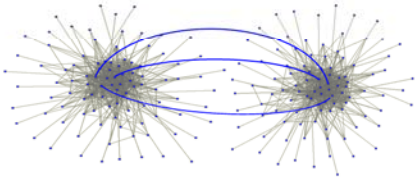
Congestion and Cascades in Coupled Payment Systems

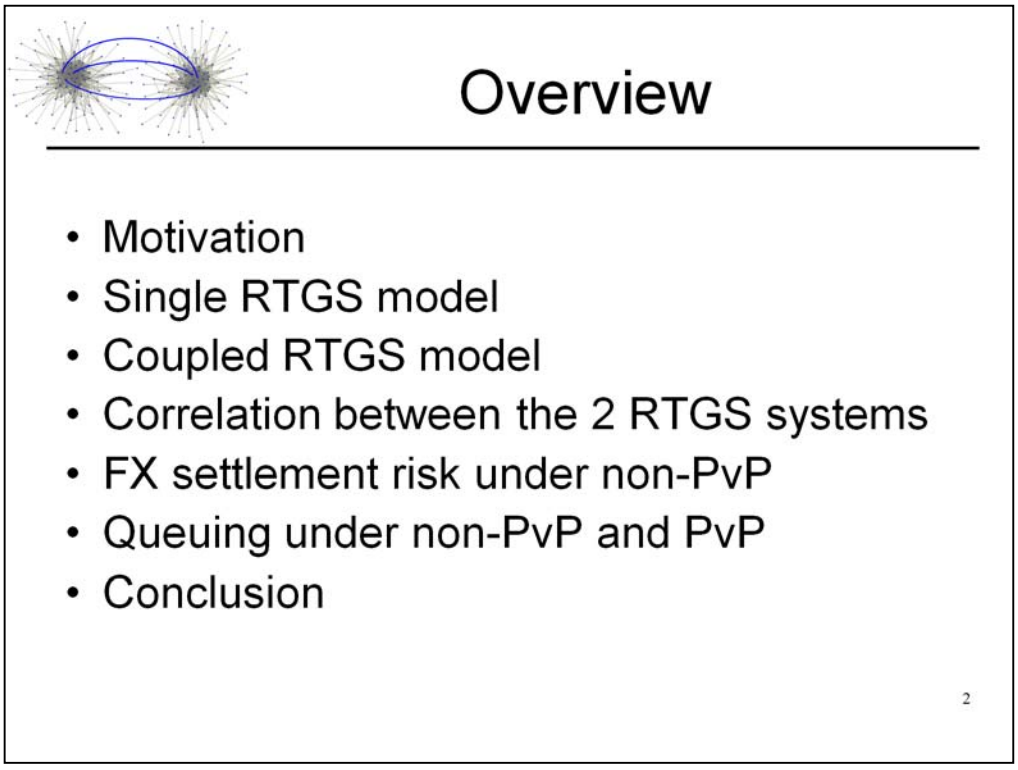


Fabien Renault[1]
Morten L. Bech[2]
Walt Beyeler[3]
Robert J. Glass[3]
Kimmo Soramäki[4]

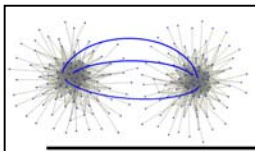
[1]Banque de France
[2]Federal Reserve Bank of New York
[3]Sandia National Laboratories
[4]ECB, Helsinki University of Technology

Joint Bank of England / ECB Conference on
"Payments and monetary and financial stability"
Frankfurt 12 November 2007

Speaker: Fabien



Speaker: Fabien



Motivation

- The 2001 Group of Ten *"Report on Consolidation in the Financial Sector"* (the Ferguson report) noted a possible increased interdependence between the different systems due to:
  - The emergence of global institutions that participate to many systems
  - The emergence of global service providers offering services to many systems
  - The development of DvP procedures linking RTGS and SSS
  - The development of CLS
- The report suggested that these trends might accentuate the role of payment and settlement systems in the transmission of disruptions across the financial system.
- To complement this previous work, the CPSS (Committee on Payment and Settlement Systems) commissioned a working group to:
  - describe the different interdependencies existing among the payment and settlement systems of CPSS countries
  - analyze the risk implications of the different interdependencies

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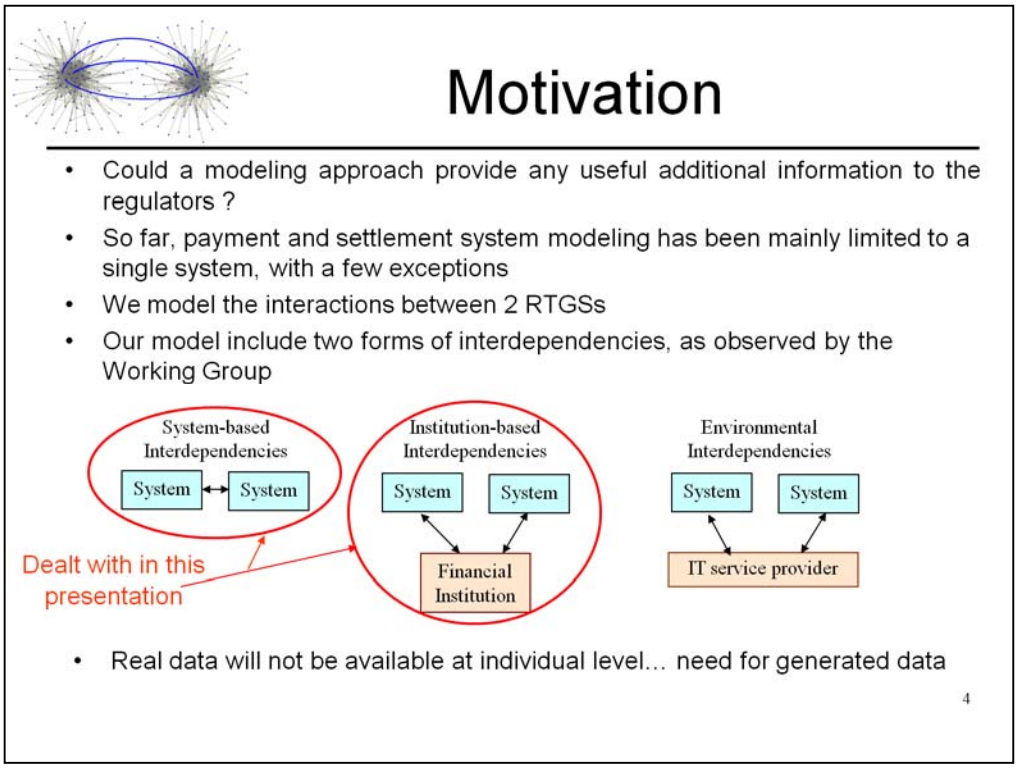
Speaker: Fabien



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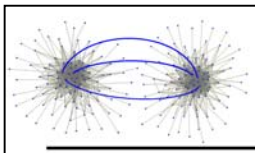
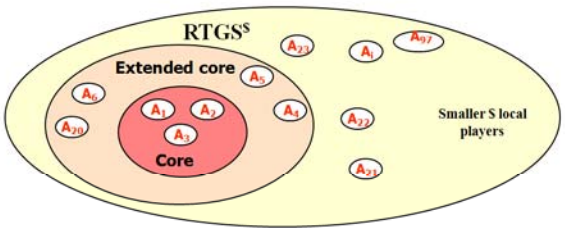


Single RTGS model

Model description

- RTGS$ is a "virtual" RTGS
- The value of all payments is taken equal to 1
- Many participating banks of different sizes (initial balance at the CB, volumes emitted and received, number of counterparties…)



- The structure of the network (scale-free with an average of 12 counterparties per bank) was chosen in order to mimic the structure of the core of FedWire
- Payments are generated randomly between a bank and one of its counterparties, according to an intensity varying Poisson process
- Payments are settled immediately if the paying bank has sufficient liquidity, else they are queued until the paying bank receives some liquidity

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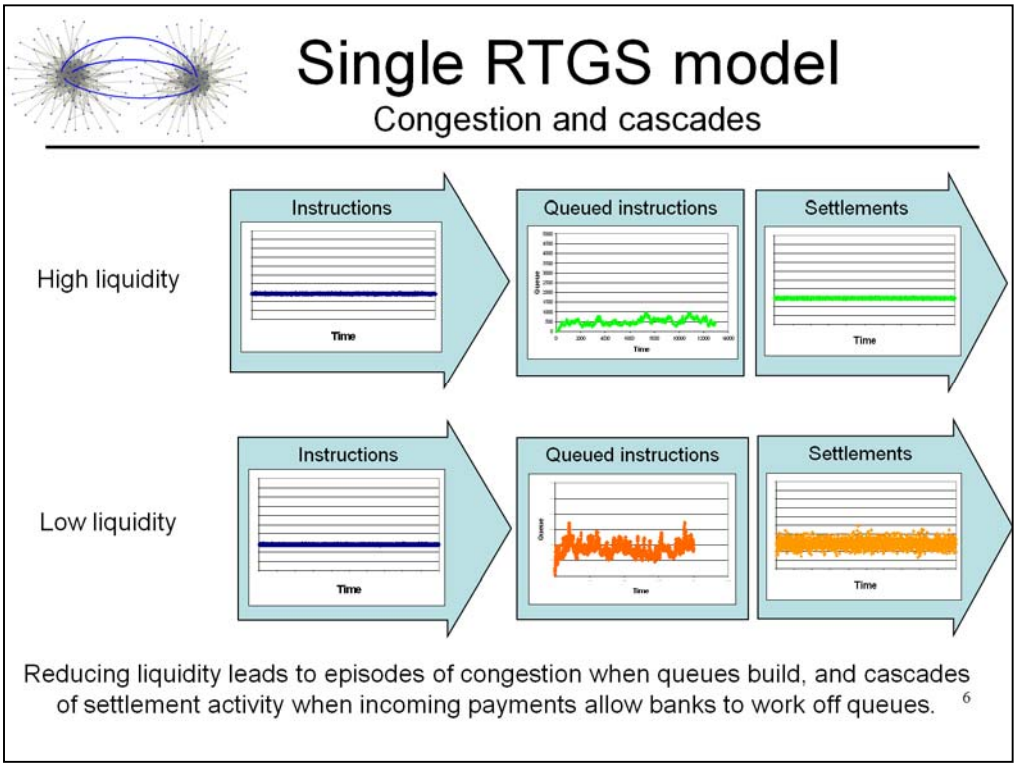
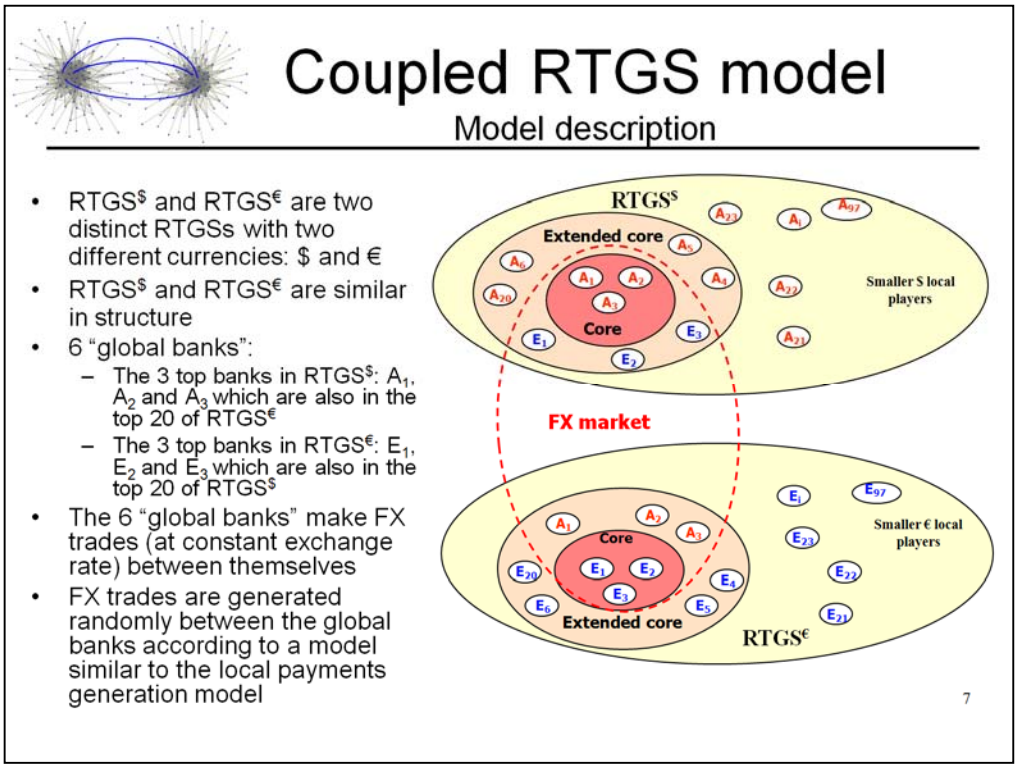
Speaker: Fabien



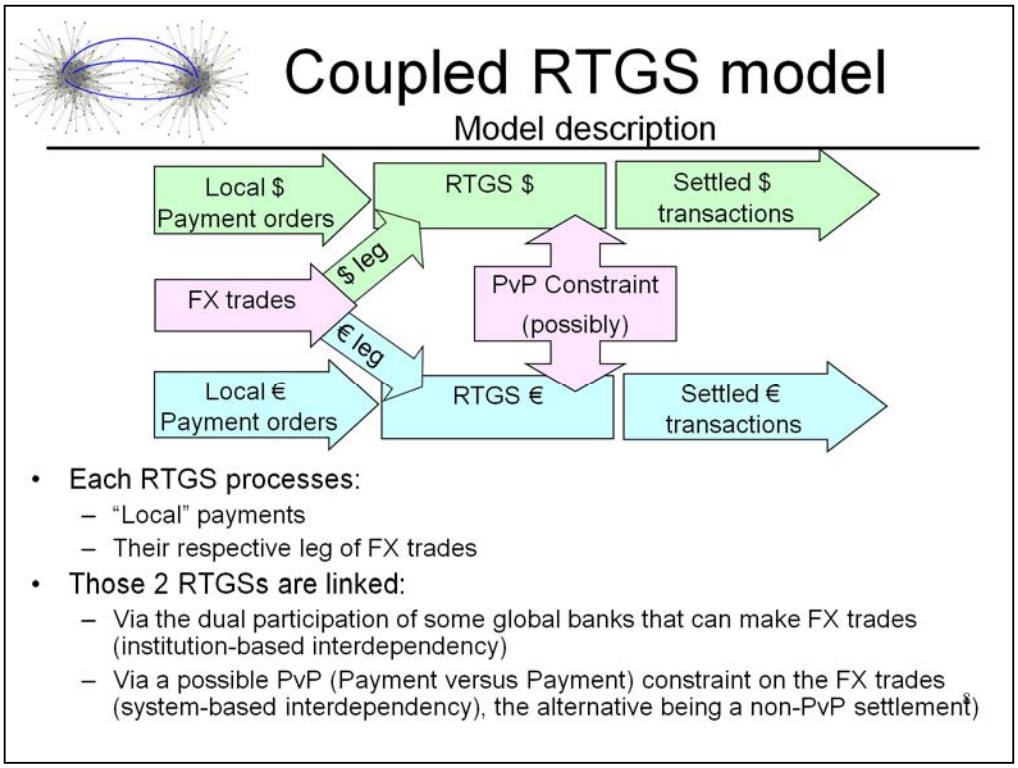
Speaker: Robert

Lowering liquidity couples processing across banks. Payments loose correlation with input because their timing becomes determined by internal dynamics of the system.

NOTE: we would see increasing correlation of payment activity between neighboring banks as correlation with instructions declines. This is akin to reaction function.



Speaker: Fabien



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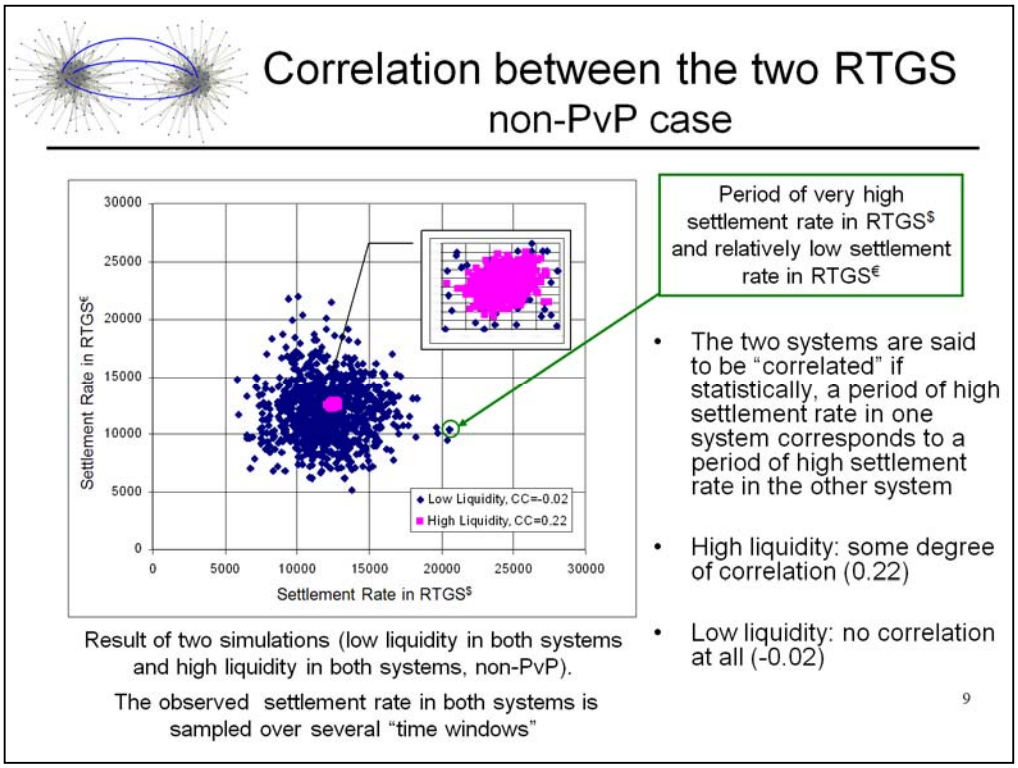
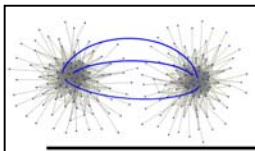


Speaker: Walter

This is the settlement rate for the entire system, not just FX

We're showing settlement rates in the two systems measured over 1000 small time windows using different networks in each system

The systems are correlated only because their response is correlated to the input which is identical in each system…

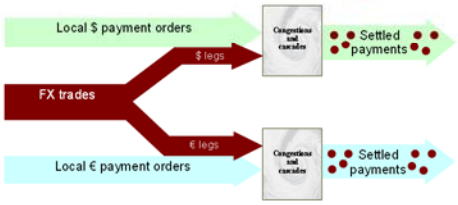


Correlation between the two RTGS sum-up

High liquidity non-PvP

Correlation: 0.22 (institution-based interdependency)

Low liquidity non-PvP



Correlation: - 0.02 (none)

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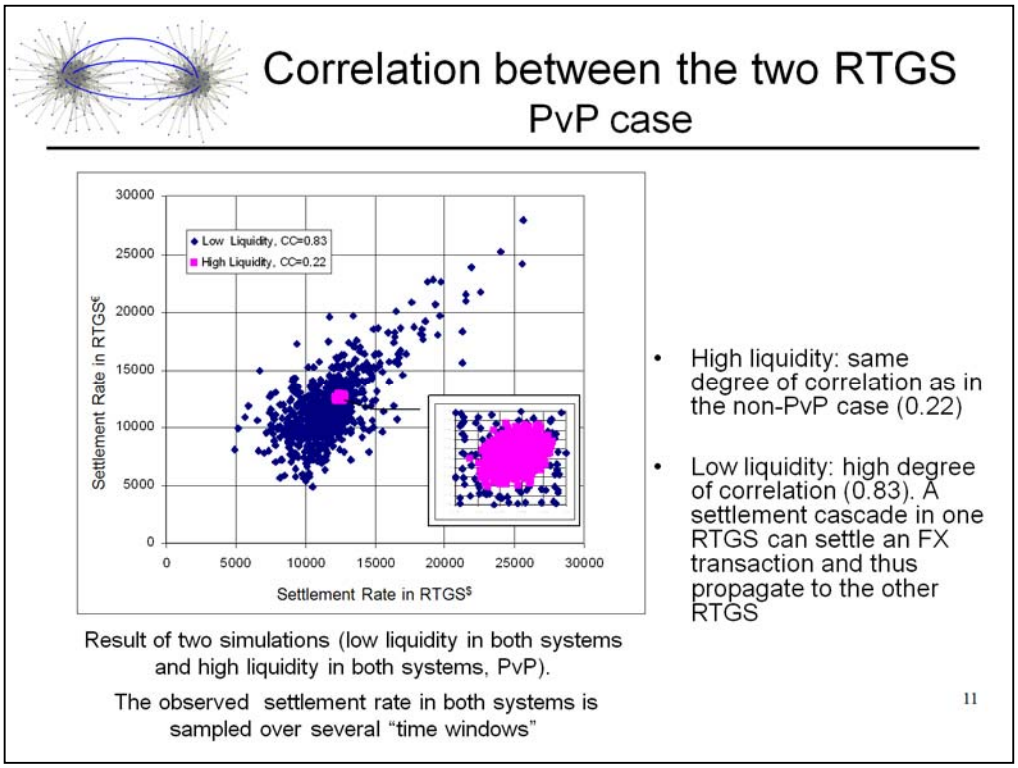
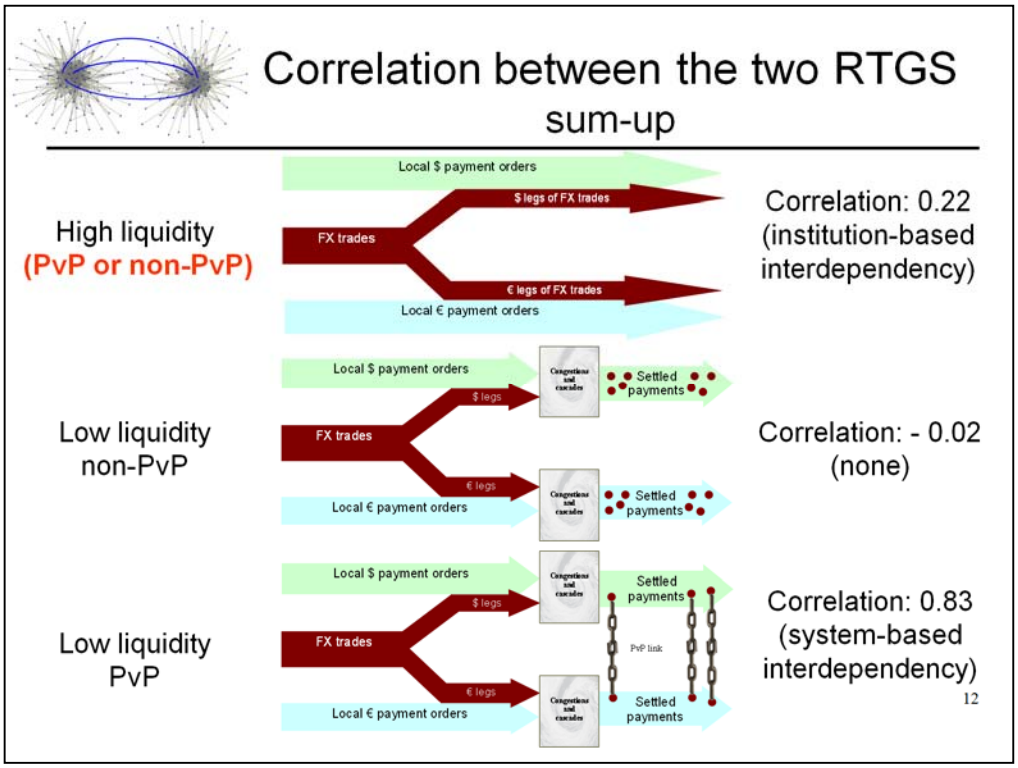


Speaker: Walter

Note scale change from 25000 for FoP up to 35000 for PvP here

We're showing settlement rates in the two systems measured over 1000 small time windows using different networks in each system

Red arrows points out the correlated high settlement rates (cascades) in each system triggered by PvP payments, there are also corresponding periods of correlated low settlement rates


Correlation between the two RTGS sum-up
High liquidity
(PvP or non-PvP)
Local $ payment orders
$ legs of FX trades
FX trades
€ legs of FX trades
Local € payment orders
Correlation: 0.22
(institution-based interdependency)
Low liquidity
non-PvP
Local $ payment orders
$ legs
FX trades
€ legs
Local € payment orders
Settled payments
Settled payments
Correlation: - 0.02
(none)
Low liquidity
PvP
Local $ payment orders
$ legs
FX trades
€ legs
Local € payment orders
Settled payments
PvP link
Settled payments
Correlation: 0.83
(system-based interdependency)
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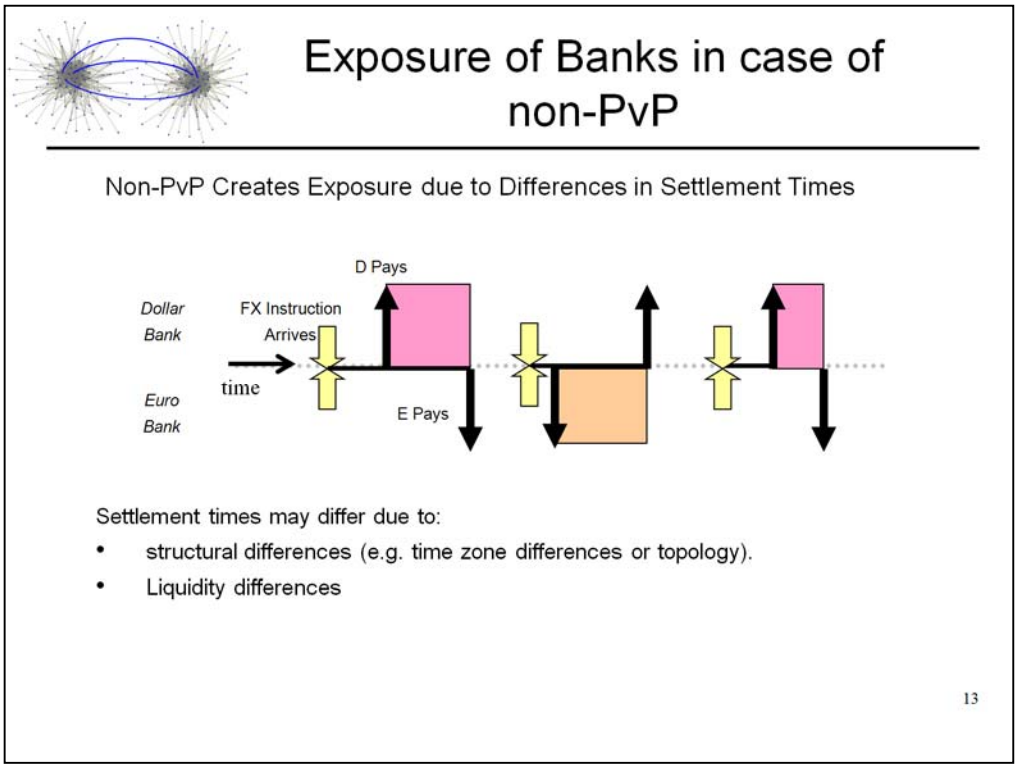
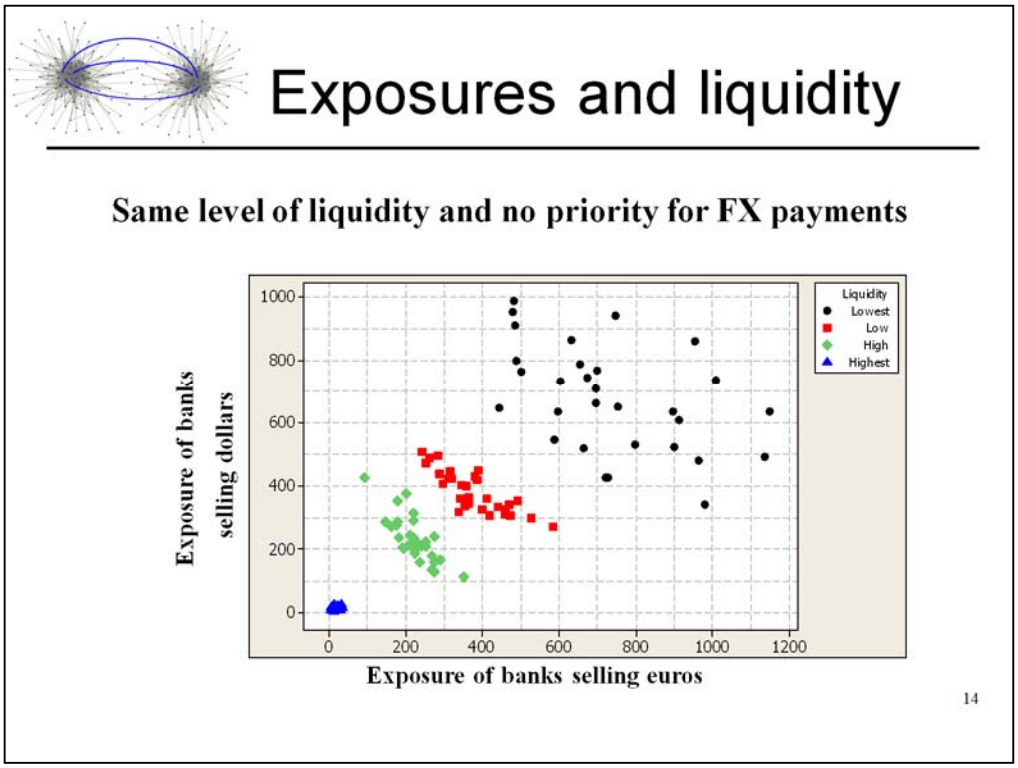


Speaker: Walter

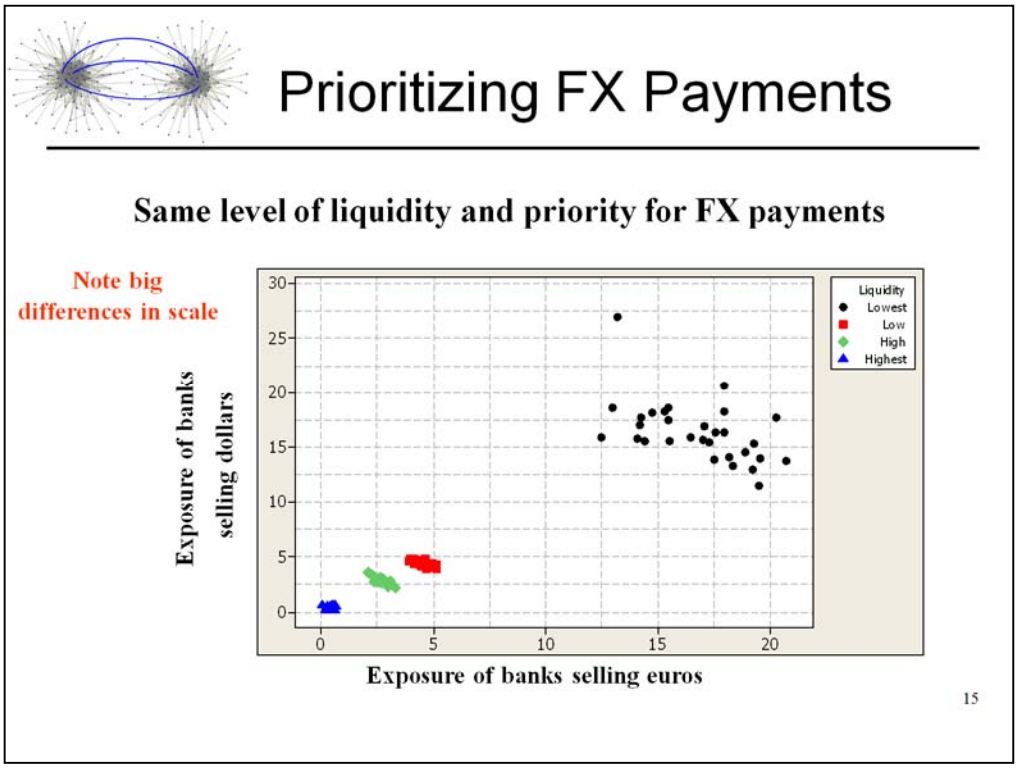


Speaker: Morten

We here show exposures between the € selling banks and the $ selling banks, when both RTGSs have the same level of liquidity and with a no priority for FX payments.

As expected the aggregate exposures increase as liquidity decrease.

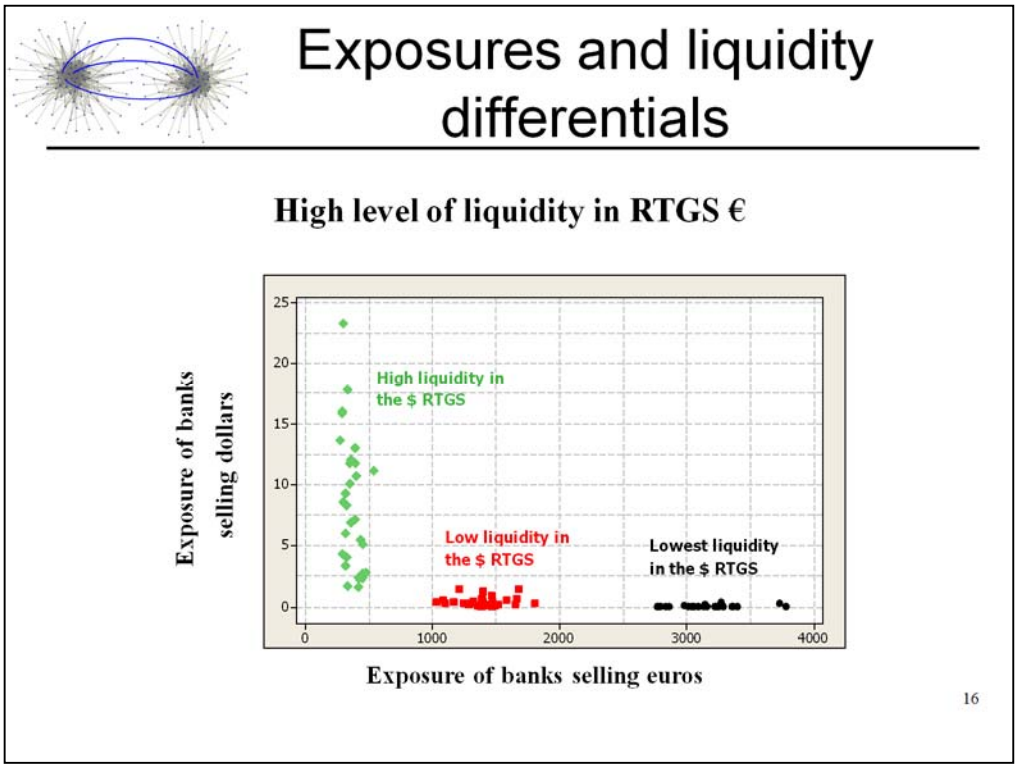
Whether the euro selling banks or the dollar selling banks are



Speaker: Morten

We here show exposures between the € selling banks and the $ selling banks, when both RTGSs have the same level of liquidity and with a priority for FX payments.

In this particular case the priority for FX payments is sufficient to eliminate most of the exposure. Obviously all other types of payments are queued to a higher degree.

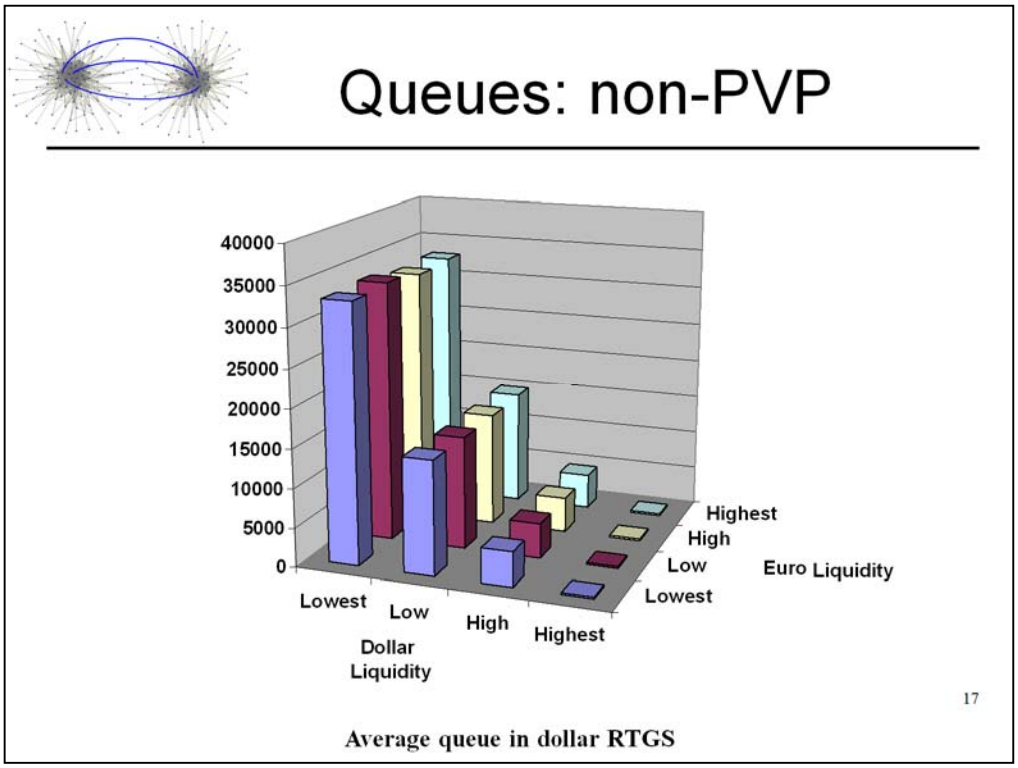


Speaker: Morten

Here we show exposures between the € selling and the $ selling banks, when euro liquidity is at the highest level and dollar liquidity varies.

The less liquid the dollar system is the higher is the exposure for the banks selling euros because euros are settled quicker than dollars.

Whether the euro selling banks or the dollar selling banks are



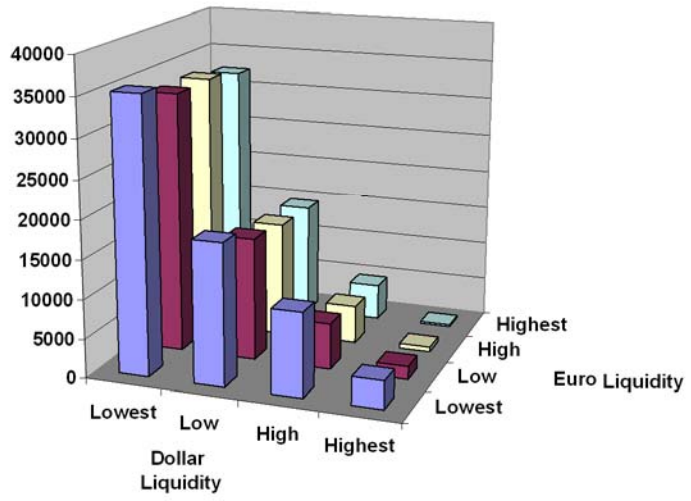
Speaker: Morten

PvP eliminates the FX related exposures but introduces queuing

Here, we show the average

There are more queuing in the two systems when there is a PvP mechanism except when both systems are super liquid.

Queues: PVP



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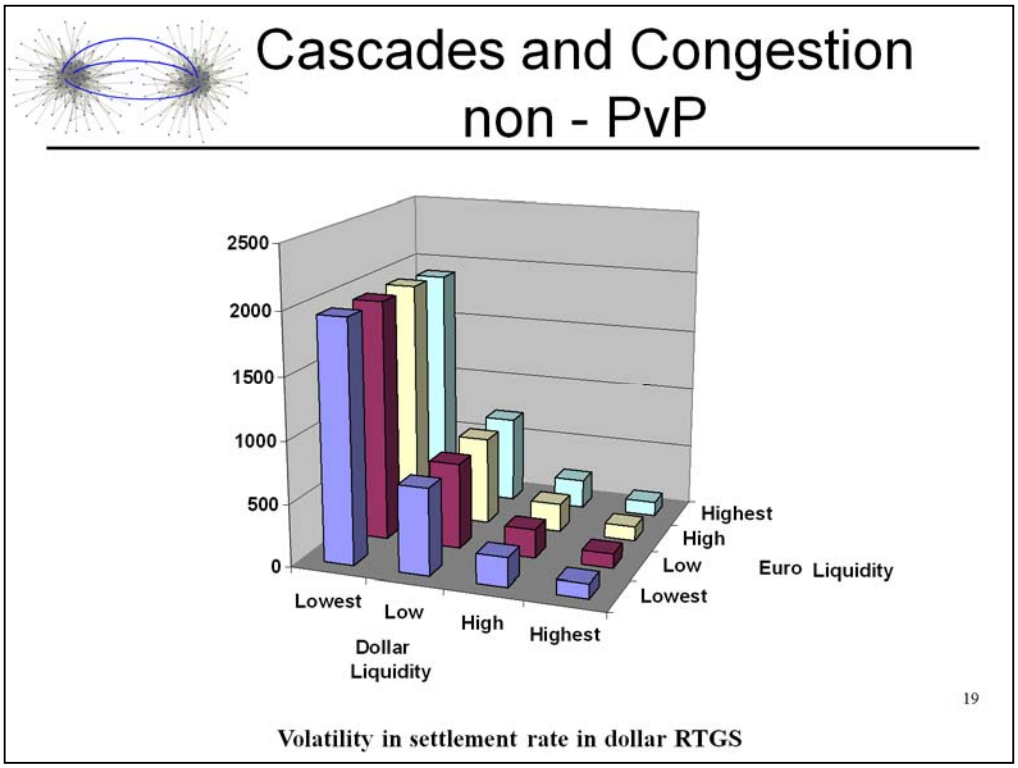
Average queue in dollar RTGS

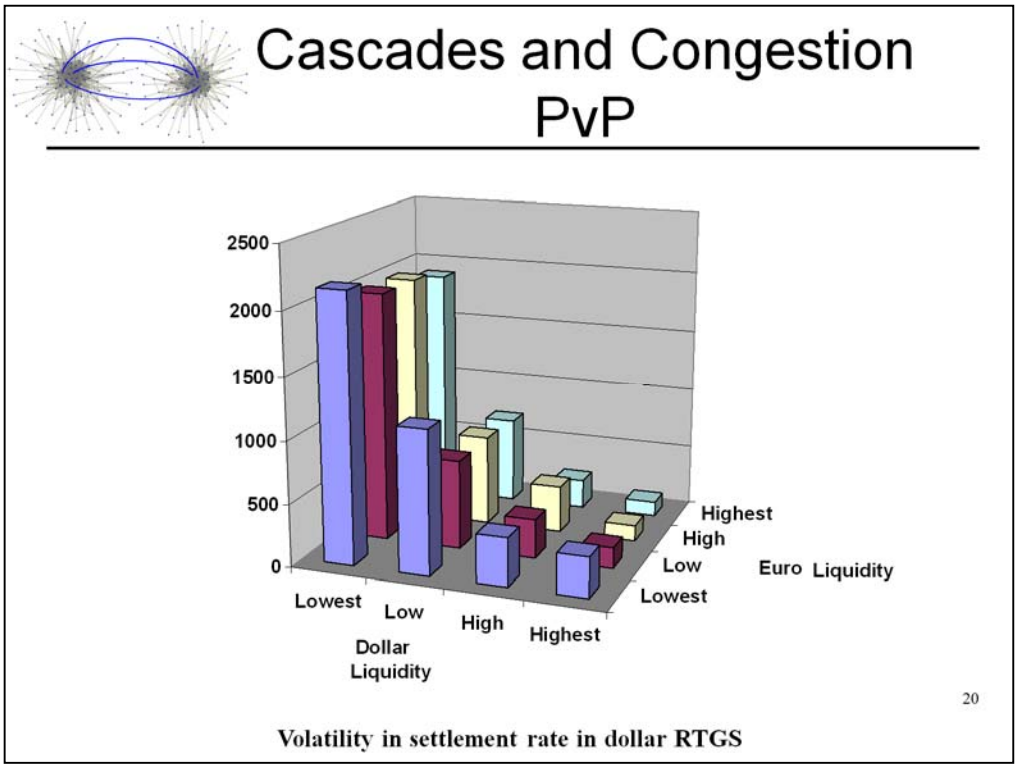


Speaker: Morten

In the case of non-PvP the degree of cascades and Congestion here measured as the variability of the settlement rate is

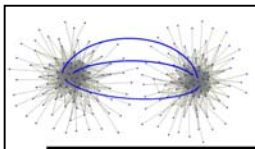
1) Decreasing in the liquidity of the system

2) Does not depend on the liquidity of the other system



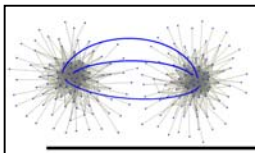
Speaker: Morten

In the case of PvP the degree of cascades and Congestion is higher than non-PvP and the level depends on the liquidity of the other system.



Conclusions

- At high liquidity the common FX drive creates discernable correlation in settlement
- At low liquidity
  - Congestion destroys instruction/settlement correlation in each system,
  - Coupling via PvP *amplifies* the settlement/settlement correlation by coordinating the settlement cascades in the two systems
- Queuing in systems increases and becomes interdependent with PvP
- Congestion and cascades becomes more prevalent with PvP
- Exposure among banks in the two systems
  - Is inversely related to liquidity available.
  - Is reduced by prioritizing FX
- Banks selling the most liquid currency are exposed



Upcoming Investigations

- Effect of settling FX trades through a net funding mechanism
  - Decrease of the interdependency ?
  - However, the time critical payments would force the banks to set some liquidity aside…
- Reaction of the global system to shocks
  - Contagion of a local shock from one RTGS to another
    - Default of a local player (will the crisis spread out to the other currency zone?)
  - Effects of global shocks
    - Default of a global player
    - Total shut-down of a RTGS
    - Operational problems affecting the FX link
- Influence of an intraday FX swap market
  - Reduced queuing in normal operation
  - As a mitigation of a local shock affecting one RTGS (beneficial interdependency)
- Additional market infrastructures (SSSs, CCPs, ICSDs, DNSs, markets...)

Speaker: Fabien