

# *From Funding Liquidity to Market Liquidity: Evidence from Danish bond markets*

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# Findings - 1

- Danish covered bonds and government bonds are equally liquid (MiFID data).
- Bond market liquidity is driven by Euro money market stress i.e. funding liquidity drives market liquidity.
- The results on funding liquidity also hold true for other European government bonds (MTS data).
- No evidence of a spiraling effect.

# Findings - 2

- No reason not to consider Danish covered bonds as being 'extremely liquid' in regulatory liquidity buffers.
- LCR in the CRR/CRD-IV (Basel III) has opened up for this possibility.
- Limited effectiveness of liquidity buffers with (high quality) bonds.
- If funding stress is systemic and money markets are stressed, then it will also be hard to liquidate a bond portfolio at a fair price.

# Related Literature - 1

- Bond market liquidity.
  - Bao, Pan and Wang (2011), Dick-Nielsen, Feldhutter and Lando (2012).
- Funding constraints.
  - Xiong (2001), Kyle and Xiong (2001), Gromb and Vayanos (2002), Brunnermeier and Pedersen (2009), Fontaine and Garcia (2012), Adrain, Etula and Muir (2013).
- MiFID and MTS data.
  - Dick-Nielsen, Gyntelberg and Sangill (2012), Gyntelberg, Hördahl, Ters and Urban (2013).

# Data - 1

- MiFID transaction data – complete transaction record of Danish bond market transactions from Nov 2007 to Dec 2011.
- Secondary market transactions above DKKm 10 (app. EURm 1.3).
- Focus on benchmark bonds from large issuers with similar credit quality (65-85% of the market for covered bonds).
- DK covered bond market size (140% of GDP), government bonds (40% of GDP).

# Data - 2

- We consider 4 groups of Danish bonds:
  - Short term government bonds (treasury bonds with <5 years to maturity).
  - Long term government bonds (treasury bonds with 5-10 years to maturity).
  - Short term covered bonds (1-year fixed rate bullet bonds (ARMS)).
  - Long term covered bonds (30-year fixed rate callable bonds).

# Data - 3

- Danish mortgage bonds are funded by issuances of covered bonds.
- The issuance is completely dominated by a few major institutions.
- The issuers follow a 'match funding' principle which provide a hedge against interest rate, currency and prepayment risk.
- During the last fifteen years the market has shifted from the 30-year fixed rate callable mortgage loan to 1-year adjustable rate mortgages.

# Data - 4

Market (Monthly average)	Long Covered		Short Covered		Long Government	Short Government
	Market	Sample	Market	Sample	Market/Sample	Market/Sample
Amount outst. (DKKbn)	494	424	750	497	174	257
Number of Bonds	115.1	78.7	35.7	17.5	2.8	4.2
Bond Size (DKKbn)	4.3	5.4	22.1	29.7	63.6	62.3
Turnover (DKKbn)	115	104.7	332	155	76	65
Number of trades	2,109	1,891	1,763	928	591	405
Mean tradesize (DKKm)	54.2	55.1	158	156	136.6	169.4
Median tradesize (DKKm)	26.9	28.0	69.0	70.1	47.8	66.1
Time to Maturity	26.0	26.3	0.64	0.63	8.03	2.53



# Methodology - 1

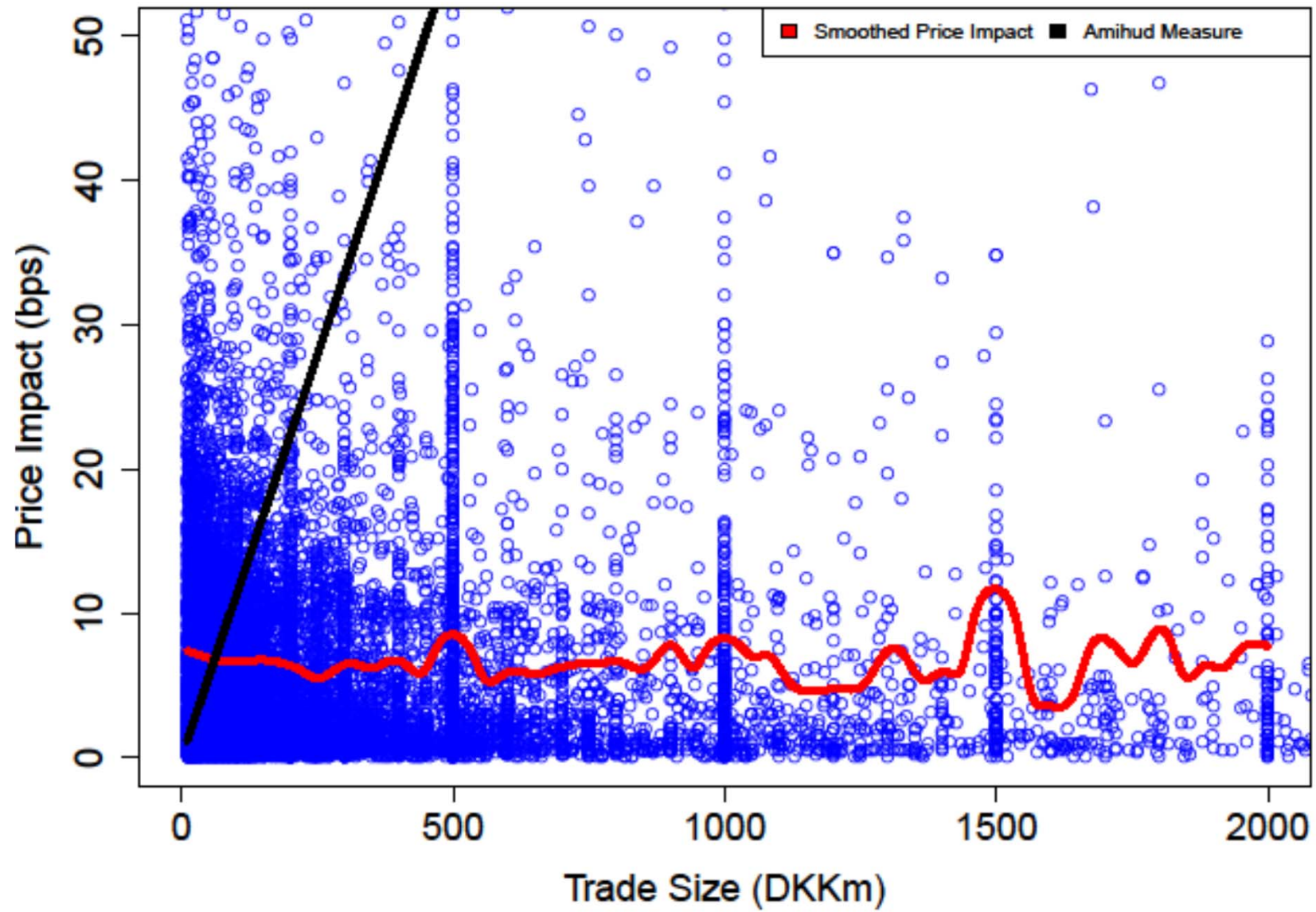
- Market liquidity is measured by ‘raw’ price impact:

$$PI = \frac{|p_i - p_{i-1}|}{p_{i-1}}$$

- Standard stock market measures assume a linear relationship with volume (Kyle 1985, Amihud 2002):

$$PI = \lambda \times \text{trade size}$$

We find that the relationship is flat in our sample.

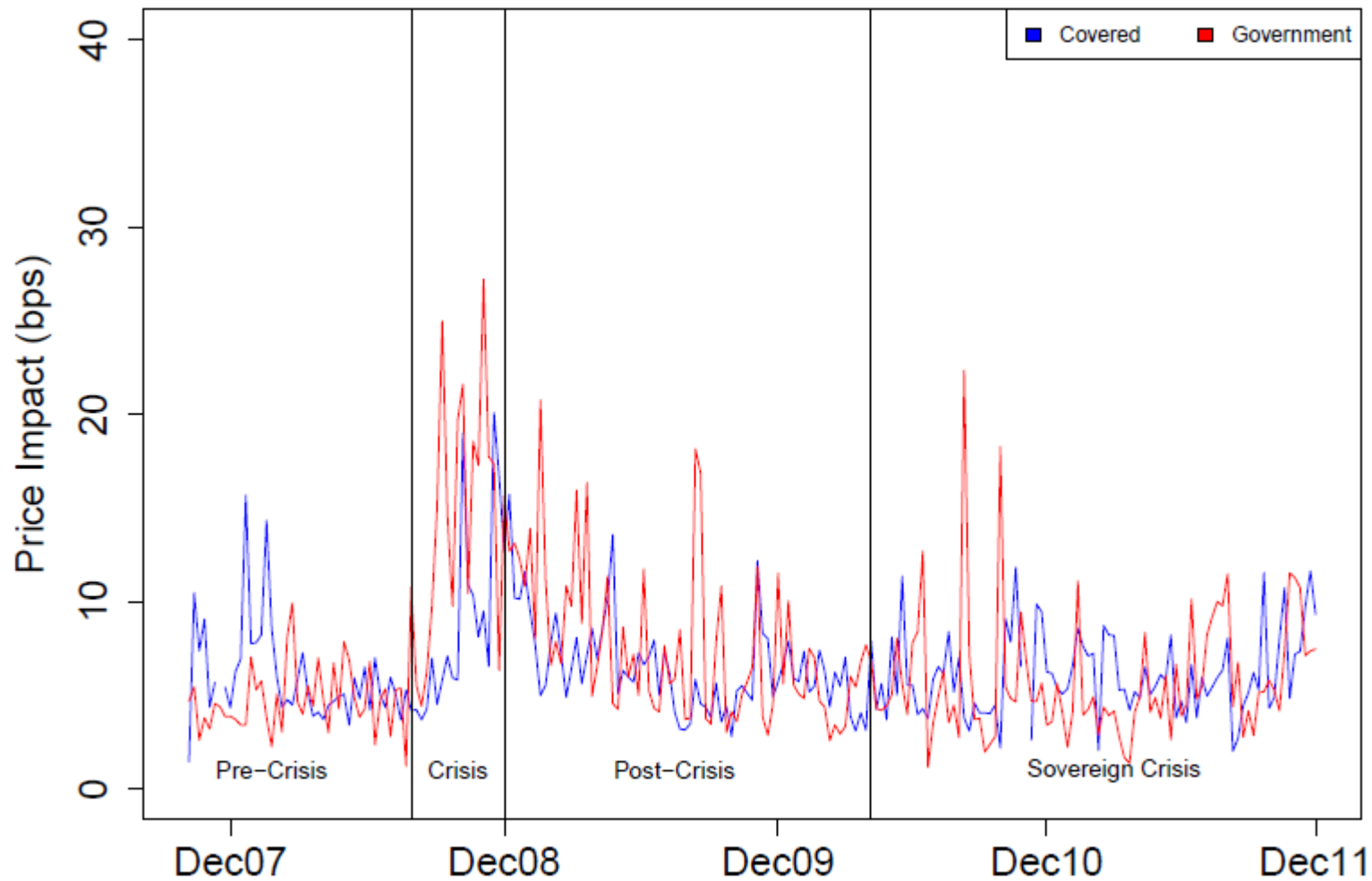


# Market Liquidity - 1

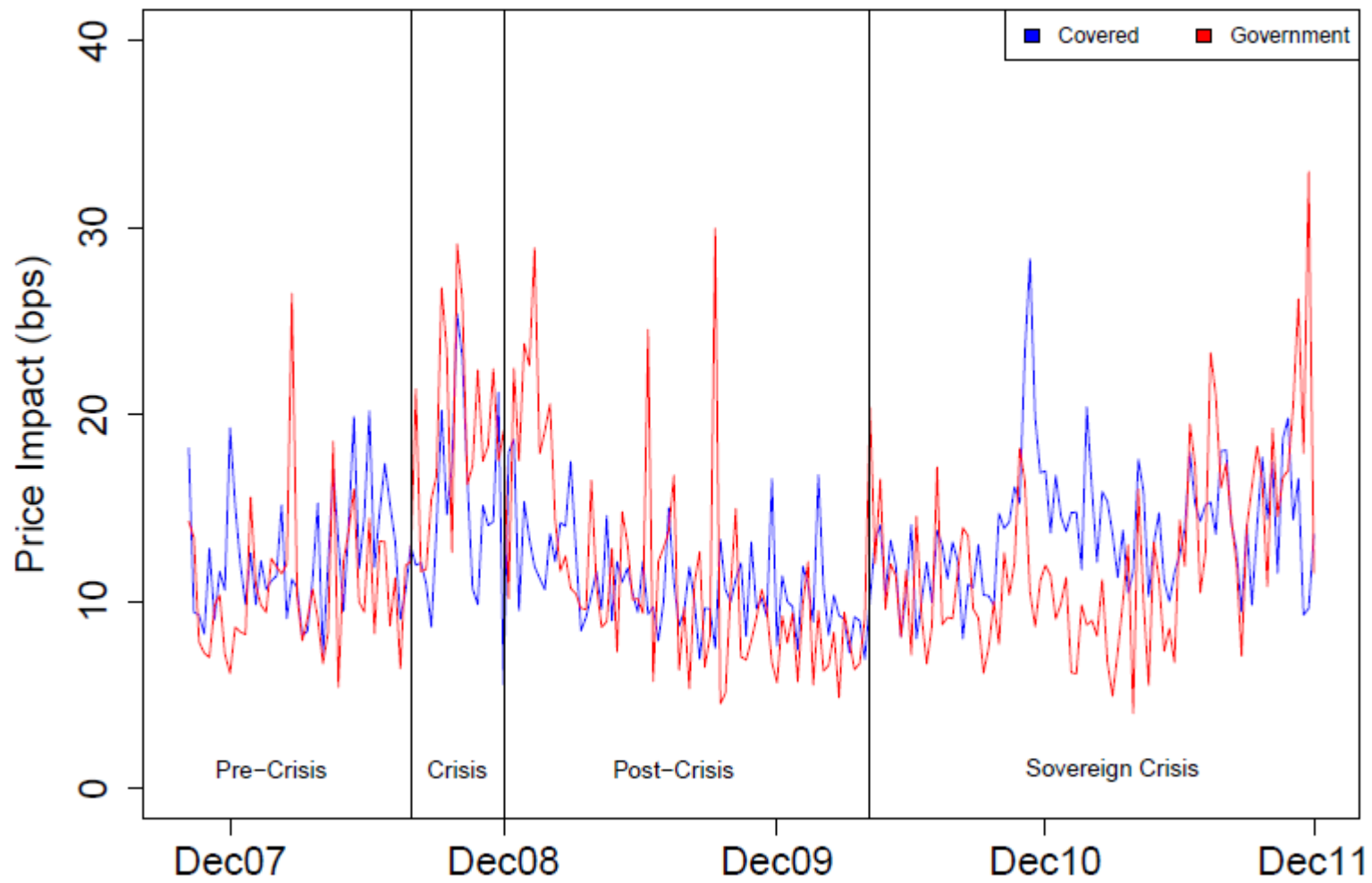
- Danish government bonds were slightly more liquid than covered bonds before the crisis.
- During the crisis covered bonds were slightly more liquid.
- The level of liquidity has been the same for the two groups after the crisis.
- Both markets were active and fairly liquid even during the peak of the crisis.

Period	Market	20 mill.	50 mill.	100 mill.	200 mill.
Pre-Crisis	Long Covered	7.90	8.18	7.52	7.33
	Short Covered	5.03	4.57	3.42	3.00
	Long Government	9.62	8.73	7.50	5.87
	Short Government	3.53	3.03	2.86	2.44
Crisis	Long Covered	5.79	10.28	11.42	9.25
	Short Covered	3.45	3.23	8.24	6.05
	Long Government	10.65	11.27	13.55	7.72
	Short Government	9.32	8.32	8.63	8.26
Post-Crisis	Long Covered	6.61	7.49	7.72	6.18
	Short Covered	3.28	3.26	3.42	2.98
	Long Government	7.90	8.47	7.13	5.76
	Short Government	2.93	6.28	4.58	3.93
Sovereign Crisis	Long Covered	8.74	9.64	9.65	8.61
	Short Covered	2.95	2.97	2.14	2.50
	Long Government	7.32	8.36	9.30	7.33
	Short Government	3.63	2.25	2.76	1.82

- Price impact (bps) for standard trading sizes.



- Short term bonds



- Long term bonds

# Market Liquidity - 5

- Dealer – Customer transactions (daily avg. volume in DKKm).

<b>Market</b>	Pre-Crisis	Crisis	Post-Crisis	Sovereign Crisis
Short covered	1,240	2,670	3,860	3,530
Short Gov.	410	700	360	740
Long covered	1,800	2,170	1,330	1,330
Long Gov.	910	720	630	700

# Market Liquidity - 6

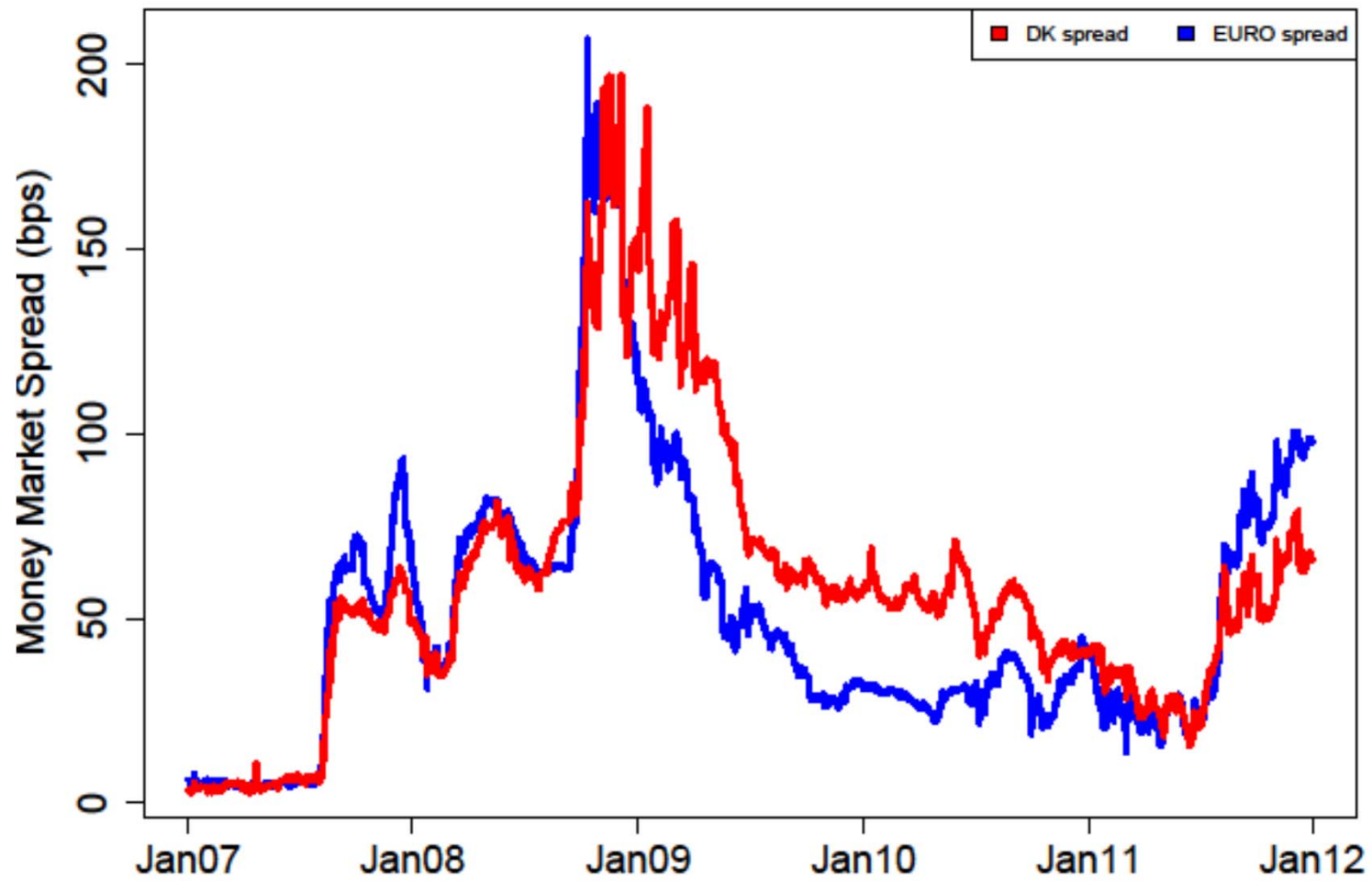
- Interdealer transactions (daily avg. volume in DKKm).

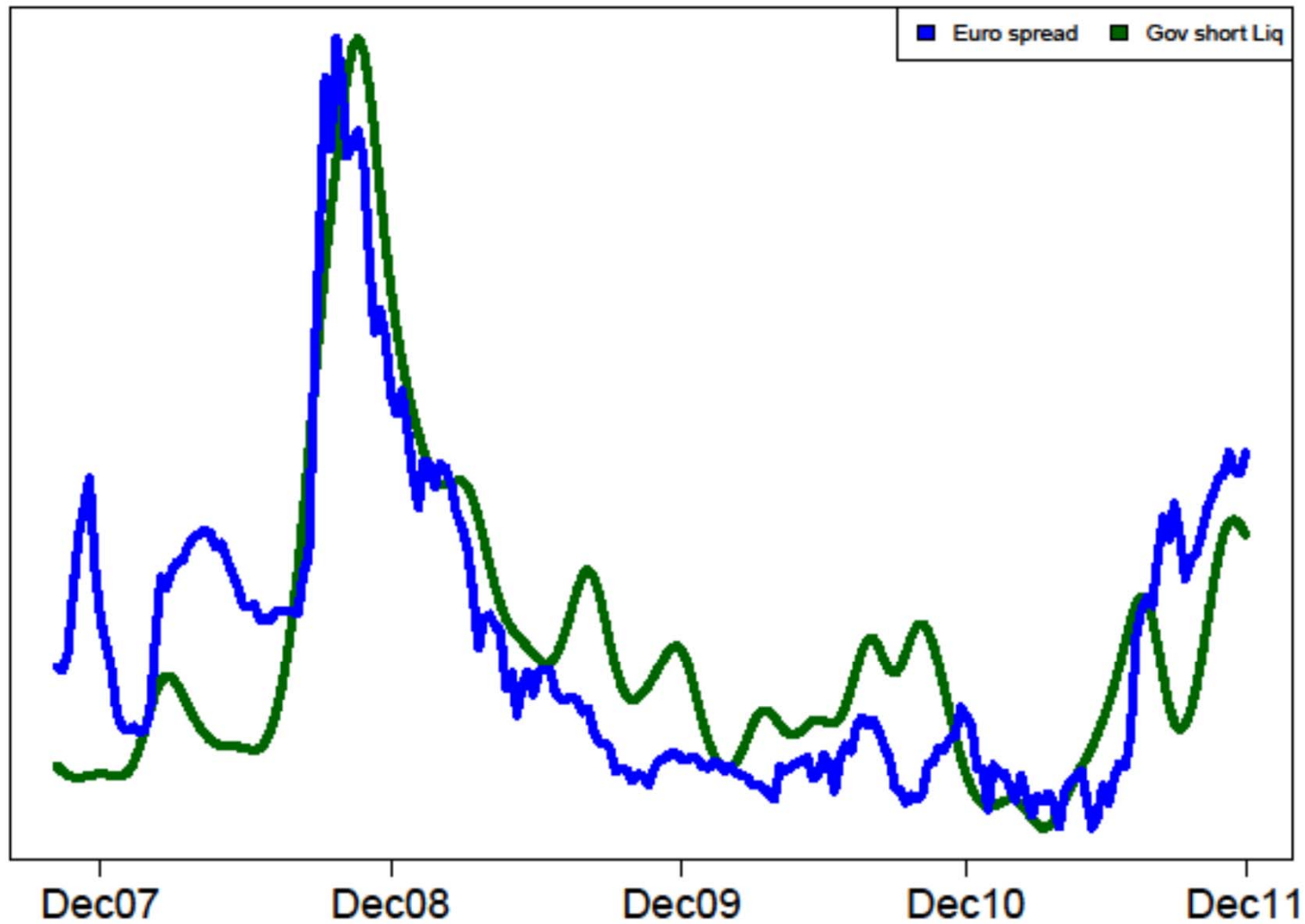
<b>Market</b>	Pre-Crisis	Crisis	Post-Crisis	Sovereign Crisis
Short covered	210	110	230	230
Short Gov.	170	50	50	130
Long covered	790	850	610	560
Long Gov.	180	110	90	80



# Funding Liquidity - 1

- "Will it be the same in the next crisis?"  
or  
"Which factors can explain market liquidity?"
- Let money market spreads proxy for funding liquidity (Brunnermeier (2009), Hameed et. al (2010)).
  - Euro spread = EURIBOR3m – EONIA3m
  - DK spread = CIBOR3m – CITA3m





- The Euro money market spread versus smoothed short term government bonds.

# Funding Liquidity - 4

- Granger causality tests from funding liquidity to market liquidity in levels.
- Strong connection - except for long term covered bonds (noicy).

Granger Causality Test P-value	Short Cov	Long Cov	Short Gov	Long Gov
EUspread does not cause	<0.001	0.08	<0.001	<0.001
DKspread does not cause	0.003	0.93	<0.001	<0.001

- Possible unit root issue in the levels.

# Funding Liquidity - 5

- Regression in weekly changes.

Bond Series	Long Covered	Short Covered	Long Government	Short Government
Intercept	-0.001 (0.16)	0.02 (0.13)	0.01 (0.21)	-0.005 (0.16)
$\Delta PI_{t-1}$	-0.38*** (0.07)	-0.43*** (0.04)	-0.52*** (0.07)	-0.43*** (0.06)
$\Delta EUspread_{t-1}$	3.64 (3.50)	-2.54 (2.77)	10.98** (5.22)	9.34** (3.96)
$\Delta DKspread_{t-1}$	-3.48 (4.29)	4.70* (2.82)	-0.08 (4.30)	-0.29 (3.91)
$R^2$	0.15	0.21	0.26	0.20
N	217	211	217	217

# Funding Liquidity - 6

- Principal component analysis of the weekly changes.

	1PC	2PC	3PC	4PC
$\Delta$ Long Covered	0.50	-0.48	0.54	0.48
$\Delta$ Short Covered	0.18	0.84	0.13	0.50
$\Delta$ Long Government	0.68	-0.13	-0.81	0.25
$\Delta$ Short Government	0.51	0.23	0.18	-0.68
Cum. % explained	29%	56%	79%	100%

# Funding Liquidity - 7

- Regression on the weekly principal components.

PC Series	1. Bond PC	2. Bond PC	3. Bond PC	4. Bond PC
Intercept	-0.001 (0.04)	-0.02 (0.04)	0.01 (0.04)	-0.01 (0.04)
$PC_{t-1}$	-0.37*** (0.05)	-0.47*** (0.04)	-0.45*** (0.05)	-0.52*** (0.05)
$\Delta EUspread_{t-1}$	2.70** (1.15)	-1.24* (0.74)	-0.81 (0.80)	-0.49 (0.79)
$\Delta DKspread_{t-1}$	-0.45 (1.12)	1.72** (0.81)	-0.20 (0.83)	0.38 (0.89)
$R^2$	0.15	0.25	0.22	0.26
N	211	211	211	211

# Funding Liquidity - 8

- Euro spreads drive the changes in market liquidity.
- The country spread is important for the second PC. The second PC loaded heavily on the short term covered bonds.
- Euro spreads drive the DK spreads with no significant feedback. (See table in the paper).
- No significant feedback effect from market liquidity to the money market (maybe faster than the weekly frequency). (See table in the paper).

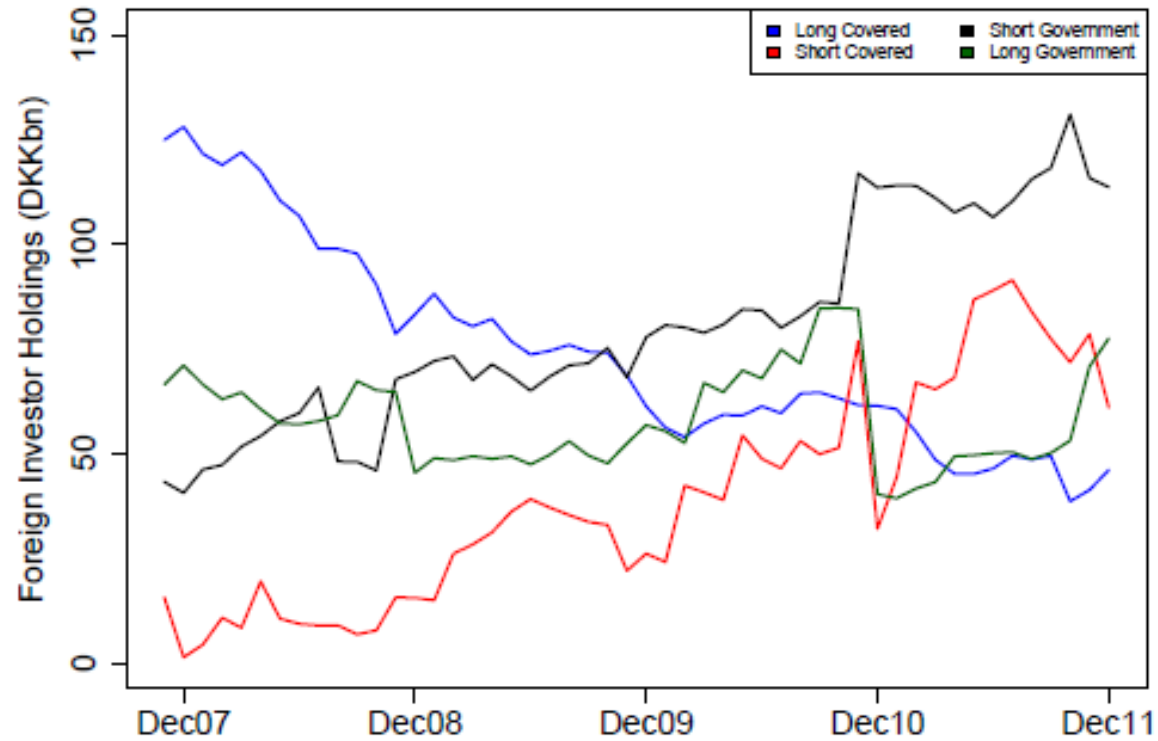


# Funding Liquidity - 9

PC Series	1. Bond PC	2. Bond PC	3. Bond PC	4. Bond PC
Intercept	-0.005 (0.04)	-0.02 (0.04)	0.01 (0.04)	-0.01 (0.04)
$PC_{t-1}$	-0.37*** (0.05)	-0.47*** (0.04)	-0.45*** (0.05)	-0.52*** (0.05)
spreadPC1 $_{t-1}$	0.13** (0.05)	0.03 (0.05)	-0.06 (0.04)	-0.01 (0.03)
spreadPC2 $_{t-1}$	0.19 (0.13)	-0.18** (0.08)	-0.04 (0.09)	-0.05 (0.10)
$R^2$	0.15	0.25	0.22	0.26
N	211	211	211	211

- Regression using principal components of the money market spreads.

# Funding Liquidity - 10



- Foreign investor holdings.

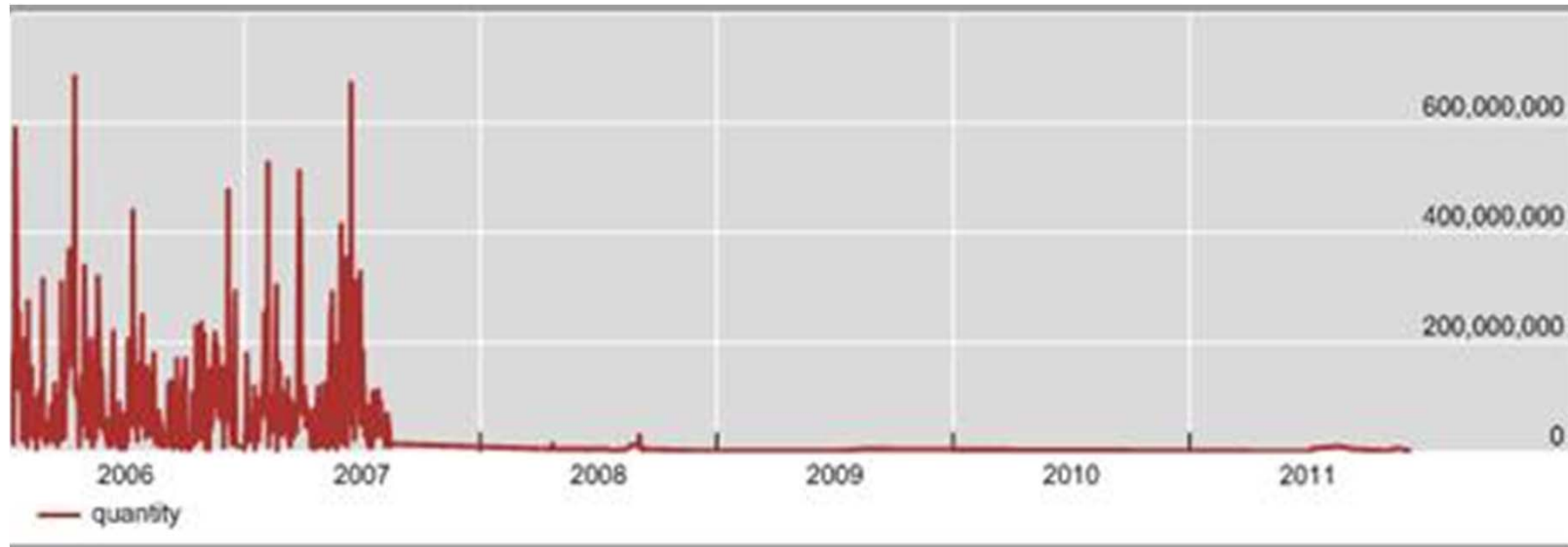
# MTS evidence - 1

- Use MTS data to look at the rest of Europe (preliminary work).
- Supposedly binding and executable quotes.
- Calculate weekly median bid-ask spreads from average daily data:

$$bidask = \frac{P_{ask} - P_{bid}}{P_{ask}}$$

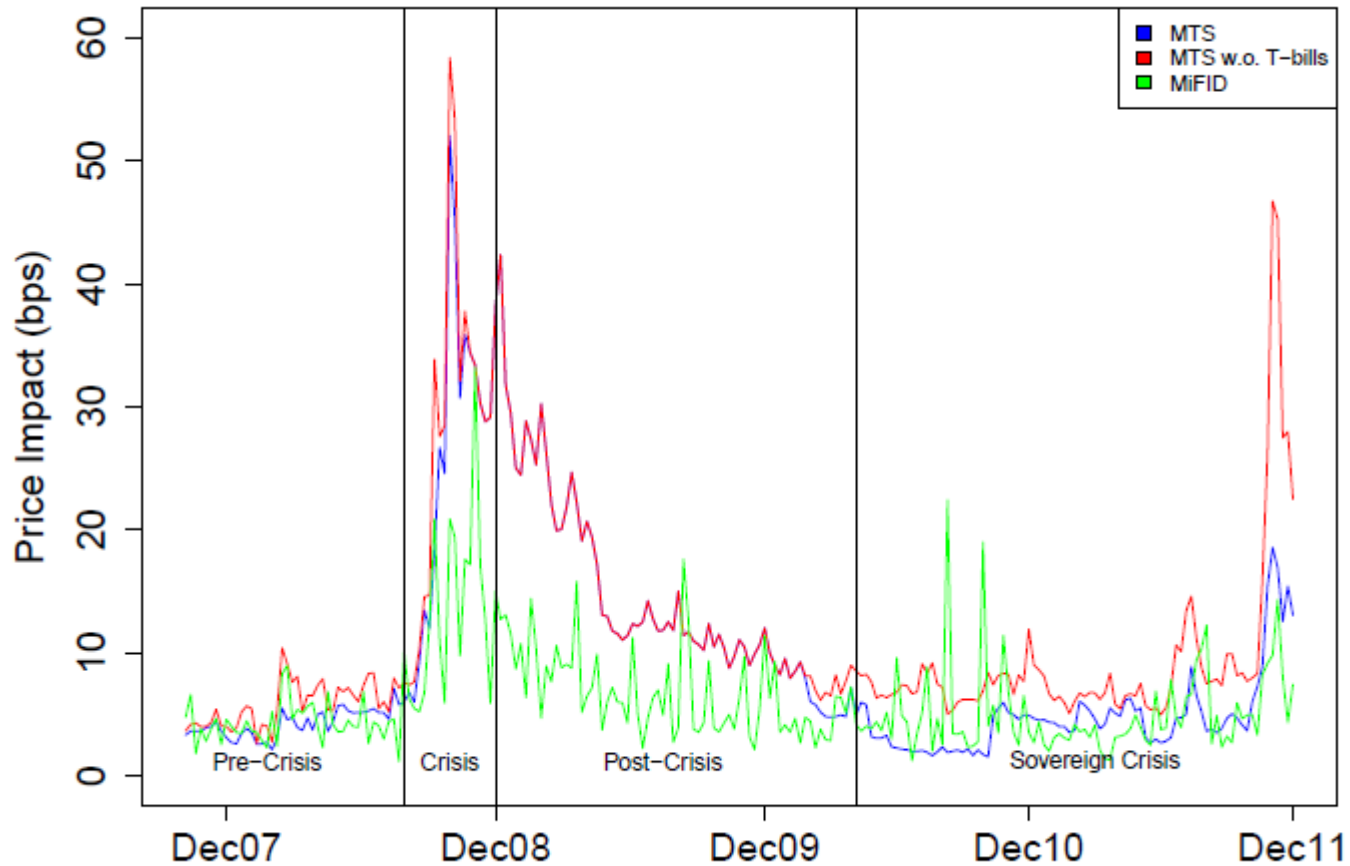
- Only government bond data, covered bonds stopped being quoted on MTS with the beginning of the crisis and has not returned yet.

# MTS evidence - 2



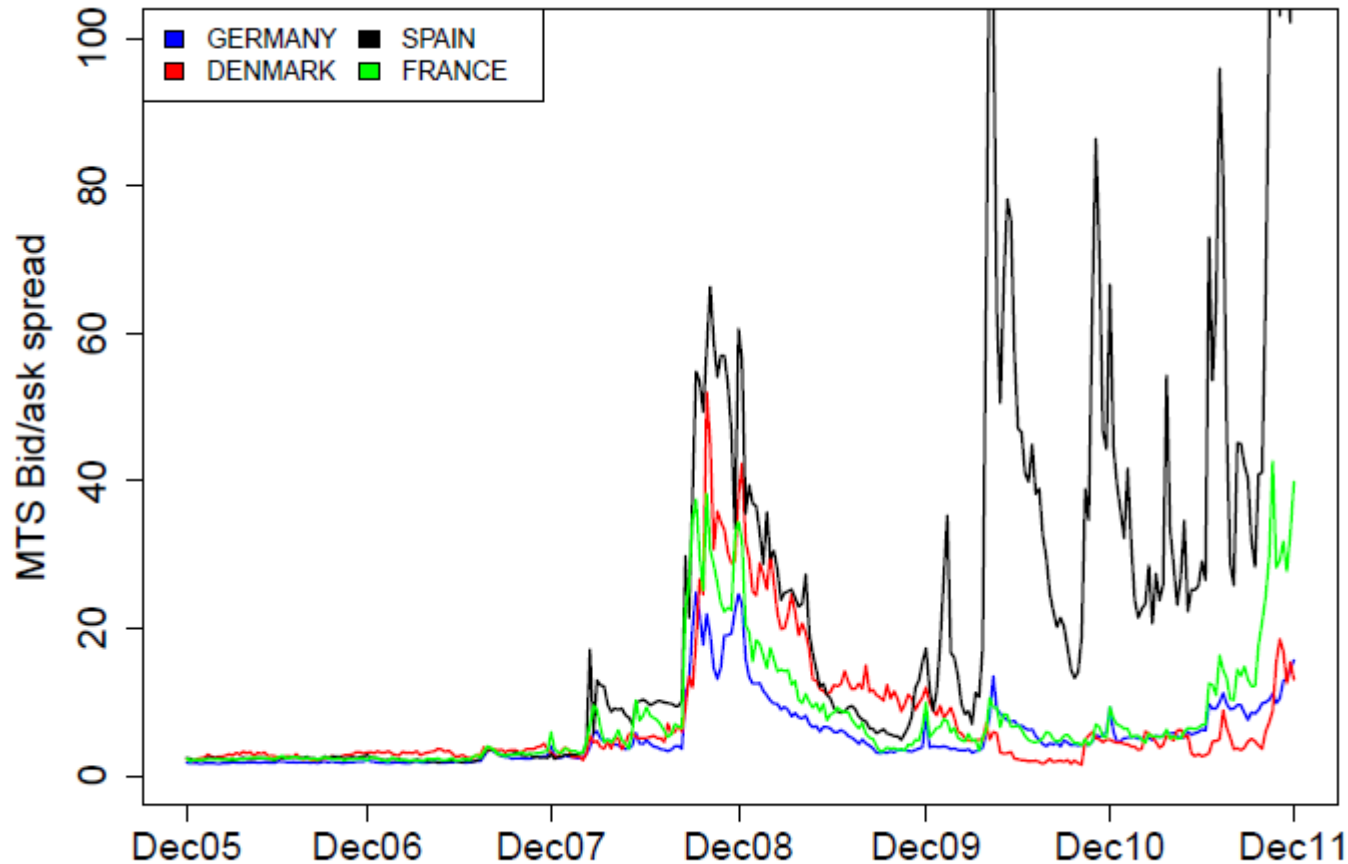
- Quoted covered bond volume on MTS.

# MTS evidence - 3



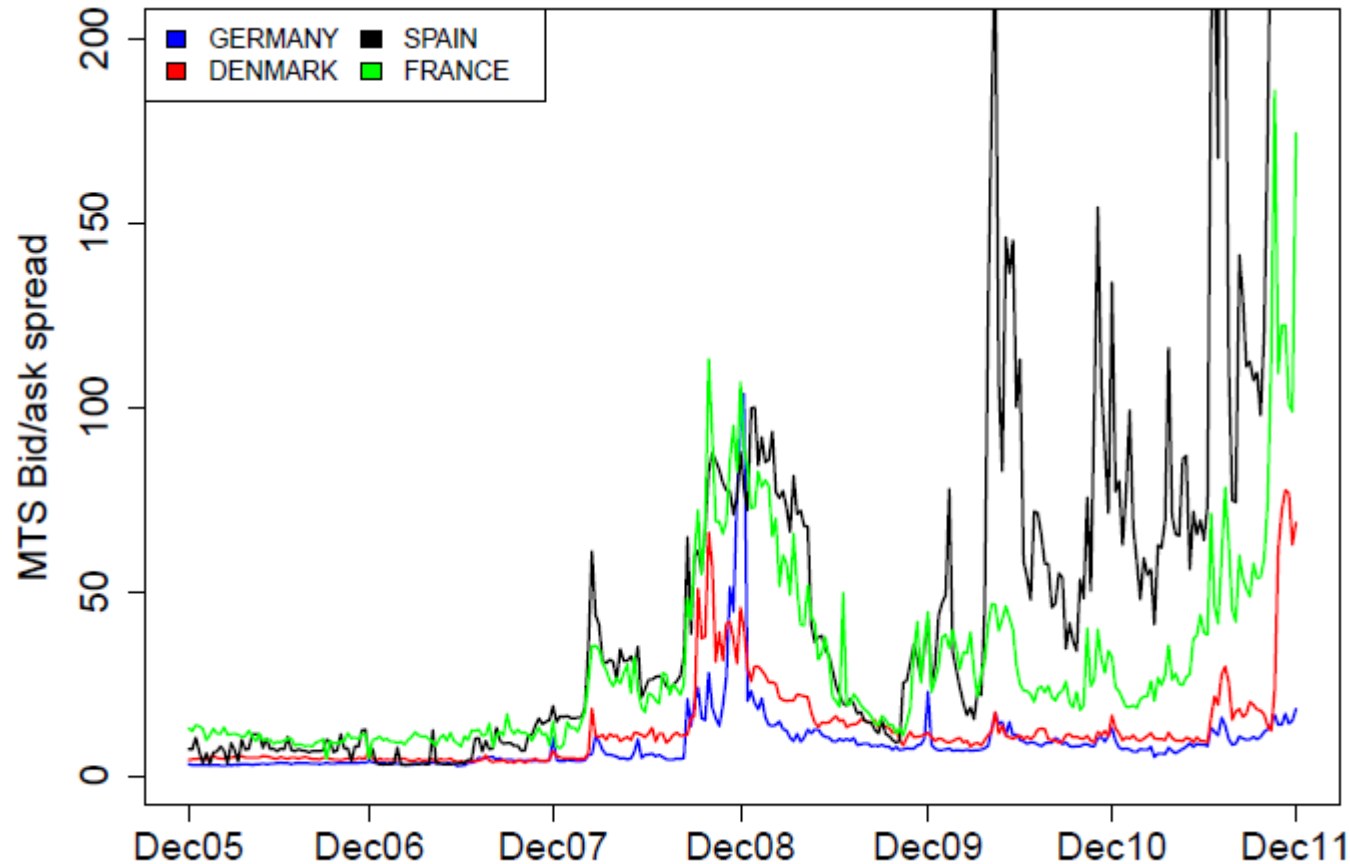
- MIFID versus MTS for Danish short term government.

# MTS evidence - 4



- Average weekly quoted bid-ask for short term government bonds.

# MTS evidence - 5



- Average weekly quoted bid-ask for long term government bonds.

# MTS evidence - 6

	1PC	2PC	3PC	4PC	5PC	6PC	7PC	8PC
$\Delta$ Short DE	0.46	0.17	0.23	-0.08	-0.22	-0.50	-0.63	0.09
$\Delta$ Short DK	0.33	0.47	-0.27	0.14	0.33	0.59	-0.34	-0.08
$\Delta$ Short ES	0.42	-0.48	-0.07	-0.09	-0.02	0.05	0.01	-0.76
$\Delta$ Short FR	0.11	0.08	0.73	0.03	0.64	-0.07	0.17	-0.08
$\Delta$ Long DE	0.35	0.32	0.33	-0.29	-0.53	0.32	0.44	0.04
$\Delta$ Long DK	0.35	0.31	-0.47	-0.05	0.25	-0.51	0.49	0.00
$\Delta$ Long ES	0.35	-0.50	-0.11	-0.43	0.25	0.19	-0.02	0.58
$\Delta$ Long FR	0.35	-0.25	0.06	0.83	-0.14	0.04	0.16	0.26
Cum. % explained	37%	54%	70%	79%	87%	93%	97%	100%

- Principal component analysis of weekly changes in MTS bid-ask spreads.



# MTS evidence - 7

PC Series	1. Bond PC	2. Bond PC	3. Bond PC	4. Bond PC
Intercept	-0.001 (0.12)	-0.003 (0.08)	-0.004 (0.07)	-0.006 (0.06)
$PC_{t-1}$	-0.003 (0.07)	-0.09 (0.07)	0.42*** (0.06)	-0.30*** (0.07)
$\Delta EUspread_{t-1}$	3.31** (1.44)	1.72* (0.94)	-1.36 (0.84)	0.68 (0.67)
$R^2$	0.03	0.02	0.19	0.08
N	216	216	216	216

- Regression using the PCs and the Euro money market spread.

# MTS evidence - 8

- The first principal component of the changes is driven by the Euro spread. The component loads ‘equally’ on all 8 bid-ask series.
- The second principal component is also related to the Euro spread. It seems to be a ‘sovereign crisis’ factor separating out Spain and long term French bonds.
- The overall conclusion from the MTS analysis is the same as with the Danish MiFID data.
- Funding liquidity drives market liquidity.

# Summary - 1

- Danish covered bonds and government bonds are equally liquid.
- The Danish bond market was active and fairly liquid during the crisis.
- The bond market liquidity is driven by stress in the Euro money market i.e. funding liquidity.
- This finding is robust when expanding to MTS government bond quotes for Germany, France, Spain and Denmark.