

日本銀行 金融高度化センター ワークショップ
「市場流動性の諸問題 ―各種市場の流動性指標の活用に向けて―」

「欧州国債市場の流動性指標」

Liquidity Measures of Sovereign Bond Markets: In case of Euro Crisis

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金融危機における信用リスクと流動性の関係

- 金融危機において、市場への流動性供給側が危機を増幅しているのではないか

Brunnermeier and Pedersen (2009) etc.

Funding constraints

Margin call

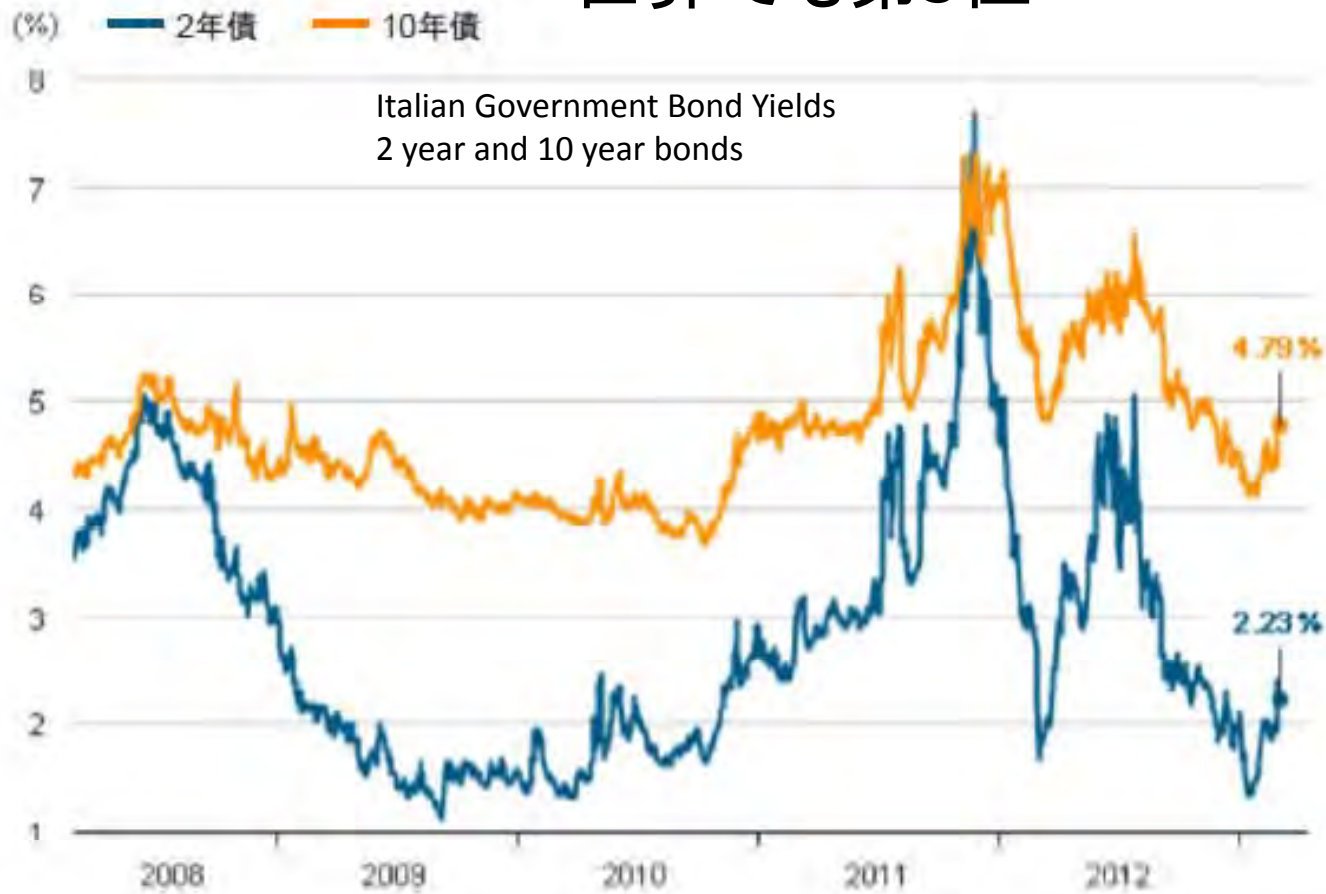
Internal risk management

- 流動性供給行動の変化を詳細データで確認
- 信用リスクと市場流動性の相互依存関係に注目
- さまざまな流動性指標から流動性変化の特徴をみる
- 最近の3本の共著論文にもとづき、構成している



イタリア国債利回りの推移

イタリア国債市場は欧州最大、 世界でも第3位



Pelizzon et al.[2013-2]

Non-linear behavior of market illiquidity

- A relationship between changes in Italian sovereign credit risk and market illiquidity in the (secondary) sovereign bond market is shaper when the CDS spread is above 500 bps.

Intervention effects

- The strength of the relationship diminishes after the announcement of the LTRO (Long-Term Refinancing Operations) by the ECB on December 8, 2011.

A key research question

How liquidity is provided at extremely difficult market

- Under stressful circumstances, what causes non-linear feature of illiquidity?
- focus on providers of liquidity? Any drastic change at the time of crisis

- Italian Sovereign Bond Market = **inter-dealer market**
 - Primary dealers are assigned as **designated market makers**
- Its bond futures market
 - Typical **order-driven market**
 - No-designated market makers

Literature: Adverse selection

- Gorton and Metrick (2010)

argue that large adverse shocks strongly increased the information sensitivity of securitized debt.

- According to this view, the reduction in liquidity is a symptom for severed adverse selection problems

- Asymmetric information (uncertainty) gets severer because resolution of crisis depends on Government/central bank commitment.

Inventory positions & volatility

- Inventory positions affect prices and liquidity
Amihud and Mendelson 1980, Ho and Stoll 1980
- Volatility affects liquidity Glosten & Milgrom 1986
- Higher volatility tightens funding constraints of market makers and thereby reduces their liquidity-provision capacity Brunnermeier and Pedersen 2009

- market makers reduced liquidity supply in response to elevated levels of risk, tighter funding constraints, and reduced competition.
- In addition, a surge in liquidity demand from the public increase imbalance between buy and sell

Withdrawal of liquidity supply

Nagel[2012]

- high-volatility assets suffers the strongest increases in volatility during periods of turmoil, a more pronounced withdrawal of liquidity supply
- Black Monday 1987
 - One third of NASDAQ market makers quit market-making on October 19 (on that day!)

US SEC Report on October 1987 Crash

Hypothesis on Market Makers Behavior

Facing enormous risk and uncertainty, market makers can do the followings:

- H1: they widen bid-ask spread to cover expected loss from large price changes.
- H2: many if not all withdraw from the market. It results in large reduction of depth.
 - H2A Each market maker equally reduce her exposure
 - H2B Most of market-makers abandon making market.

MTS market

- Largest interdealer market in EU government bond markets (not only Italian but also other European sovereign bonds)
- Our focus is Italian MTS
 - Primary Dealers: Posting quotes
 - Other dealers: Taking liquidity from primary dealers
 - Minimum trading unit :1 Million Euro

MTS Data

After June 2011

- Trade-by-trade data
- Order-by-order data
- Individual quotes posted by market makers ID

Before May June2011

- Trade-by-trade data
- Best 3 Quotes and aggregated quantity

BTP futures market

- Italian Government bond futures are traded on Eurex Exchange
- Eurex offers electronic continuous trading platform
- Liquidity is provided by limit orders from participants
- Long-Term Euro-BTP Futures contracts started in September 2009 and have been most actively traded among the other contracts (Mid_, Short_).
 - The average daily volume is 143,000 contracts during our sample period
 - the average daily number of trades is 4,255.
 - Contract value is EUR 100,000
 - Minimum Trading Unit is EUR 1 Million
 - Minimum Price Change is in percent of the par value, with two decimal places. The Minimum Price Change is 0.01 percent
 - Tick Data provided by Thomson Reuters, time & sales, quote history

Sample Italian bonds on the MTS

Our data covers 148 Italian bond traded on the MTS between June 2011 and November 2012 (=377 days).

Maturity Group	# Bonds	Coupon Rate	Avg- Maturity
0.25	9	0	0.27
0.50	24	0	0.51
1.00	32	0	1.01
2.00	11	0	2.02
3.00	10	3.20	2.99
5.00	13	3.87	5.03
6.00	13	Floating	6.70
10.00	19	4.44	10.41
15.00	7	4.57	15.71
30.00	10	5.88	30.88

- ▶ Coupon Bearing Bonds
- ▶ Non-Coupon-Bearing Bonds

Liquidity Metrics

Liquidity Measures	MTS	BTP Futures
Quoted (Percent) Bid-Ask Spread	✓	✓
Effective Spread	△	✓
Quote Revisions per day	✓	✓
Depth		
Depth at Best Ask (Million Euro)	✓	✓
Depth at Best Bid (Million Euro)	✓	✓
Market Impact Measure		
Amihud Measure	△	✓
Lambda (hypothetical trading cost)	✓	-
Trading Activity		
Total Number of Trades	✓	✓
buyer initiated trades	✓	✓
seller initiated trades	✓	✓
Total Volume (Million Euro)	✓	✓
buyer initiated volume	✓	✓
seller initiated volume	✓	✓
Absolute Trade Imbalance(%)	✓	✓
Absolute Volume Imbalance (%)	✓	✓

Market Makers		
Number of Double Quotes	✓	
quoting time per quote (min)	✓	
total quoting time per day (min)	✓	
Number of Single Quote	✓	
quoting time per quote (min)	✓	
total quoting time per day (min)	✓	
Quoted (Percent) Bid-Ask Spread		
Best posted by Double Quotes:	✓	
Best posted by Single Quote:	✓	
Depth		
Depth Hidden at Best Ask	✓	
Depth Hidden at Best Bid	✓	
Total Depth at Ask	✓	
Total Depth at Bid	✓	
Total Depth Hidden at Ask	✓	
Total Depth Hidden at Bid	✓	
Dispersion of Quotes		
Ask from double quote	✓	
Bid from double quote	✓	
Ask from single quote	✓	
Bid from single quote	✓	
Quote Revisions per day		
double quotes	✓	
single quote	✓	
Depth Imbalance		
Depth Imbalance in Total	✓	
Absolute Imbalance in Total	✓	

Sample Bonds and Period

- 10 year on-the-run BTP.
 - BTP Futures
- June 1, 2011 – November 15, 2012
 - 2011: June 1 – Dec 30, 2011
 - 2012: Jan 2 – Nov.15, 2012

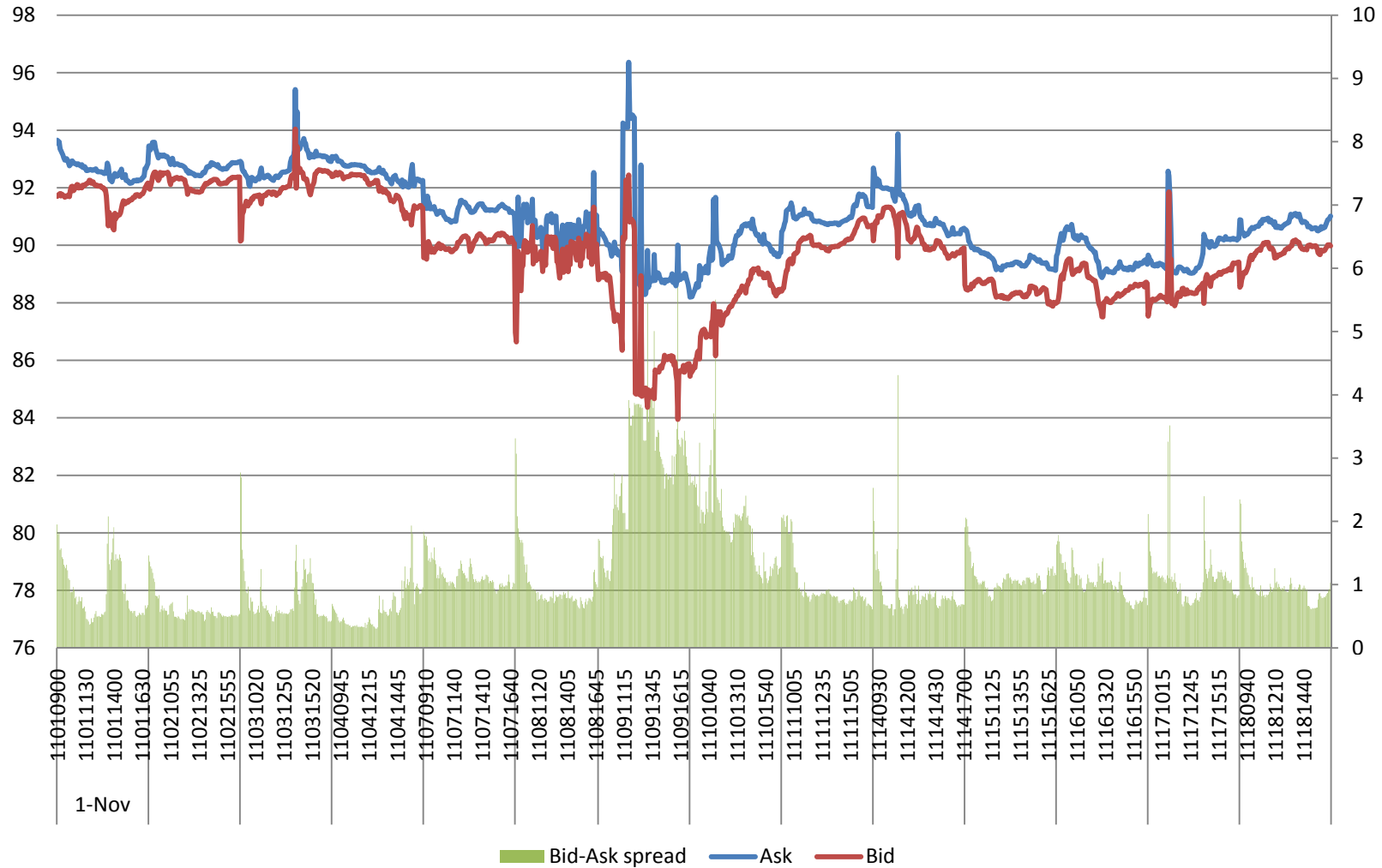
Hypothesis 1 Market Maker Behavior

H1: they widen bid-ask spread to cover expected loss from large price changes

- Bid-ask spread widens when credit risk rises
- Changes in bid-ask spread relative to credit risk is non-linear
- Compare to Futures bid-ask spread, cash spread change is amplified at crisis time.

H1: Intraday examination 1

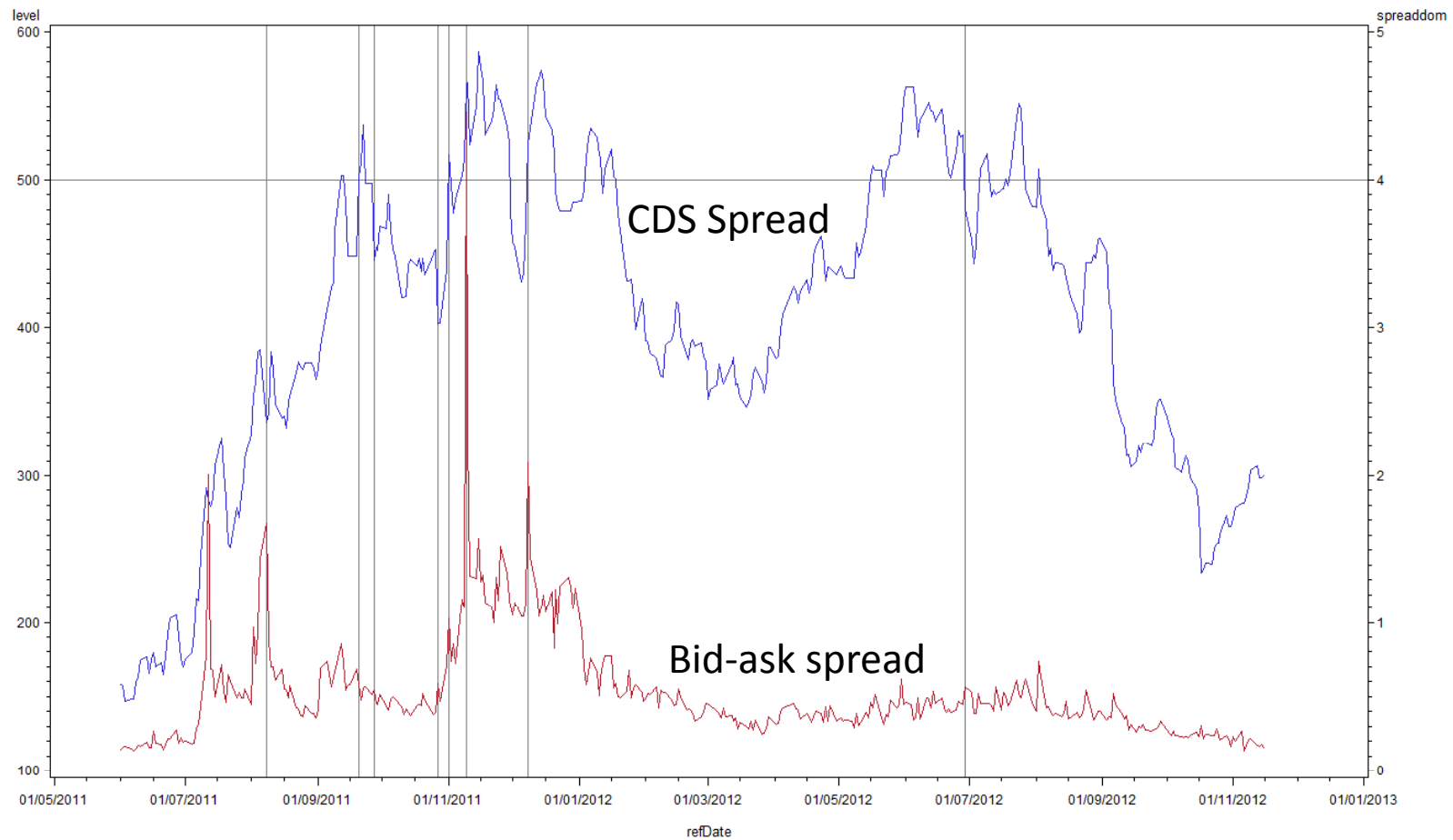
Italian 10yr Government Bonds



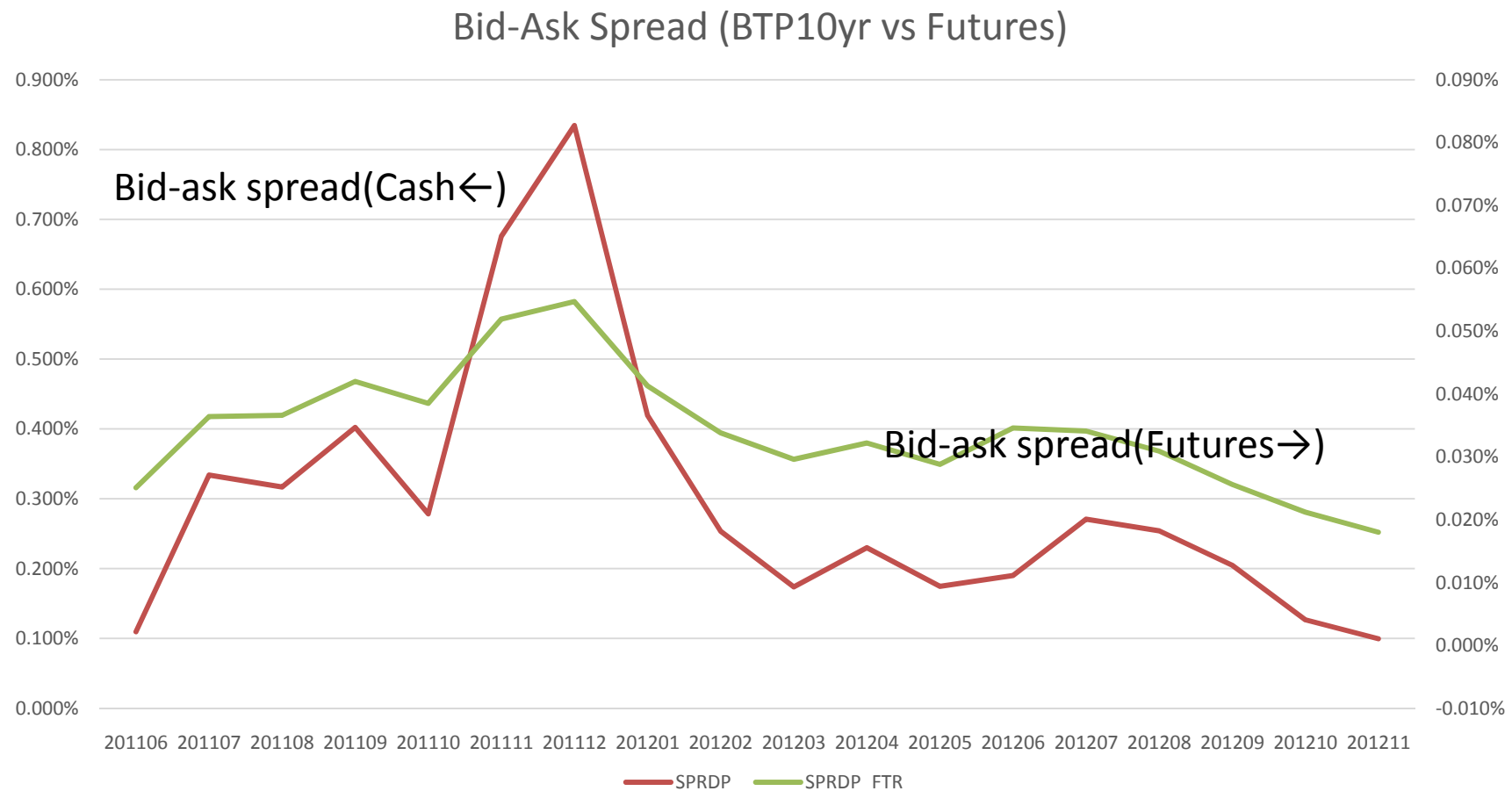
- This graph shows deeper reaction of either ask or bid at some occasion.

THE BID-ASK and CDS SPREAD

- Strong non-linear relation.
- Structural break above CDS500bp. (Pelizzon 2013-2)

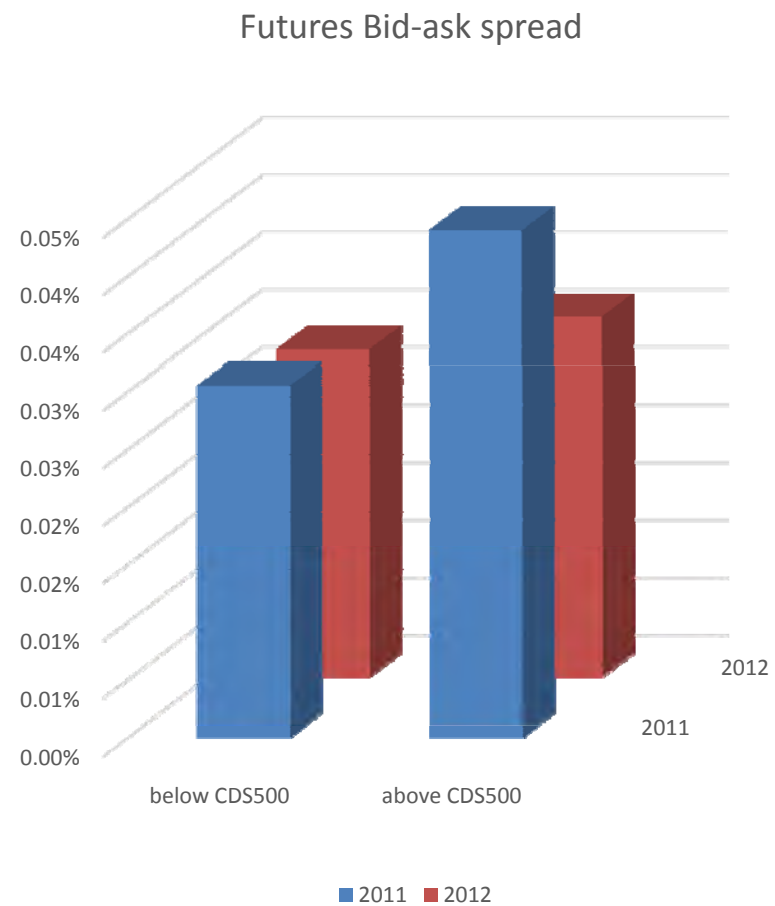
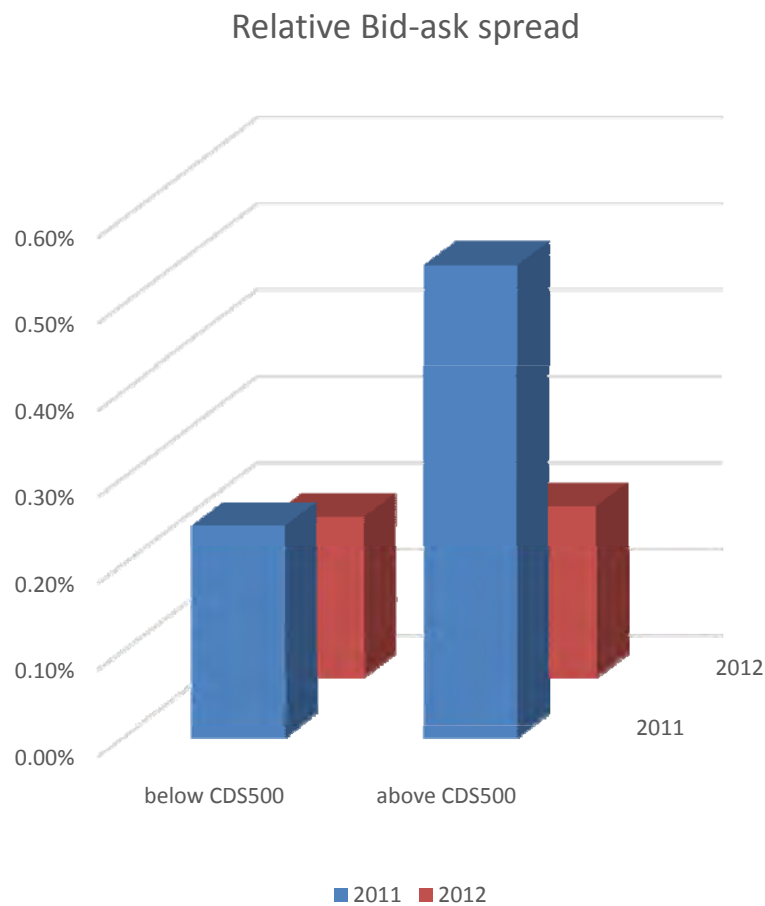


H1: Monthly Average Bid-Ask Spread Cash vs. Futures



- Futures bid-ask spread almost always one tenth of cash bonds market.
- At financial crisis, it seems illiquidity of cash market is amplified.

H1: Bid-ask spread for Cash and Futures Below/Above CDS500



- Both cash and futures spreads widen above CDS500.
- The degree of jump is much bigger for cash than for futures. (2.5 times vs. 30%)

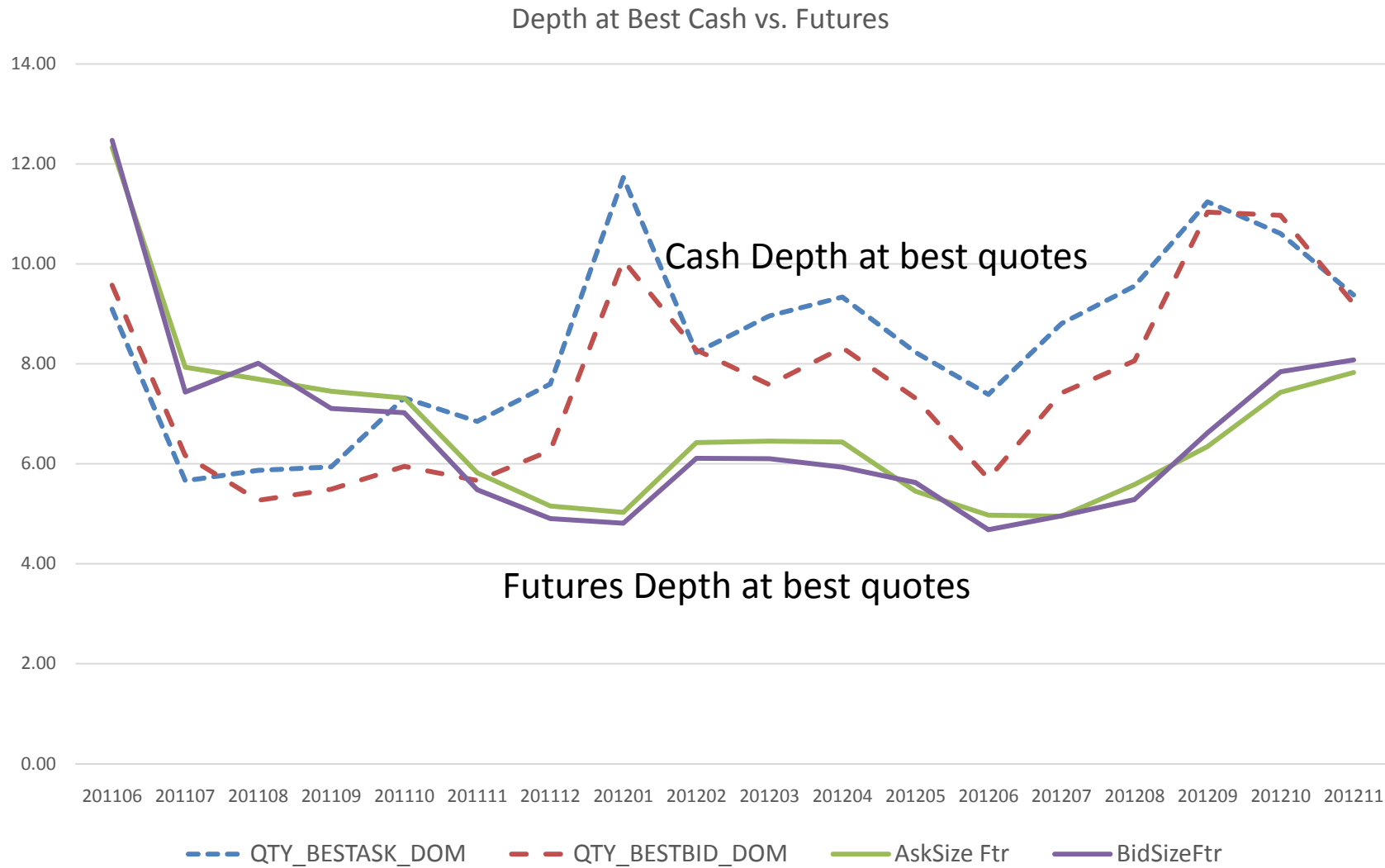
Hypothesis 2 on Market Makers Behavior

- H2: many if not all withdraw from the market. It results in large reduction of depth.

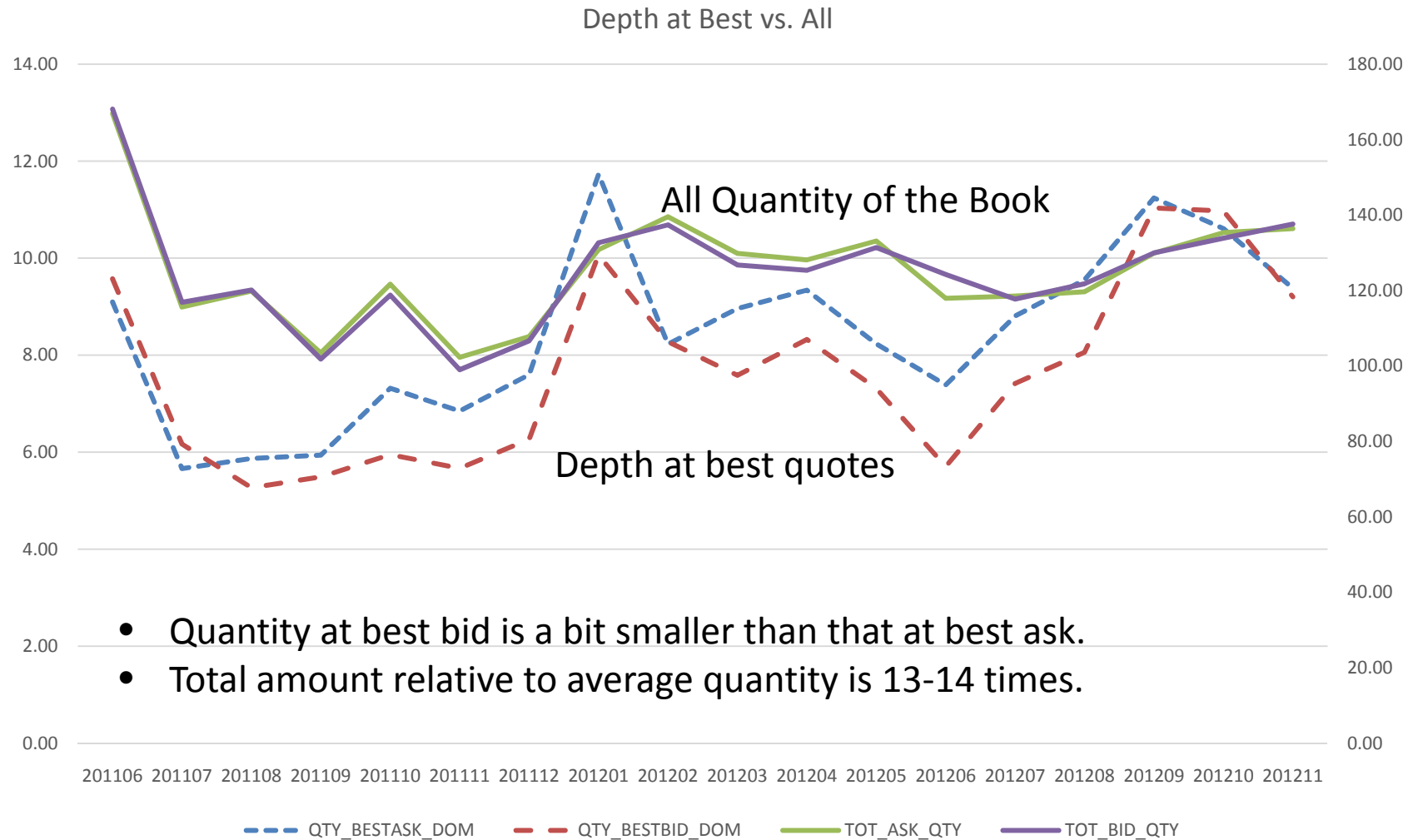
- H2A: Each market maker equally reduce her exposure
- H2B: Most of market-makers abandon making market.

– The number of MMs posting best quotes were lower during the period of crisis which triggered by downgrading of government bonds, after the announcement of ECB it started to rise.

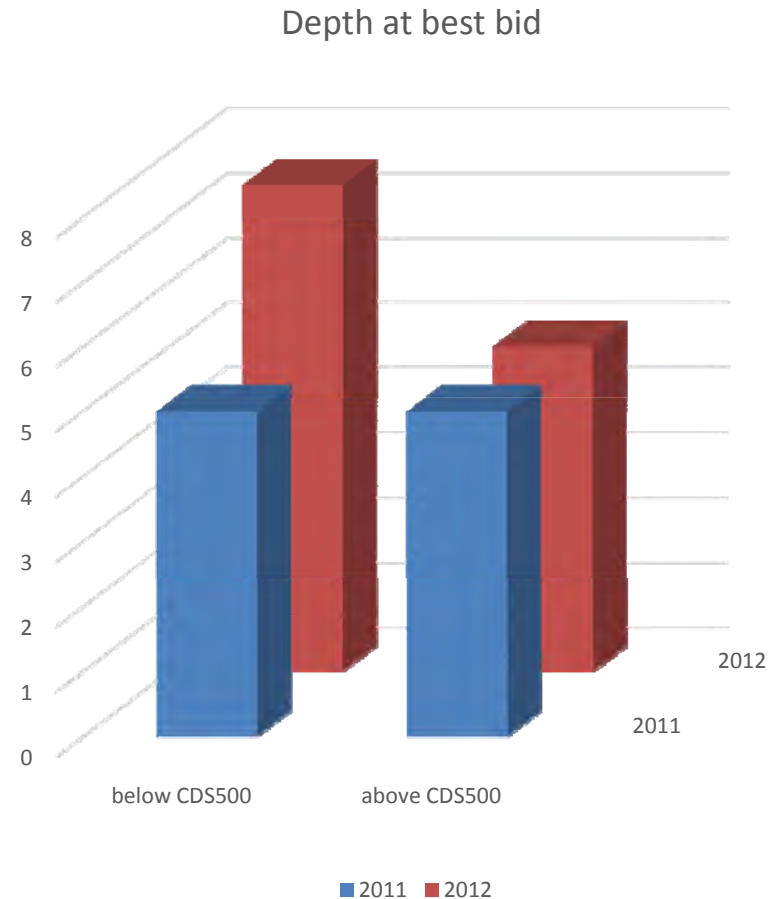
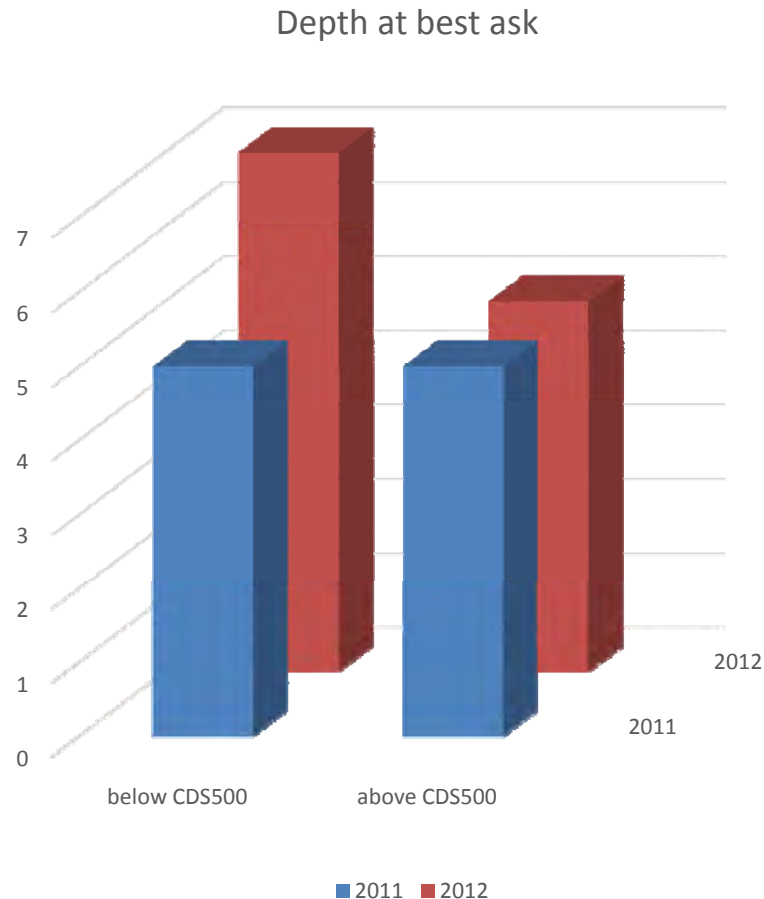
H2: Depth of Cash vs. Futures



H2: Best Depth vs. All Book

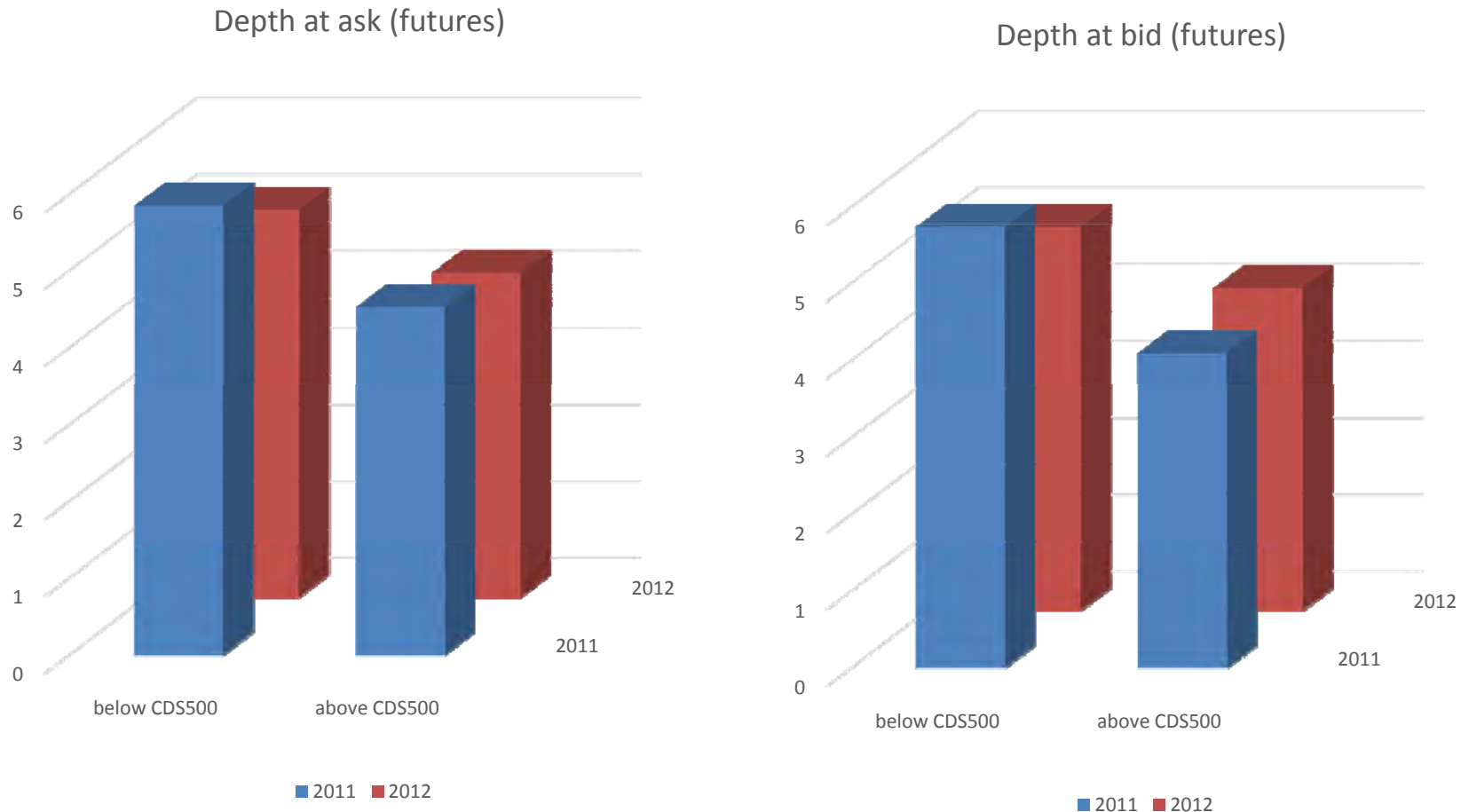


H2: Depth for Cash



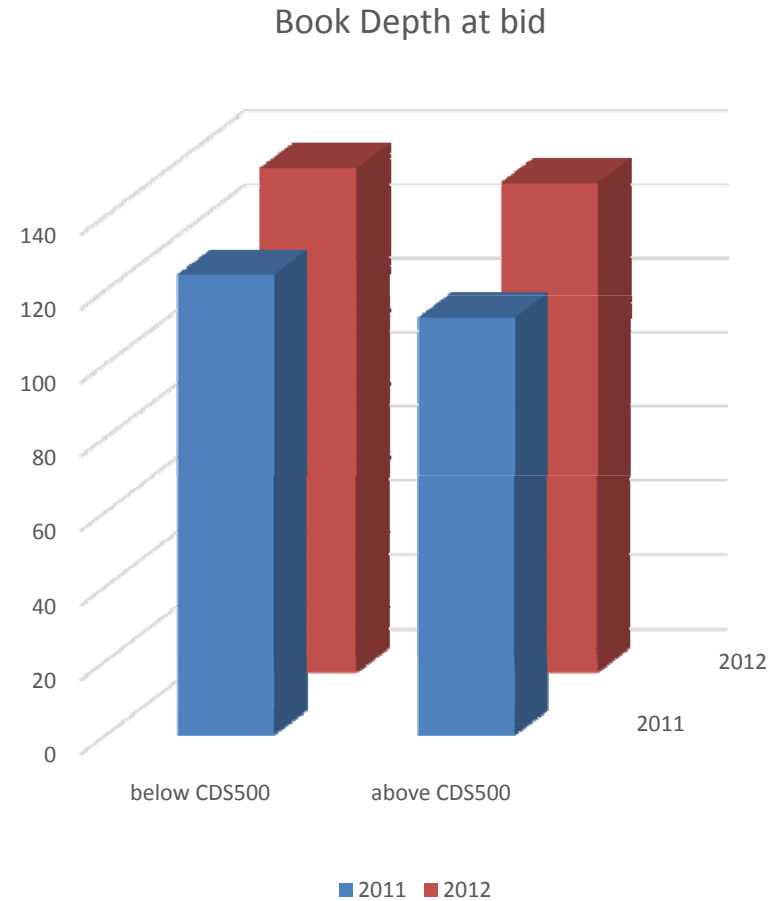
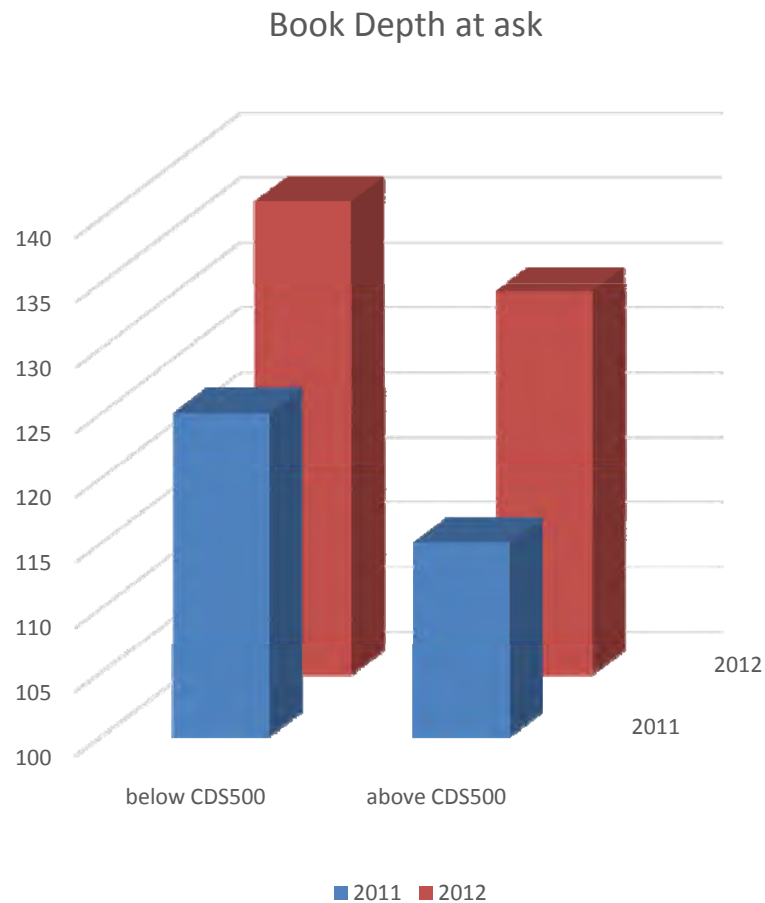
- The depth at best quotes did not change much
- Average level of depth on 2011 is lower than that on 2012. It does not change whether CDS is below or above 500.

H2A: Depth futures



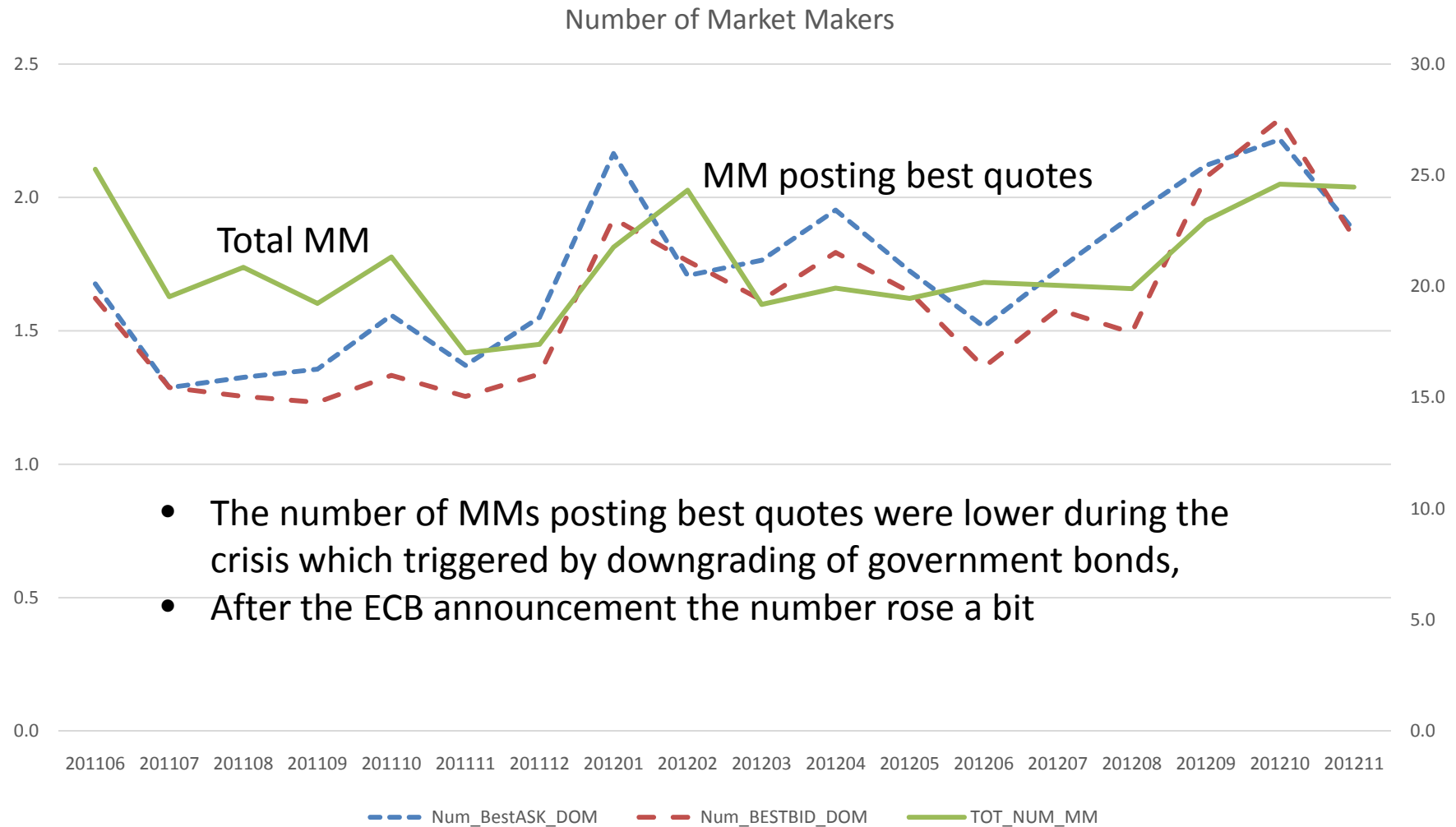
- Difference between below and above CDS 500 is more apparent in case of futures
- This is consistent to hypothesis 2A. In futures market liquidity is provided by public limit orders.

H2A&B: Book depth for BTP10

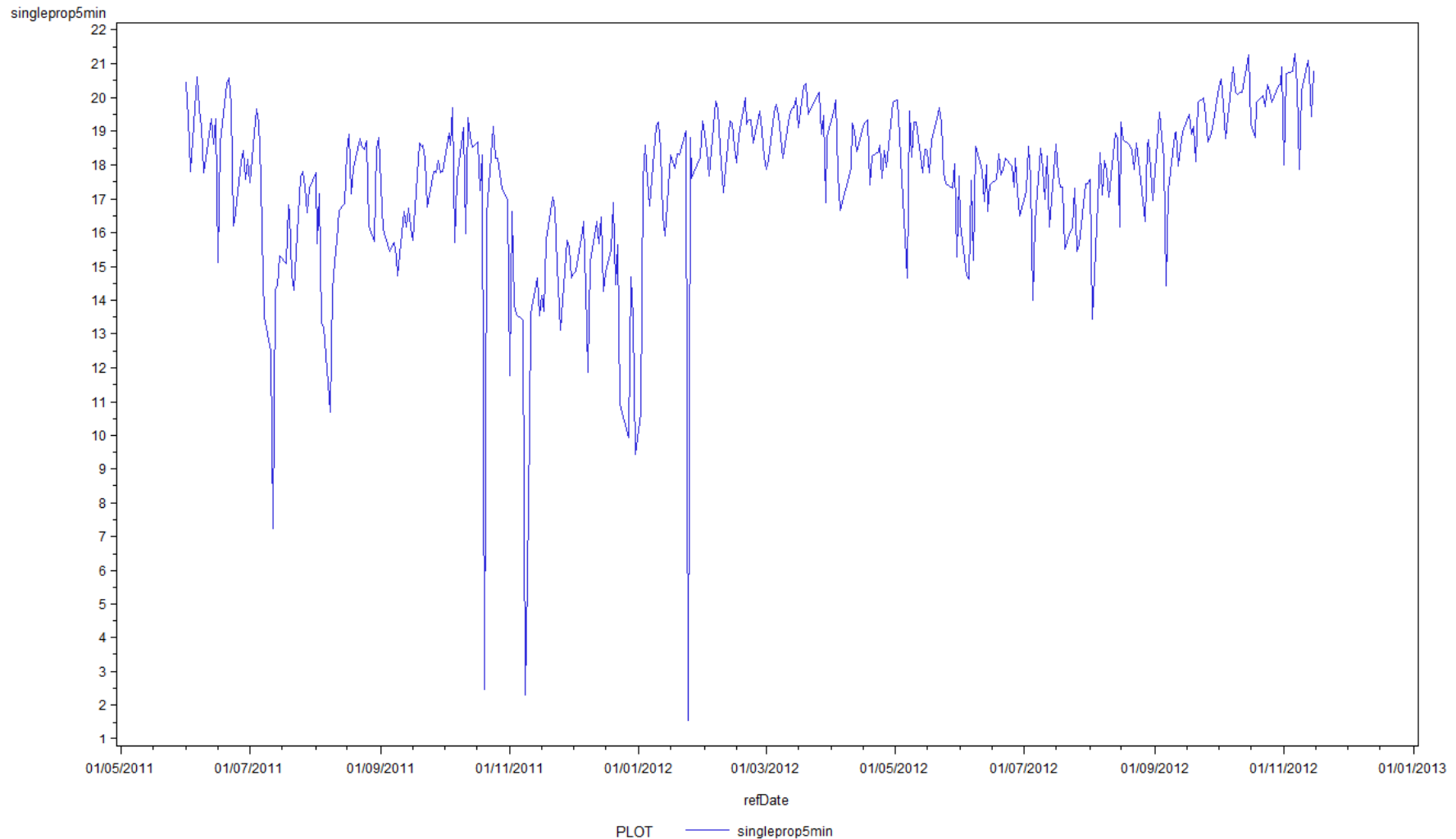


- Total amount of liquidity (Book depth) declines above CDS 500.
 - Only MMs posting best quotes keep remaining at market, but other MMs escaped.
- This results confirm an effect from primary dealers' obligation of market making.

H2A&B: Monthly Average Number of Market Makers

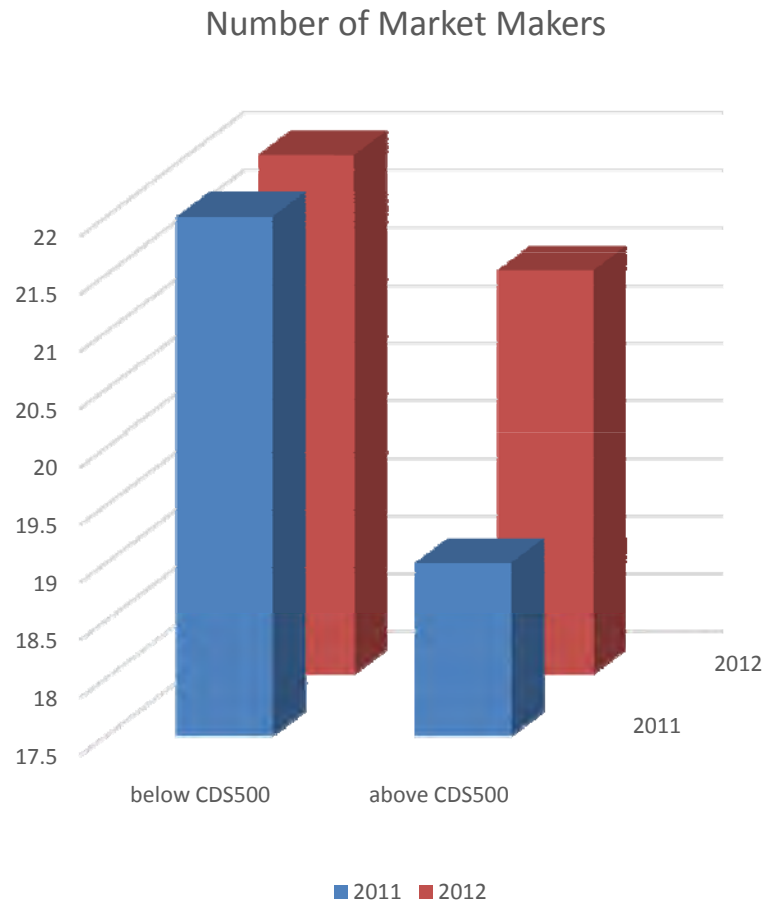


H2B: Market maker participation per bond



- The number of MM often drop to one or two during the crisis.
- It calmed down after 2012

H2A&B: Market Maker Participation for BTP10

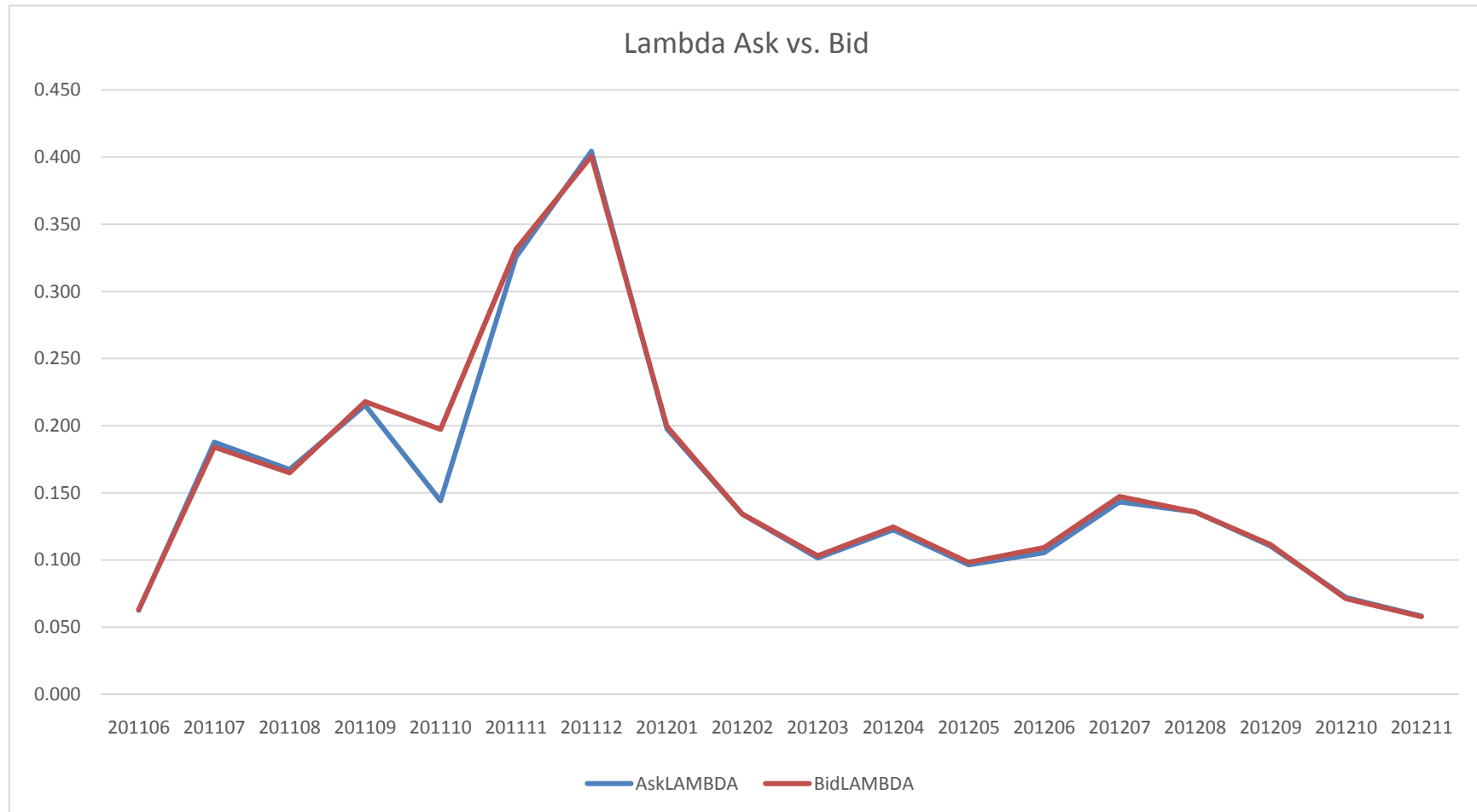


Statistically significant reduction for both years

- Interpretation for the previous slides confirmed by this.
- MM participation was reduced at the time of larger risk.
- But it does not last for long time period, say 5-15 minute most of time.

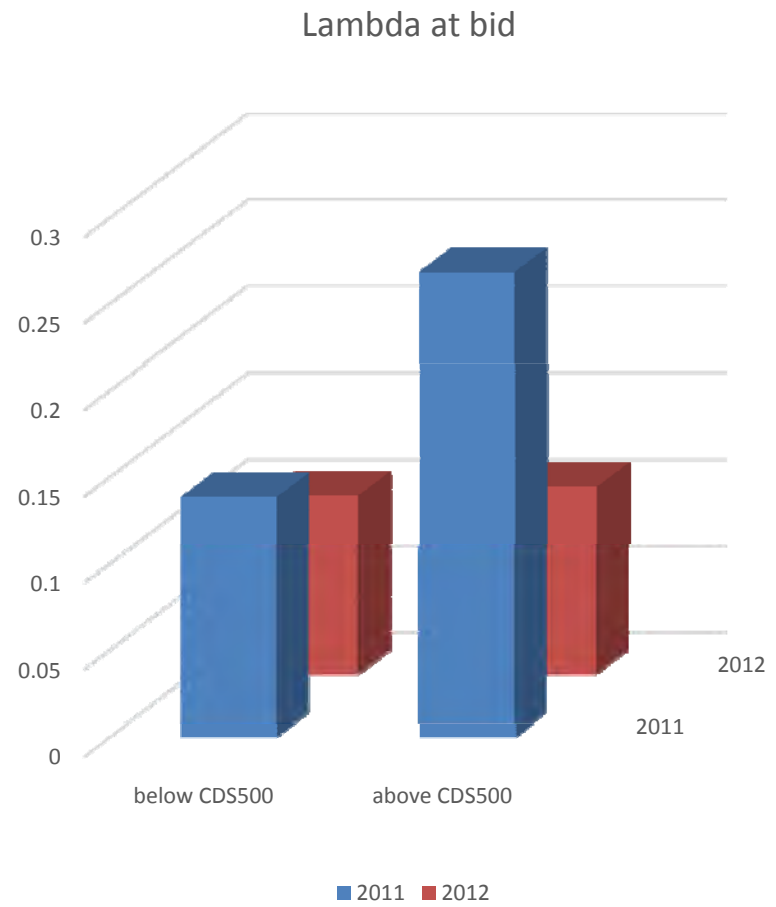
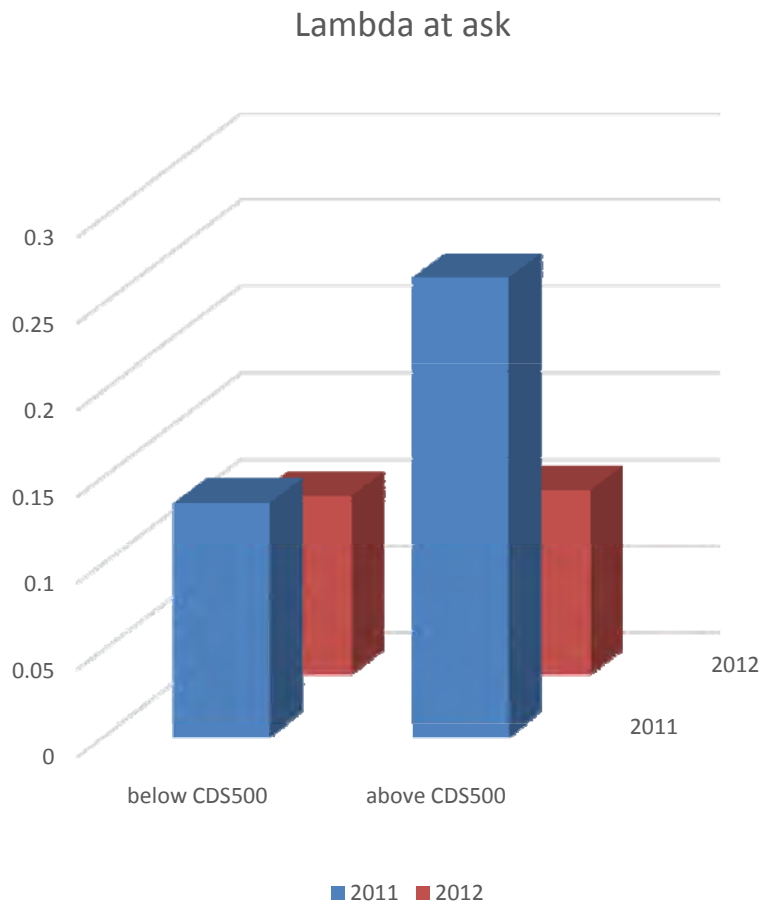
Lambda (Ex-ante)

Implied transaction cost of an order equivalent to 15 million euro including a half-bid-ask spread.



- They move almost identical except Oct and Nov 2011. Bid-side suffers more.

Lambda (Ex-ante)



- The difference below/above CDS 500 reflects reduction of total book.

A summary of Below/above CDS500

		BTP cash	BTP futures
Bid-ask spread	2011	24.4 bps. Vs. 54.6 bps.	3.8 bps. Vs. 5.1 bps.
	2012	18.5 bps. Vs. 19.8 bps.	3.0 bps. Vs. 3.6 bps.
Depth Ask	2011	5.0 vs. 5.0	5.9 vs. 4.5
	2012	7.5 vs. 5.0	5.1 vs. 4.2
Depth Bid	2011	5.0 vs. 5.0	5.8 vs. 4.1
	2012	7.5 vs. 5.0	5.0 vs. 4.2
Book Ask	2011	125 vs. 115	Depth at best quotes are insensitive to credit risk conditions which other measures respond. This is due to market maker obligation.
	2012	136.5 vs. 129.5	
Book Bid	2011	124 vs. 112.5	
	2012	136 vs. 132	
Number of MM	2011	22 vs. 19	
	2012	22 vs. 21	
Lambda Ask (Bid similar)	2011	0.135 vs. 0.265	
	2012	0.103 vs. 0.107	

Event study

To test timing of changes in MM behavior, we choose eight events based upon jumps or drops of CDS.

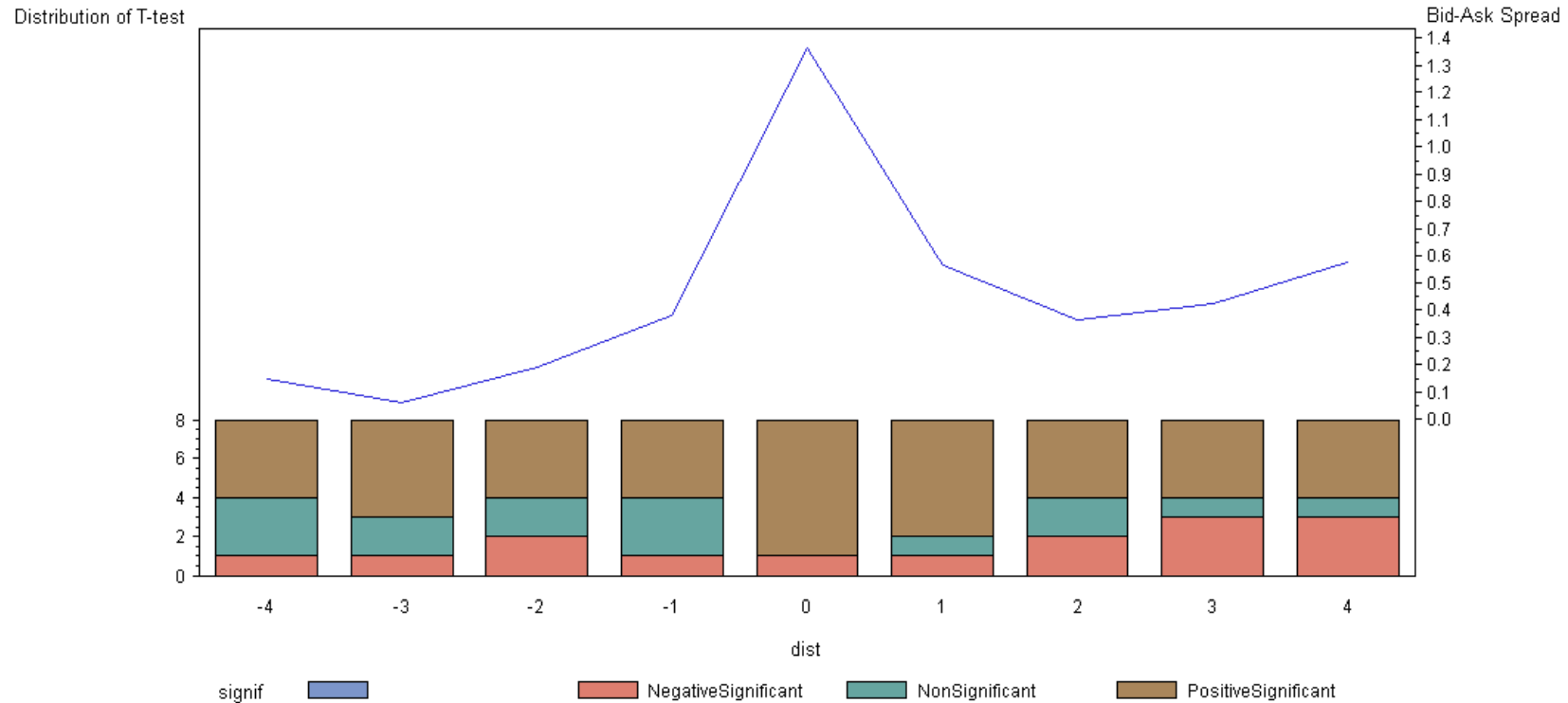
Date	ΔCDS_t	CDS_t
August 08, 2011	-49.47	336.21
September 20, 2011	53.90	502.22
September 27, 2011	-51.77	445.77
October 27, 2011	-51.04	402.40
November 01, 2011	77.53	517.06
November 09, 2011	50.33	564.64
December 08, 2011	52.58	524.44
June 29, 2012	-49.26	480.99

We calculate the Abnormal Liquidity Measure for bond i on day t around event d .

$$ALM_{dit} = \frac{LM_{dit} - CLM_{di}}{CLM_{di}}$$

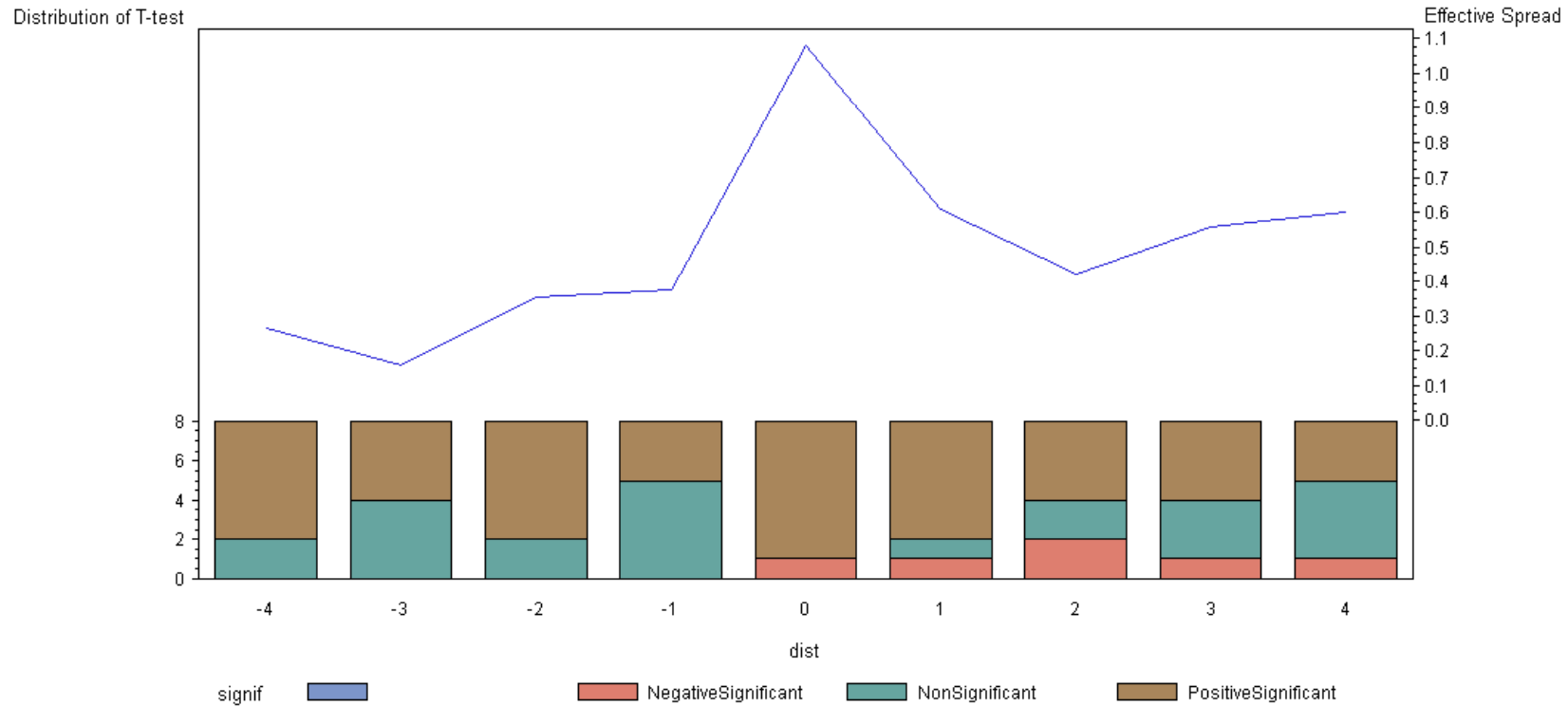
- ▶ The event days are those where the top 1% and bottom 1% CDS changes took place (8 days).
- ▶ For a 8-day window around each event we calculate the ALM_{dit} for bond i .
- ▶ CLM_{di} is the Comparison Liquidity Measure, which we define as the median of $LM_{d-9,i}, LM_{d-10,i}, \dots, LM_{d-19,i}$.
- ▶ ALM_t are graphed in the following slides. $D(=8)$ t -test are calculated across the l bonds for each event and each liquidity measure.

Quoted Spread



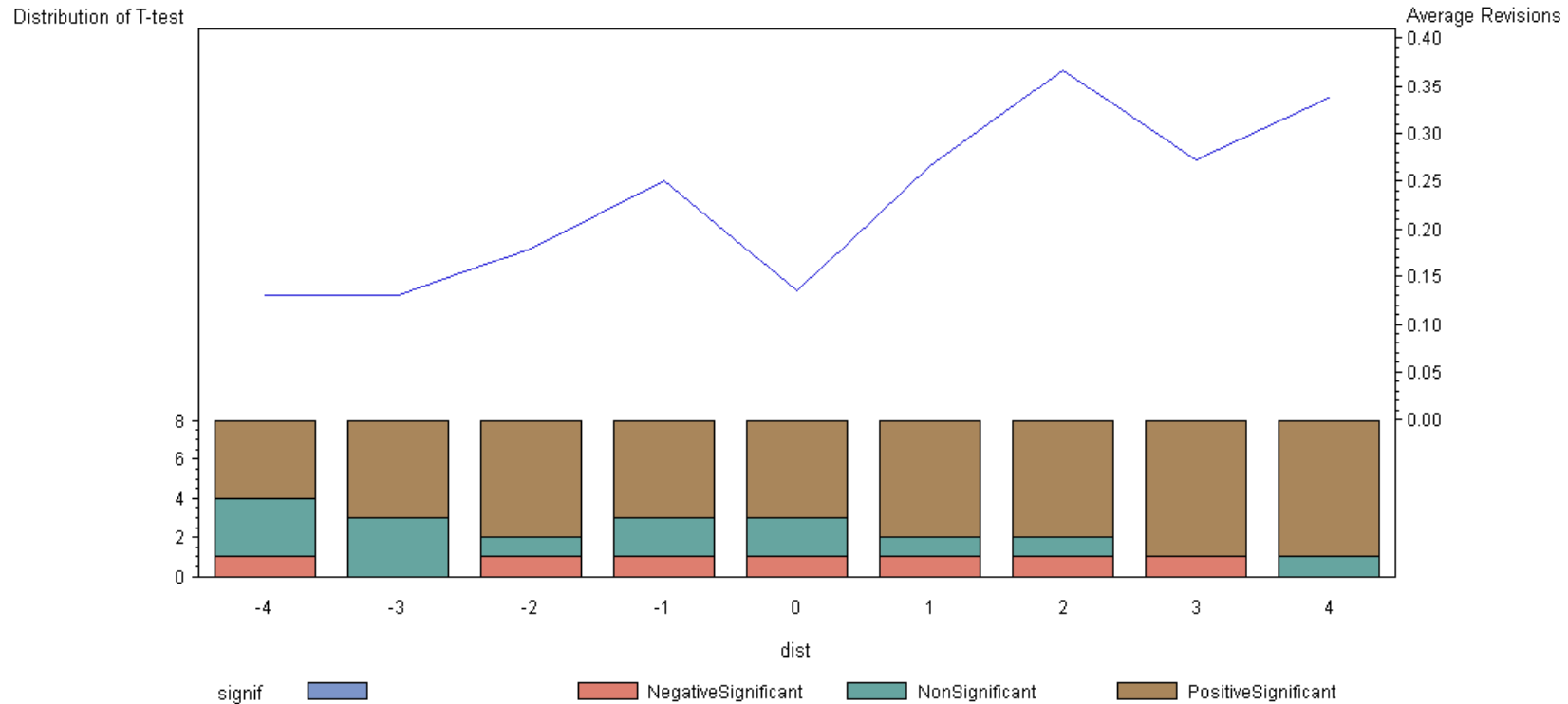
- 7 out of 8 are significant positive change at day-0
- 130% increase in quoted bid-ask spread relative to pre-event
- It decreased on next day, but stayed at 50% wider than before.

Effective spread



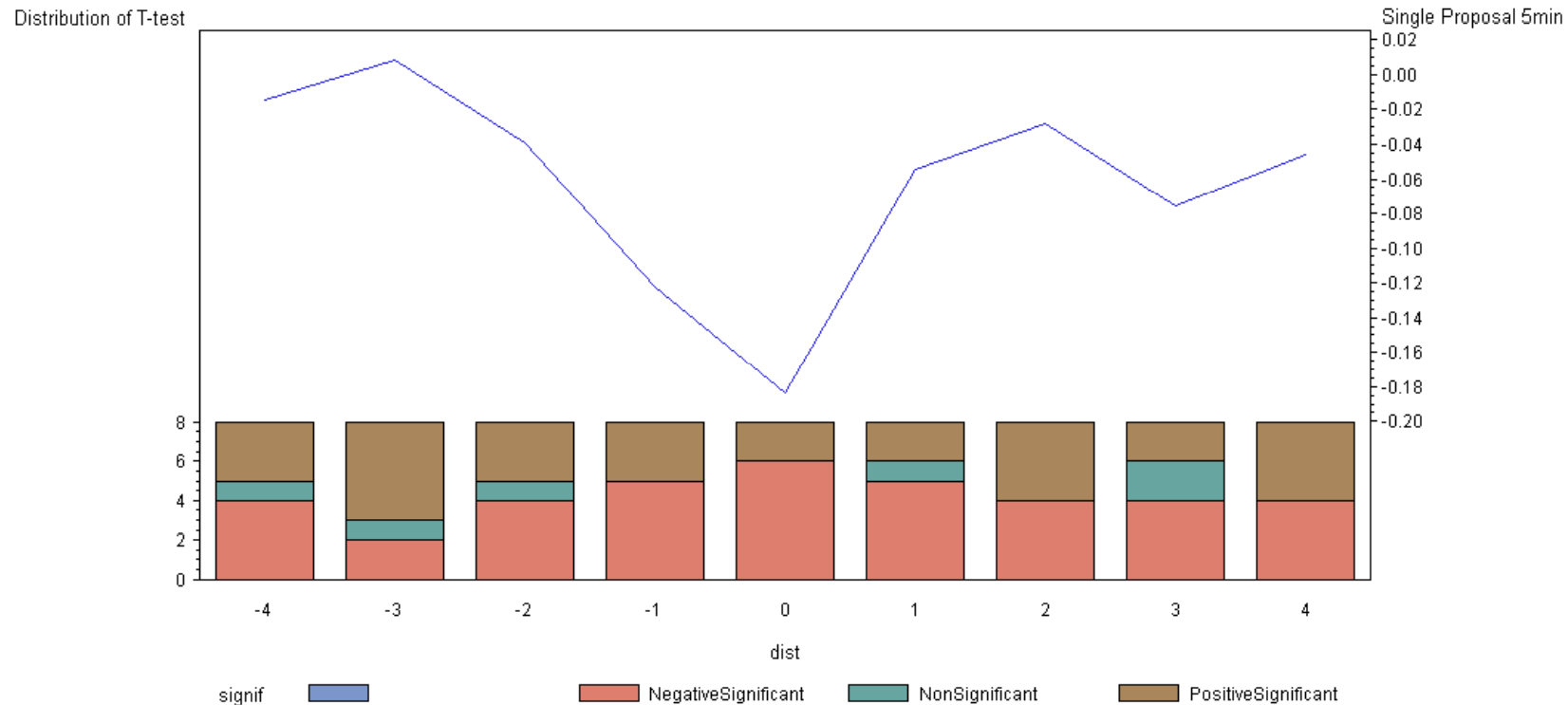
- Market makers suddenly increases effective bid ask spread at 2 times higher than previous period. It results in higher trading costs for liquidity demanders.

Average quote updates by market makers



- Market makers increased quote updates two days before the event.
- Market makers less actively updates quotes on the event day while keeping bid ask spread very large.
- They resume more frequent quote revisions after the event day.

Average number of market makers per five-minute interval



- It started reduction two days before the event.
- Many market makers are disappearing one day before the event. But they quickly come back on day+1.

Conclusions

- Under stressful circumstances, liquidity providers withdraw from the market
 - smaller depth at best quotes in Futures market
 - In cash market, the number of market makers decline
- They widen bid-ask spread to avoid potential loss.
 - In cash market the jump of spread is much bigger.
- When market makers anticipate some surprise, they stop market making if possible.
- Primary dealers have obligation of making market. It affects their behavior (A key players were posting wide quotes rather than withdraw from the market).

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