

Time series study of TARGET2
overnight loans:
comparison to credit default swaps
and stock prices

Eero Tölö, Heli Snellman,
Matti Virén & Esa Jokivuolle

Disclaimer

The views expressed in this presentation are those of the authors and do not necessarily reflect the views of the Bank of Finland.

Motivation

- Is overnight loan data useful as a bank stress indicator?
- How does it compare to credit default swaps or stocks?
- Potentially the data could be more informative and reliable

Approach

- Panel of 50 banks that participate in TARGET2 and have both publicly traded stock and CDS.
- Standard time series tools to analyze overnight loan data against credit-default swaps and common stock
- High degree of anonymity, all analyses on aggregate level.

Data

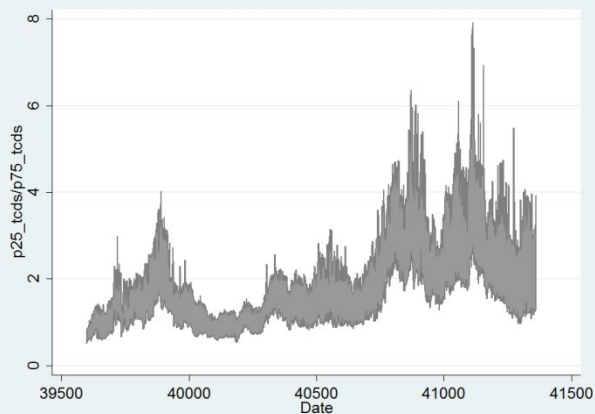
Time period: 1.6.2008 – 31.3.2013

Data	Source
Raw money market data => 1. ON rate 2. ON Loan value 3. ON counterparties 4. Dispersion measure	TARGET2 Money Market database (DnB WP 2013)
5. Stock price 6. Credit default swap spreads (CDS) 7. Financial statements	Bloomberg

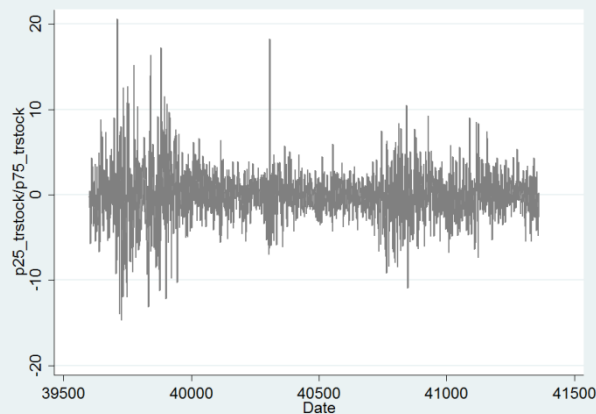
Look at aggregate panel data

The grey area is between 1st and 3rd quartile

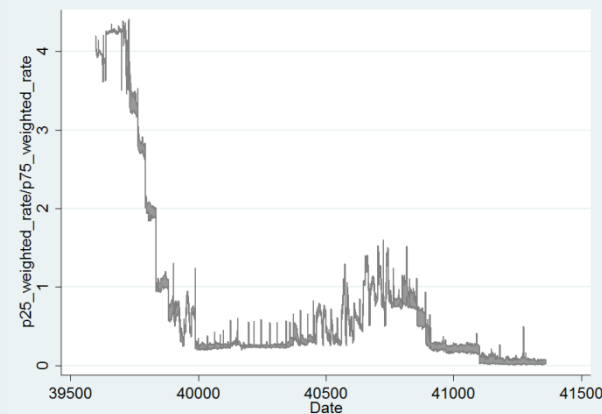
CDS SPREAD



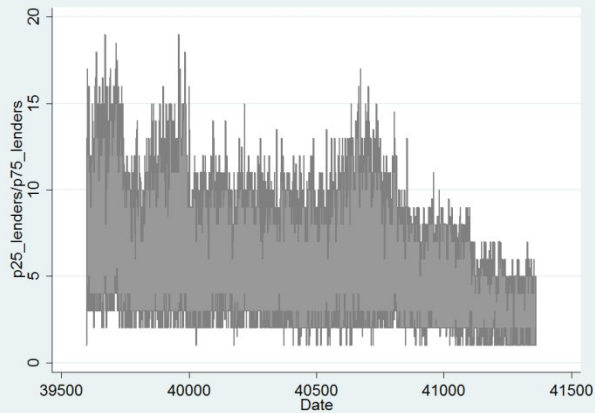
DAILY STOCK RETURN



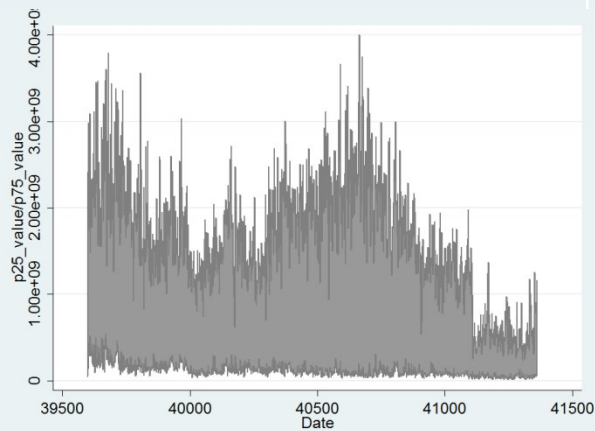
ON INTEREST RATE



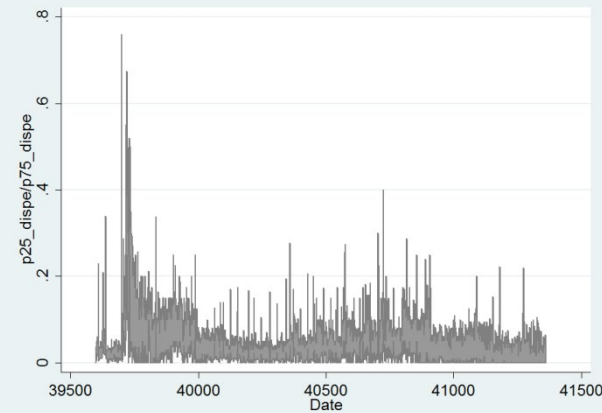
NUMBER OF ON LENDERS



VALUE OF ON LOANS



DISPERSION OF ON RATES



Analytical tools

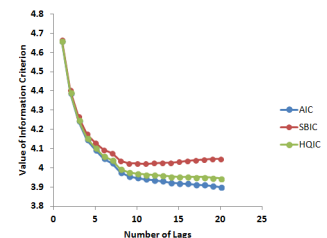
- Vector autoregression
- Causality relationships
- Cross-sectional correlation in CDS and ON spread

Vector Autoregression model

$$y_t^i = a_0^i + \sum_{k=1}^p A_k y_{t-k}^i + e_t^i \text{ for each day } t \text{ and bank } i$$

$$y_t^i = \begin{bmatrix} \Delta C_t^i \\ \Delta R_t^i \\ \Delta \log S_t^i \\ \Delta \log V_t^i \\ \Delta \log N_t^i \\ \Delta D_t^i \end{bmatrix}$$

- Regression coeffs. A_k independent of bank i
- Use the first difference to ensure stationarity.
- p is the number of lags included
- Information criteria suggest approx. 10 lags

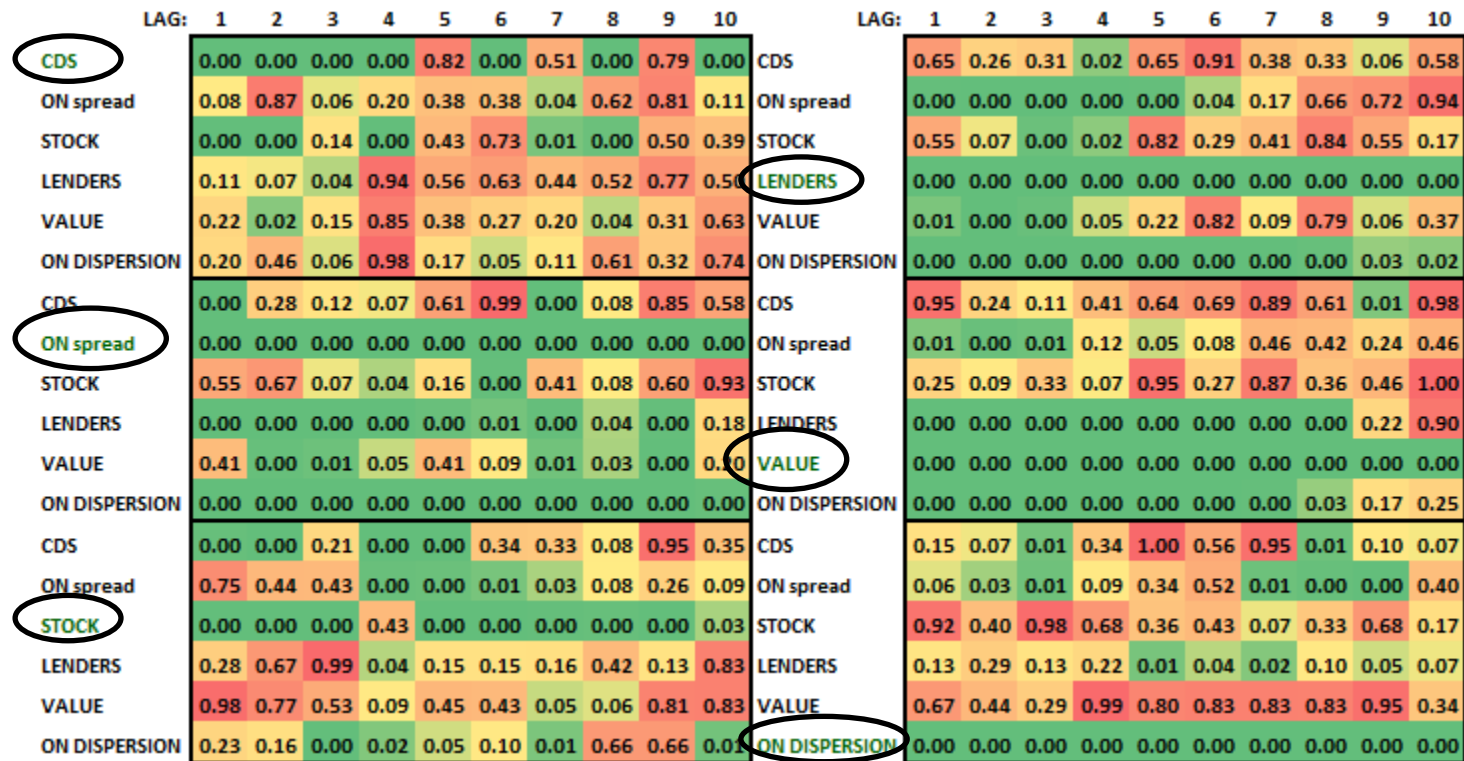


VAR output example

Equation	R-sq
cds	2.9 %
spread	30.2 %
stock	1.3 %
lenders	27.2 %
value	29.6 %
dispersion	35.2 %

- R^2 the fraction of variance explained
- First difference taken $\Rightarrow R^2$ smaller
- R^2 smaller for cds and stock

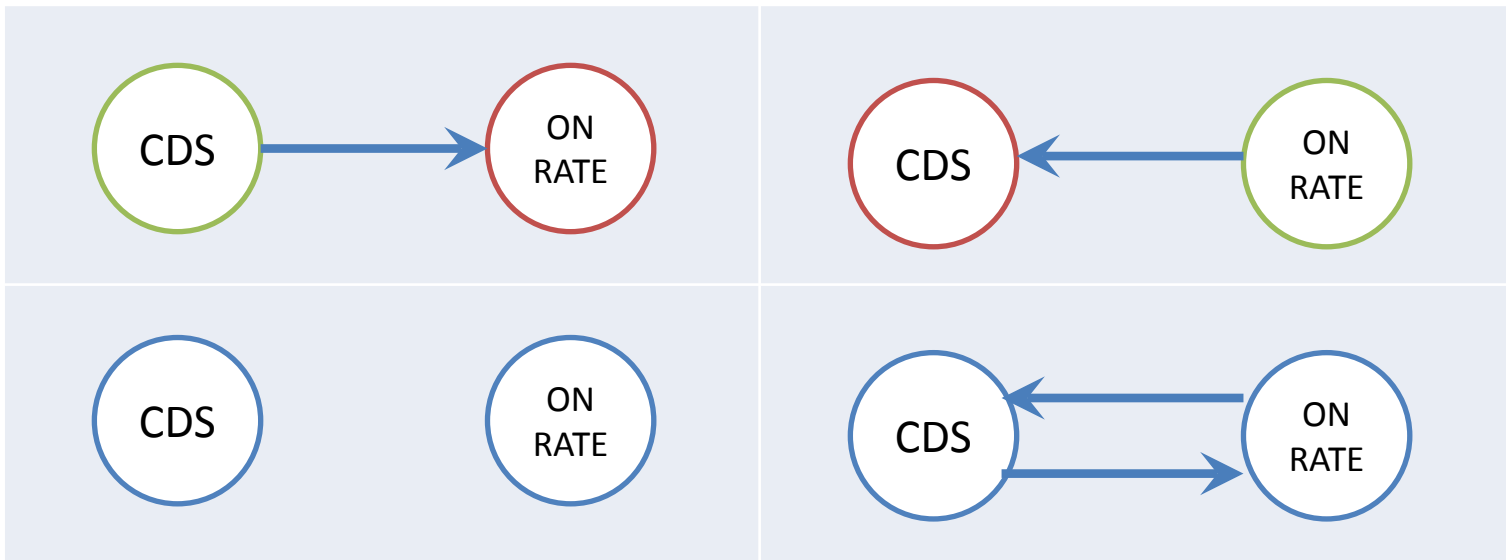
Heat map of significance of individual coeffs.



Greener color means smaller p-value (i.e. more significance)

Granger causality

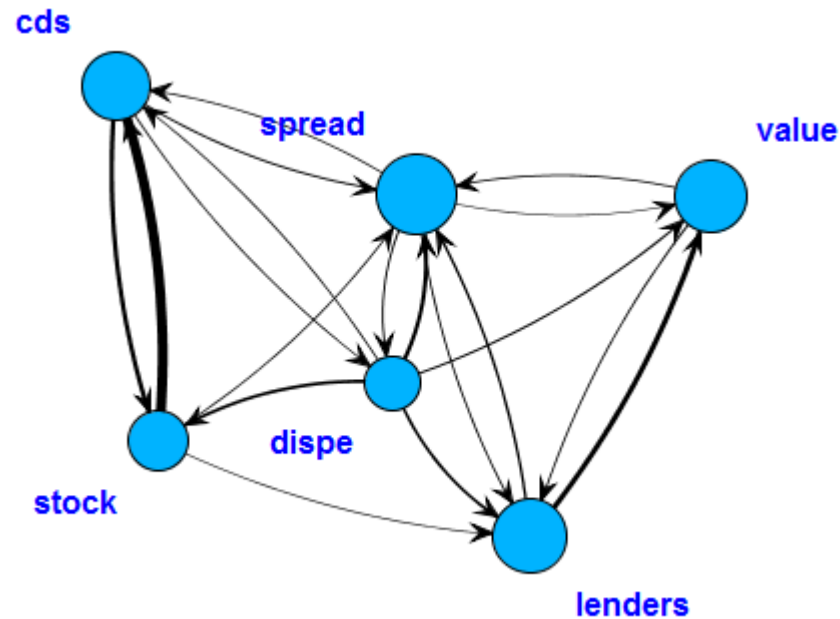
- Statistical hypothesis test for causality
 - Example: Does the CDS at time t_1 depend on the past ON rate spread at time $t_2 < t_1$ or vice versa?



Granger causality test results

Dependent	Explanatory	p-value	-LN(p)	Dependent	Explanatory	p-value	-LN(p)
cds	spread	0.004313	5.446033	lenders	cds	0.236209	1.443038
cds	stock	6.42E-122	279.056	lenders	spread	0.000311	8.077198
cds	lenders	0.28436	1.257513	lenders	stock	0.023066	3.769416
cds	value	0.10955	2.211371	lenders	value	0.00036	7.928823
cds	dispe	0.002533	5.97845	lenders	dispe	3.29E-11	24.13816
spread	cds	0.000101	9.200885	value	cds	0.336442	1.08933
spread	stock	0.002314	6.068752	value	spread	0.044212	3.118754
spread	lenders	5.04E-08	16.80327	value	stock	0.388173	0.946304
spread	value	0.000983	6.924769	value	lenders	3.11E-32	72.54714
spread	dispe	7.09E-20	44.09288	value	dispe	1.69E-05	10.98642
stock	cds	3.10E-24	54.13193	dispe	cds	0.002709	5.911035
stock	spread	0.113251	2.178147	dispe	spread	0.00017	8.680006
stock	lenders	0.224348	1.494557	dispe	stock	0.570409	0.561402
stock	value	0.421265	0.864493	dispe	lenders	0.288285	1.243805
stock	dispe	7.30E-14	30.249	dispe	value	0.684896	0.378488

Or more artistically...

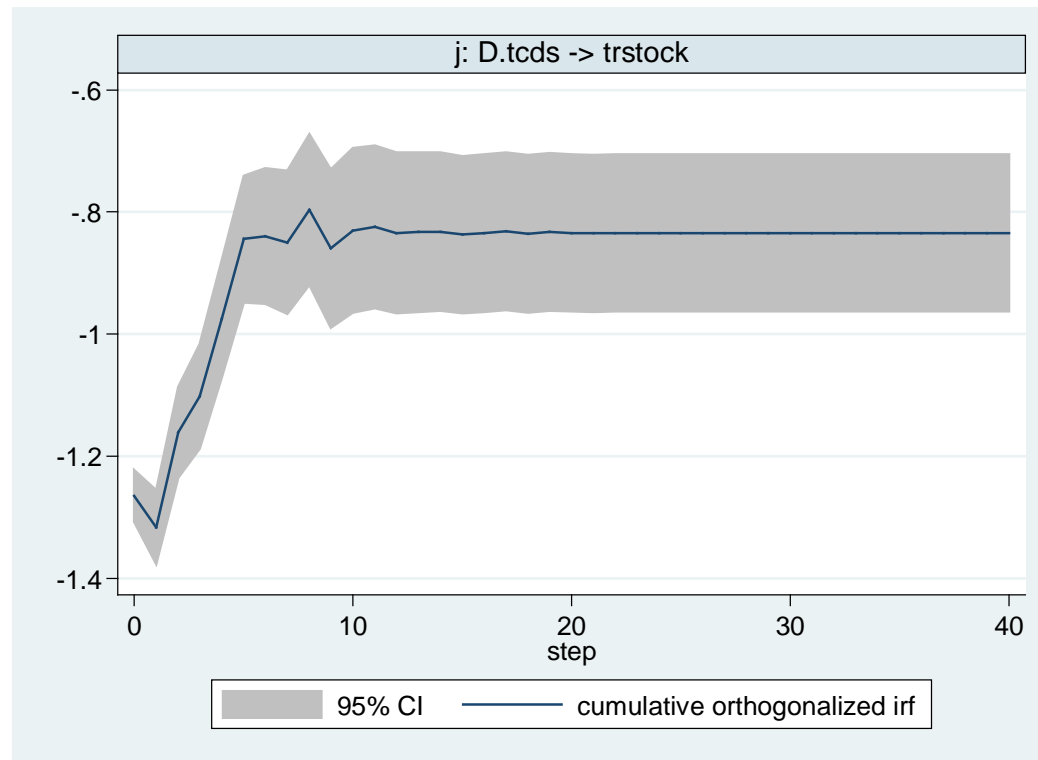


- Arrow thickness indicates power of the relationship
- Only arrows with $p < 0.05$ are shown

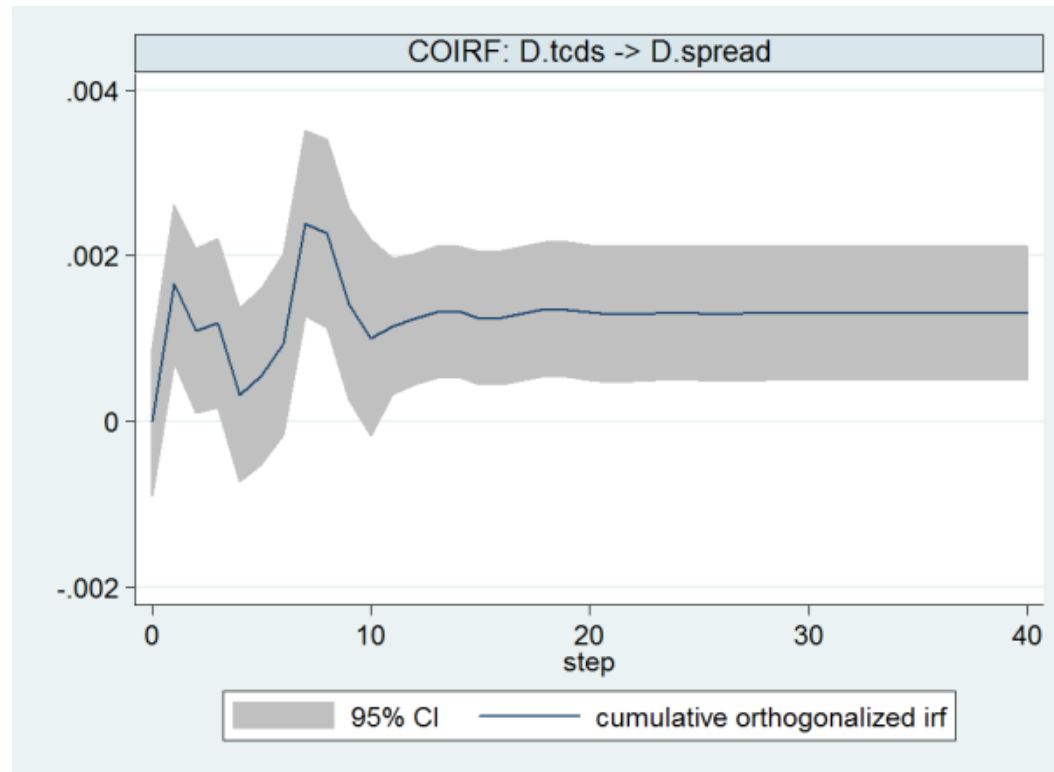
Impulse response functions

- Many lagged variables in VAR
- IRFs allow to extract the sign and size of the dependence between variables
- We use cumulative (Cholesky) orthogonalized IRF to extract the impulse of individual variables.

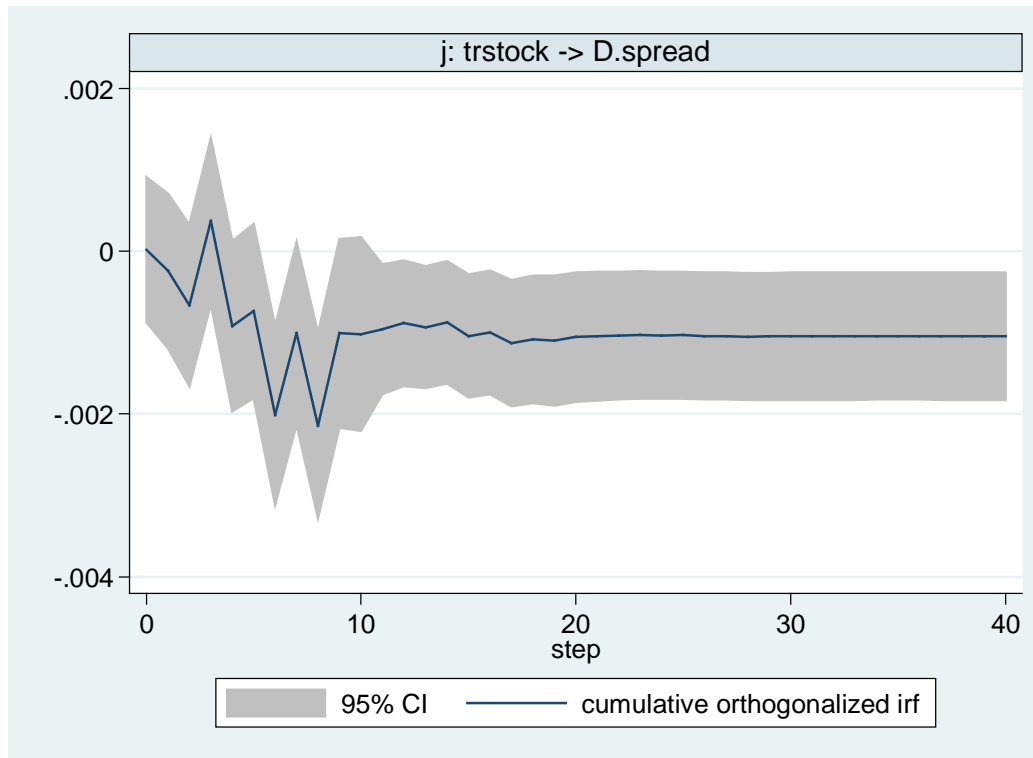
Response of bank stock prices to an increase in CDS spreads



Response of ON interest rate spreads to CDS spreads



Response of ON interest spreads to stock prices

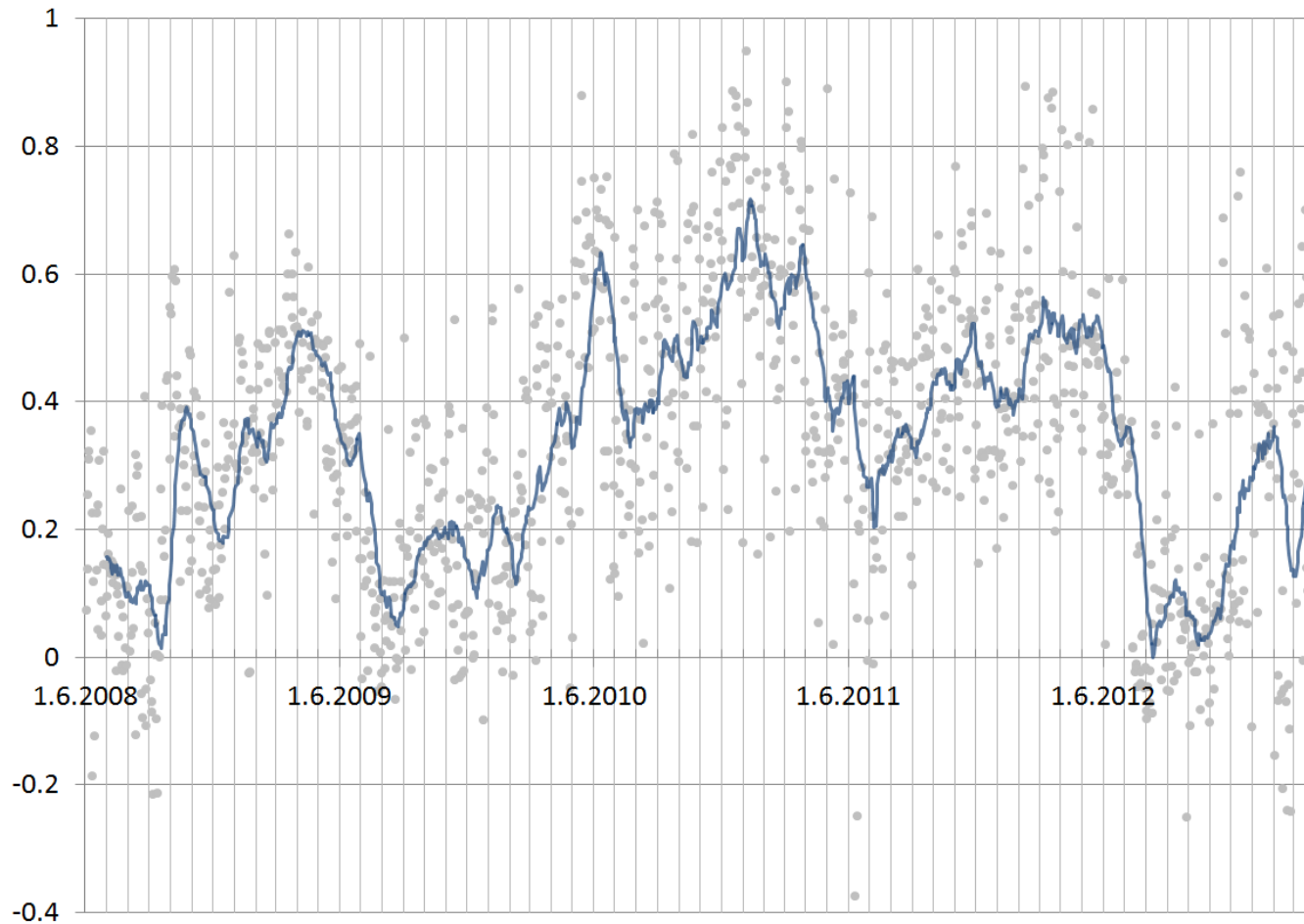


So far...

- Correct signs in relationships between key variables
- Statistically significant but weak impulse responses
- Promising but work is not yet finished...

CDS-ON spread correlation

Daily correlations and their one month moving average



Follow-up work

- Model time dependence of relationships
- More control variables
- More careful scrutiny of the data

Summing up

- Already at this stage the results are quite interesting and promising

Thank You!