



Implicit bilateral limits in Large Value Payment Systems

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◆ Disclaimer:

- Presentation is based on the views of the author and does not necessarily reflect any official views of Bank of Finland
- Work on progress...

◆ Acknowledgements:

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Outline

- ◆ Motivation and background
- ◆ Estimation of internal intraday limits from payment data
 - Replication of the payment system process flow
 - Estimates based on BoF-PSS2 bilateral statistics
- ◆ Validation of the estimated intraday limits
 - Do they reflect counterparty risk?
 - Do they match with overnight positions?
- ◆ Discussion and conclusions

Motivation and background

- ◆ Counterparty risk is a priority for banks
 - Basel II, pillar I
- ◆ Intraday liquidity management in large value payment systems might be too
 - Incentives exist for delaying payments if liquidity is costly
 - Anecdotal evidence for internal limits or liquidity management systems from many markets
 - E.g. Target2 or LVTS in Canada has explicit possibility to set intraday counterparty limits
- ◆ Subprime crisis combines the liquidity and counterparty risk perspectives

Reserach questions:

- ◆ Can the level of internal counterparty limits be indirectly observed and estimated from payment system data?
- ◆ What is the rationale behind the level of such limits?
- ◆ Are there recent changes in the behaviour of the banks in large value payment systems?

Possibly yes.

Estimation of limits

- ◆ Data from Finnish large value payment system (BoF-RTGS) is used
 - Data period: 07/1997- 12/2007
 - In 2007: 2600 transactions per day, value ~70 times GDP in year
 - 24 participant banks included in the study, 552 relevant bank pairs (A to B \neq B to A)
- ◆ Simulation of the system with Bank of Finland Payment and Settlement System Simulator (BoF-PSS2)
 - Replications of realistic process flow: queues, gridlocks, limits, balances, settlement algorithms.
 - Recording of bilateral positions
 - "bilateral limits in use" and non restricting limit values in place

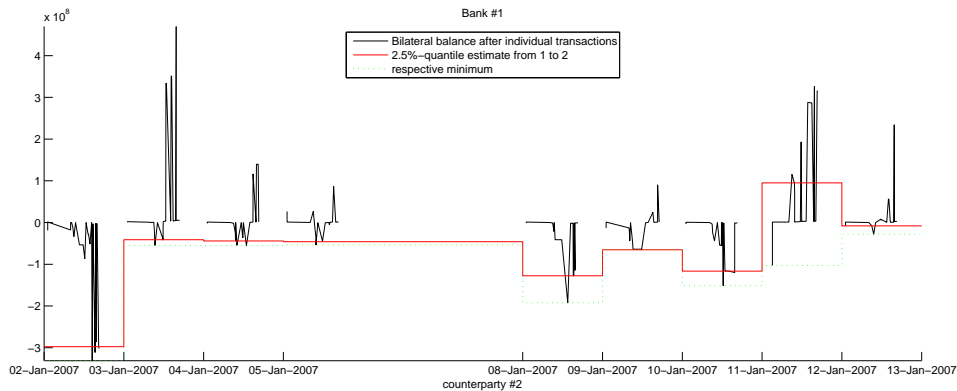
Bilateral positions

- ◆ Observed bilateral position should stay within the limit if there is such
- ◆ The internal counterparty limit is however...
 - not reached every day
 - not likely to be reached exactly
 - possibly bypassed by prioritized transactions
- ◆ "Ultimate limit" driven by
 - Capacity of intraday liquidity
 - Perceptions of the counterparty riskiness

Tested methods for capturing the magnitude of internal limits

- ◆ Minimum bilateral balances
 - ◆ Quantiles
 - of empirical distribution of bilateral positions after all transactions in a given pair of banks
 - Allows given share of prioritized outlier payments to violate the limit
 - ◆ Barrier function estimates
 - More complex way to do essentially the same thing as above
- ⇒ Estimation results give daily and monthly time series for each bilateral pair of banks

Bilateral positions and some estimated limits



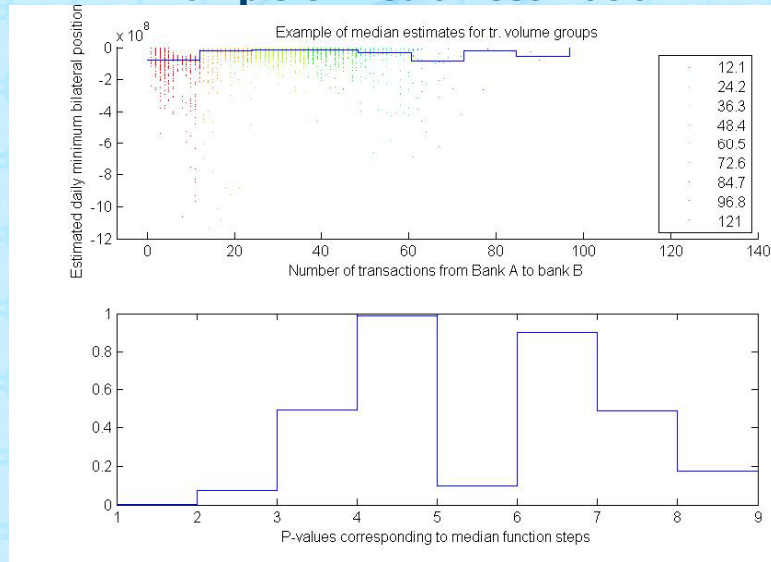
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Alternative estimation; interaction with transaction volume

- ◆ Larger number of transactions
 - ⇒ higher probability of internal limit becoming active constraint
 - ⇒ Higher accuracy of estimates (on average)?
- ◆ To utilise this hypothesis
 1. Daily simple estimates (minimum) are grouped
 2. Median value within each group
 3. "ultimate limit" = level after which significant increase in the median

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Example of median estimation



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Do the limits make any sense? (Part 1)

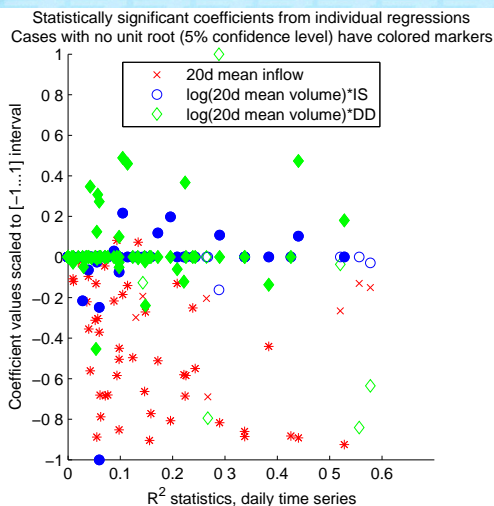
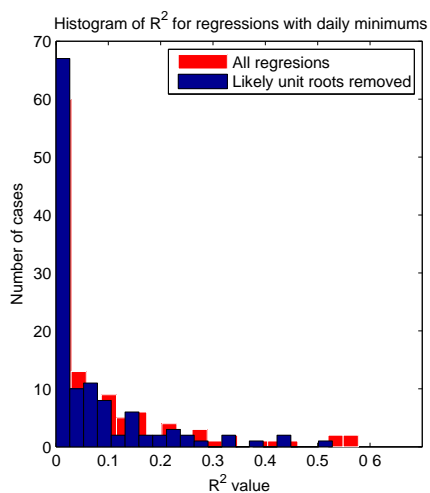
- ◆ Regression analysis of the estimated value of limits with
 1. independent external variables, such as
 - Distance to default of counterparties (ala KMV Moody's),
 - Overall sentiment of the market: interest rate spread between Eurepo and Euribor
 2. Independent variables derived from the payment flow
 - Volume of the transaction flow
 - Value of payments received from a counterparty in the past
 3. Interaction terms, where applicable
- ◆ Which quantile estimate gives best fit for the model?

Example: daily time series of minimum intraday bilateral balance of Bank A vis-a-vis bank B explained in simple stepwise OLS with

- daily time series of default risk (DD) of bank B
- general market sentiment daily (Eurepo-Euribor)
- Daily floating average of incoming funds from B to A, average over 20 bank days

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Results, daily time series



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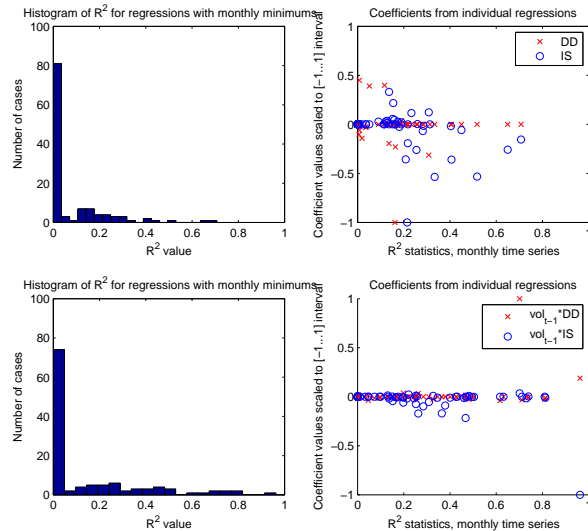
Result details, daily regressions

- ◆ Is some quantile estimate explained better than others?
 - Test with Wilcoxon rank sum test for distribution of R^2 values from different sets of regressions
 - No significant difference observed in the fit of the regressions
- ◆ 7% of pairwise limit time series excluded from regressions due to likely unit root. Only data since 4/2002 included in ADF-unitroot test to increase accuracy
- ◆ Tested combinations: $\{DD, IS\}$, $\{DD, IS, TV\}$, $\{Volume_{20\text{-period m. average}} * DD, Vol_{20} * IS, TV\}$, $\{Vol_{20} * DD, Vol_{20} * IS\}$, $\{\log(Vol_{20}) * DD, \log(Vol_{20}) * IS, TV\}$
- ◆ Stepwise regression with 5% significance threshold to be included and 10% threshold to be excluded

Different independent variables in regressions with daily time series	Number of times when significant	Number of times when significant, (unit roots removed)	Sign of the coefficient
Log(20 days mean volume)*Distance to default_DD	16	14	?
Log(20 days mean volume)*Interest rate spread (IS)	31	24	?
20 days mean value, incoming payments (TV)	58	50	-
Nr significant independent variables	Nr of cases		
filtered cases with likely unit root	-	7 %	
0	51 %	43 %	
1	23 %	25 %	
2	20 %	22 %	
3	6 %	3 %	
Highest individual R2 value	0,578	0,528	

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Results, monthly time series



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Result details, monthly regressions

- ◆ Again no statistically difference between quantile estimates in R² (minimum, 0.5%, 1%, 2.5%, 5%, 7.5% and 10% quantiles tested)
- ◆ Monthly time series more often nonstationary
 - 50,5% of cases which could be run through ADF-unit root test failed to reject unit root
- ◆ Sign of interest rate spread's (IS) coefficient could be negative in cases where there is so... explanatory power

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Do the limits make any sense? (Part 2)

- ◆ Comparison to overnight loan positions
 - Loans identified from payments data
 - Takes into account the accumulated positions
- ◆ Method by Furfine (1999)
 - Finding transaction pairs, which
 - are paid on one day and returned on the next day with principal and interest
 - match the overnight interest rates closely
 - have principal value in large round figure
- ◆ Data from 2007 in BoF-RTGS
 - 12 banks out of the 24 active in the overnight market, number of days with activity varies (0-176 days out of 256)

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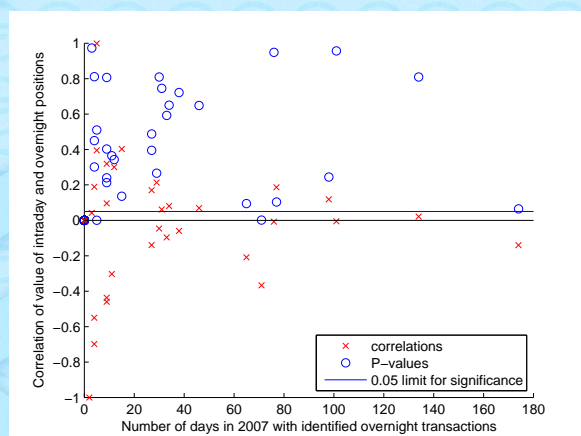
Correlations of estimated intraday and overnight position

• No correlation can be observed between estimated intraday limit (minimum position) and overnight position.

Also

• In monthly level ratio of average overnight vs intraday position has range of 0.1 ... 1000 (excluding outliers)

⇒ Markets for overnight loans completely different from payment streams intraday



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Restrictions of the current approach

- ◆ Bank pairs were treated individually
- ◆ Participation in multiple systems
- ◆ Counterparty positions in multiple currencies
- ◆ The intermediary role of banks: mixture of customer payments and own transactions
- ◆ Not all banks may have invested in intraday liquidity management
- ◆ Intraday approach does not capture accumulated positions

Possible ways to overcome several of these restrictions are proposed – Try it out!

Conclusions

- ◆ Minimum bilateral positions from simulation serve as a proxy for internal intraday counterparty limit (?)
- ◆ If there are internal intraday limits used in Finnish market, the levels are not set by counterparty risk measures
- ◆ Decreased confidence in the interbank market **may** reflect in less strict intraday liquidity management in the payment systems
- ◆ The presented method can be used for
 - comparison of magnitudes of intraday and other exposures
 - observing patterns or changes in intraday liquidity management
 - Identifying free riders