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

Key markets:
- Eurex, NYSE Euronext, Liffe, LSE, Deutsche Borse, Borsa Italiana,

Key markets:
- CME Group, CBOE, NYSE, ISE, NASDAQ OMX

Key markets:
- Bovespa BM&F

Key markets:
- ASX, KRX, HKEx, Taiwan, TSE, SGX, NSE

Source: Optiver
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

Overview Trading Framework

Trading Application -> Market Link -> Exchange

Market Link -> Position Management

Position Management -> Risk Monitoring

Exchange -> Clearing

Clearing -> Risk Monitoring

NO SURPRISES!
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)
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:

\[ \delta \sigma_2 = \frac{t_1}{\sqrt{t_2}} \delta \sigma_1 \]

Weighted Vega:

\[ \text{Vega}_{\text{weighted}} = \min \left( \frac{T_{\text{scale}}}{t}, 3 \right) \times \text{Vega} \]
Weighted Vega – Backtesting Charts

SIE GY:
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 (< 17 minutes). Without trade busts it could have been USD 100 Mln.
- 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:

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<th>Time</th>
<th>Perceived Delta</th>
<th>Hedge Transaction</th>
<th>True Delta (pre-hedge)</th>
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</table>
Oscillation incident (2)

Slowly oscillating into larger and larger positions....
Overview Trading Framework

- Trading Application
- Market Link
- Position Management
- Risk Monitoring
- Instrument Definition
- Exchange
- Intraday Trade Rec
- Clearing

Order/Quote
Trade
Positions
Position & Valuation
Instrument Definitions
Kill Switch/Panic Button

NO SURPRISES!
Overview Pre-Trade Limits

Limits per individual Order/Quote:
- Order/Quote Value
- Order/Quote Volume

Limits over all active orders and quotes:
- Outstanding Order/Quote Volume
- Frequency Limits

Limits on Trade information:
- Trade Volume
- Frequency

Legend Information Flows:
- Orders/Quotes
- Trades
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).
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):
\[ OO \times OV = 50 \times 50 = 2,500 \text{ options} \]

The total exposure in the Looping scenario (LS) is:
\[ TF \times OV \times 30 = 20/2 \times 50 \times 30 = 15,000 \text{ options} \]

Worst case: deep ITM options (D=1). Contract size 10. CashDelta one option: \[ \€ 1 \times 10 \times 3,065 = \€ 30.6k \]

Scenario Exposures: IS: \[ \€ 2,500 \times 30.6k = \€ 76.5Mln \]
LS: \[ \€ 15,000 \times 30.6k = \€ 459Mln \]

Assume adverse market move. For large indices 3%

Scenario losses: IS= \[ \€ 76.5Mln \times 3\% = \€ 2.3Mln \]
LS= \[ \€ 459Mln \times 3\% = \€ 13.8Mln \]
The EC contribution from the ATR scenarios:

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

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
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

Robert van Gulik, Ph.D.
Group Head Risk

Stravinskylaan 3095, 1077ZX Amsterdam, The Netherlands
T: +31 (0)20 7087469
M: +31 (0)6 21846160
E: RobertvanGulik@optiver.com

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.

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