Who is critical, how and when?

A granular analysis of the criticality of participants in RTGS payment systems

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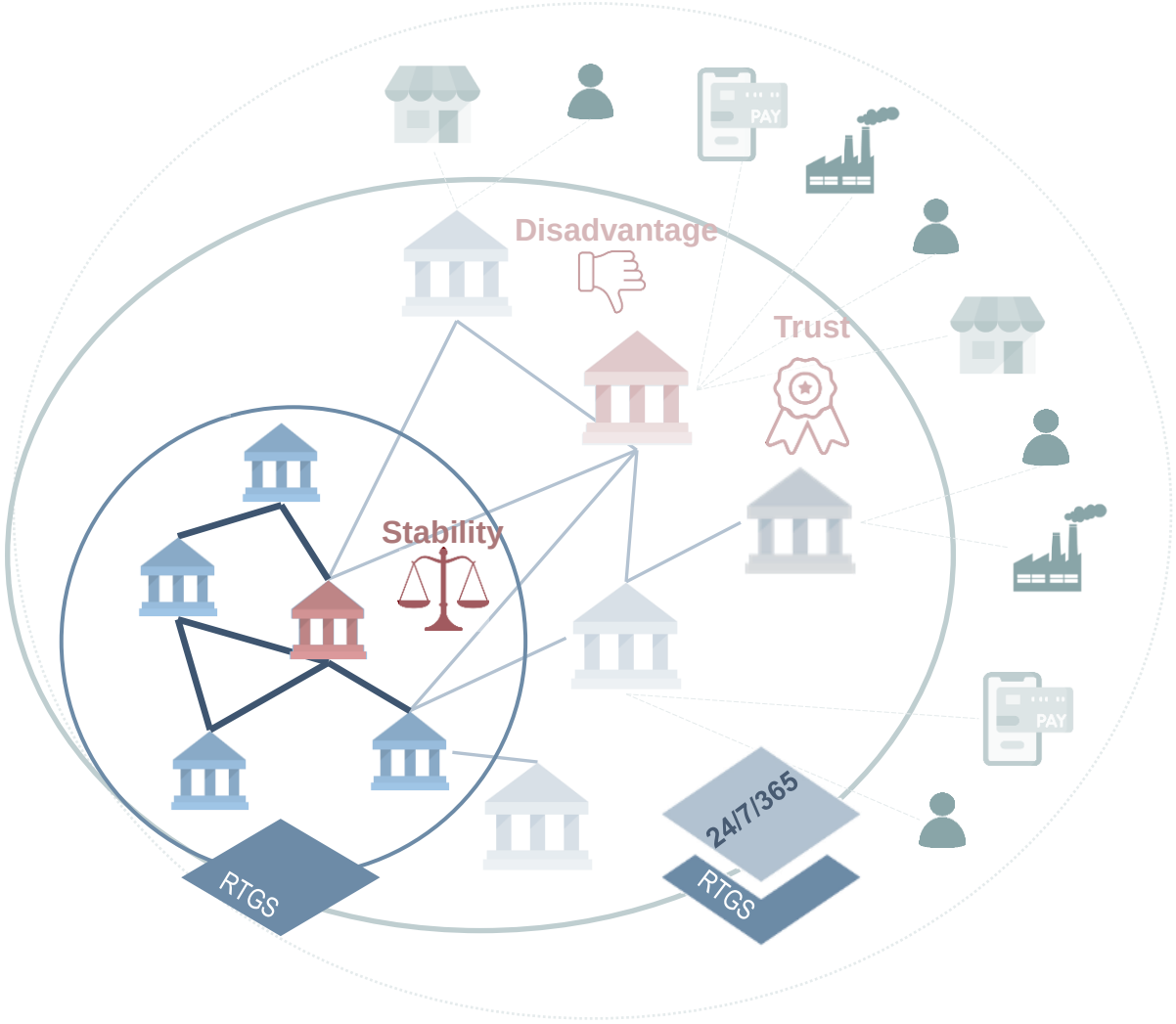
Motivation, research question, findings and contribution

Identification of critical participants is also relevant for customer payments



- An RTGS participant's **criticality** depends on how much its operational problems could affect others and the system as a whole.
- For **interbank** payment networks, operational problems can have an impact on financial stability.
- In **customer** payment networks, they can undermine public trust and create disadvantages.
- As payments shift from cash to digital, becoming instant and available 24/7, authorities face **new challenges**.

Motivation for the paper

- To ensure RTGS resilience, authorities should identify **critical participants** and set specific operational requirements for them.*
- This is a **complex task**, balancing system safety and added costs for participants.
- **Methods** have evolved from activity-based to more recent simulations and network approaches.
- The rise of instant payments and their integration into RTGS payment systems** requires considering **new perspectives** for defining critical participants: **payment category** and **intra-year time frequencies**.
- This paper explores the benefits of moving away from an average-based approach to defining critical participants and the effect of including these two perspectives.

*__Principles for Financial Market Infrastructures__ (PFMI, 3.17.19) by CPMI-IOSCO: They state that operators identify critical participants based on transaction volumes and values, and more generally, the potential impact on other participants and the system as a whole in the event of a significant operational problem.

**BIS CPMI Report 2021

Research question and methodology

Research question

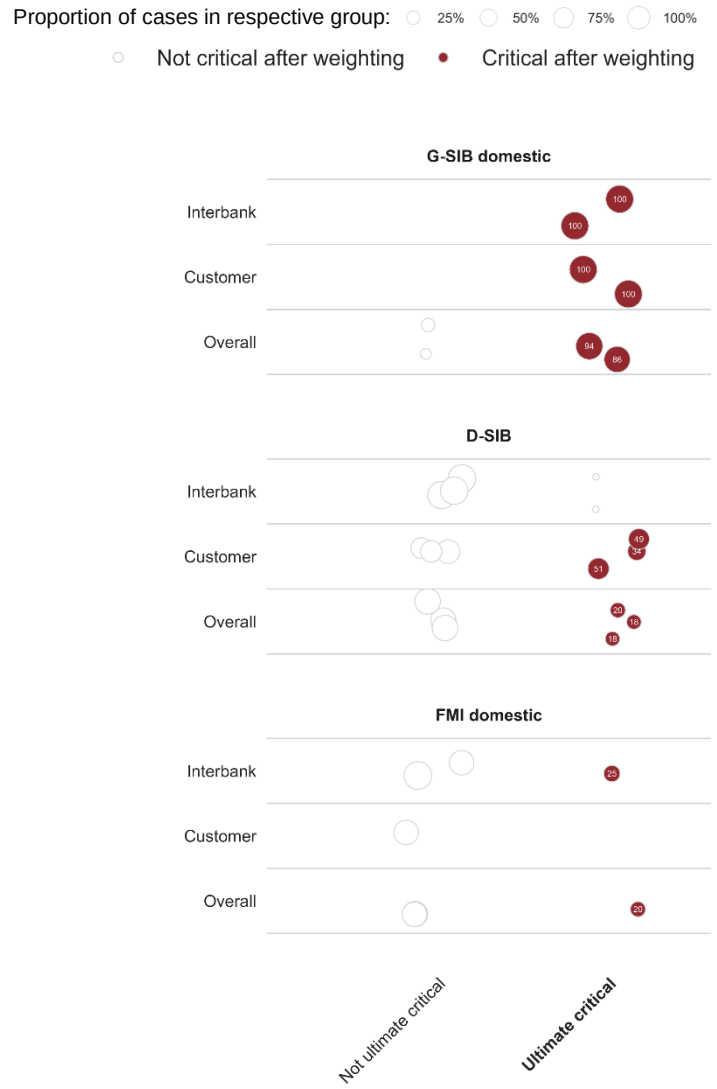
- How does **adding the new perspectives** payment category and intra-year frequency to the definition method **change the group of critical participants** in an RTGS system?

- Does this mean that in addition to the ‘usual suspects’, i.e. big international banks, **additional participant categories** are also defined **as critical?** And if so, in which payment categories and with what frequency?

Methodology

- We extend the recently presented clustering/network approach by **Glowka, Müller, and Weber (2024)** with these two perspectives, apply it to payments data from **SIC**, Switzerland’s integrated RTGS system, and weight the results according to economic relevance.

Main findings



- The two Swiss big banks (**domestic G-SIBs**) remain critical **across all extensions (i.e. across 240 scenarios** of the two perspectives**)** of the economically weighted clustering/network approach.

- When considering **customer payments,** mid-sized domestically-oriented banks (**D-SIBs**) also become critical.

- **Intra-year frequencies** highlight criticality at **night** and during **economically busy periods**, especially for D-SIBs and domestic FMIs.

These findings are **not fully captured** in the **overall perspective** of all SIC payments. Analyses should thus identify critical participants in the two proposed perspectives to avoid overlooking relevant groups.

Literature and contribution

Our work contributes to the literature on …

- … the identification of **critical participants in RTGS systems** (see Furfine 2003, Boss et al. 2004 or Soramäki et al. 2007)
  - ➢ The clustering/network approach by Glowka, Müller and Weber 2024 can also identify critical participants in an integrated RTGS system (settling interbank and customer payments), across various time frequencies and with economic weighting.

- … identification of critical **interbank-**payment participants (see Bech et al. 2010, Craig/von Peter 2010, Glowka et al. 2024)
  - ➢ Time frequency matters: Some interbank-focused participants, such as domestic FMIs, are only identified in higher-frequency perspectives, particularly at night.

- … identification of critical **customer-**payment participants (this literature is emerging, see e.g. BIS CPMI 2021)
  - ➢ The group of critical customer-focused participants is larger than the interbank group and includes mid-sized banks that focus on domestic transactions, esp. during the night and economically active periods.

- … analysis of **integrated RTGS systems** (see Rørdam and Bech 2009 or Alexandrova-Kabadjova/Solis 2012)
  - ➢ Evaluating payment categories (interbank/customer) separately is worthwile: Critical participants might not be identified in an overall or interbank analysis.

Methodology

Illustration of method

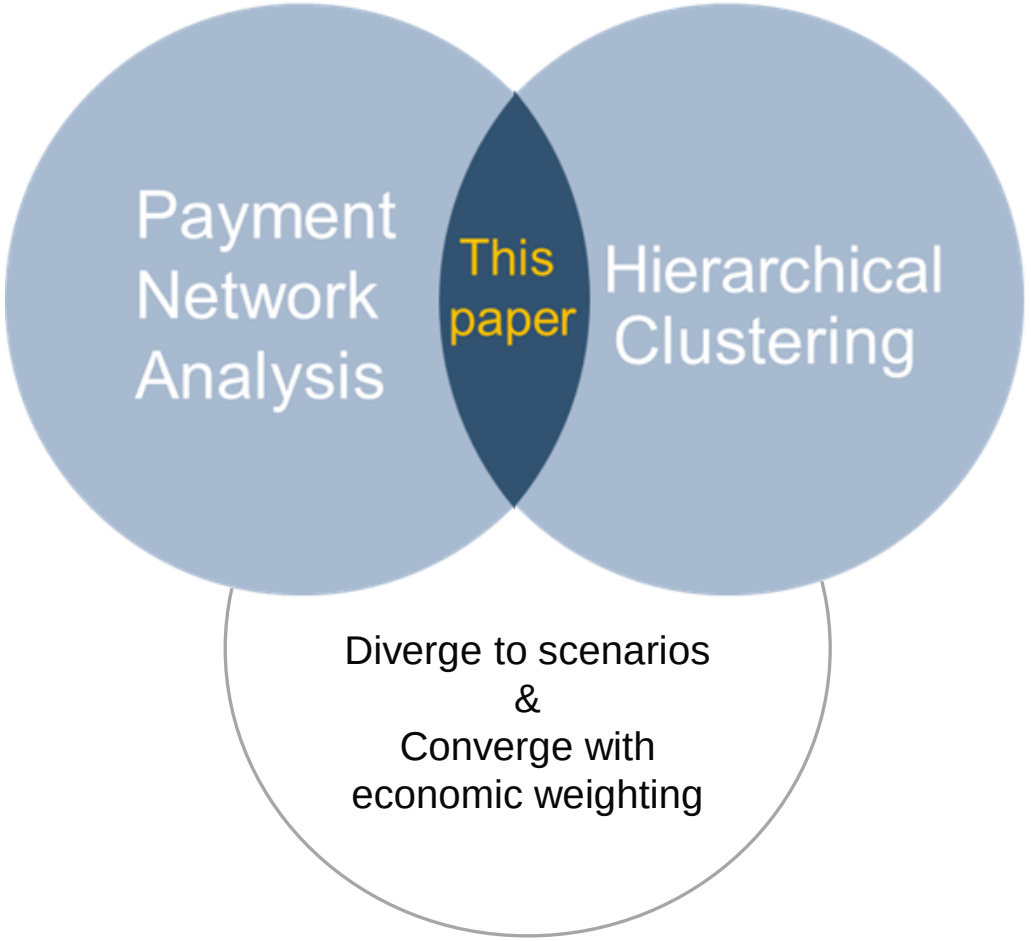


Illustration of method to decide on a participant's criticality

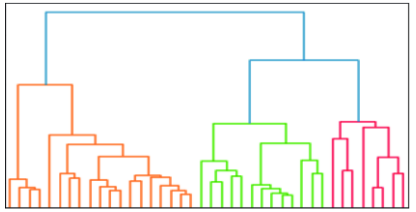
Payment Network Analysis (PNA) | Hierarchical Clustering (HClust) | Economic Weighting

1

Four PNA indicators
- Traffic share
- Out degree centrality
- In degree centrality
- Eigenvector centrality

2

Three clusters based on PNA indicator values



3

Binary PNA indicator
Indicates whether all four PNA indicator values of a participant exceed the *median* of the values in the *central cluster* (in green)

4

Above-median criticality indicator
Indicates whether a participant is in the critical cluster (in pink) *and* the binary PNA indicator shows above-median values.

5

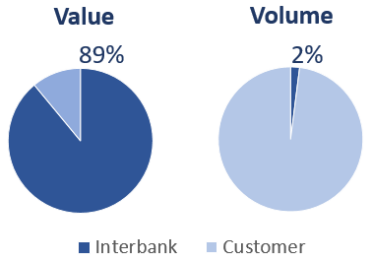
Ultimate criticality indicator
Binary criticality indicator weighted by the economic relevance of scenarios

Data

SIC – Switzerland's integrated RTGS system

- The SIC is an **integrated RTGS** system that settles both interbank and customer payments, accounting for **around a quarter of Switzerland's digital payments**.

- In 2023, 302 participants (domestic and foreign) handled an average of **4 million daily transactions**. Large-value interbank payments made up 89% of the total value but only 2% of the transactions, with the rest being low-value customer payments.

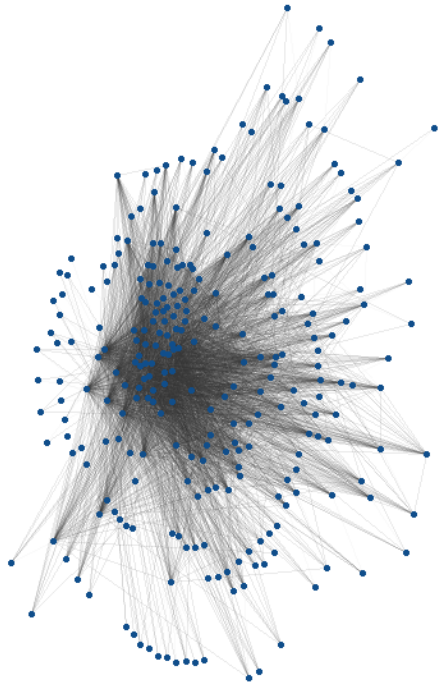


- We analyse the SIC data at the level of the **"economic unit"**, whereby payments made over settlement accounts of the same economic unit are aggregated.

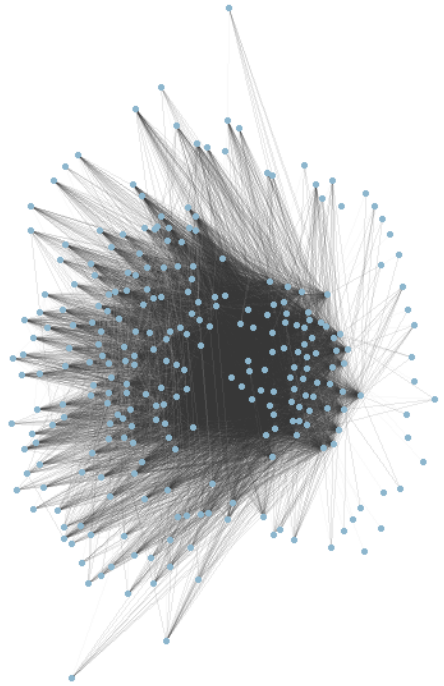
- The **Swiss National Bank's transactions** are fully **excluded** from the analysis.

Dual structure in SIC payment networks: interbank network broader, sparser and less concentrated than customer network

SIC interbank payments (2023)



SIC customer payments (2023)

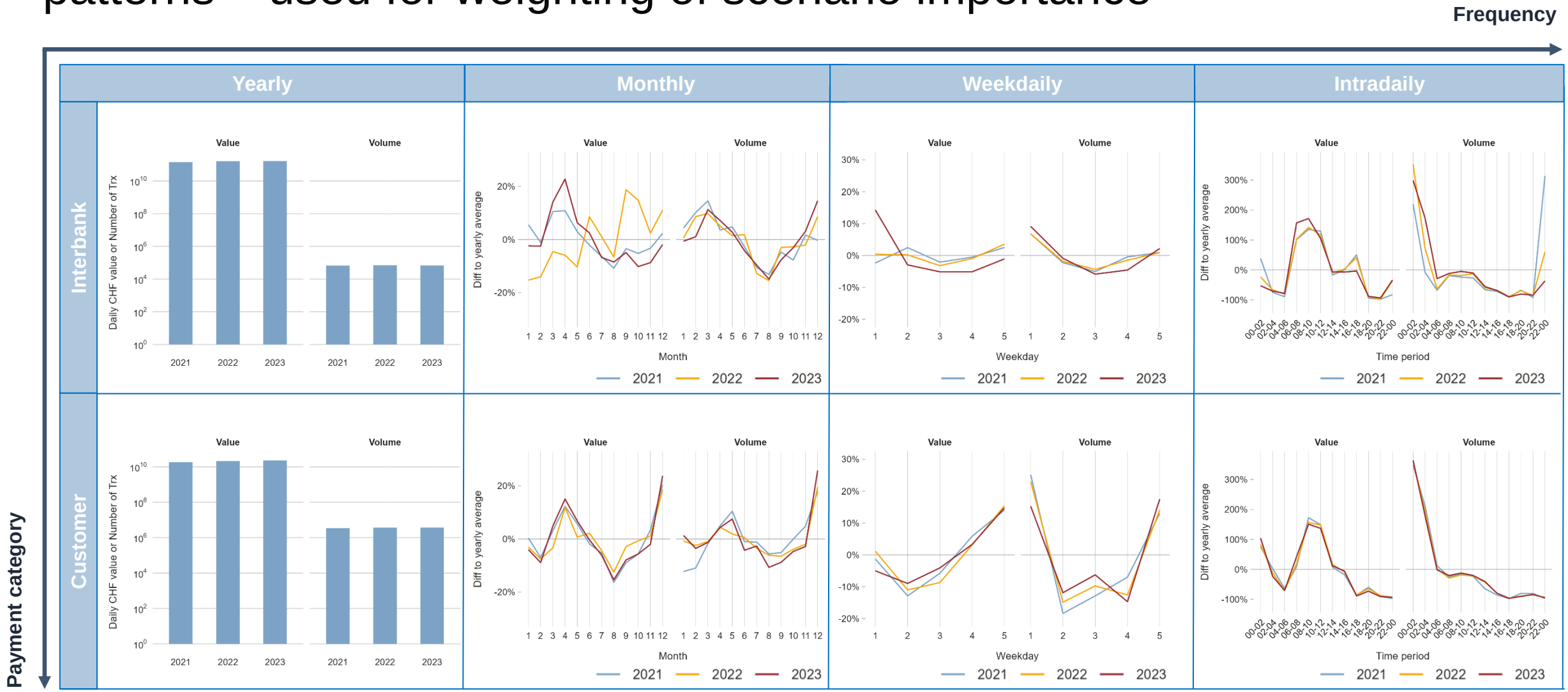


Summary statistics of SIC payment networks (year 2023)

	Nodes count	Edge density	Compo-nents	Nodes in core, %	Diameter	Recipro-city	Transiti-vity
Interbank							
whole day	**282**	**0.12**	**26**	**27**	**4**	**0.77**	**0.53**
- night	260	0.11	52	25	5	0.71	0.57
- morning	275	0.07	28	17	5	0.71	0.38
- afternoon	279	0.06	39	14	5	0.65	0.34
Customer							
whole day	**273**	**0.28**	**36**	**36**	**3**	**0.80**	**0.66**
- night	262	0.21	57	35	4	0.71	0.63
- morning	267	0.25	36	35	4	0.78	0.65
- afternoon	266	0.23	38	31	3	0.76	0.63

Note: These indicators are based on SIC payment networks of the year 2023 between nodes at the level of the 'economic unit' and exclude all SNB transactions.

Both perspectives of SIC data show clear intra-year seasonality patterns – used for weighting of scenario importance

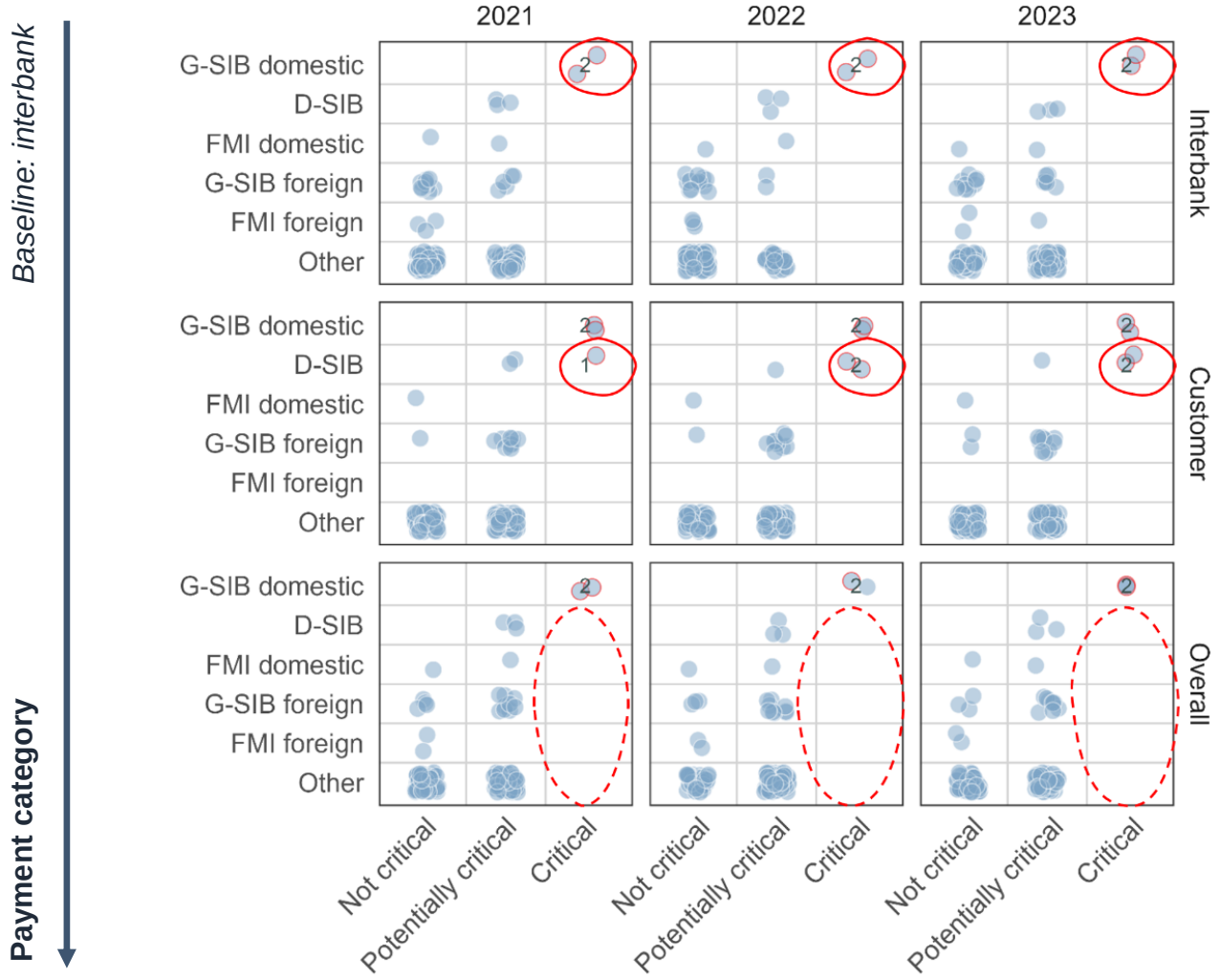


Results

Groups of the 304 SIC participants (2021-2023)

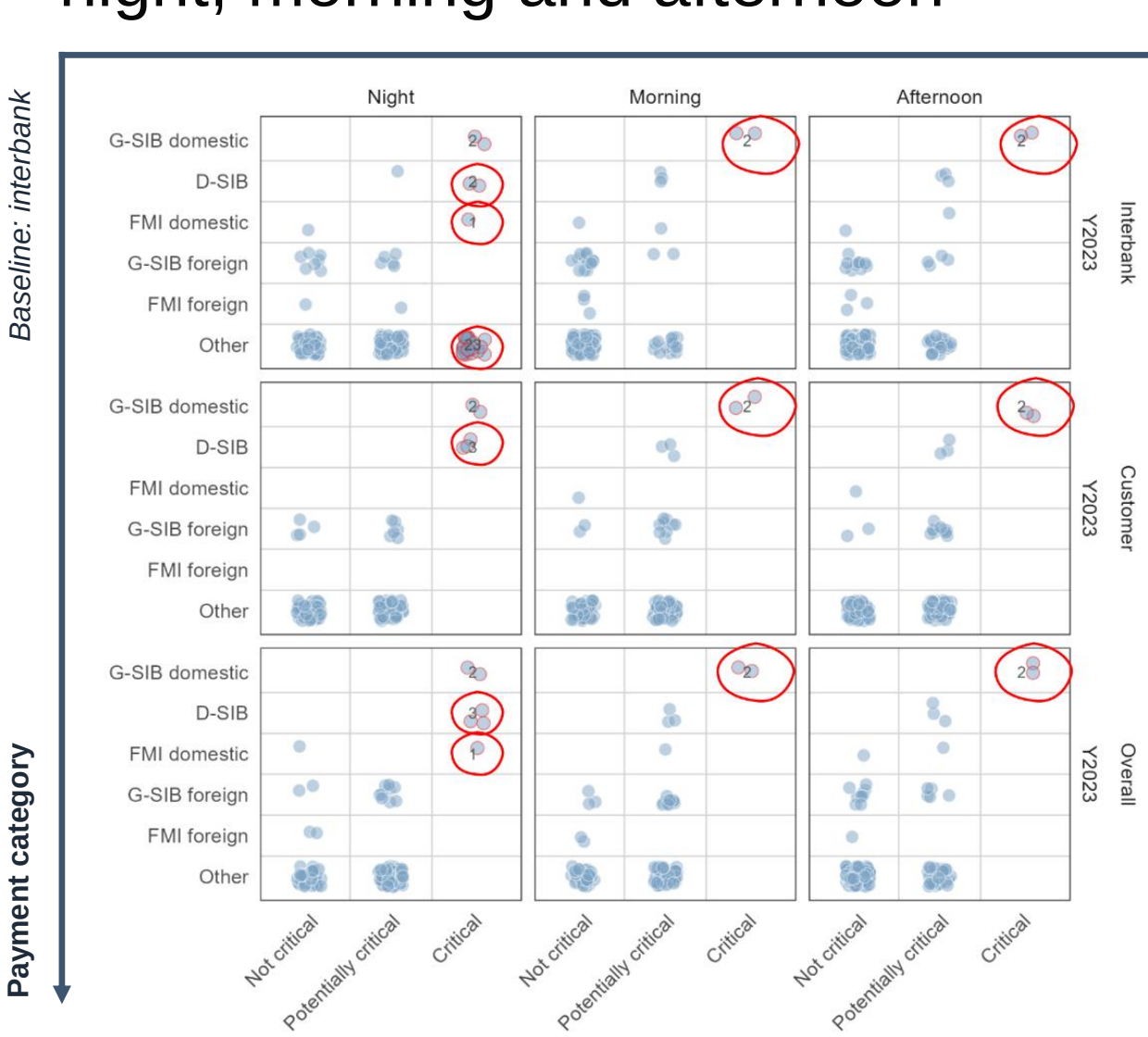
- **G-SIBs domestic** (2)
- **G-SIBs foreign** (18)
- **D-SIBs** (3)
- **FMIs domestic** (3)
- **FMIs foreign** (3)
- **Other participants** (275)

Results by payment categories (years 2021-2023): interbank, customer and overall



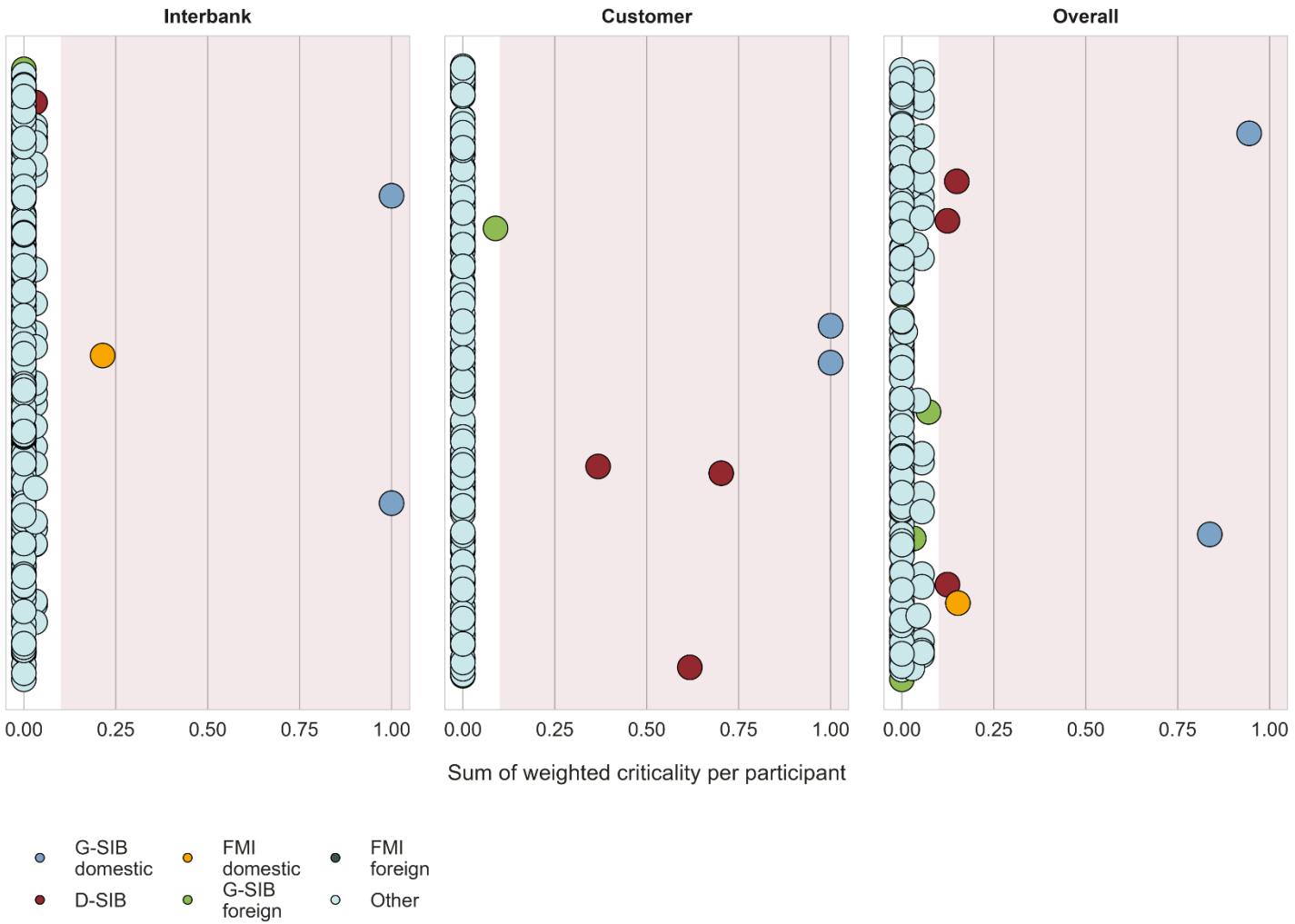
- In interbank and customer perspectives: Two domestic **G-SIBs** in the critical cluster across all years.
- In customer perspective: One to two **D-SIBs** in critical cluster.
  - This criticality is not visible in the overall perspective.

Results by intra-year frequencies (e.g. intradaily 2023): night, morning and afternoon



- Night: On top of the **two domestic G-SIBs**, the following participants are critical:
  - Interbank: **two D-SIBs**, **domestic FMIs**, multiple other participants
  - Customer: all **three D-SIBs**
  - Overall: criticality prevails also for **D-SIBs** and **domestic FMIs**
- Morning: Only the domestic G-SIBs
- Afternoon: Only the domestic G-SIBs

Assigning ultimate criticality after weighting



- The two Swiss big banks (**domestic G-SIBs**) are ultimate critical in all payment categories.
- All three mid-sized domestically-oriented banks (**D-SIBs**) are ultimate critical when considering customer payments and the overall networks.
- A **domestic FMI** is ultimate critical in interbank payments and overall networks.
- The participants in the **other three groups** (foreign G-SIBs, foreign FMIs, Other) are never ultimate critical.

Conclusion

Conclusion

- The rise in digital payments requires a resilient, always-on payment system to meet the growing demands of businesses and consumers.
- Authorities are advised to consider financial stability, economic disadvantages, and public trust when identifying critical participants in RTGS systems.
- The clustering/network approach of Glowka, Müller and Weber (2024), applied with economic weighting and on category- and time-dependent SIC payment networks, identifies both the usual critical participants, i.e. G-SIBs, as well as additional groups. These include D-SIBs in customer payments during economically busy periods and domestic FMIs for interbank payments at night.
- Annual frequency analysis may overlook critical participants, highlighting the need for more granular analysis.
- This procedure could be extended to volume-based payment networks, used in RTGS simulations to narrow down participants and scenarios, or applied to more granular networks such as geographical regions.

Thank you for your attention!

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