Simulations using historical data

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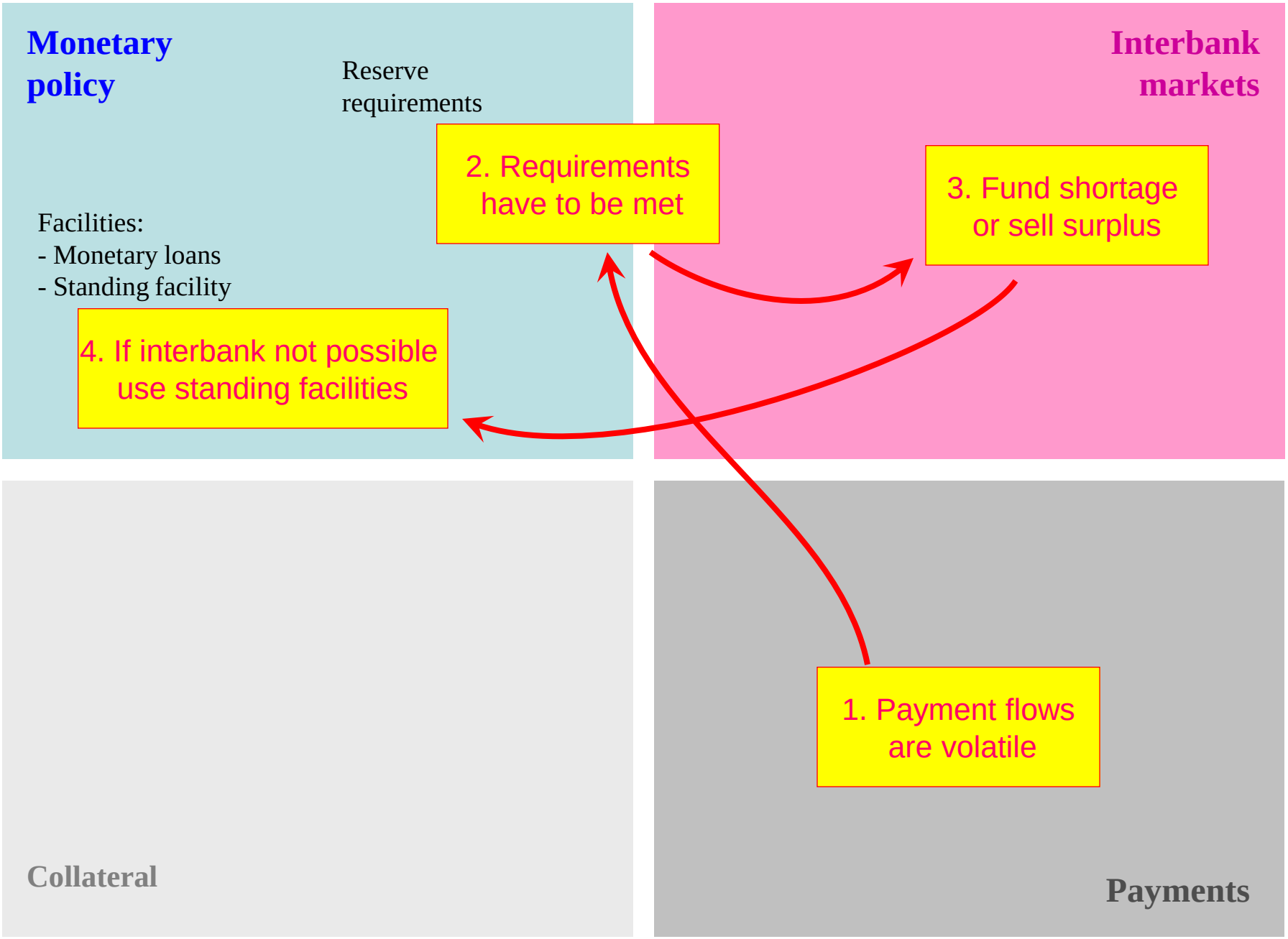
Outline

- Objective
- Examples of simulations
- Behavioural rules
- Reduction number of transactions
- How to
- Conclusions
- Future work

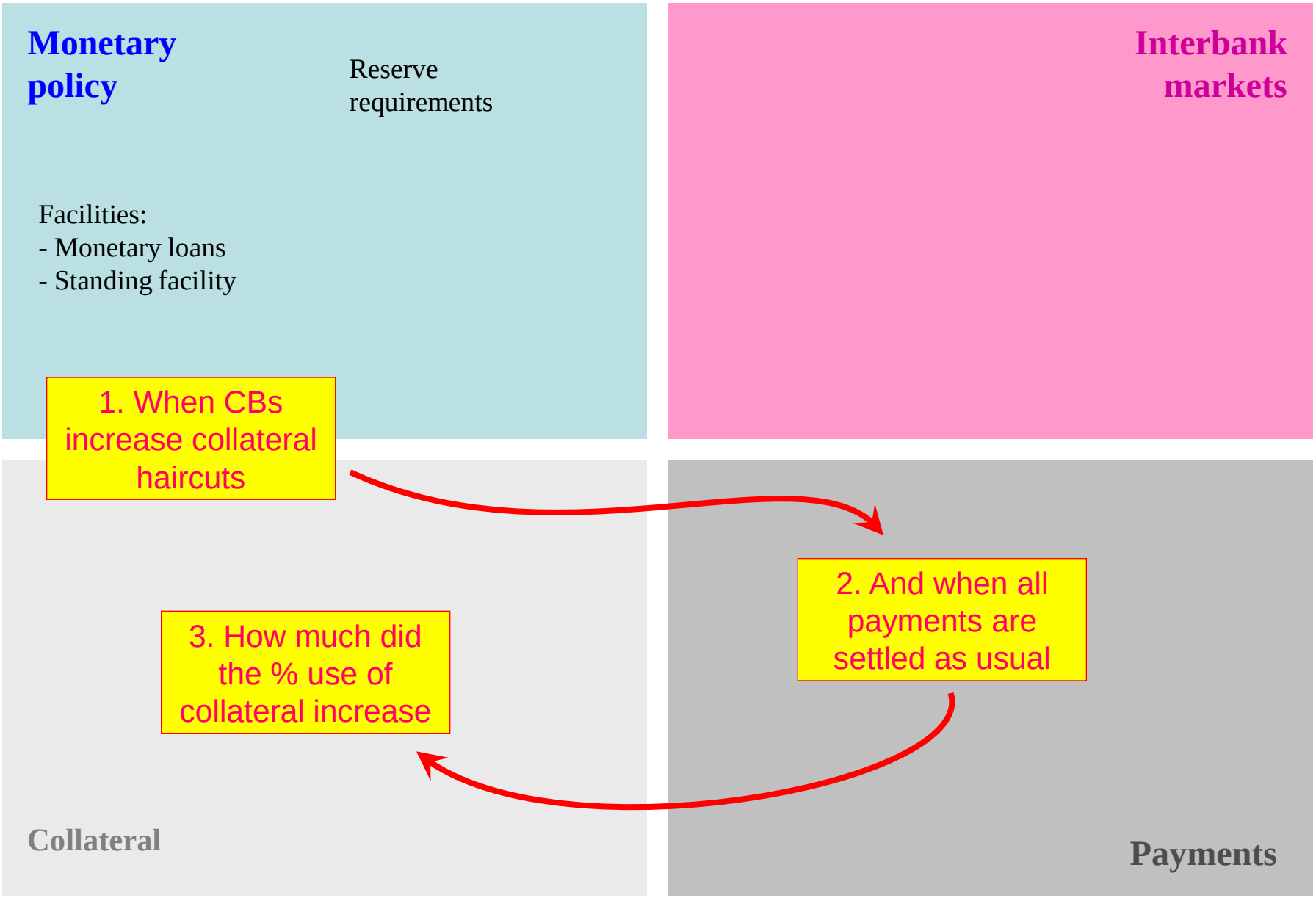
Objective

- How can simulations be improved using historical data?
- How to include behavioural aspects?
- How to deal with very large data sets?
  - statistically correct simulations

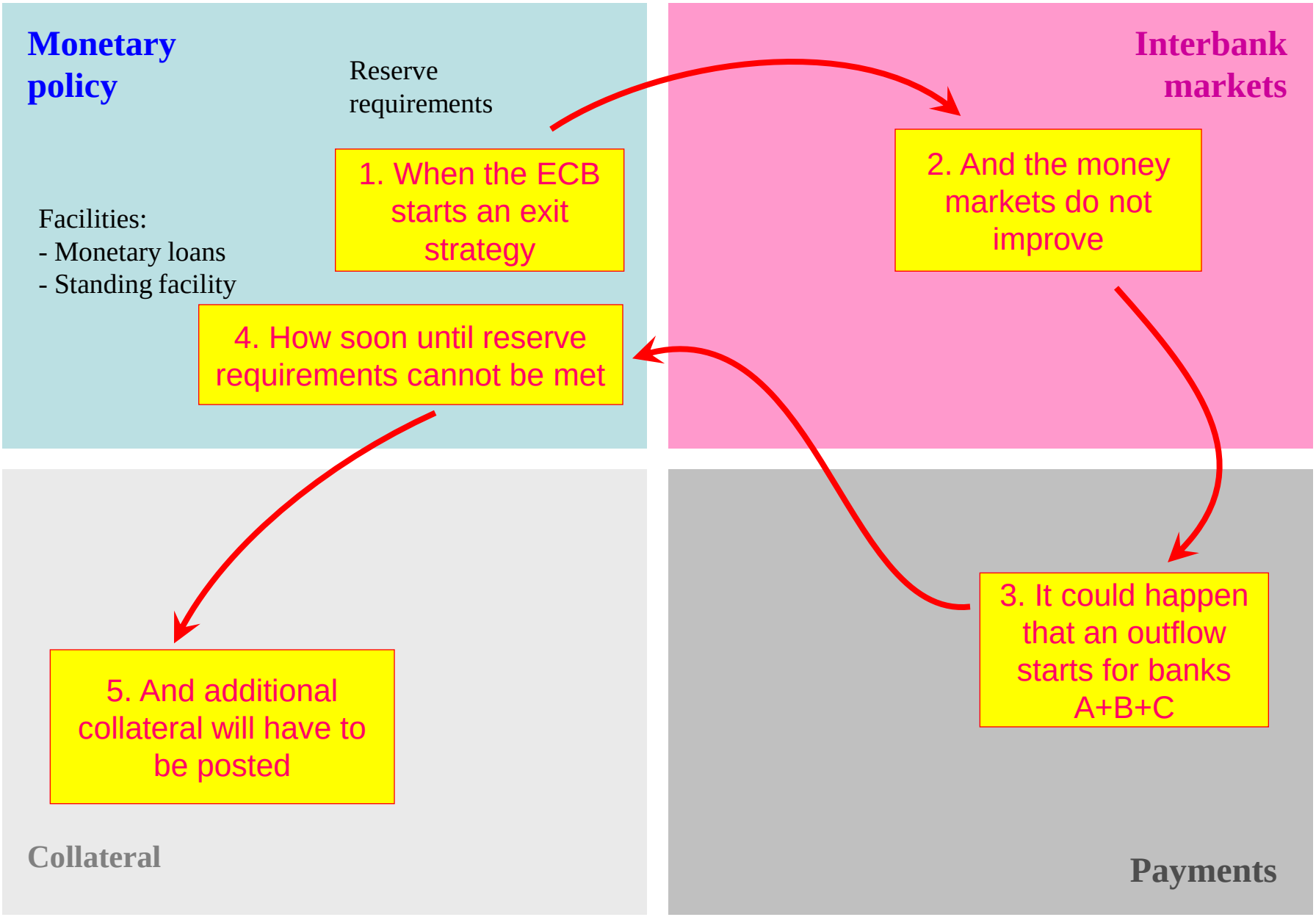
Liquidity elements in an LVPS



Example 1: When a CB increases collateral haircuts?



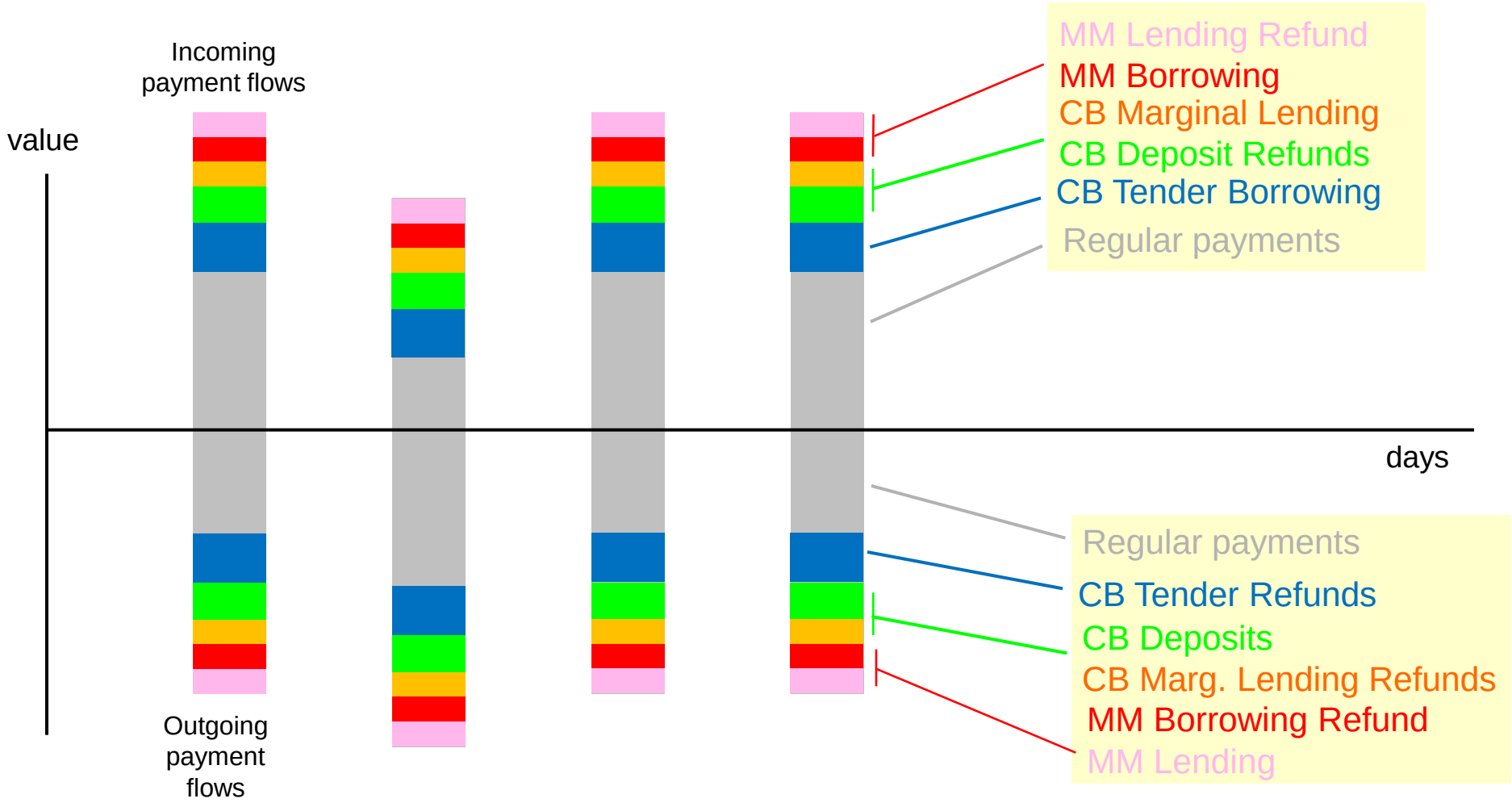
Example 2: CB starts exit strategy (monetary policy)?



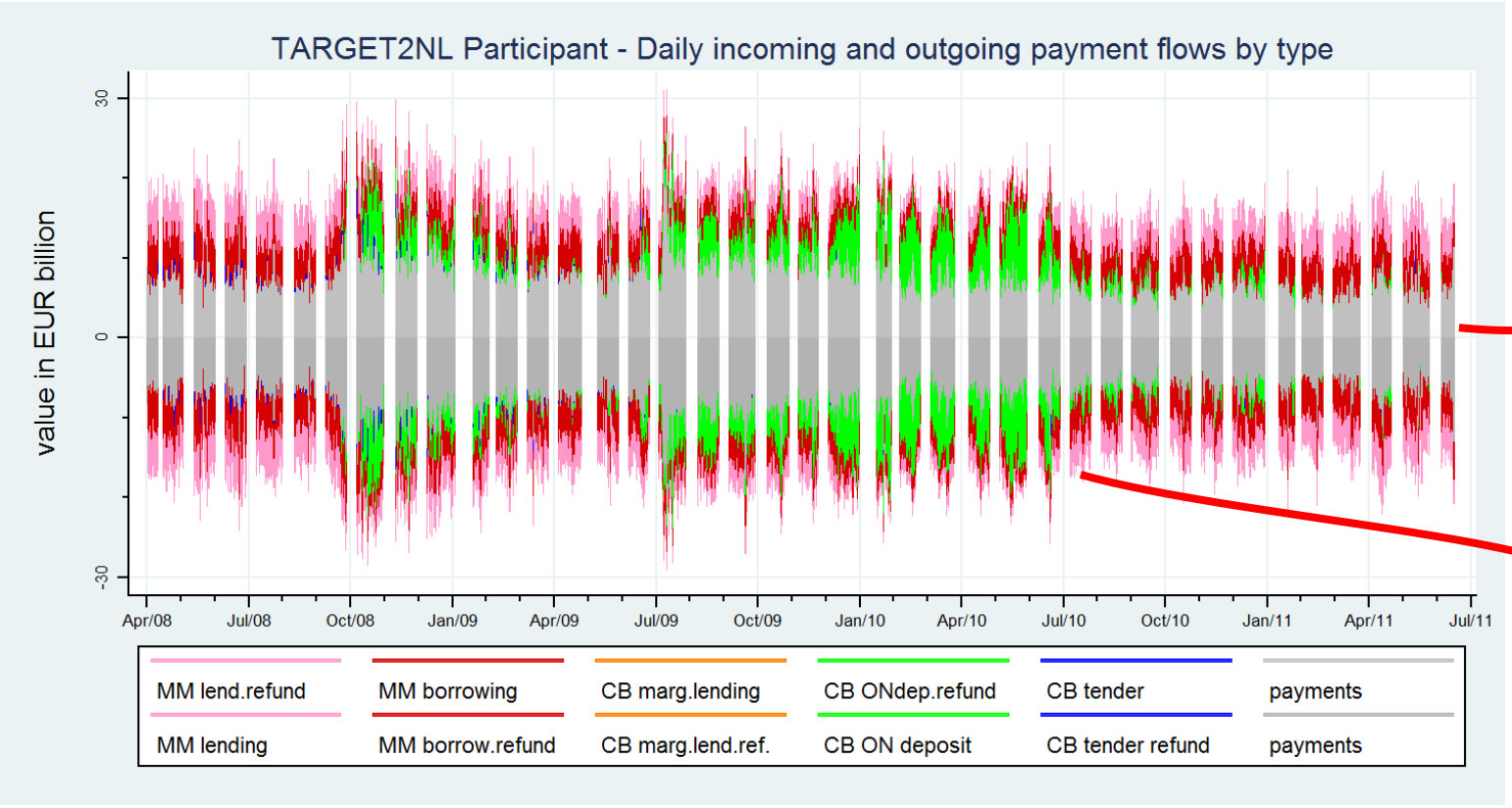
Preparation of the data: cleaning (1/3)

1. Cleaning of historical transaction data from interbank loans, monetary policy transactions, marginal lending and ECB overnight deposit.

Preparation of the data: cleaning (2/3)



Preparation of the data: cleaning (3/3)



Regular payments is only a small portion

Liquidity payments depend on end-of-day prognosis

When in a simulation the end-of-day balance would be different from realisation in the past, this would lead to different liquidity payments

Preparation of the data: behavioural rules (1/2)

1. Data cleanup (liquidity transactions)
2. Changing access to tenders and/or amount of cash reserve requirements depending on the central bank's role in the scenario.
3. Changing the amount a bank can borrow in the interbank money market depending on the level of trust in this bank.
4. Setting bilateral limits depending on the bank’s type.
5. Increasing the outgoing payments' amount when the stress with respect to a bank continues.
6. Dividing payment transactions into priorities, e.g.: 1) very time-critical, 2) time-critical 3) other payment transactions.

Preparation of the data: behavioural rules (2/2)

7. Changing the outgoing payments' timing.
8. Decreasing the collateral to be used for intraday credit and tenders, when the stress scenario aims to simulate severe on-going problems.
9. Decreasing the collateral in response to reduced eligibility and/or increased haircuts of collateral.

Applying the preparational/behaviour rules to different simulation types

	1 Data cleanup	2 Access monetary policy	3 Access interbank market	4 Bilateral limits	5 Outflow of payments	6 Priority of payments	7 Timing of payments	8 Decrease collateral	9 Eligibility of collateral
1) Liquidity problems (individual bank)	*		*	*	*	*	*	*	*
2) Decreased trust in interbank money market	*	*	*				*		*
3) Operational disruption		*		*		*	*		
4) Your simulation	-	-	-	-	-	-	-	-	-

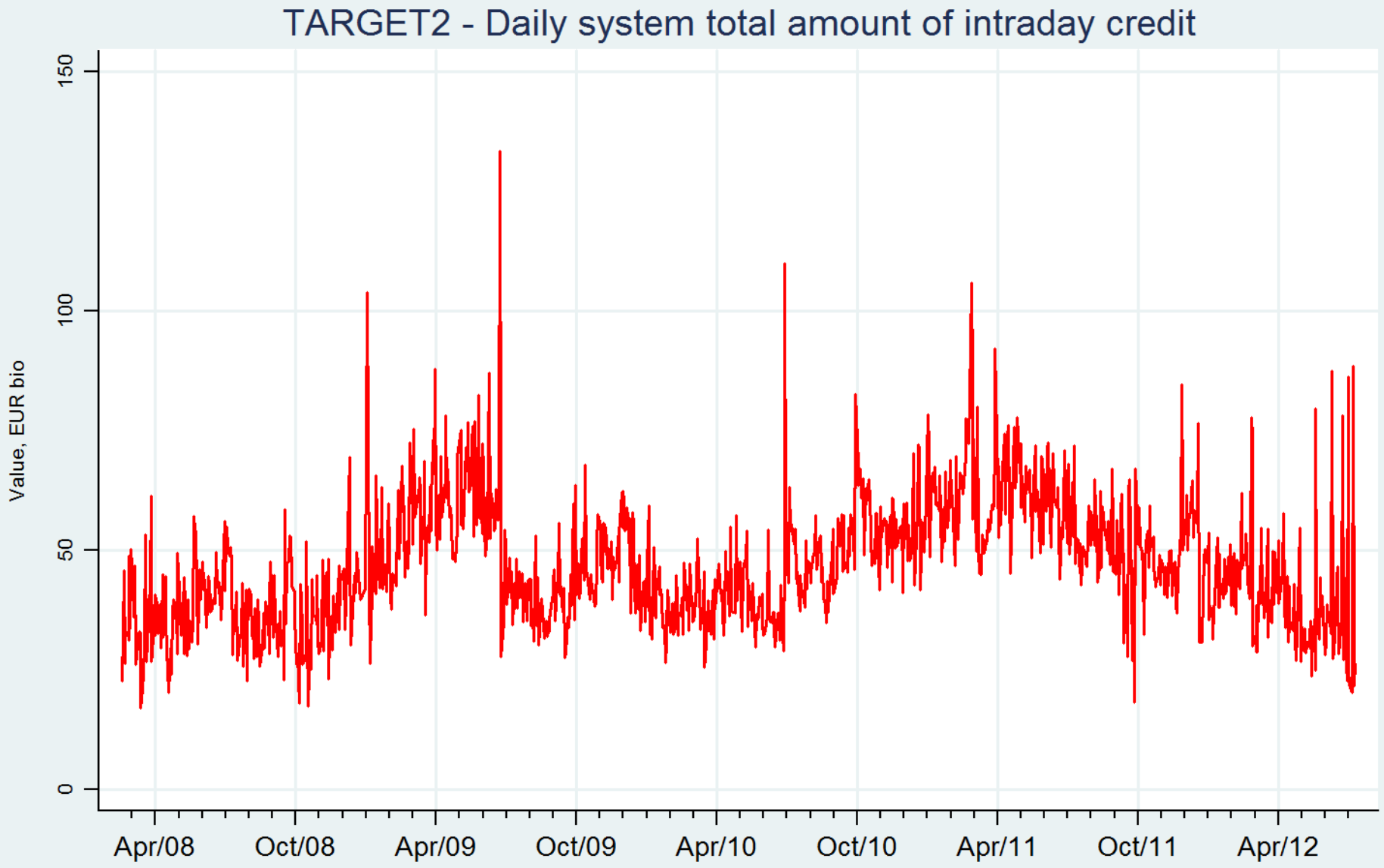
Liquidity problems (individual bank)

1. Interbank loans have to be filtered to calculate new liquidity position
2. ..
3. Determine amount a bank can borrow in interbank money market
4. Set bilateral limits to/from bank if trust in bank decreases
5. In case customer start distrusting bank increase customer payments
6. Set/change priorities to different payment types
7. Change (decrease) payment timing
8. Ongoing trouble: decrease collateral for IDC
9. CB: increase haircuts on collateral

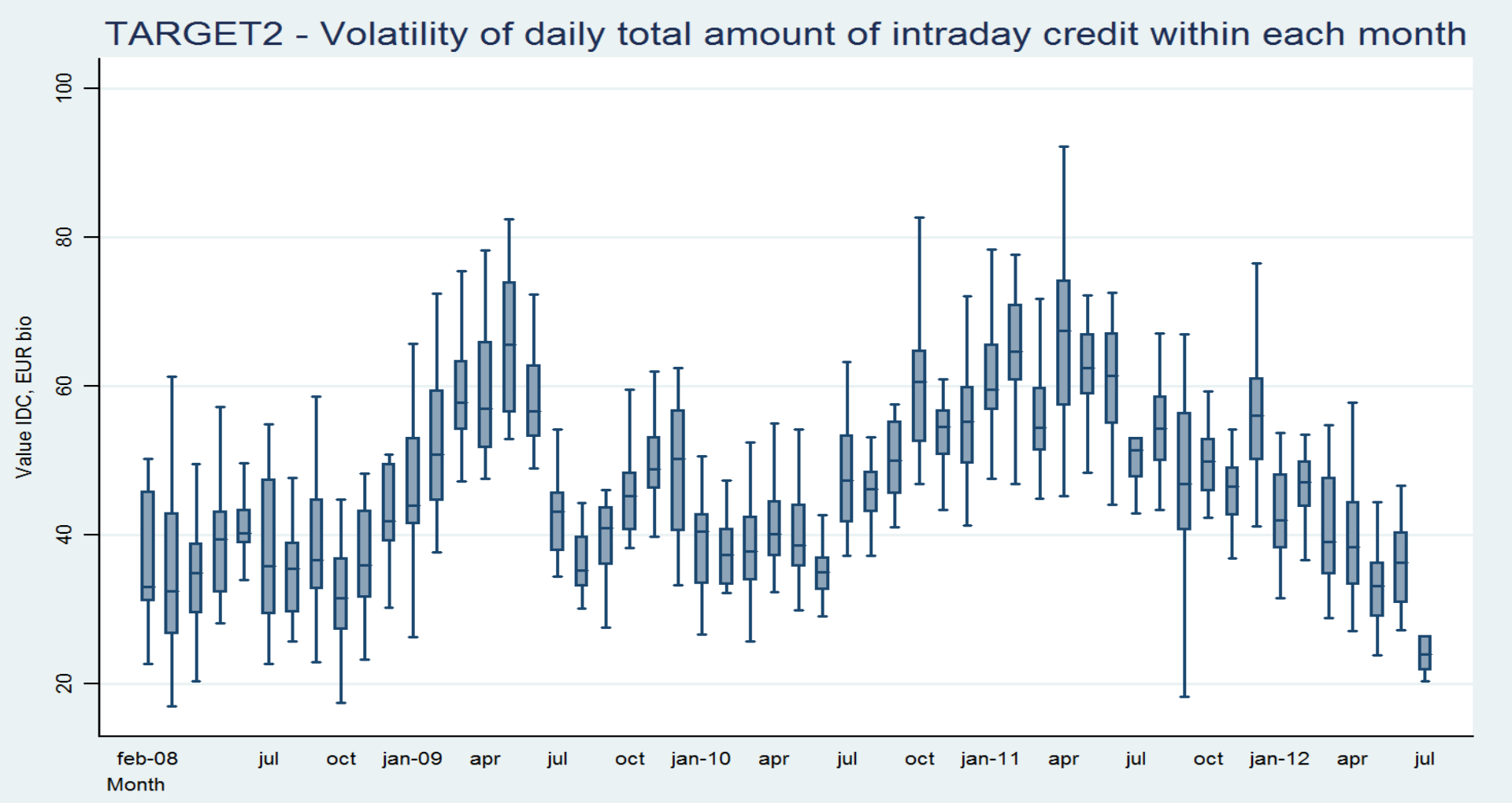
Reduction number of transactions

- How many business is required for simulation (Time span)?
- Is it possible to handle this amount of data?

Time span of simulation (1)
Most commonly used: 1 month



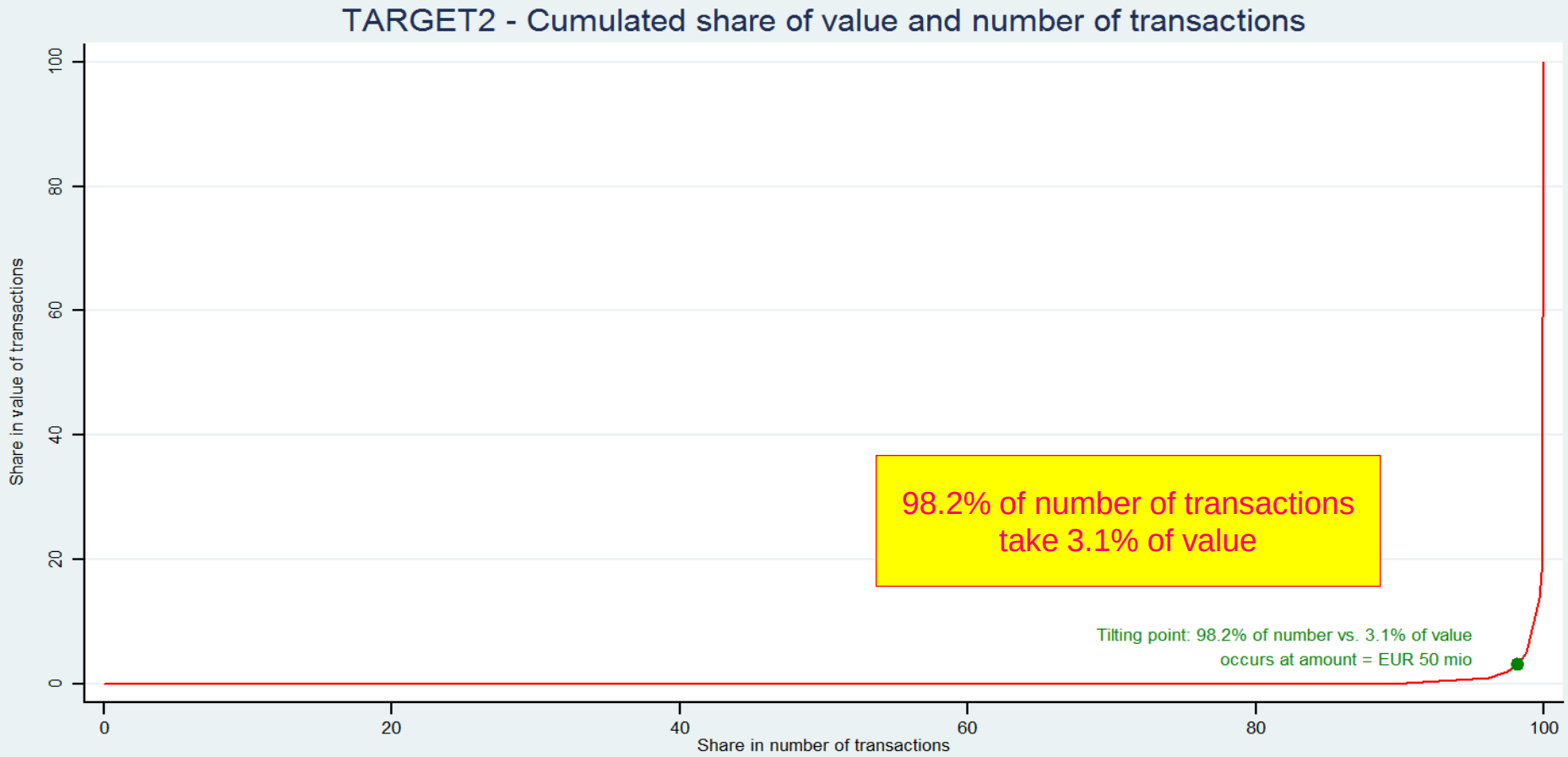
Time span of simulation (2)
TARGET2 monthly data on intraday credit



Each month present does not cover all possible liquidity scenarios

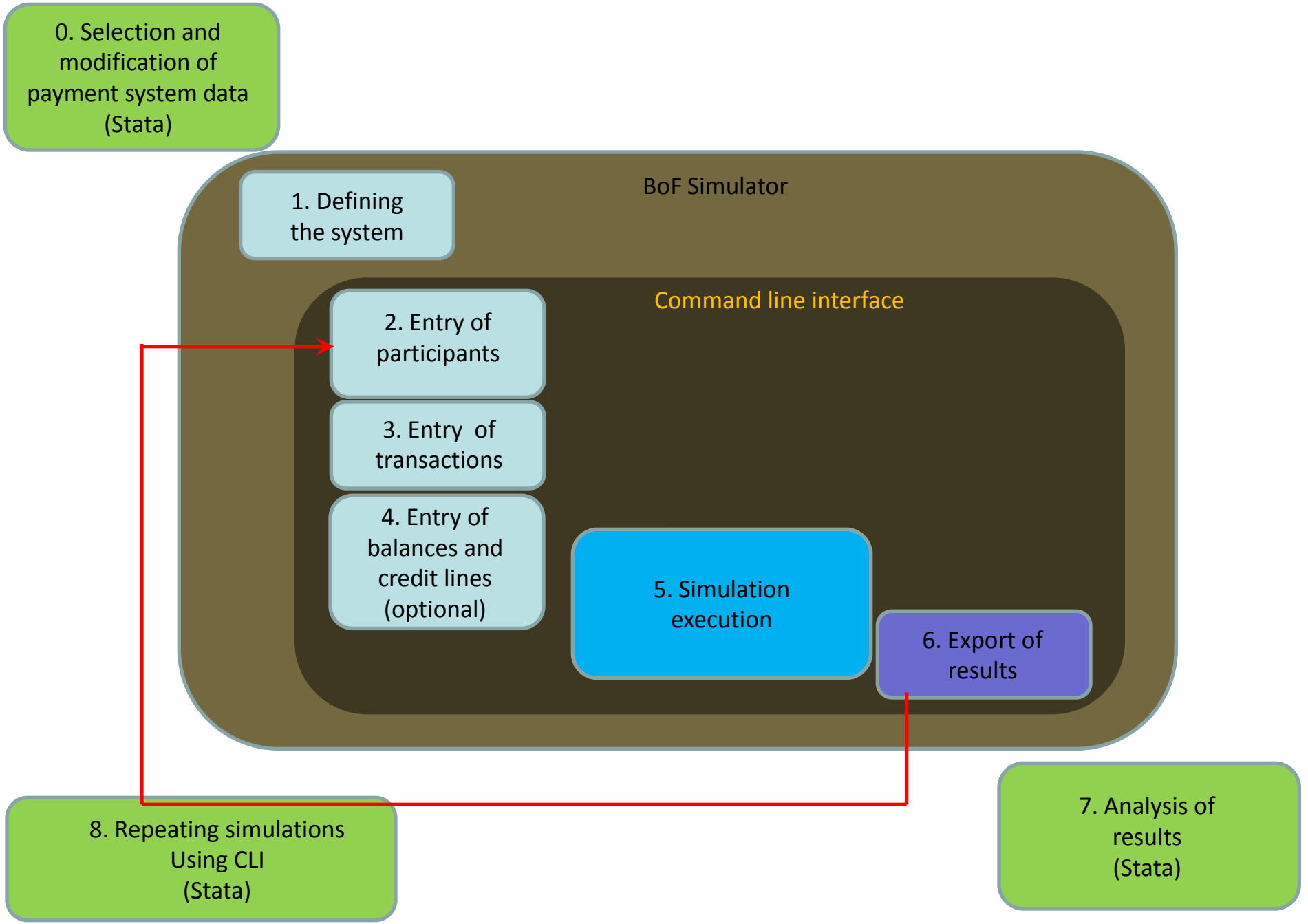
Therefore: the desire to increase the time span to 6 months or longer

Time span of simulation (3)
Number of transactions within a simulation

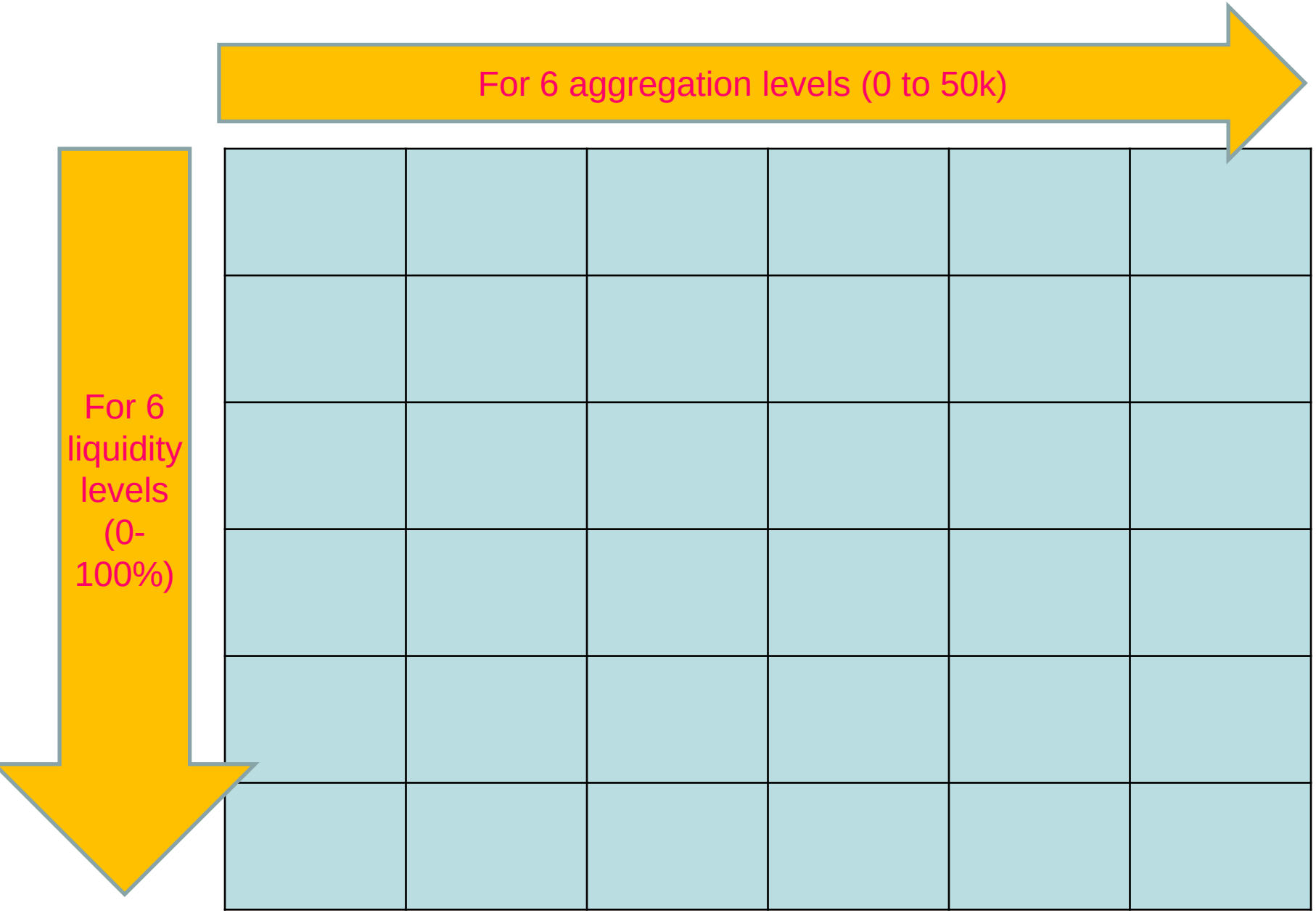


Most probably the number of transactions can be decreased,
by aggregating small value payments, without disturbing the liquidity outcome

(How to) Actions and Simulator components when performing simulations



(how to) Repeating simulations using CLI from within Stata (1)



(how to) Repeating simulations using CLI from within Stata (2)

Aggregation level

Liquidity level within aggr. level

First results are promising:

When aggregation transactions

below EUR 50k

no differences occur

compared to original situation

at any liquidity level

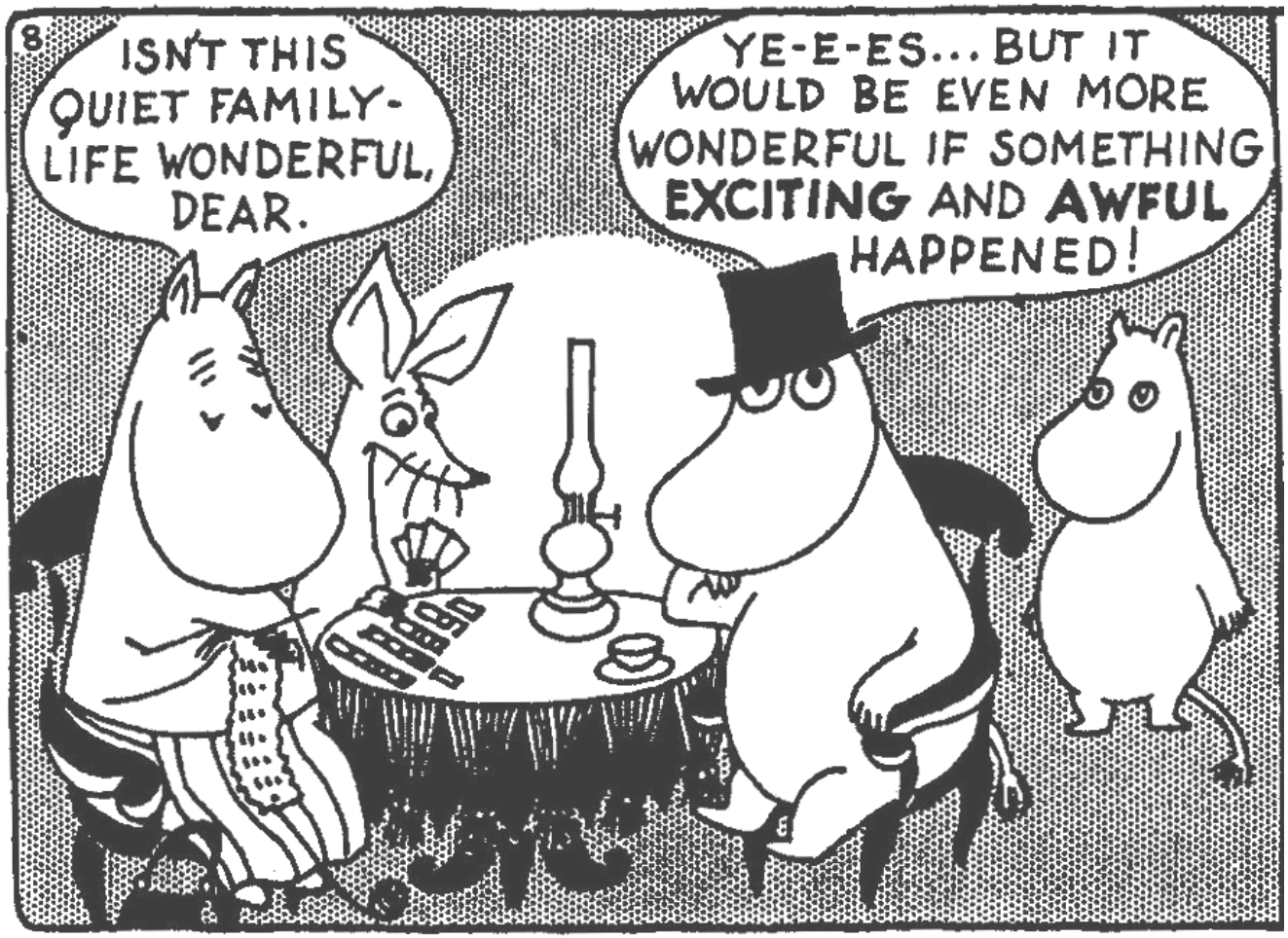
Aggregating transactions between participants up to 50k shrinks the number of transactions to 7%

Conclusions

- Simulations may require cleaning of data (depending on simulation type).
- Include behavioural aspects: Banks do react to a shock.
- Statistical correctness of simulation requires at least 6 months of (historical) data:
  - Aggregating transactions shows promising results.
  - Command Line Interface of Simulator saves time.

Future work

- Finding maximum aggregation level
- Creation and entry of money market transactions within simulations (requires a money market model)
- Improve behavioural patterns



Thanks for your attention
Kiitos huomiosta

Relevant literature

- Furfine (1999): Financial Markets, Institutions and Instruments, 8:24–44.
  - developed an algorithm to filter interbank loans from RTGS data.

- Heijmans, Heuver, Walraven (2010). DNB Working Paper 276.
  - improved Furfines algorithm and made it suitable for the (Dutch) euro market.

- Heijmans and Heuver (2011). DNB Working Paper 316.
  - identified behavioural aspects from Dutch RTGS data (TARGET2-NL)

- Heijmans and Heuver (2012), preparing simulations in Large Value Payment Systems using Historical Data.

  Chapter 3 in Simulation in Computational Finance and Economics: Tools and Emerging Application (Ed. Alexandrova-Kabadjova, Martinex-Jaramillo, Garcia-Almanza and Tsang).