What is the impact of a failing participant in a LVPS on its environment and does time matter?

Work in progress

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Disclaimer

Heijmans and Van der Woerd are members of one of the user groups with access to TARGET2 data in accordance with Article 1(2) of Decision ECB/2010/9 of 29 July 2010 on access to and use of certain TARGET2 data. DNB and the MIPC have checked the paper against the rules for guaranteeing the confidentiality of transaction level data imposed by the MIPC pursuant to Article 1(4) of the above mentioned issue. The views expressed in the paper are solely those of the authors and do not necessarily represent the views of the authors affiliations. All remaining errors are the authors responsibility.

Participants in Large Value Payments Systems (LVPS) can encounter **disruptions** due to:

- IT infrastructure failure,
- cyber-attacks,
- etc.

This affects

- the **disrupted participant**.
- the liquidity position of the **receivers** of their payments.
- potentially the **entire system**.

To mitigate the risk of a disruption in TARGET2:

- Participants have to **report** disruptions to the operators.
- Incident report for critical participants after **30 minutes**.
- Operators **monitor** participants to detect possible payment interruptions.

Participants vary in:

- Payment frequency
- Payment size
- Importance to receivers and system

This paper aims to:

1. Identify the **Minimum Outage Time Interval** (MOTI) a participant has **NOT** sent in any payment instructions to be considered an outage.

2. Measure the **impact** of an outage over time (intraday), starting at MOTI.

Operators could use these results when monitoring participants.

WELL, THERE GOES
THE NEIGHBORHOOD...

Outline

Relevant literature 1/2

Operational outages:

- Klee (2010):
  - detection outages in Fedwire (15 minutes cut off).
- Glowka, Paulick and Schultze (2018):
  - defining outages of longer than 30 minutes with no or low activity for TARGET2 (SLA reporting time).
- Arjani and Heijmans (2020):
  - Similar to Glowka et al (2018), but for Canadian LVTS including validation.

Relevant literature 2/2

Measuring impact:

- Heijmans and Wendt (2019):
  - ▶ Measuring impact of failure in terms of liquidity and network impact for banks and FMIs in TARGET2 at daily basis.

Timing and free riding:

- Bech and Garratt (2003, 2006):
  - ▶ Game theoretical model on intentional delay.
- Diehl (2013):
  - ▶ Free riding in TARGET2-BBK.
- Glowka (2019):
  - ▶ Payment profiles describing general payment behavior of participants.

What do we add to the literature?

- Define participant specific outage time intervals (MOTIs) instead of fixed cut off (15 or 30 min).
- Measuring the impact over time (instead of fixed time, e.g. day).
- Intraday picture (per hour): keeping track of difference in payment activity (e.g. lunch dips).
- Relate liquidity impact to 'size of receiving banks'.

Outline

Data:

- TARGET2:
    - Introduction date & time (not settlement)
    - Sender (BIC8)
    - Receiver (BIC8)
    - Payment value
    - Payment type

- Participant selection:
    - At least 1 payment each 10 minutes.
    - Participants with interbank payments

- Payment type selection:
    - MOTI: Only transactions initiated by banks themselves.
    - Impact: interbank payments.

MOTI Definition

We define a **MOTI per bank, per hour**:

1. Take the set I_{bh} of maximum time intervals between two payments per day.
2. On this set we calculate the MOTI as

$$MOTI_{bh} = \text{mean}(I_{bh}) + 3 \cdot \text{st.dev}(I_{bh})$$

To compare results we group banks into **MOTI groups**, based on their average MOTI between 9.00-17.00

MOTI statistics:

MOTI group (nr)	MOTI group (min)	Number of banks	Avg. daily amount (billion EUR)	Avg. daily volume
1	0-10	29	31.6	7709
2	10-20	34	7.0	1937
3	20-30	38	6.7	722
4	30-40	55	1.2	486
5	40-50	93	2.2	258
6	50+	93	1.2	114

MOTI per hour
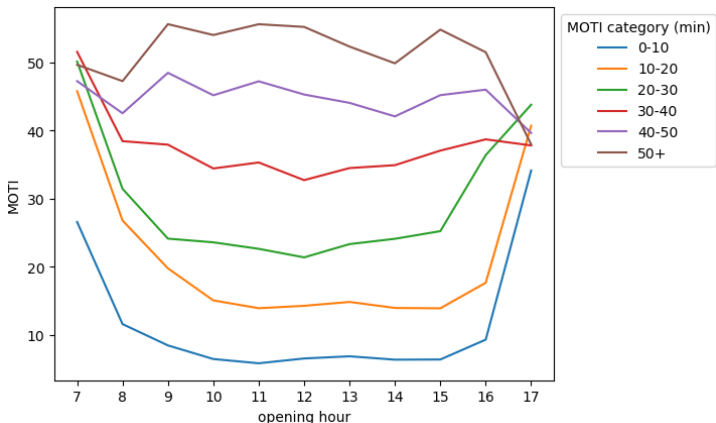
- Payments in the first hour are entered before opening of the system.
- No client payments in the last hour.

Outline

We distinguish three types of impact:

1. Liquidity Impact (LI)
   - Sender's perspective:
     - ⋆ Value of payments not sent during time of outage.
   - Receiver's perspective:
     - ⋆ Payments' share not received relative to total daily amount received.

2. Systemic Impact (SI)
   - The number of receivers (degree) that would normally receive at least 1 payment during outage time.

④ Combined Impact (CI)

  ▶ In line with Heijmans & Wendt (2023):

  $$CI_b = \sqrt{(LI_b(norm)^2 + (SI_b(norm))^2}$$

  ▶ How to normalise and set thresholds for low, medium and high risk? For example:

 $$CI_{level} = \begin{cases} low & \text{if } CI < 0.7 \\ medium & \text{if } 0.7 <= CI < 1.0 \\ high & \text{if } CI >= 1 \end{cases}$$

Medium

Low   High
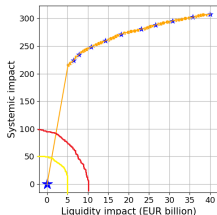
RISK

SI & LI - Bank Group 1
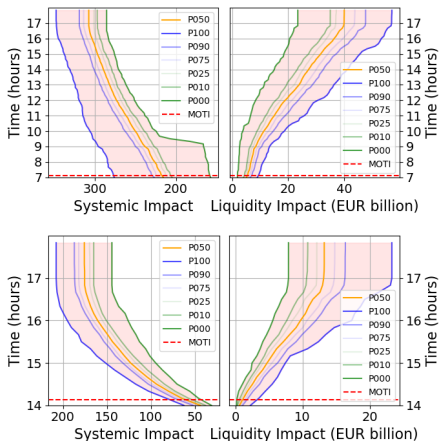
- Spread in SI & LI between days is large.
- Explosive growth of network after opening.
- Growth of network much slower at other hours.
- Growth of liquidity at start of day not as large as expected (due to payment instructions before 7.00).
- Last hour little activity.
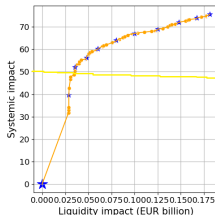
SI & LI - Bank Group 4
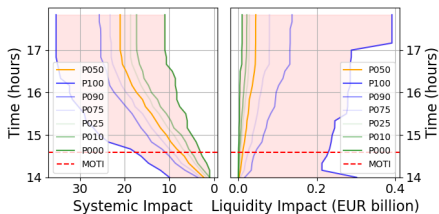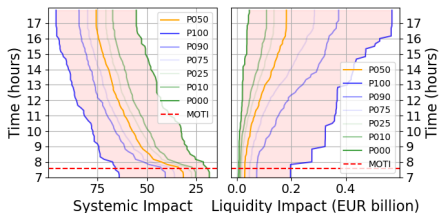
- SI & LI smaller than for bank group 1.
- Spread in SI & LI between days is large.
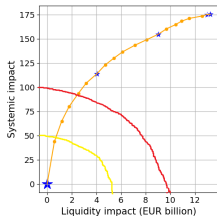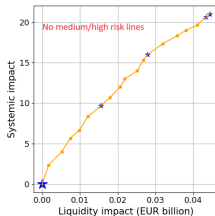- Growth of network fastest at opening.

CI

BG1, 07:00

BG4, 07:00

BG1, 14:00

BG4, 14:00

- Assessing CI on bank level, combining SI & LI.
- Evolution of impact highly depends on timing and bank.
- To do: determine exact risk levels
- Small(er) banks never reach a critical risk level (medium or high) $\Rightarrow$ not system critical.

Concluding remarks

- We have developed a bank specific but straightforward MOTI.
- We provide insights in the intraday evolution of the impact of an outage of a single bank.
  - The impact changes substantially at different starting times of the outage.
- Our method can be used by operators to identify potential outages and assess its potential impact & criticality.

Next steps:

- Include impact on the liquidity of receiving participants.
- Determine exact risk levels
  - Banks in $BG1 - BG3$ give rise to medium or even high risks.
  - Banks in $BG4 - BG6$ barely give rise to medium risk and not to high risk.