Tit for tat in payment systems

How protective is retaliation when a major participant defaults?

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Agenda

- TOP and the Bank of Finland Payments and Settlement Simulator
- Time-dependency of the impact of an operational default
- Participants' reactions to a default
- Controlling participants' exposures
- Future work

TOP and PSS

- TOP: the Dutch interbank payment system
  - RTGS
  - queues, but no liquidity-saving mechanisms
  - no central limits
  - no tiering, all banks participate directly
  - central bank credit obtained by pledging collateral
  - part of TARGET: not a closed system
  - ⇒ potential impact of disruption reaches beyond the boundaries of the system

TOP and PSS

- Simulating TOP
  - June 2004: 1 month of simulations (22 days)
  - number (24.4 thd) & value (160 bn) of transactions close to yearly average
  - no special role of institutional variables
  - no special days & (US) holidays

TOP and PSS

- Simulating TOP: 440 simulations
  - benchmark simulation to approximate TOP
  - Simulation with netting to assess lower liquidity bound
  - Scenario 1: default of a major participant at different times of the day (12 simulations p.d.)
  - Scenario 2: participants react: stop-sending after 10, 30 min, 1 hour, 2 or 4 hours (110 simulations)
  - Scenario 3: participants react when exposure reaches 25%, 10% or 5% of capital (66 simulations)

TOP and PSS

- Simulating TOP
  - Upper bound of liquidity: 50.18 bn
  - Lower bound of liquidity: 10.78 bn
  - Actual liquidity in the system: > 61 bn

  … but distribution of this liquidity plays a role in the simulations

Timing of default

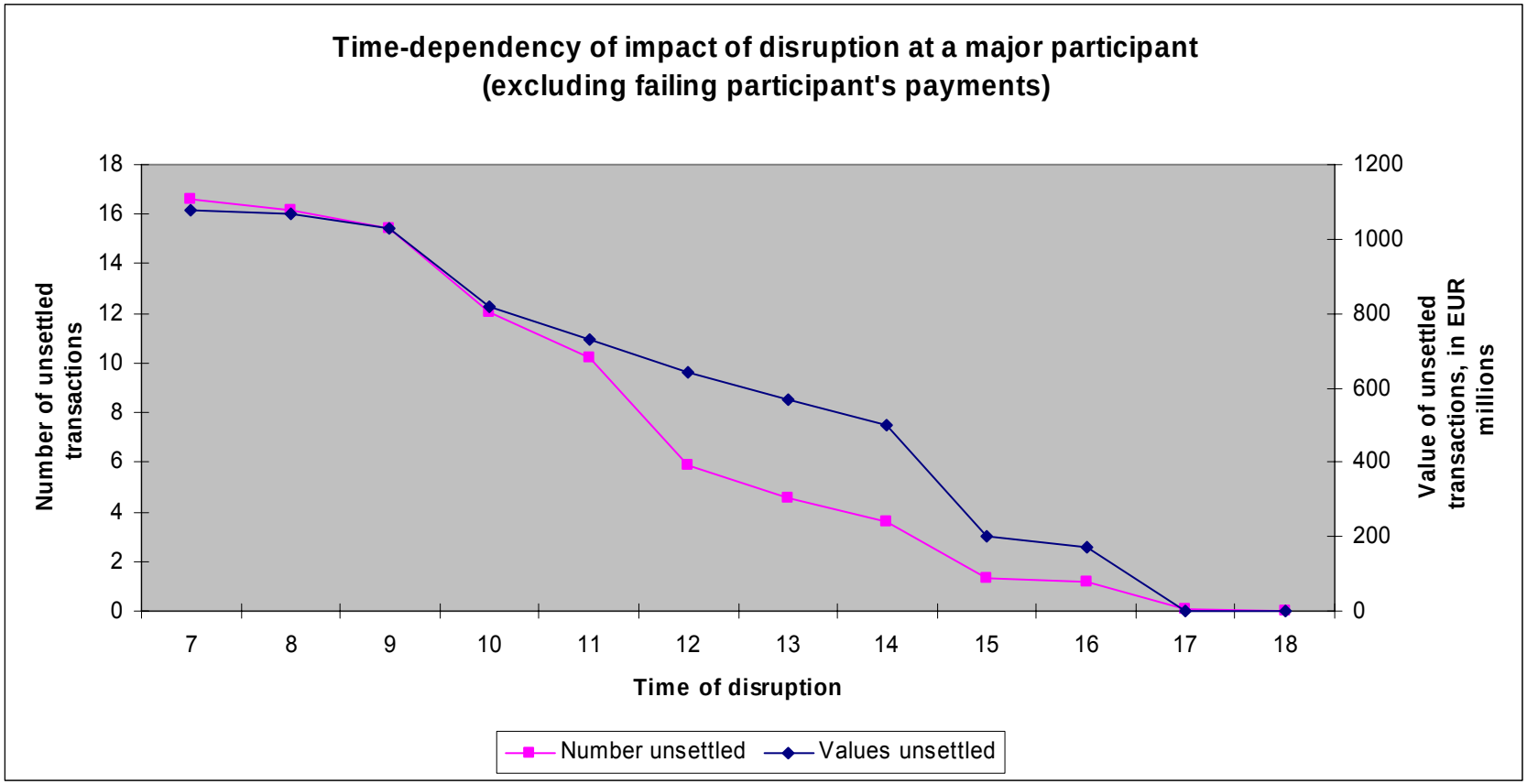
- Operational default of a major participant
  - Default occurs at different times of the day, between 07.00 and 18.00
  - Default lasts for the rest of the day
    - If not: payment systems would very rapidly resume normal operations
  - Maximum expected by counterparties: more than 7.000 payments, with a value of more than EUR 50 bn

Timing of default

- Time-dependency of the impact of default
  - Secondary defaults
  - Liquidity sink effect
- Implicit assumption
  - no interbank market: distribution of liquidity matters

Timing of default

- Time-dependency of the impact of default

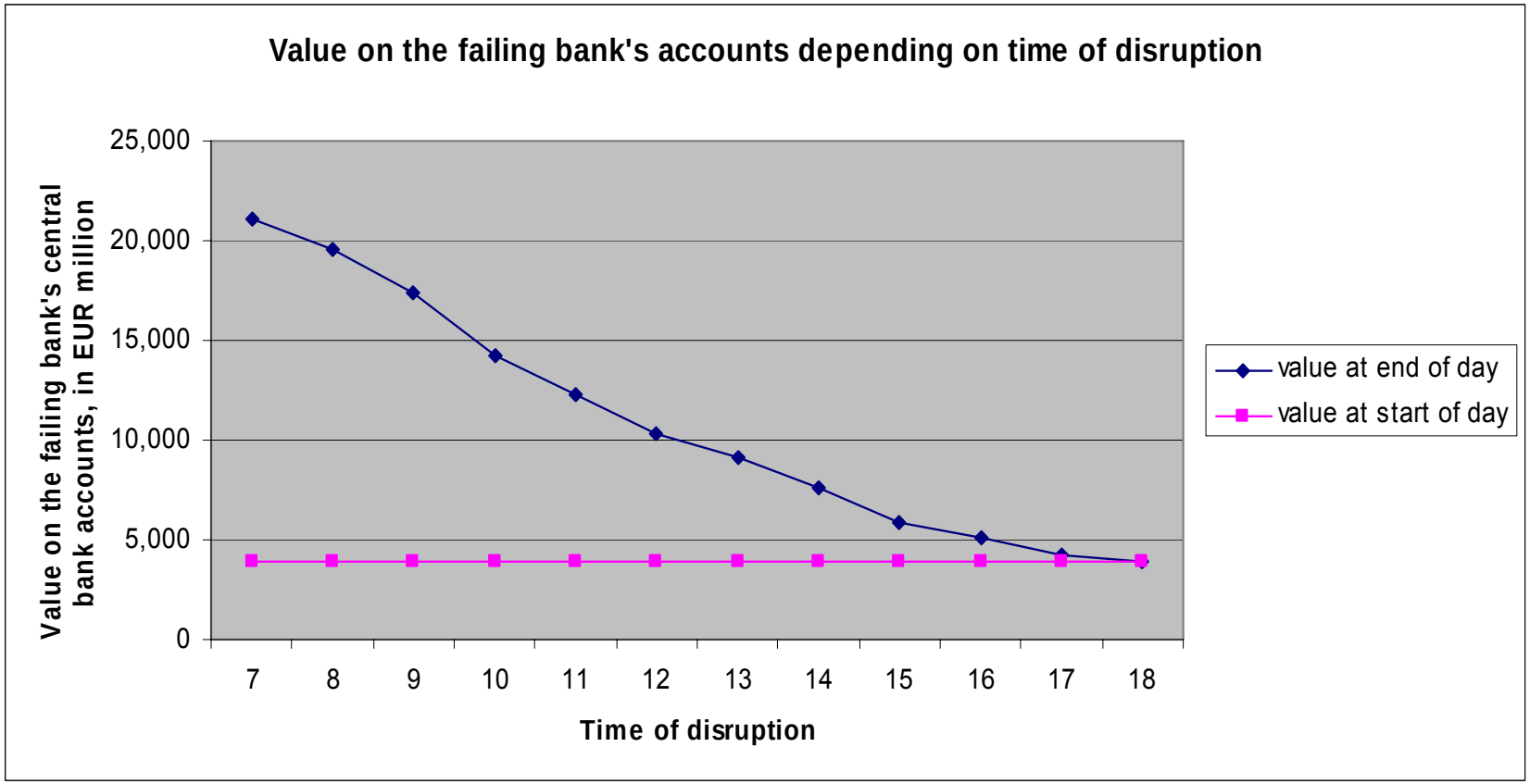


Timing of default

- Time-dependency of the impact of default
  - Payments made *before* default can remain unsettled *due to that* default, if they are still in the queue,
  - Counterintuitive increase in the number of failed payments between 7.00 and 8.00. This “hump” disappears when unsettled payments made by failing bank are excluded.

Timing of default

- The “liquidity sink”



Participants' reaction to default

- Reactions according to two "rules"
  - Timed stop-sending
  - Exposure control
- Assessment of
  - Secondary defaults
  - Costs of default for the system

Participants' reaction to default

- Costs of default to the system
  - Banks need to rely on additional (overnight) liquidity when they receive insufficient funds during the day
  - Marginal lending facility in June: 3% p.a.
  - EONIA June average: 2.03% p.a.
  - Liquidity costs of a system disruption: depends on where banks obtain additional liquidity (market = minimum cost, central bank = maximum cost)
  - Determined by difference between end of day negative positions in scenarios 1-3 and benchmark

Participants' reaction to default

- Timed stop-sending

  Beford et al. (2005): "Anecdotal evidence from CHAPS Sterling suggests that the time-lag between an operational failure and the flow of payments to that bank slowing significantly is (…) ten minutes"

  ≠ Mazars & Woelfel (2005)

  ….what difference does that make?

Participants' reaction to default

- Timed stop-sending
  - Counterparties stop sending payments to failing bank 10 min, 30 min, 1 hour, 2 or 4 hours after default
  - ⇔assumes perfect (but not necessarily immediate) and simultaneous information in the market
  - Liquidity = actual liquidity in the system
  - ⇔ partly endogenous
  - ⇒ Simulations provide information about the additional liquidity needed at end of day to cope with a default, not about the impact of this default at different liquidity levels.

Participants' reaction to default

- Timed stop-sending

		Unsettled payments		Additional liquidity		
		Number	Value (EUR million)	Value (EUR million)	Costs of overnight overdraft (EUR thousands)	
					EONIA	marginal lending
Time before participants react						
	10 min	4.86	303.37	907.22	73.65	108.85
	30 min	4.86	303.37	907.43	73.67	108.88
	1 hour	4.90	319.23	906.55	73.60	108.77
	2 hours	5.00	329.65	981.92	79.72	117.81
	4 hours	7.43	510.46	1477.31	119.96	177.28
	Unlimited (> 11 hours)	16.62	1075.18	1770.53	143.77	212.46

Participants' reaction to default

- Exposure control
  - "grote postenregeling": banks should not build up exposure towards any counterparty exceeding 25% of their regulatory capital

  (note that this concerns solvability protection, not geared towards operational failures)
  - Use % of regulatory capital as proxy for limits in banks' internal systems: 25%, 10%, 5%

Participants' reaction to default

- Exposure control
  - Foreign banks: relatively low regulatory capital ⇔ low limits in the model
  - European banks operating under a European passport: proxy by creating "peer group" of 4-6 Dutch banks with similar payment flows (values)

Participants' reaction to default

- Exposure control

		Unsettled payments		Additional liquidity		
		Number	Value (EUR million)	Value (EUR million)	Costs of overnight overdraft (EUR thousands)	
					EONIA	marginal lending
Exposure limited to (in % of regulatory capital)						
	5%	8.71	756.96	1220.07	99.06	146.39
	10%	9.00	783.71	1368.85	111.14	164.24
	25%	9.38	850.42	1605.66	130.37	192.66
	Unlimited	16.62	1075.18	1770.53	143.77	212.46

Participants' reaction to default

- Limits and assumptions: this exercise does not take into account:
  - the initiator of payment (bank vs. client)
  - the payment type (eg money market operations)
  - the value (small vs. big)
  - the relation between the failing bank and the other banks
  - the location of the counterparty
  - For exposure control - the order of payments (a first payment early in the day would not be blocked)

Controlling participants' exposures

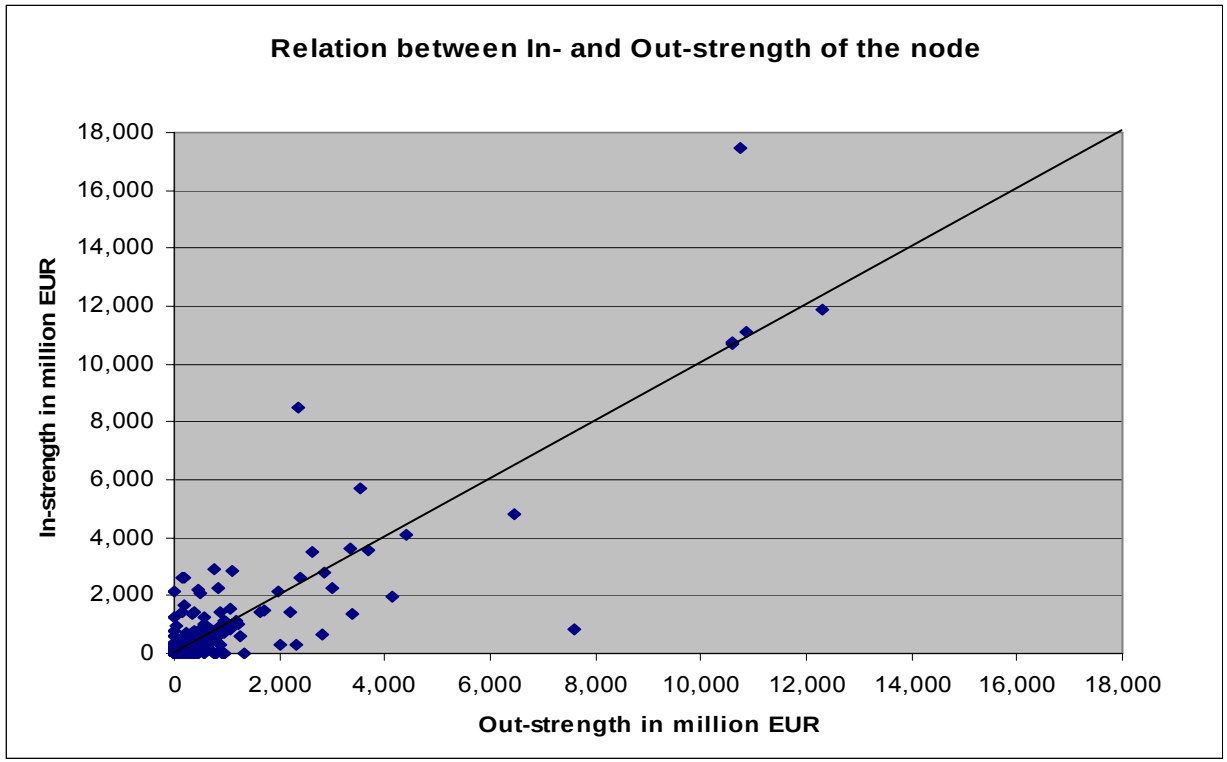
- Ability to control exposures determined by degree of reciprocity with failing bank
- Consider failing bank and its counterparties as a partial network, which would be a "tree" network,

⇔all payments are sent or received by the failing bank

Controlling participants' exposures

- In "network speak":
  - node: each payment system participant
  - link: each payment between 2 banks
  - reciprocity: the fraction of links for which there is a link in the opposite direction
  - In- vs. out-strength: the weight (in number or value) of payments received or sent by the node

Controlling participants' exposures



Controlling participants' exposures

- Weighted link reciprocity

$$\rho^{\omega} = \frac{\sum_{i \neq j} (e_{ij} - \bar{e})(e_{ji} - \bar{e})}{\sum_{i \neq j} (e_{ij} - \bar{e})^2}$$

- where $\bar{e} = \frac{\sum_{i \neq j} e_{ij}}{N(N-1)}$ is the average link weight

Controlling participants' exposures

- $\rho_\omega > 0$: weighted reciprocal networks

⇔ banks can control their exposures to each other by not sending payments after default

- $\rho_\omega < 0$: weighted anti-reciprocal networks

⇔ banks can only limit their exposure when they send more than they receive

- with $\rho_\omega = 0$ the network is neutral, bank's ability to control their exposure is limited

Controlling participants' exposures

- Weighted link reciprocity in a "tree" network

$$\bar{e} = \frac{\sum e_{iB}}{N-1} \qquad \text{and} \qquad \rho^{\omega} = \frac{\sum (e_{iB} - \bar{e})(e_{Bi} - \bar{e})}{\sum (e_{iB} - \bar{e})^2}$$

in our data: $\rho^{\omega} \approx 0$

$\Rightarrow$ the partial network is neutral

Further work

- General
  - confidence intervals & other statistical information
- Timing of default
  - calculate the additional liquidity needed and the cost of that liquidity
  - exercises with timed stop-sending and exposure control with different default times

Further work

- Timed stop-sending
  - vary reaction delays: 6, 8 hours.
  - stop-sending not as function of default time, but of when participants were expecting payments
- Exposure control
  - exposure at 3 % of regulatory capital (reporting threshold)

Further work

- Controlling exposures
- vary the network characteristics
- analyse the relation between in-/out-strength and weighted reciprocity,

  & between weighted reciprocity and ability to control exposure