It’s all about data: using advanced analytics as an investigative tool

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15 years
Of historical data

3.1+ billion
Payment messages exchanged between institutions from 2003 to 2018, aggregated by month and by country

11,000
SWIFT users

200+
Countries and territories
Questions

What insights could be drawn from the "Big Data" of the network?

What are useful learnings for the community?
What is a network?
Networks and Network Analytics

- Networks consist of nodes and links
- Network Visualization is important (but hard)
- Network analytics
  - Analyse links and their properties
  - Detect clusters and communities
  - Identify important nodes and choke points
- How do we model the SWIFT payments as a network?
  - Country level
  - Bank level
  - Payment level
1. The global network of payment flows
Monthly total message volume
Monthly message volume - Seasonal variation

Peaks in December
Bottoms in February and August
Monthly message volume - Trend

Financial crisis cost $5 trillion in lost payments

Reduced growth since 2014
Anomaly: Anomalies in time series

We need a model to predict next observation in a time series. If prediction is incorrect, it is an anomaly.

We use Hierarchical Gaussian Process Regression to estimate adaptive confidence intervals.
Link level analysis: Volume of payments

Normal

Sustained growth in volume during several years...

Anomalous

Unexpected drop in volume to just a few payments
Network structure

How do countries interact with each other?

United Kingdom
390 links

Estonia
101 links

Eswatini
56 links
Counterparty relationships

Decline in links after the financial crisis, driven by cuts to offshore centers.

Sharp increase in links until 2004
Theoretical network connectivity
Evolution of the payments network structure

March 2007

March 2017
Maximum spanning tree is a filtering technique that identifies the strongest links and the community structure.
April 2018, 50% network traffic, maximum spanning tree

At Sibos 2014 Gottfried Leibbrandt presented FNA research and showed the backbone network of SWIFT.

The same structure still applies today, but most traffic from Austria, Sweden and Belgium have moved from Germany to the UK. USA increased traffic with The Netherlands, South Korea and Singapore.
Anomaly: changing network structure

What happens when a node is removed from the network?
Link level analysis: number of counterparties

Drop in counterparties for one country

Compensation of traffic to its largest remaining link
Link level analysis: number of counterparties

Compensation of traffic to its largest remaining link
Using an unsupervised machine learning algorithm, we identify communities of countries that deal more with each other, than across the communities.
Communities restructure themselves on the network

2013

2018
SWIFT - Most important Countries

SinkRank, Top Countries

- United States
- Germany
- United Kingdom
- China
- France
- Italy
- Hong Kong

Rank

200301 200501 200701 200901 201101 201301
SWIFT - Most Volatile Flows

Relative Importance by SinkRank, Most Volatile Countries

- DR Congo
- Sudan
- Palestine
- Iran
- Venezuela