Cooperative behaviour in a blockchain for humanitarian aid during the COVID-19 pandemic

Cheick Tidiane Ba, Galdeman Alessia, Matteo Zignani, Sabrina Gaito

COMPUTER SCIENCE DEPT. UNIVERSITY OF MILAN

onnets LAB

Computer Science
UNIVERSITÀ DEGLI STUDI DI MILANO

Models

Multilayer Networks

Co-evolution
Multireciprocity
Multicommunity
Network completion

Temporal Networks

Network growth and evolution
Burstiness
Microdynamics
Temporal motifs
Graph Evolution rules

AI on Graphs

Graph Neural Networks
Link prediction
Graph embedding
Node classification
Strength prediction

Applications

Urban Networks

Mobility network
On-phone networks
Human behavior

Online social networks

Blockchain online social networks
User migration

Economic Networks

Transaction networks
NFT sales networks

Mobile Networks

Opportunistic networks
Edge computing
5G and 6G

Web3

A PARADIGM FOR A DECENTRALIZED WEB

Over-centralization

Decentralization by blockchains

- Web3 services:
  - Decentralized Finance (DeFi)
  - Decentralized Autonomous Organization (DAO)
  - Non-fungible Token (NFT)
  - Decentralized Online Social Media

Blockchain for Good

- Blockchain for humanitarian aid
  - Delivery of financial aid
  - Fight corruption
  - Secure digital identities
  - Coordination among NPOs

Building blocks – UN blockchain project - supports identification and access to food for Jordans' Refugee; through a scan the iris. Building blocks WFP Image

Delivering financial aid

- Standard: cash transfers and vouchers
- Complementary currencies
  - Currencies that support the official national currency
  - A.k.a. local / community currencies (4,500+)
  - Studies on them in COVID-19 pandemic
    - Mumbuca E-Dinheiro, Brazil
    - Zielony, Poland
    - Sarafu, Kenya

Sarafu

Grassroots Economics

- Digital complementary currency system
- Payments using mobile phones, transferring digital tokens

Image from https://www.youtube.com/watch?v=eT53cREs6hU

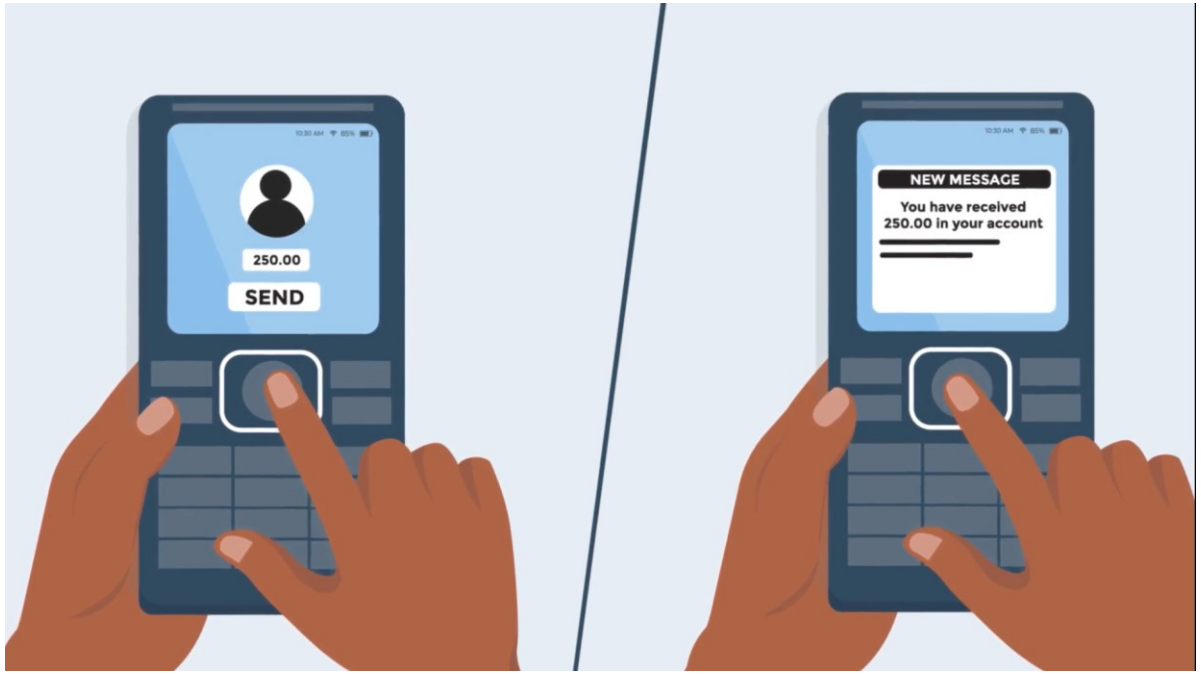


Image from https://www.youtube.com/watch?v=uYeyFuJi4UM

Sarafu

Grassroots Economics

- Collaboration with Red Cross for humanitarian aid during the COVID-19 pandemic
- Kitabu Blockchain

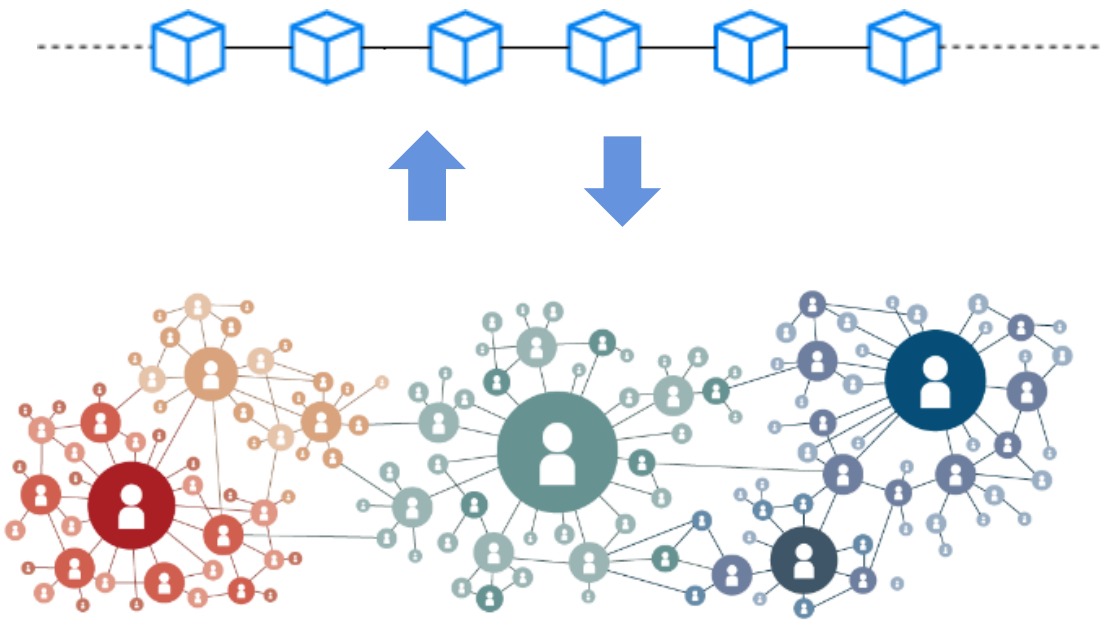
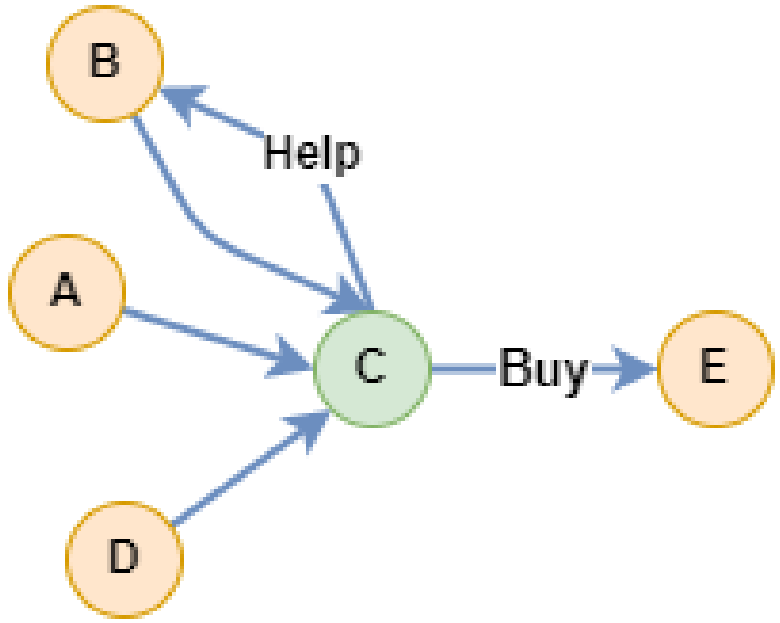


Image from https://www.youtube.com/watch?v=uYeyFuJi4UM

Cooperation in Sarafu

- *Group account*
  - Special type of account
  - Chamas community savings groups, that save and lend currency
  - Save and lend Sarafu tokens
  - Cooperation

- The higher amount of currency handled by group accounts, the greater the *cooperation*



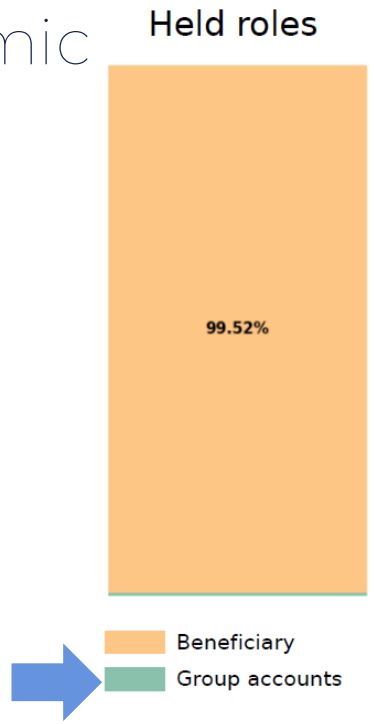
Research questions

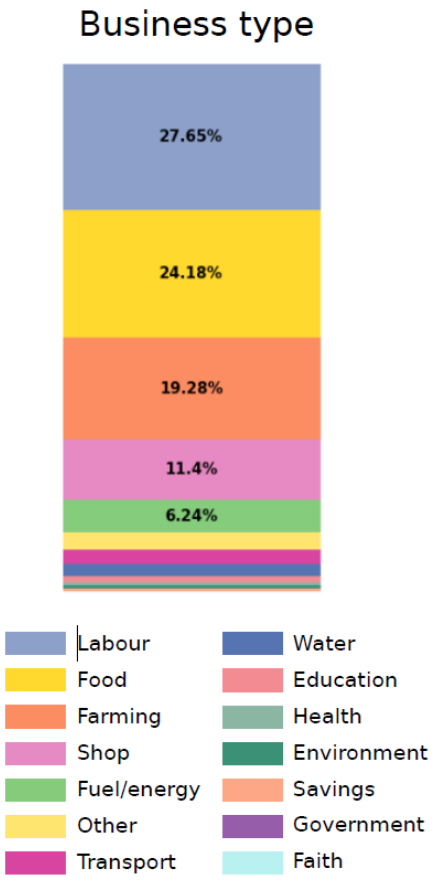
- Open problems:
  - Limited studies on complementary currencies during the COVID-19 pandemic
  - No studies on cooperative behaviour, and how it changes over time

- Research questions
  - RQ1: To what extent cooperation groups are used by Sarafu participants?
  - RQ2: Does the behaviour of cooperation groups change over time?

Dataset

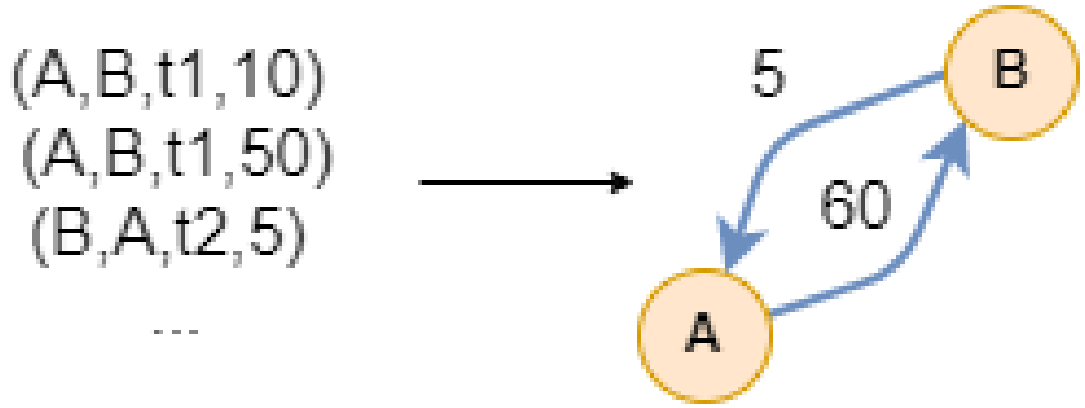
- Transactions during the COVID-19 pandemic
- Users (54999)
  - ID
  - Attributes (business type, role, …)
- Transactions (930161)
  - From
  - To
  - Time
  - Weight (amount of tokens)





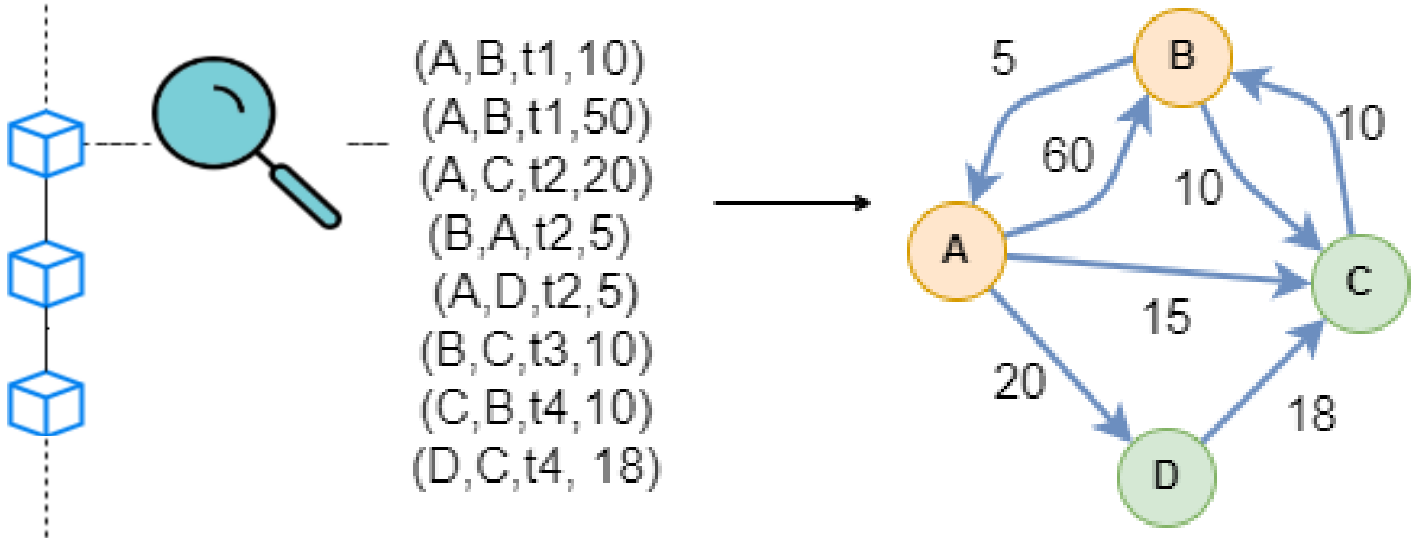
Methodology

- Network based modeling
- Transaction networks: temporal weighted graphs



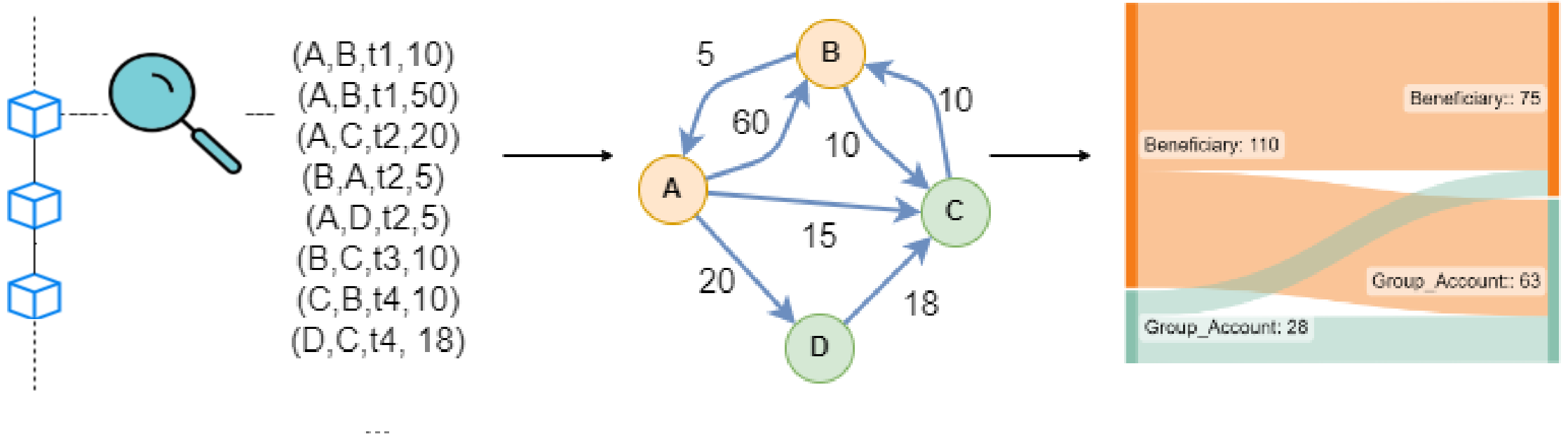
Methodology

- Transaction networks: temporal weighted graphs



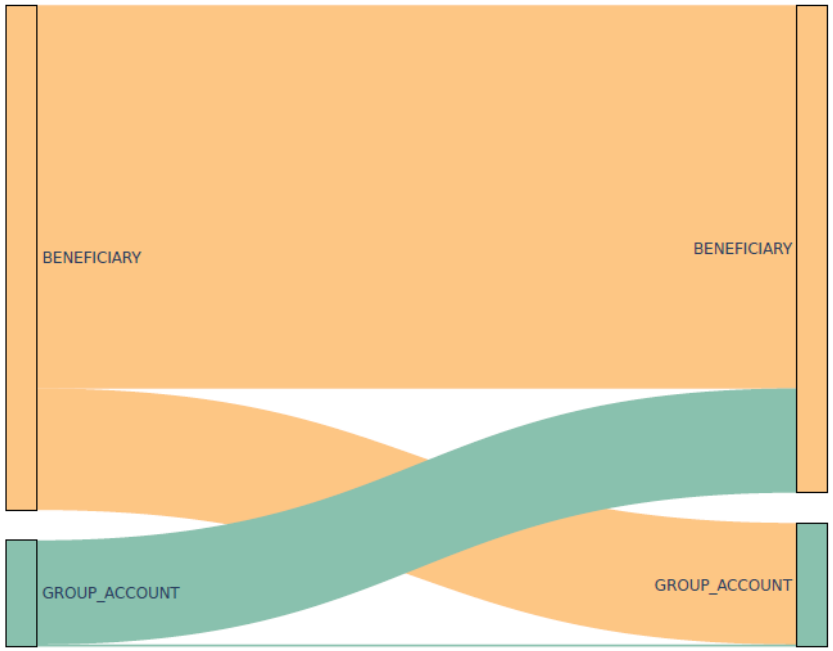
Methodology

- Transaction networks: temporal weighted graphs
- Sankey diagrams: visualize the flow of transfers

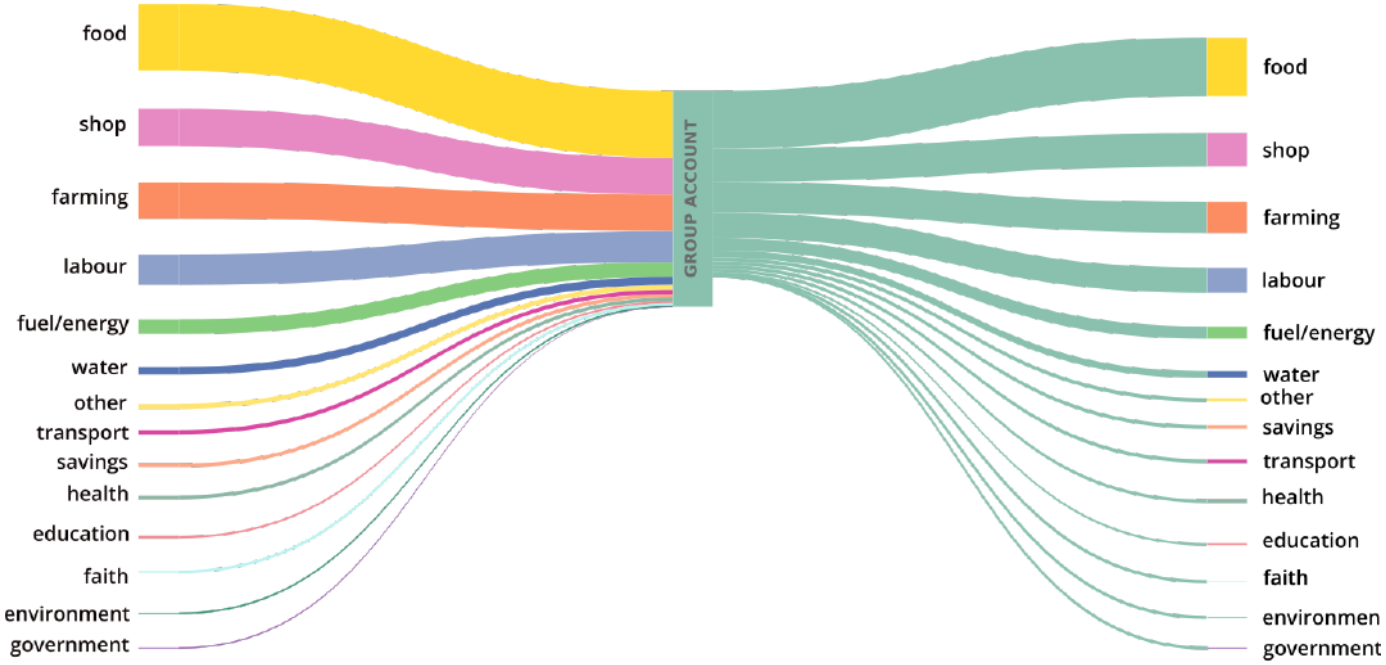


Cooperation

Flows divided by held role



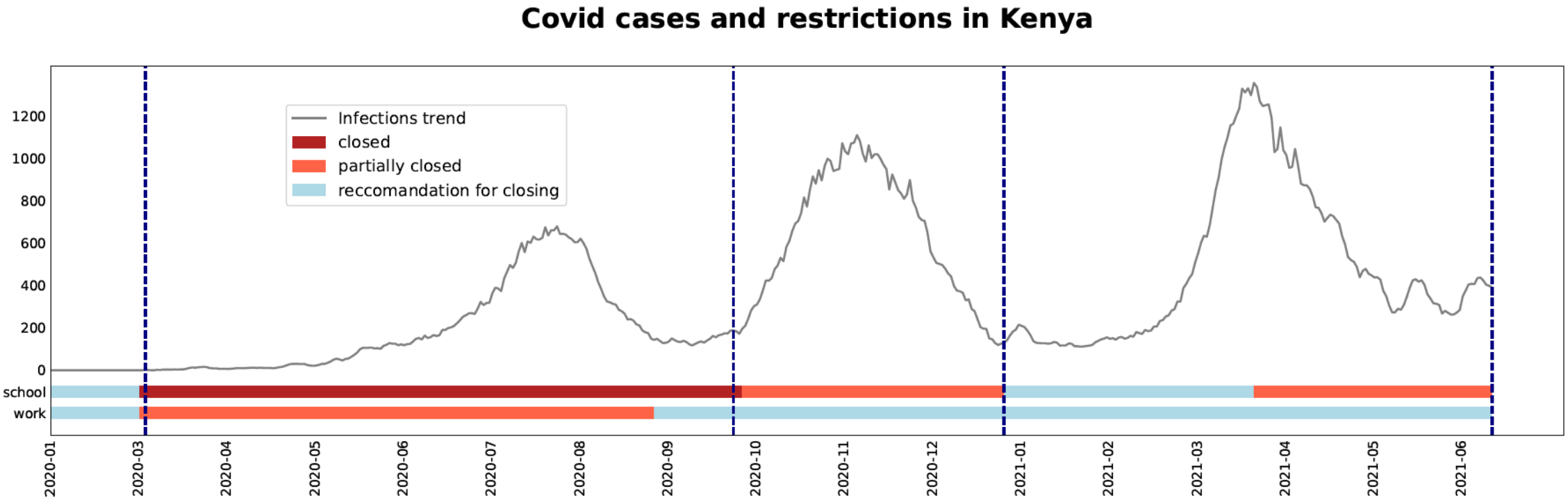
Flows divided by business type



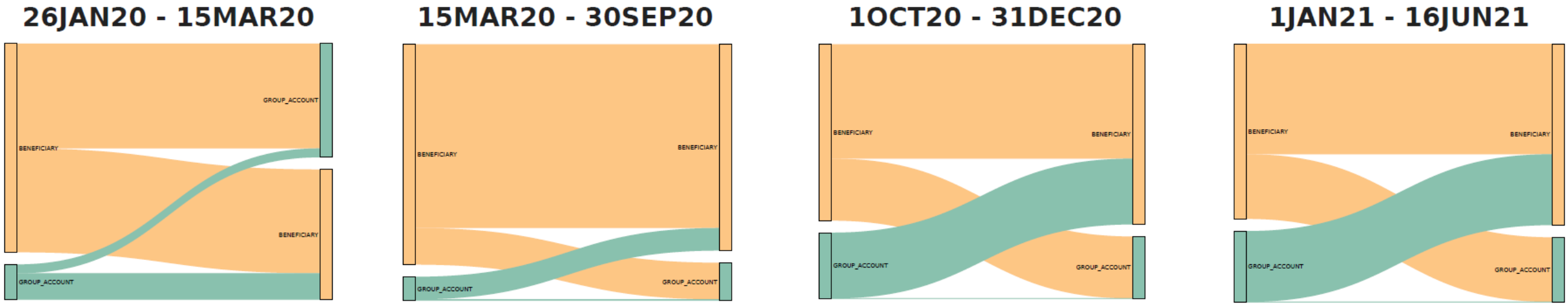
- Group accounts have an important role

Over time (1)

- Four periods of time based on pandemic situation
  - changes in the mitigation policies and restrictions

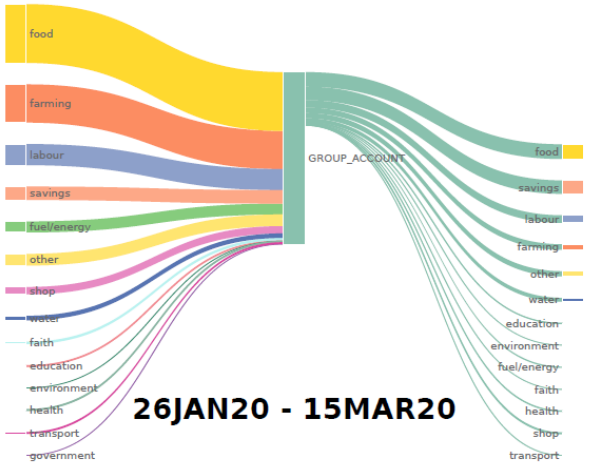


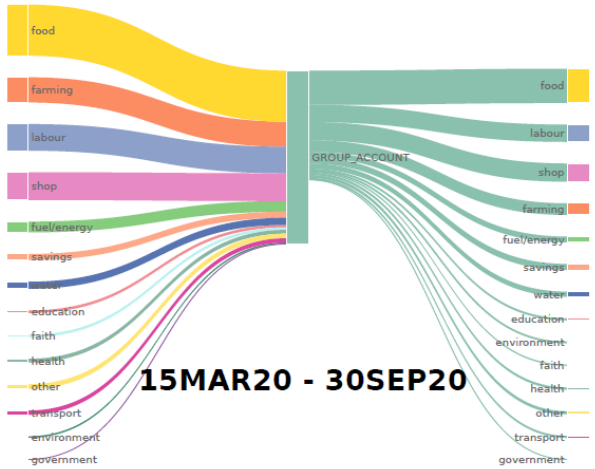
Over time (2)

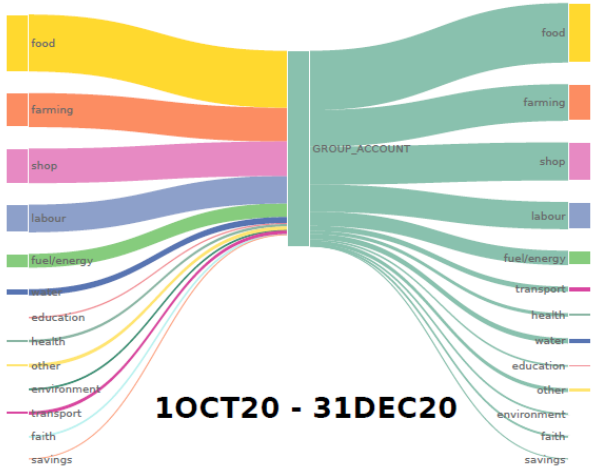


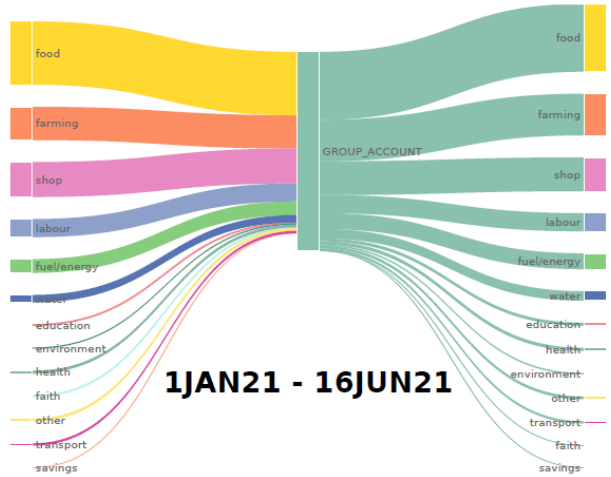
- Increase of monetary flows from group accounts

Over time (3)









- Changes in funding and spending of cooperation groups

Conclusions

- Takeaways:
  - Cooperation behaviour
    - is important
    - changes over time
  - Group accounts should be considered by other humanitarian projects

- Future works:
  - Study of other currencies
  - Study the impact of other subset of accounts
  - Leverage additional contextual information (e.g.: pandemic, economy)

Thanks for your attention!

Web3

RESEARCH GROUP WORKS

Network evolution

Graph evolution rules

Link/Transaction Prediction

Graph Neural Networks

Discrete choice models

User migration

Multilayer community detection

Influence of hubs on migration choices

Small world traits

Community detection

To see our works visit

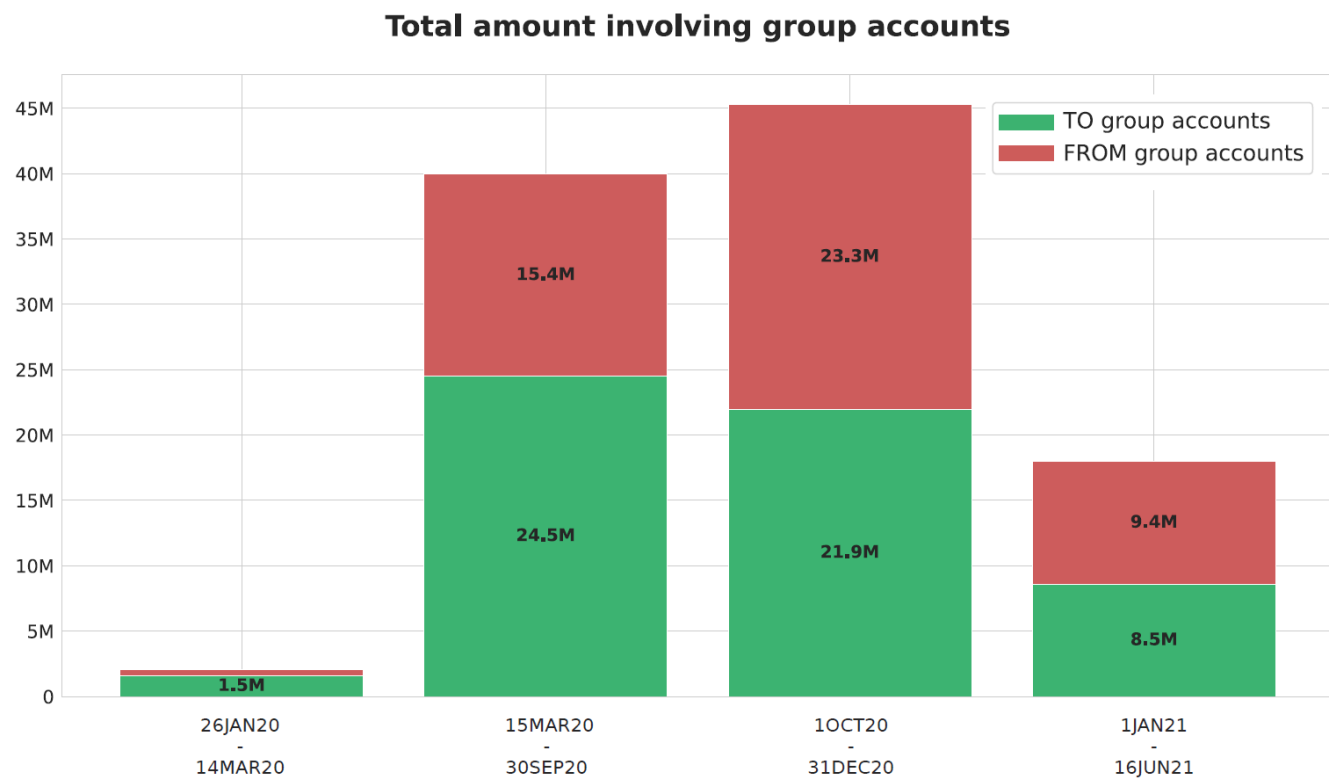
https://connets.di.unimi.it/

Backup slides

Transaction networks

Start	End	Active users	Edges	Transactions
2020-01-26	2020-03-15	4217	8281	12168
2020-03-15	2020-10-01	28070	96266	251594
2020-10-01	2021-01-01	7030	22872	63262
2021-01-01	2021-06-16	13960	35225	85026
Entire period		40343	143239	412050

Over time (4)


Total amount involving group accounts
TO group accounts
FROM group accounts
45M
40M
35M
30M
25M
20M
15M
10M
5M
0
1.5M
24.5M
15.4M
21.9M
23.3M
8.5M
9.4M
26JAN20 - 14MAR20
15MAR20 - 30SEP20
1OCT20 - 31DEC20
1JAN21 - 16JUN21

Complementary