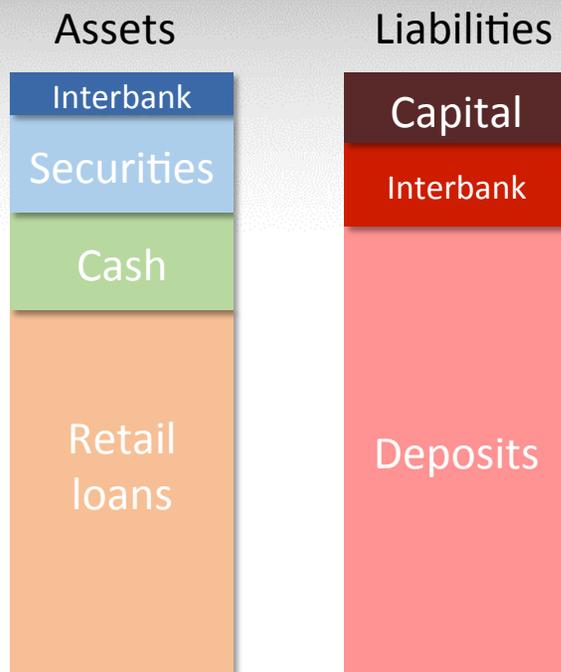


## Liabilities



# Interbank borrowing

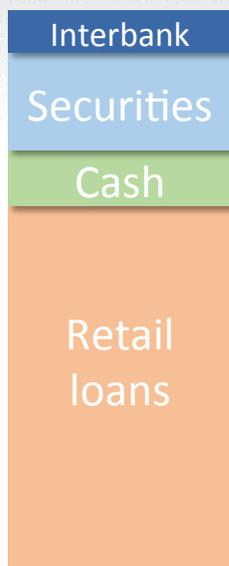
(Liquidity Ratio  $\uparrow$ , Leverage Ratio  $\downarrow$ )



## Interbank borrowing

(Liquidity Ratio↑, Leverage Ratio↓)

## Assets

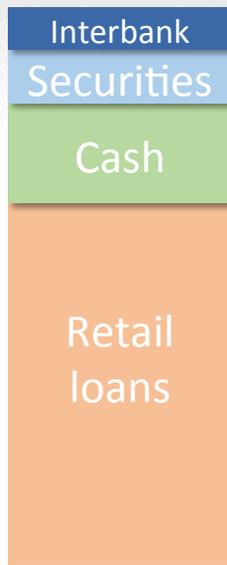


## Liabilities



**Selling securities**

## Assets



## Liabilities



**Selling securities**

## Assets

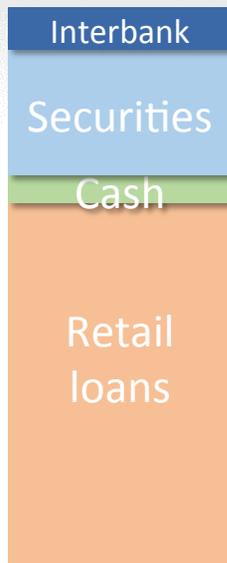


## Liabilities



**Buying securities**

## Assets

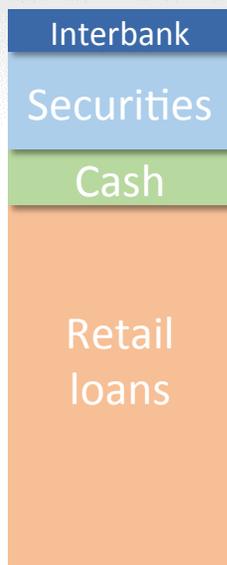


## Liabilities



**Buying securities**

## Assets



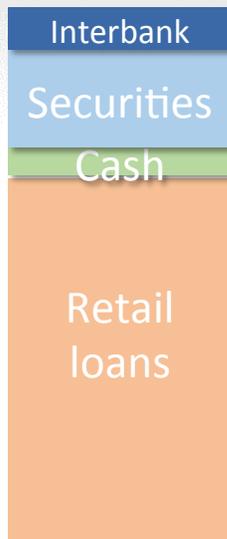
## Liabilities



# Repurchase of issued bonds, „repayment of deposits”

(Liquidity Ratio↓, Leverage Ratio↑)

## Assets



## Liabilities



# Repurchase of issued bonds, „repayment of deposits”

(Liquidity Ratio↓, Leverage Ratio↑)

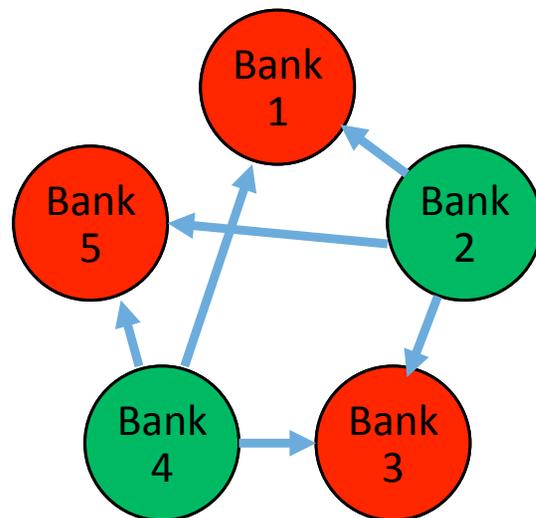
# Model of interbank lending market?

- Banks specify their cash supply and demand



# Model of interbank lending market?

- Loan between any two banks is possible (first model)
- Total O/N loans amount =  $\min(\text{total supply}, \text{total demand})$
- Loans are distributed evenly



# Model of securities market?

- Banks specify their securities supply and demand



$$\Delta p/p = \eta (\sum \text{demand} - \sum \text{supply})$$

- $\eta$  - selling of 10% of all banks securities changes the price by 5%

## Day's scenario

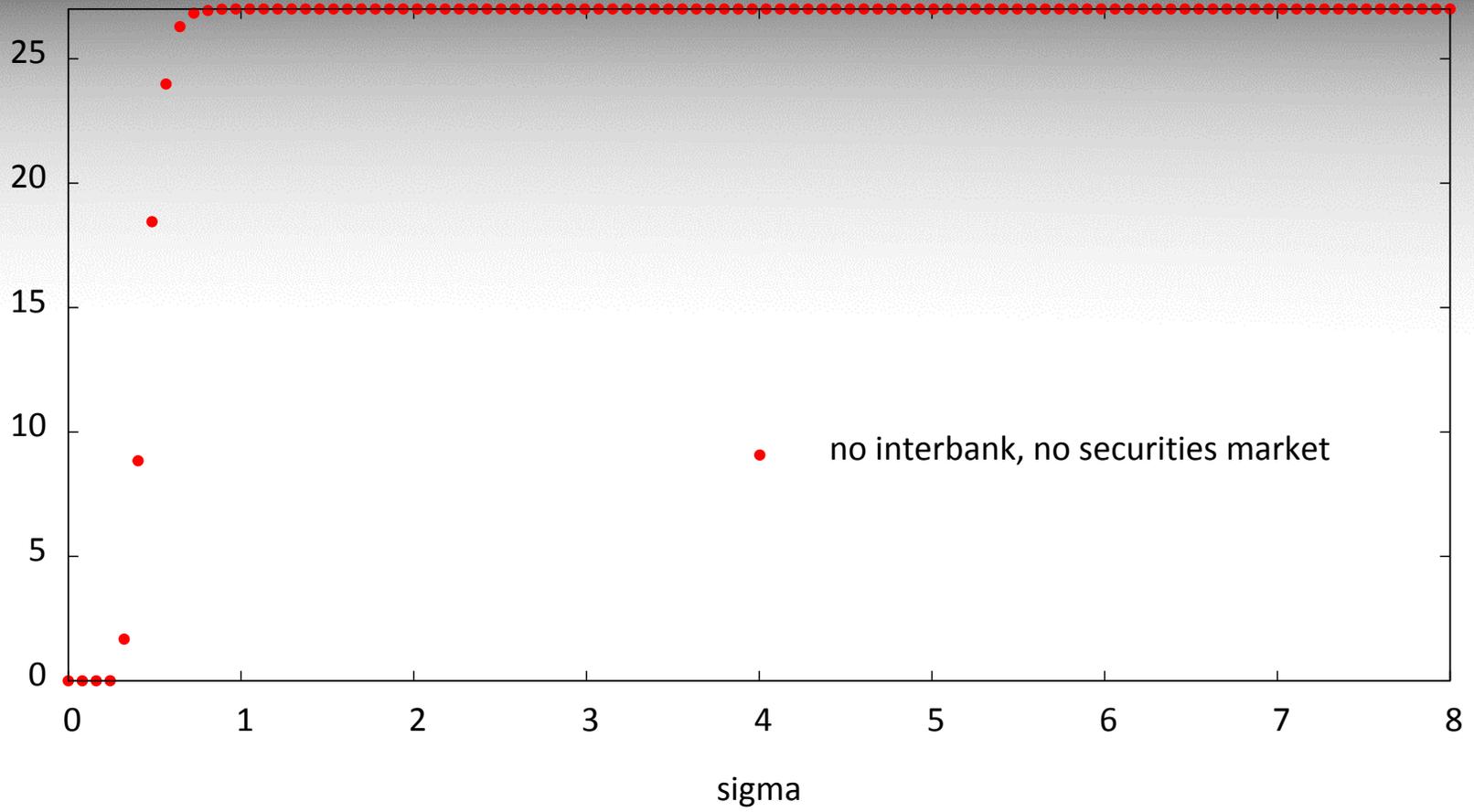
- Repayment of yesterday's O/N loans
- Change of the cash amount by

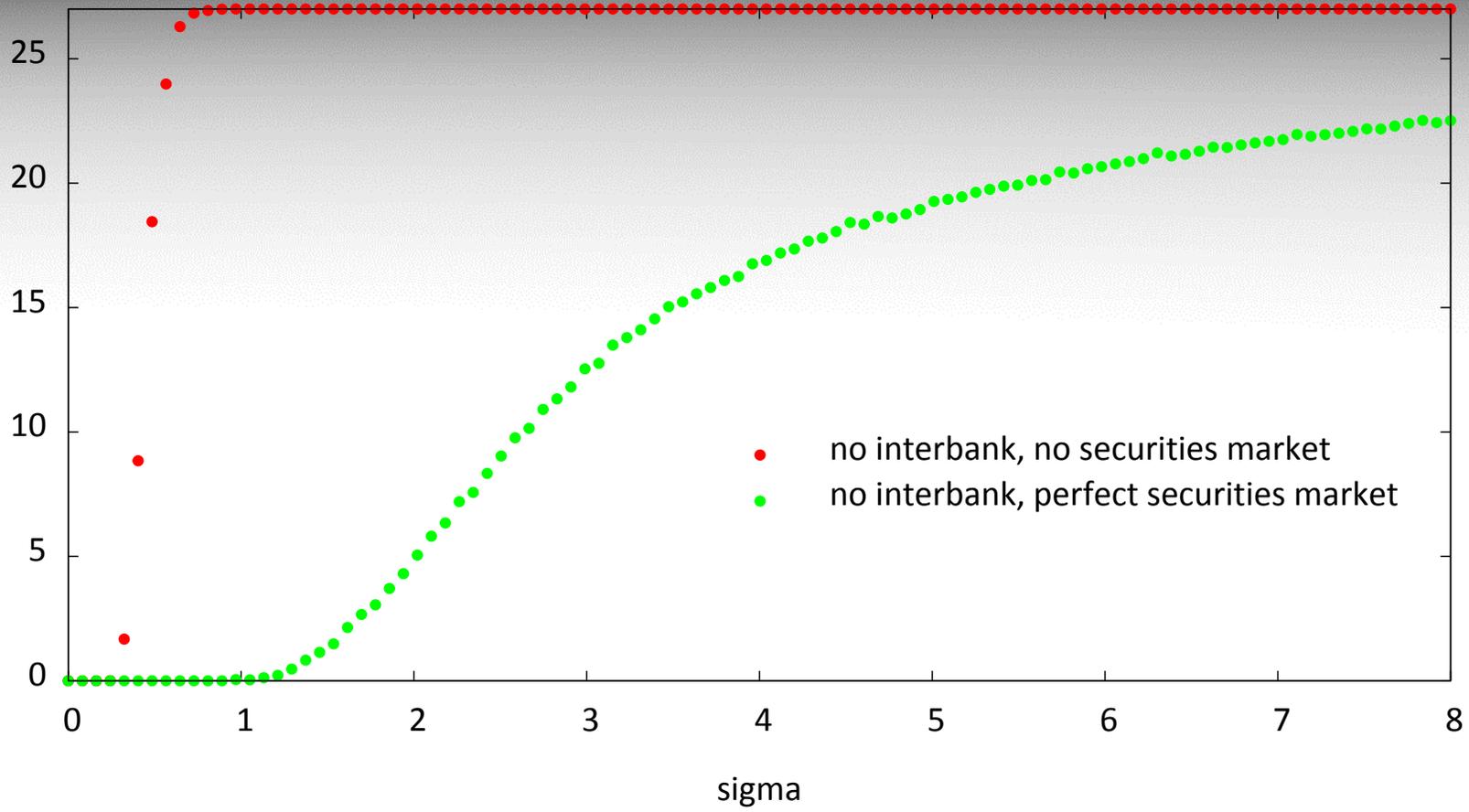
$$(\text{initial cash amount}) * \sigma * N(0,1)$$

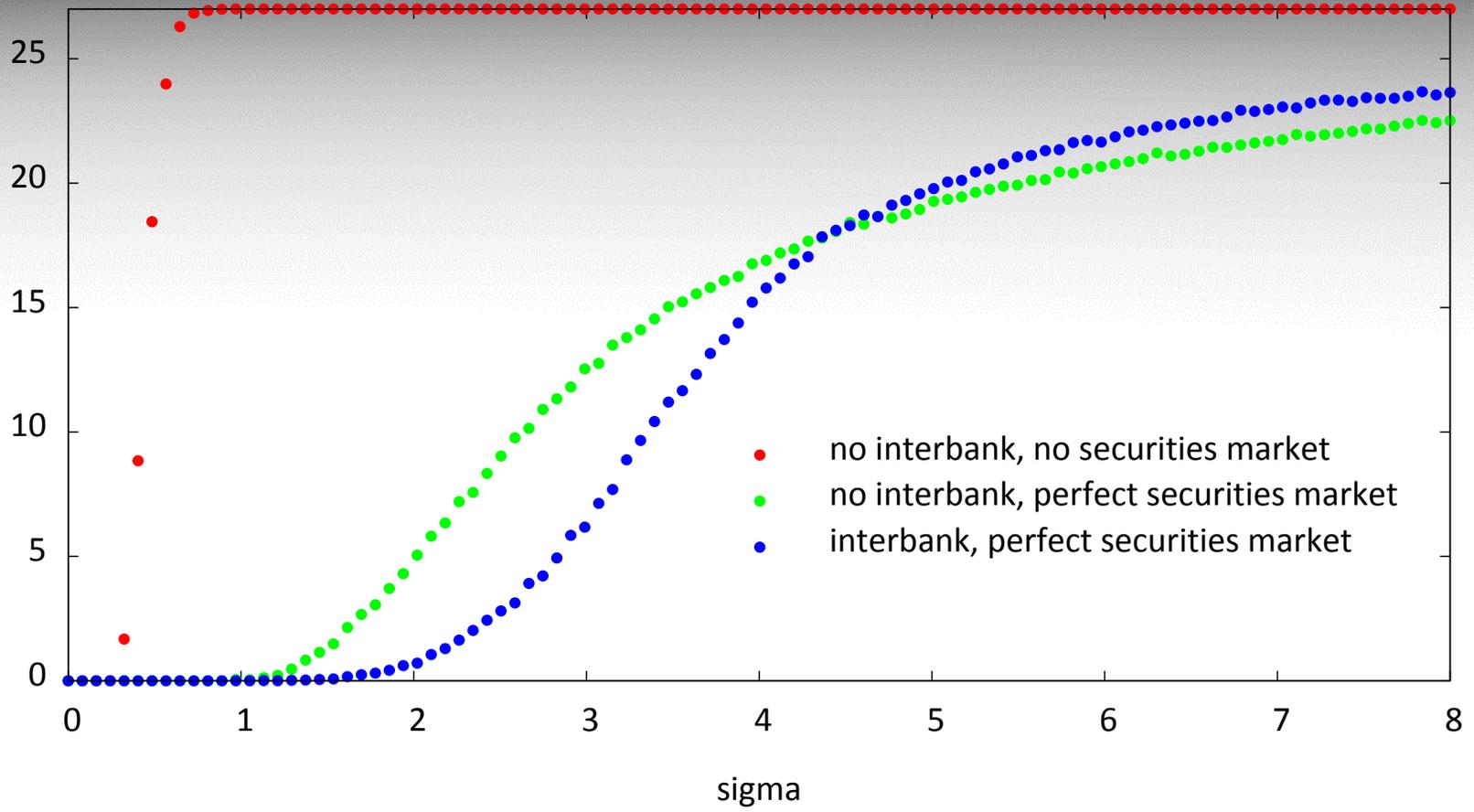
for the period of one day

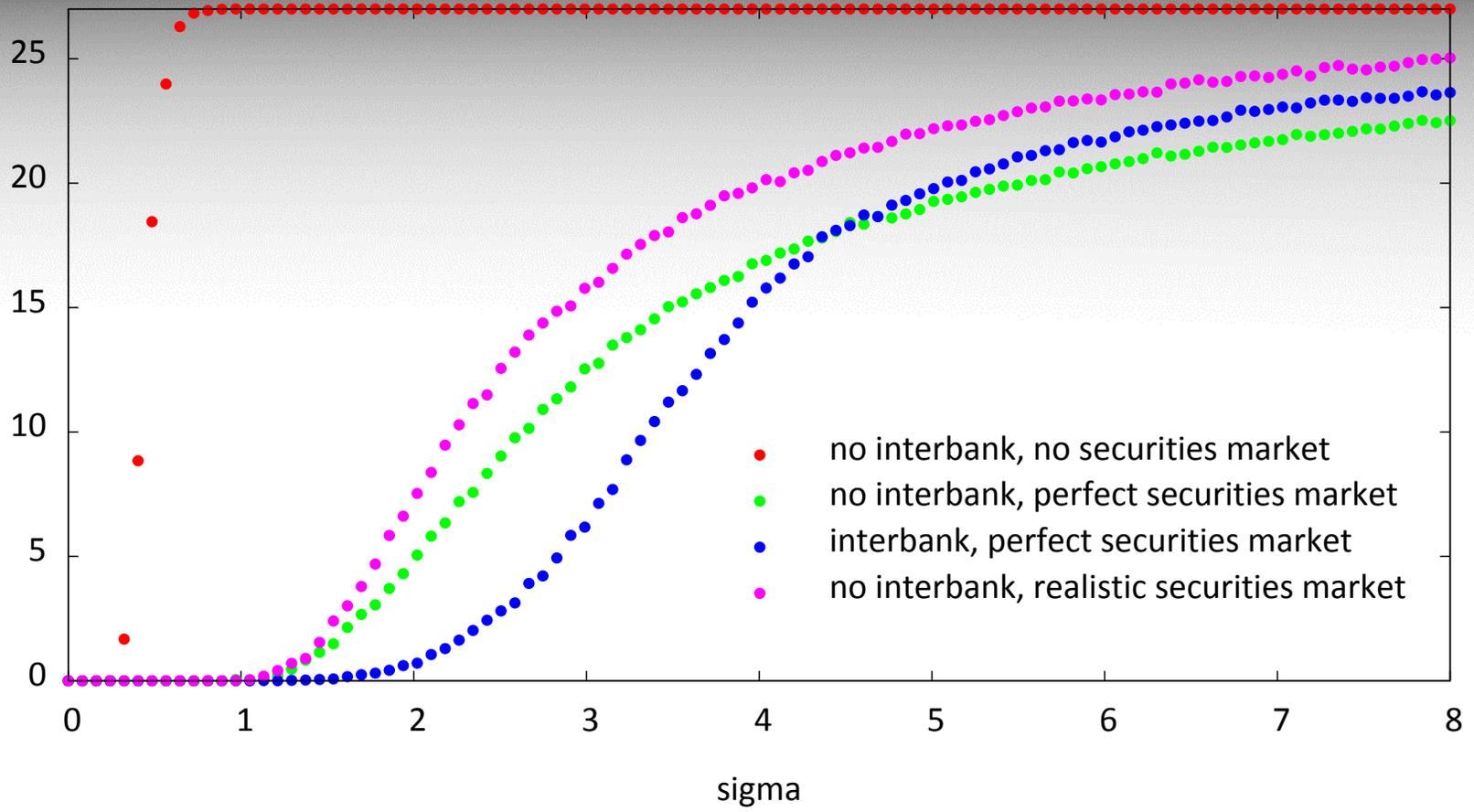
- Interbank loans market
- Securities market
- Default if Cash < 0

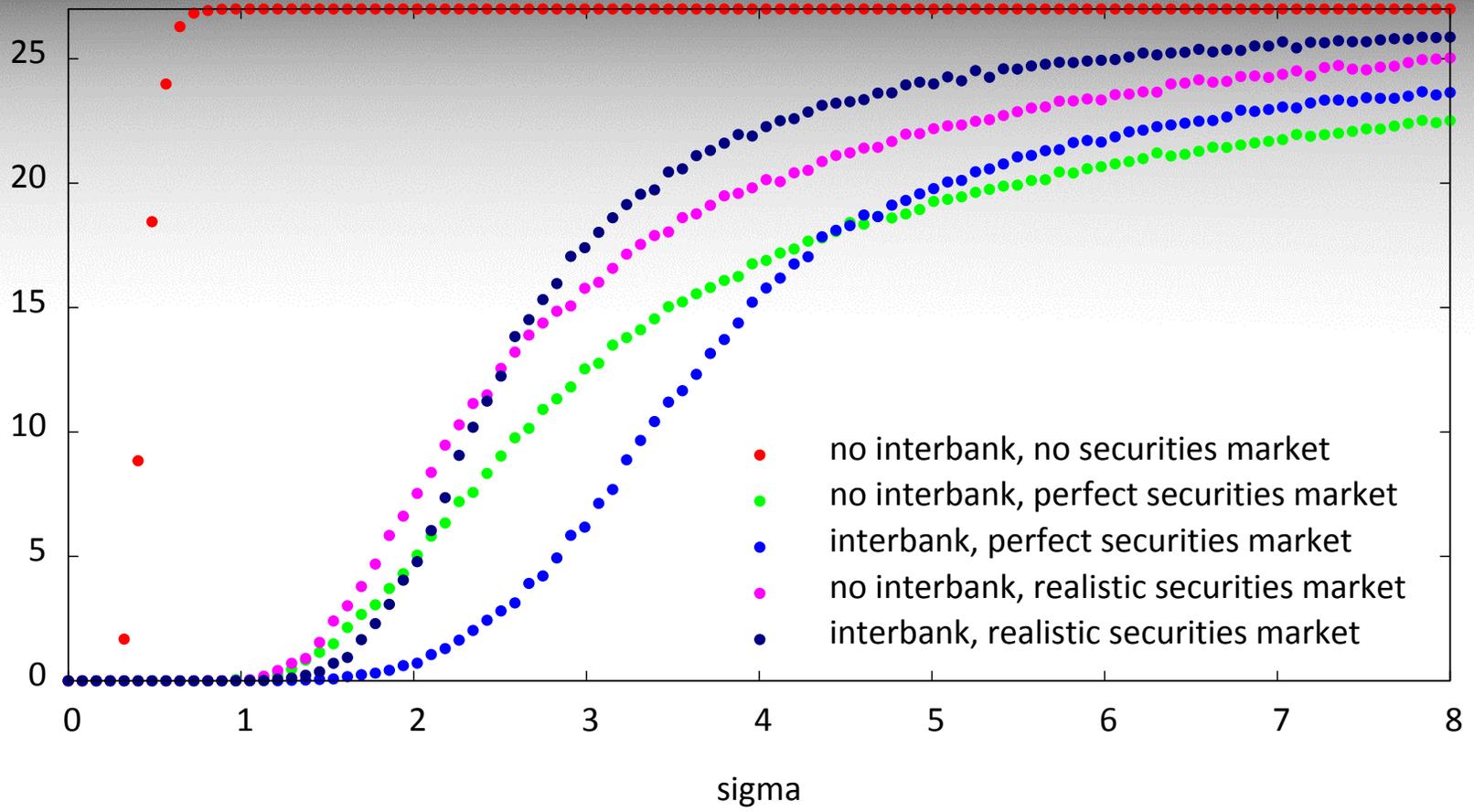
60 days simulation











Thank you!