

Risk Management at Optiver

TopQuants Conference

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Agenda

- Introduction to Optiver
- Types of Risk
- Risk Management Framework
- Capital Factors
- Questions

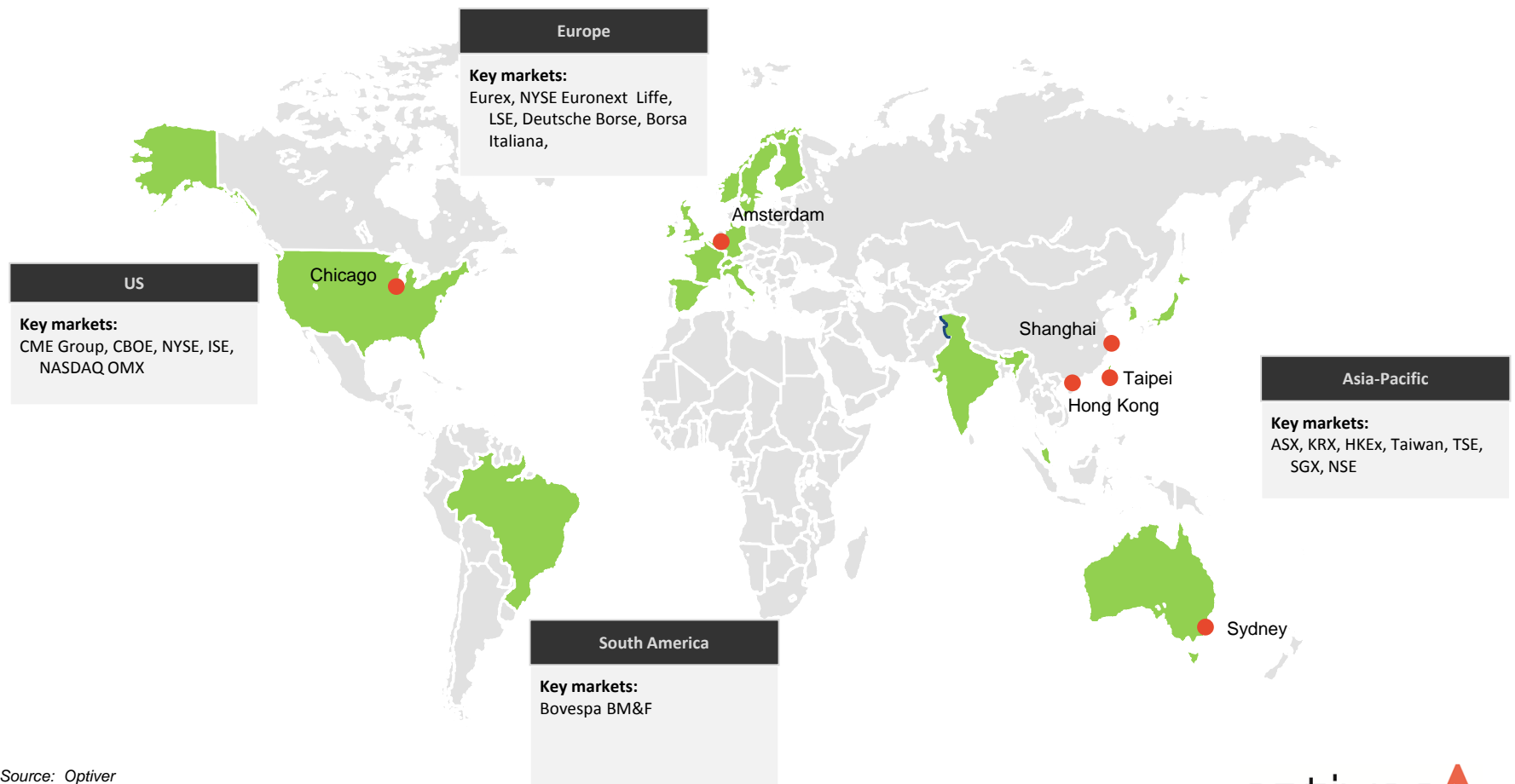
Introduction to Optiver

- Optiver is an electronic market maker/liquidity provider which uses low-latency techniques
- Proprietary Trading Firm and was founded in 1986
- It counts more than 750 employees and is globally present on all major exchanges
- Principal offices: Amsterdam, Chicago, Sydney



Introduction to Optiver (2) – Global Reach

Connectivity to 50+ exchanges and platforms globally



Source: Optiver

Introduction to Optiver (3)

Optiver is mainly active in on-screen trading:

- Cash Equities & ETFs
- Bonds and Bond Futures
- Foreign Exchange
- Commodities
- Listed, plain vanilla derivatives (Equities, Fixed Income, Foreign Exchange, Commodities, Volatility Indices)

The complexity in the Optiver's trading activities is not so much in pricing complex products, but lies in other areas:

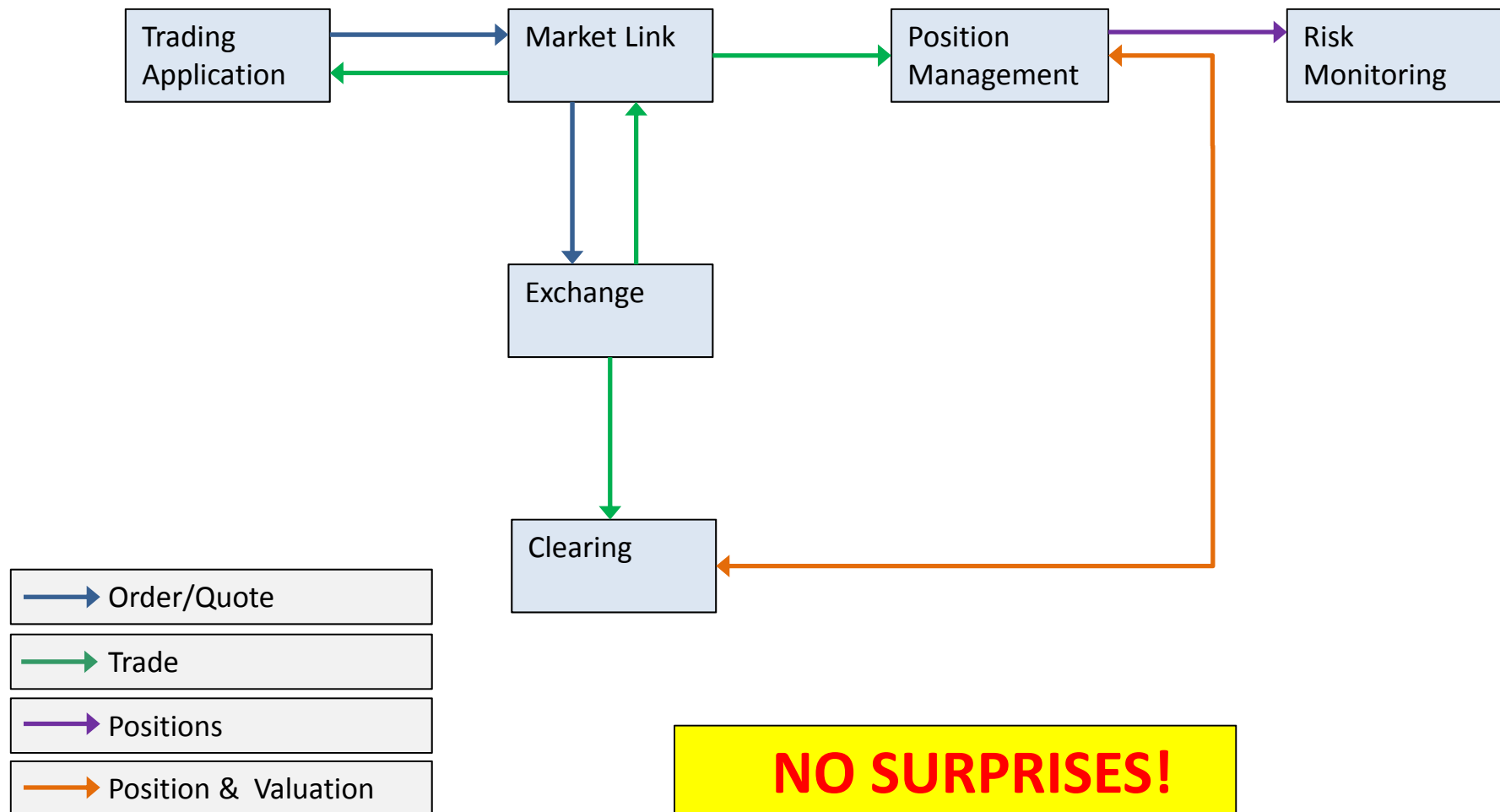
- Fast and precise pricing & calculation of Greeks for vanilla products
- Fast order/quote updates and fast execution
- Managing order books and trade portfolios containing large numbers of different instruments

Low Latency



Source: <http://sniperinmahwah.wordpress.com/2014/09/25/hft-in-my-backyard-ii/>

Overview Trading Framework



Risk Exposures at Optiver

Different Types of Risk Exposures:

- Market Risk: Relatively small compared to traded volume, in particular overnight positions
- Credit Risk: Residual Risk
- Operational Risk: All the 'standard' ORM exposures, but in particular **Automated Trading Risk (ATR)**



Risk Management at Optiver

Market Risk:

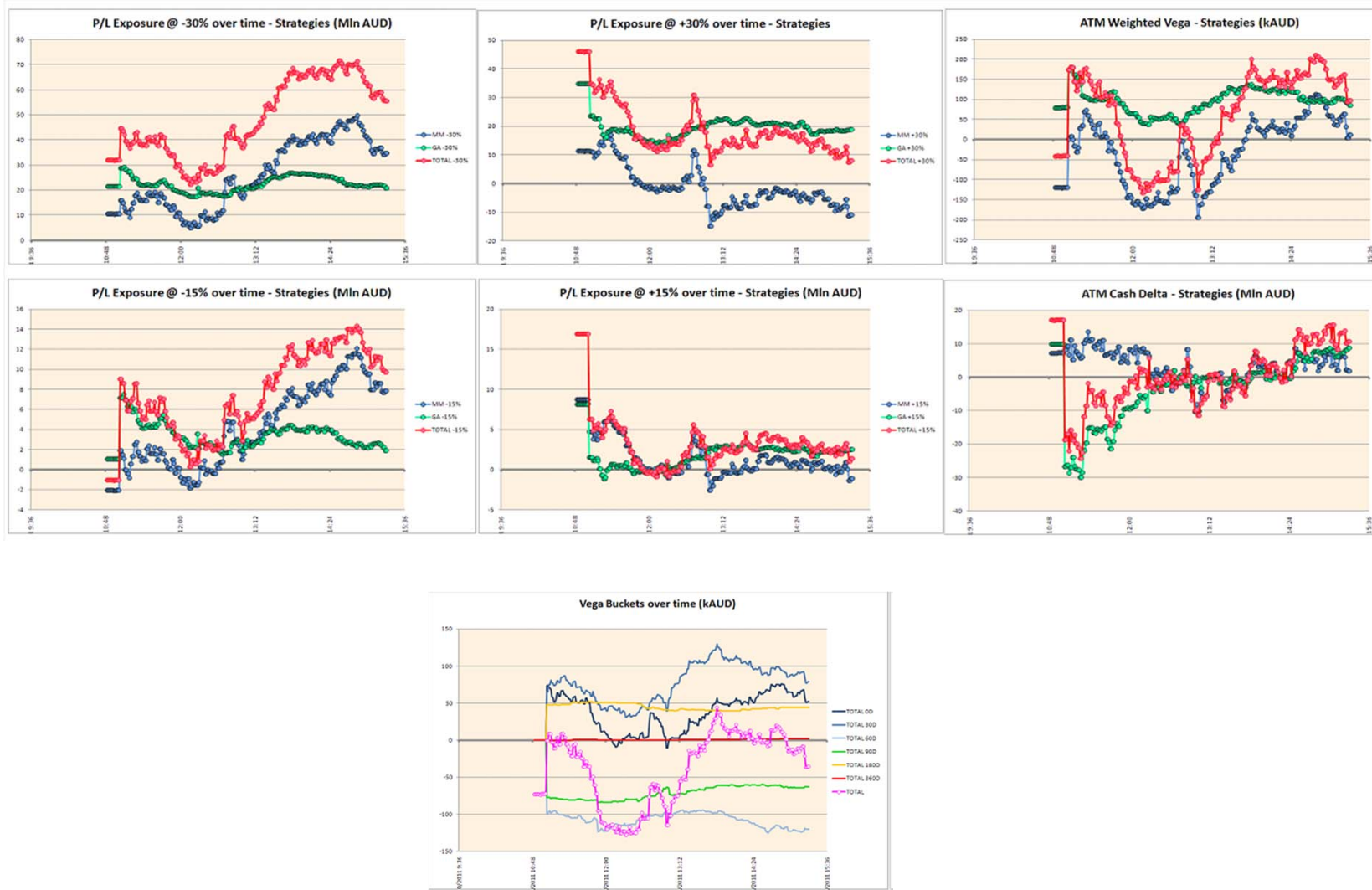
- Limit Framework based on scenario exposures and ATM Greeks
- Internally adjusted Greeks (e.g. Weighted Vega)
- Very Conservative Stress Levels in Scenarios
- Optiver needs to satisfy the capital requirements (Haircut & Credit Line) from Clearing on the overnight positions
- VaR measures only explored in Risk Capital Measures

Low-Latency Risk Management:

- All scenario exposures, Trading results and Greeks are monitored on a real-time basis!



Risk Management at Optiver (2)



Weighted Vega

When combining Vega positions for different maturities, it should be taken into account that changes in implied volatilities differ from maturity to maturity.

Forward Volatility:

$$t_1 \sigma_1^2 + (t_2 - t_1) \sigma_{12}^2 = t_2 \sigma_2^2$$

Generalization:

$$t_1 \sigma_1^2 + (t_2 - t_1) \sigma_{12}^2 + 2\rho \sqrt{(t_1(t_2 - t_1))} \sigma_1 \sigma_{12} = t_2 \sigma_2^2$$

Assume perfect correlation:

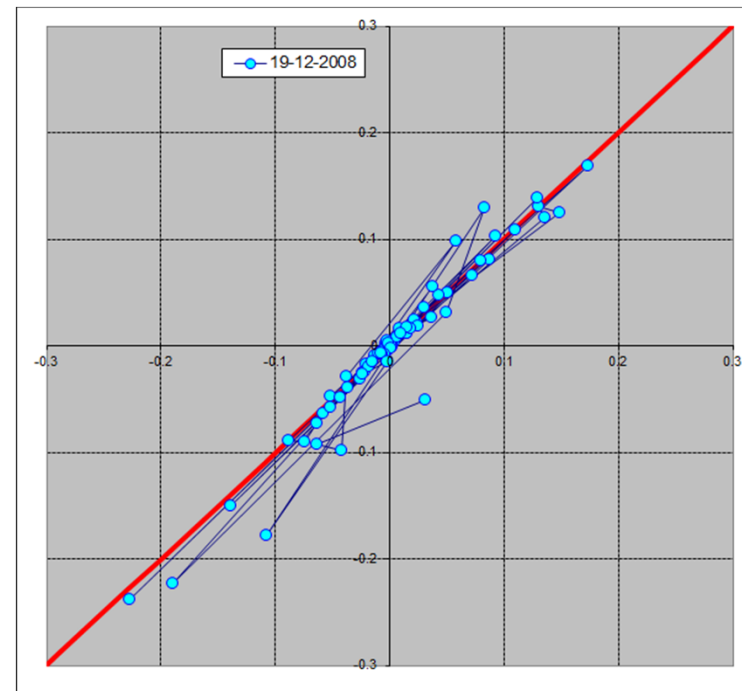
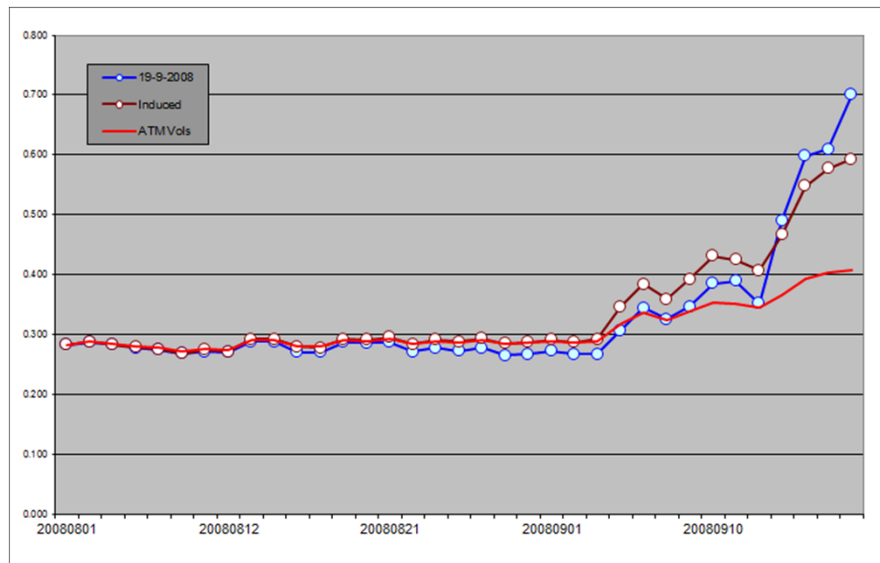
$$\delta \sigma_2 = \sqrt{\frac{t_1}{t_2}} \delta \sigma_1$$

Weighted Vega:

$$Vega_{weighted} = \min \left(\sqrt{\frac{T_{Scale}}{t}}, 3 \right) \times Vega$$

Weighted Vega – Backtesting Charts

SIE GY:

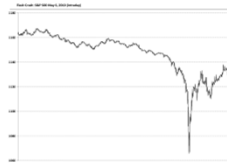


Automation Risk



The finance industry has seen in the recent past a number of dramatic losses due to ATR incidents (Losses are estimates):

- 2010: Flash Crash



- 2012: Eclipse Options: Lost USD 20 Mln (10 minutes)



- 2013: Hanmag: Lost USD 45 Mln

- 2014: Goldman Sachs: Lost USD 10 Mln (< 17minutes).
Without trade busts it could have been USD 100Mln.



- 2012: Knight Capital: Lost USD 450 Mln (45 minutes)



Rule of Thumb: Loss USD 10 Mln/min

Oscillation incident



Delta hedger: Hedge full delta position every second.

Scenario: Due to system issues, the algo receives the trade confirmations with 3 seconds delay, hedging decisions are only taken based on confirmed trades...

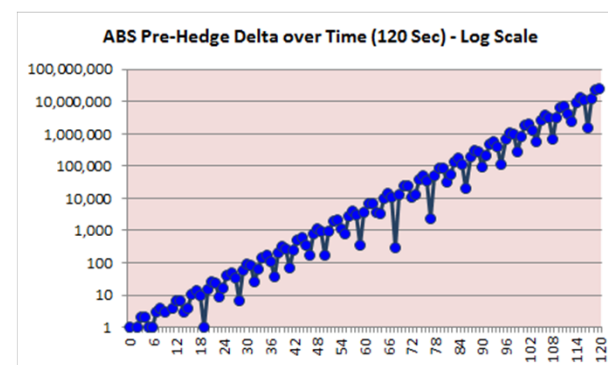
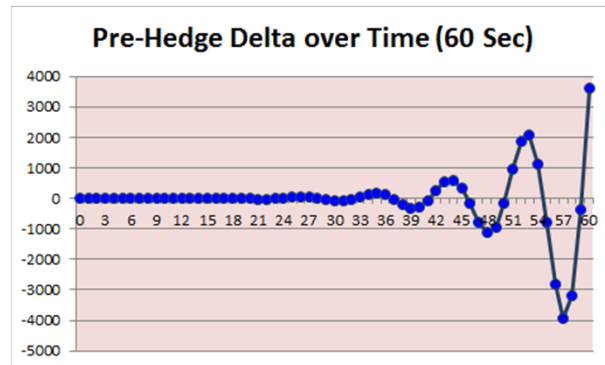
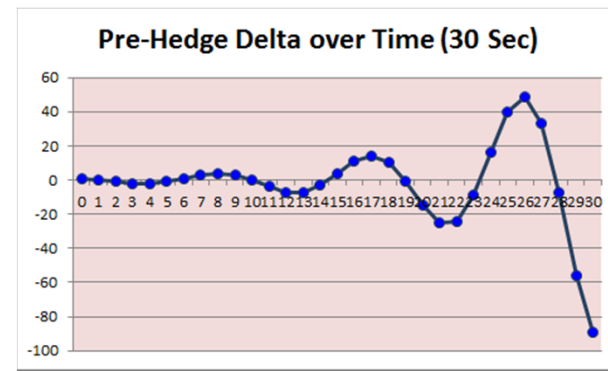
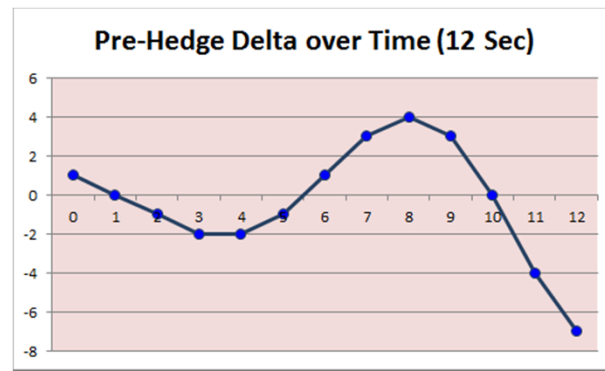
Assume at $t=0$ the CashDelta is EUR 1Mln:

Time	Perceived Delta	Hedge Transaction	True Delta (pre-hedge)
T=0	1	-1	1
T=1	1	-1	0
T=2	1	-1	-1
T=3	0	0	-2
T=4	-1	1	-2
T=5	-2	2	-1
T=6	-2	2	1
T=7	-1	1	3
T=8	1	-1	4
T=9	3	-3	3
T=10	4	-4	0
T=11	3	-3	-4
T=12	0	0	-7

Oscillation incident (2)



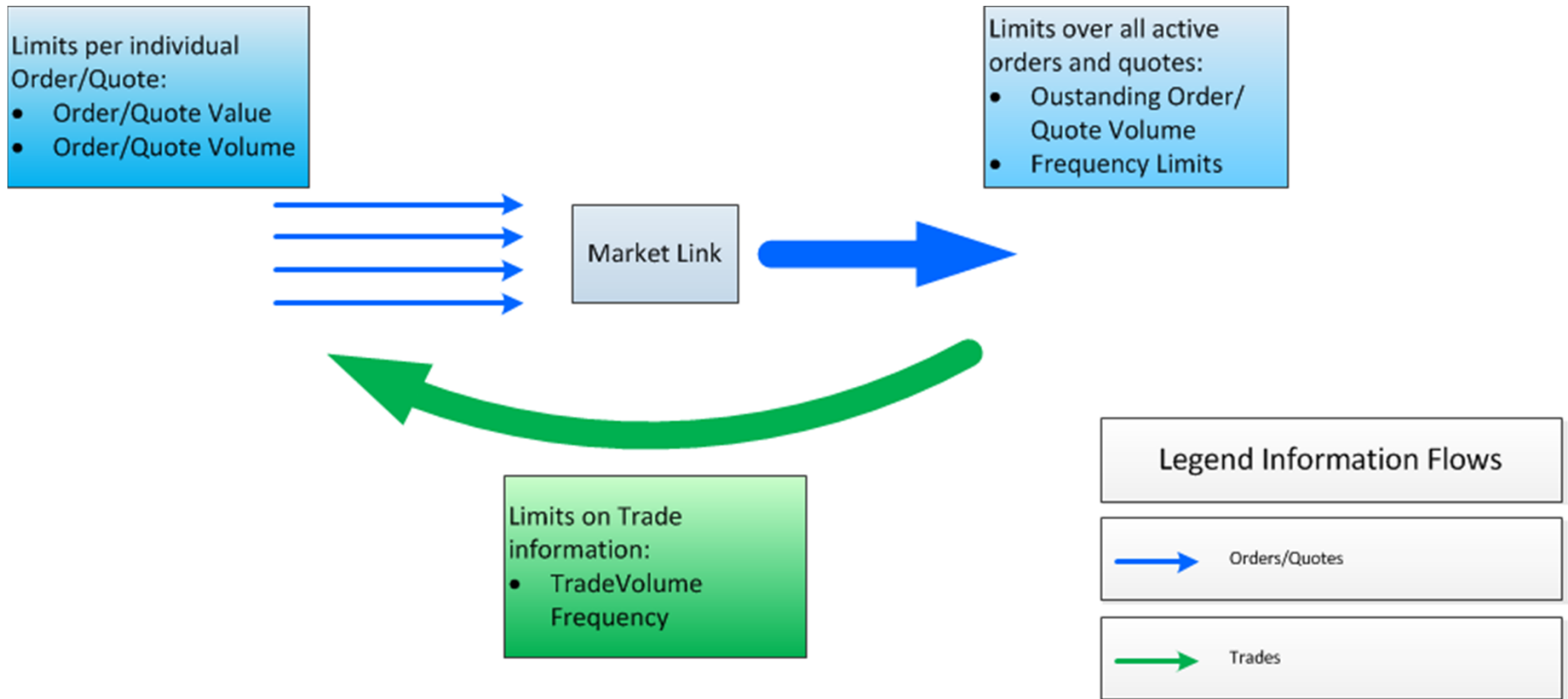
Slowly oscillating into larger and larger positions....



Overview Trading Framework



Overview Pre-Trade Limits



ATR Scenarios

The efficiency of the Pre-Trade Limits is measured by the loss exposures for a number of scenarios:

- **Instantaneous Scenario:** Max position that can be accumulated on instantaneous execution of all outstanding orders and quotes
- **Looping Scenario:** Max position that can be accumulated by continuously trading for a 30 second period.

These exposures are converted into a monetary loss by multiplying these maximum positions by a loss conversion factor (dependent on underlying value, trading activity, traded instruments)

Exposures are evaluated per algorithm, but also on aggregation levels (e.g. all algorithms trading the same underlying value).

ATR Scenarios - Example

Consider an algo trading SX5E options. The limit on the number of outstanding orders (OO) is 50. The maximum order volume (OV) is 50. The Trade frequency (TF) limit is 20 per 2 seconds.

The total exposure in the instantaneous scenario (IS):

$$OO * OV = 50 * 50 = 2,500 \text{ options}$$

The total exposure in the Looping scenario (LS) is:

$$TF * OV * 30 = 20/2 * 50 * 30 = 15,000 \text{ options}$$

Worst case: deep ITM options ($D=1$). Contract size 10.

CashDelta one option: $\text{€ } 1 * 10 * 3,065 = \text{€ } 30.6\text{k}$

Scenario Exposures: IS: $\text{€ } 2,500 * 30.6\text{k} = \text{€ } 76.5\text{Mln}$

LS: $\text{€ } 15,000 * 30.6\text{k} = \text{€ } 459\text{Mln}$

Assume adverse market move. For large indices 3%

Scenario losses:

$$\text{IS} = \text{€ } 76.5\text{Mln} * 3\% = \text{€ } 2.3\text{Mln}$$

$$\text{LS} = \text{€ } 459\text{Mln} * 3\% = \text{€ } 13.8\text{Mln}$$

ATR Scenarios – Economic Capital

The EC contribution from the ATR scenarios:

$$EC = \text{Likelihood} * \text{MaxExposure} * \text{LCF}$$

Initiatives to bring down capital at risk focus on all components of the above product:

- Lower pre-trade limits: lower max exposure
- Smarter pre-trade limits (see next slide)
- Smarter functionality: lower LCF
- Liaise with exchanges to introduce effective protection and error-trade rules: lower LCF
- Faster detection: lower Max exposure
- More reliable trading architecture: lower likelihood
- More checks and balances: lower likelihood

ATR Scenarios – Example (2)

Consider an algo trading SX5E options. The limit on the number of outstanding order volume per underlying (OOV) is 500. The TradeVolume frequency (TVF) limit is 400 per 2 seconds.

The total exposure in the instantaneous scenario (IS):
OOV=500 options

The total exposure in the Looping scenario (LS) is:
 $TVF * 30 = 400 / 2 * 30 = 6,000$ options

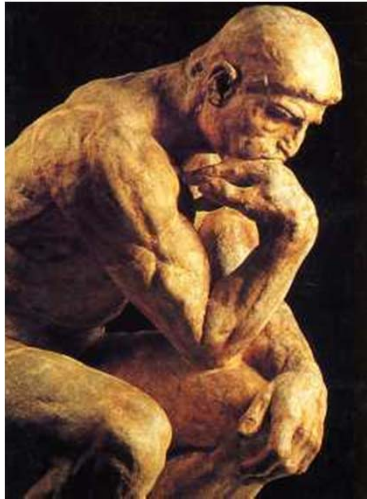
Worst case: deep ITM options ($D=1$). Contract size 10.
CashDeltas one option: $€ 1 * 10 * 3,065 = € 30.6k$

Scenario Exposures: IS: $€ 500 * 30.6k = € 15.3Mln$
LS: $€ 15,000 * 30.6k = € 184Mln$

Assume adverse market move. For large indices 3%

Scenario losses: IS= $€ 15.3Mln * 3\% = € 0.46Mln$
LS= $€ 184Mln * 3\% = € 5.5Mln$

Questions & Discussion



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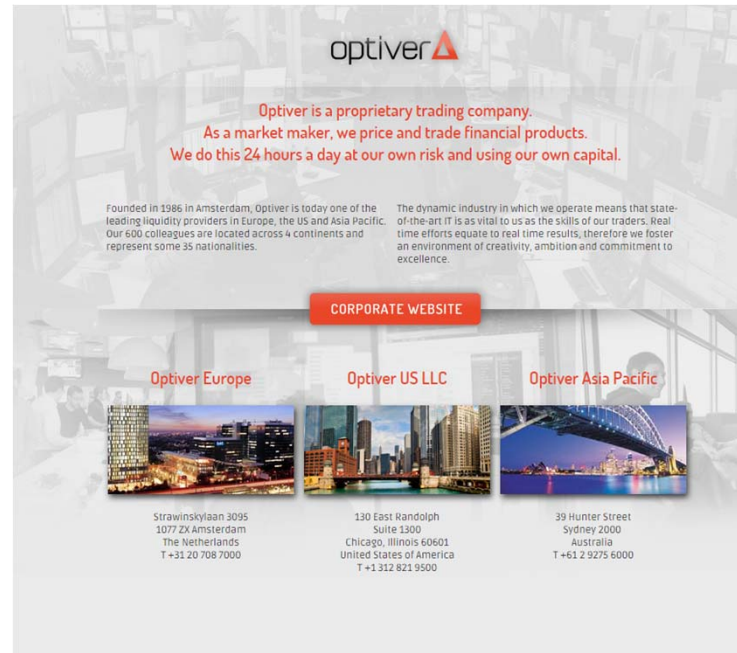
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The screenshot shows the Optiver corporate website. At the top, the Optiver logo is displayed. Below it, a red banner contains the text: "Optiver is a proprietary trading company. As a market maker, we price and trade financial products. We do this 24 hours a day at our own risk and using our own capital." Below the banner, there are two columns of text. The left column describes the company's founding in 1996 and its status as a leading liquidity provider. The right column describes the dynamic industry and the company's commitment to excellence. Below the text, there is a red button labeled "CORPORATE WEBSITE". At the bottom, there are three sections for regional offices: Optiver Europe, Optiver US LLC, and Optiver Asia Pacific. Each section includes a photograph of the office building and the company's address and contact information.

optiver 

Optiver is a proprietary trading company.
As a market maker, we price and trade financial products.
We do this 24 hours a day at our own risk and using our own capital.

Founded in 1996 in Amsterdam, Optiver is today one of the leading liquidity providers in Europe, the US and Asia Pacific. Our 600 colleagues are located across 4 continents and represent some 35 nationalities.

The dynamic industry in which we operate means that state-of-the-art IT is as vital to us as the skills of our traders. Real time efforts equate to real time results, therefore we foster an environment of creativity, ambition and commitment to excellence.

CORPORATE WEBSITE

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