MANAGING VOLATILITY
OBJECTIVE WITH VOLATILITY MANAGEMENT

MAINTAIN A FAIR AND ORDERLY MARKET!

Non objectives:
- Avoid markets to go down
- Stop trading

What can cause volatility?
- Market factors
- Events – News or other fundamental factors
- Related markets volatility
- Mistakes
  - Exchange system problem
  - Member trading application goes wrong
  - Fat finger mistakes
- Market manipulation (out of scope)
RECENT MARKET INCIDENTS

Each case is unique but have a few commonalties:

- Movement is very fast – in some movements it can be characterized as uncontrolled
- 10 years ago, in more manual markets, the development would have been different
- Large media coverage – to a large extent negative for the market
- Investors negative to the development and want to avoid this type of events

In principle all stakeholders have an interest in avoiding this type of events with extreme volatility in a short time frame

Flash Crash - 2010
Knight Capital - 2012
US opening Aug - 2015
Chinese markets – Autumn 2015
WHAT TO MEASURE

- A market wide measurement may not be needed when there is measurement on lower level
- Single instrument measurement may be difficult to manage for participants if several instruments are volatile at the same time

*Market segment can be one exchange or a segment of a market (Telecom, Financial, etc.)

Level 1: Whole market
- Main country wide index

Level 2: Market segment
- Market segment*
- Single instrument

Level 3: Single instrument
- Market segment
- Single instrument
ACTIONS TO TAKE

ACTIONS THE EXCHANGE CAN TAKE ONCE TRIGGERED:

- Halt the market for a while
  - Reopen usually done within 1 – 15 minutes
  - New reference price is the new opening price → Can be triggered several times a day
- Halt market and enter into special auction where price outside price band is disseminated (Japan)
- Close the market (for rest of day)

WHERE TO APPLY THE ACTION:
- Whole market
- Market segment
- Underlying plus derivatives
- Single instrument

For movements

The point of the reopening period is for investors to consider the situation:
- For institutional investors that make perfect sense. They will check with major clients, re-evaluate risk, new parameters for algos etc.
- A halt have a more limited value for retail investors

For pre trade risk checks
REOPENING

- Trend towards view that the market should reopen
- Single instruments re-open in almost all markets
- Market wide stops have different rules
  - Some are reopening 1 time but not 2 times
  - Not reopen at all

REOPENING PROCESS:
- The point of a temporary halt is that the market participants gets a few minutes to re-consider the situation.
- Opening is in most cases done with same auction model used in the morning auction (but shorter order collection time)
- A new reference price is established in the opening and used when measuring new volatility management
PRACTICAL EXAMPLES
THE EUROPEAN MODEL

Dynamic volatility guard

Static volatility guard
## US EQUITY MARKET

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<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>US Equity</td>
<td>Market factors</td>
<td>Whole market</td>
<td>% from opening</td>
<td>Halt</td>
<td>Auction after 15</td>
<td>Stops at 7%, 13% and 20% (close) Do not apply last 60 minutes of the day</td>
</tr>
<tr>
<td>US Equity</td>
<td>Market factors</td>
<td>Individual instrument</td>
<td>% from average last in the last rolling 5 minutes period</td>
<td>Limit state – Trades only within X % price band in 15 seconds</td>
<td>If order removed trading continues. If order remain halt for 5 minutes</td>
<td></td>
</tr>
<tr>
<td>Nasdaq US Equity</td>
<td>Mistakes</td>
<td>All orders</td>
<td>Pre-trade risk - Limits set by member</td>
<td>Kill switch</td>
<td>Discuss with exchange</td>
<td>Member set up rules for their internal users and external clients</td>
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</table>
LIMIT UP LIMIT DOWN – HOW IT WORKS

All executable orders and quotes must be within the bands. When there are no executable quotes from any exchange for 15 seconds, the market may enter a halt.

These trades are blocked from occurring because they are outside the bands.

Each update of the bands is based on the average price of trades over the previous 5 minutes.
LIMIT UP LIMIT DOWN – DETAILS

• The listing exchange distributes price bands for each stock throughout the day
  • Bands are updated every 30 seconds
  • Bands are based on the average price over the previous 5 minutes adjusted up by a percentage to get the upper band and down by a percentage to get the lower band
  • The width of the bands depends on stock activity, price, and time of day
• No trading venue is allowed to execute trades outside the price bands
• Only orders and quotes within the bands are executable and eligible for National Best Bid and Offer (NBBO)
• If there are no executable orders within the bands for 15 seconds, then the listing exchange announces a pause in trading of the stock
  • All trading venues must pause trading for 5 minutes
  • Pause ends with a re-opening auction by the listing exchange
  • Bands are re-set after the auction based on the auction price

Example:
Average price over previous 5 minutes = $10.00
Percent adjustment = 10%
Upper band = $11.00
Lower band = $9.00
LULD Halts

- A record 1,278 halts occurred on Aug 24th.
- 93% of halts on August 24th occurred before 10:30am.
- 83% of halts were in ETFs, most of which were ARCX listed.
- 58% of the halts(*) were in stocks with market cap below $100M.
- Less than 1% of the halts were S&P 500 stocks.
- The most in one day before that date was 109.
- Tuesday, August 25th had 130 halts.

<table>
<thead>
<tr>
<th>Listing exchange</th>
<th>Day</th>
<th>ETFs</th>
<th>S&amp;P 500</th>
<th>Before 10:30</th>
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<tbody>
<tr>
<td>BATS</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>3</td>
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<tr>
<td>NASDAQ</td>
<td>194</td>
<td>58</td>
<td>2</td>
<td>150</td>
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<tr>
<td>NYSE</td>
<td>78</td>
<td>0</td>
<td>6</td>
<td>73</td>
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<tr>
<td>NYSE Arca</td>
<td>999</td>
<td>999</td>
<td>0</td>
<td>958</td>
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<tr>
<td>NYSE MKT</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>1,278</strong></td>
<td><strong>1,060</strong></td>
<td><strong>8</strong></td>
<td><strong>1,188</strong></td>
</tr>
<tr>
<td><strong>Percent of cases</strong></td>
<td><strong>83%</strong></td>
<td><strong>1%</strong></td>
<td><strong>93%</strong></td>
<td></td>
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Security Float | Halts(*) |
<table>
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<tr>
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<tbody>
<tr>
<td>&lt; $100 MIL</td>
<td>101</td>
</tr>
<tr>
<td>$100 - $250 MIL</td>
<td>12</td>
</tr>
<tr>
<td>$250 - $500 MIL</td>
<td>10</td>
</tr>
<tr>
<td>$500 MIL - $1 BIL</td>
<td>9</td>
</tr>
<tr>
<td>$1 - $5 BIL</td>
<td>22</td>
</tr>
<tr>
<td>$5 - $50 BIL</td>
<td>15</td>
</tr>
<tr>
<td>&gt; $50 BIL</td>
<td>6</td>
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* Excluding ETF’s
CONCLUSIONS
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There is no overall standard for how to manage volatility. There are differences to all four parts of the model:

1. Volatility is measured for instrument level and/or on market overall level
2. Different measurements apply on how to measure
3. Most markets halt and reopen after a while – you really want to avoid market close. Market close should be to protect from systematic risks
4. Reopen is usually done within 3 – 15 minutes using same process as market opening