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# STRESS TESTING ON OPTIONS

**HKEX**  
香港交易所

Clearing Risk Management

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# AGENDA

1

Background

2

Linear Products vs Non-Linear Products

3

Stress Testing Calculation and Implementation



## Overview

Proper stress testing should be in place for it's own or clients' exposure on HKEX's products, particularly on non-linear products such as option.

### Problem

- The loss of non-linear products could increase exponentially under extreme scenarios.

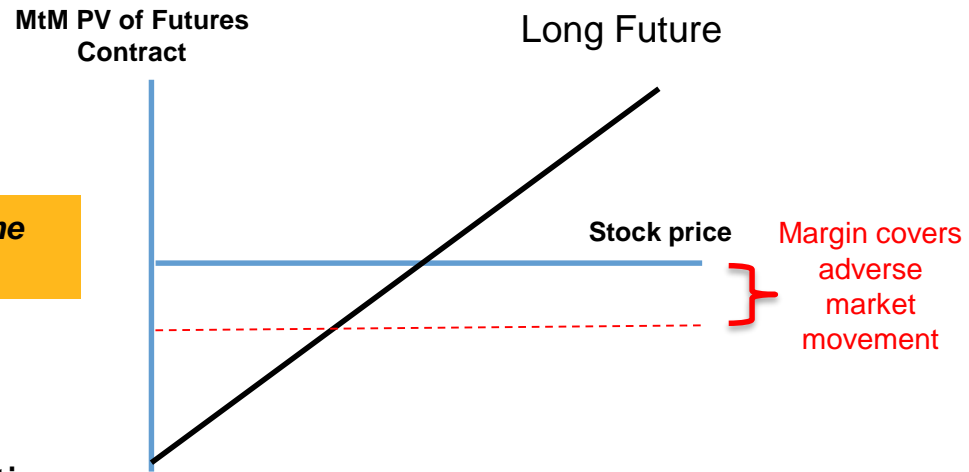
### Stress test as a tool

- to evaluate the potential portfolio loss under extreme but plausible market condition
- to form part of risk monitoring, control and governance

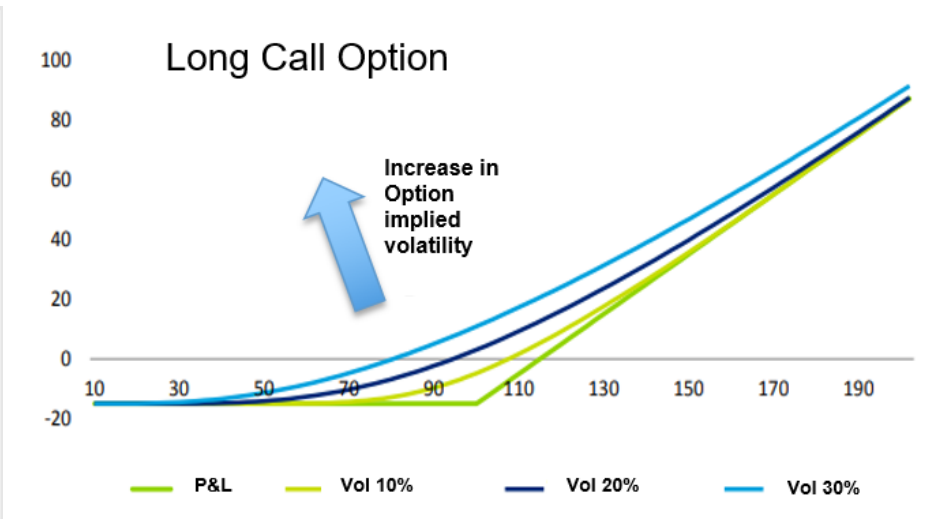
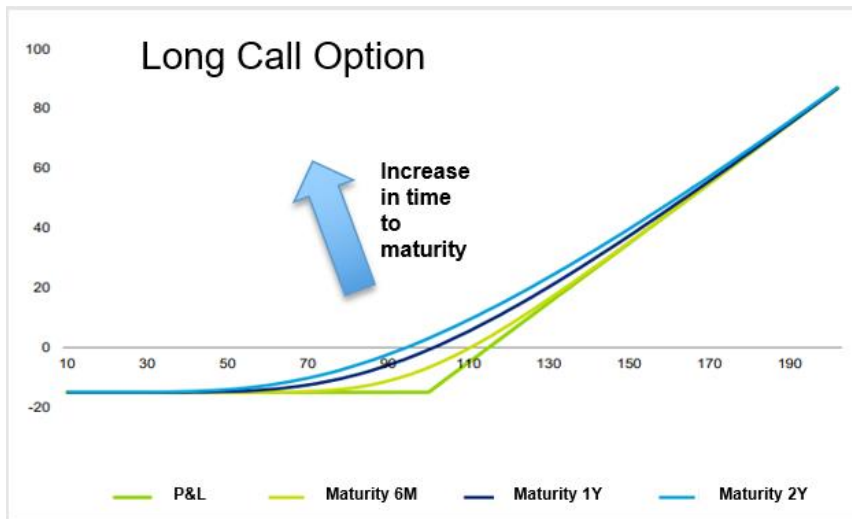
# Linear vs. Non-Linear Products

Linear Product: Index or Stock Futures

**Mark-to-Market loss is easy to predict even for extreme scenario**



Non-Linear Product: Index or Stock Options

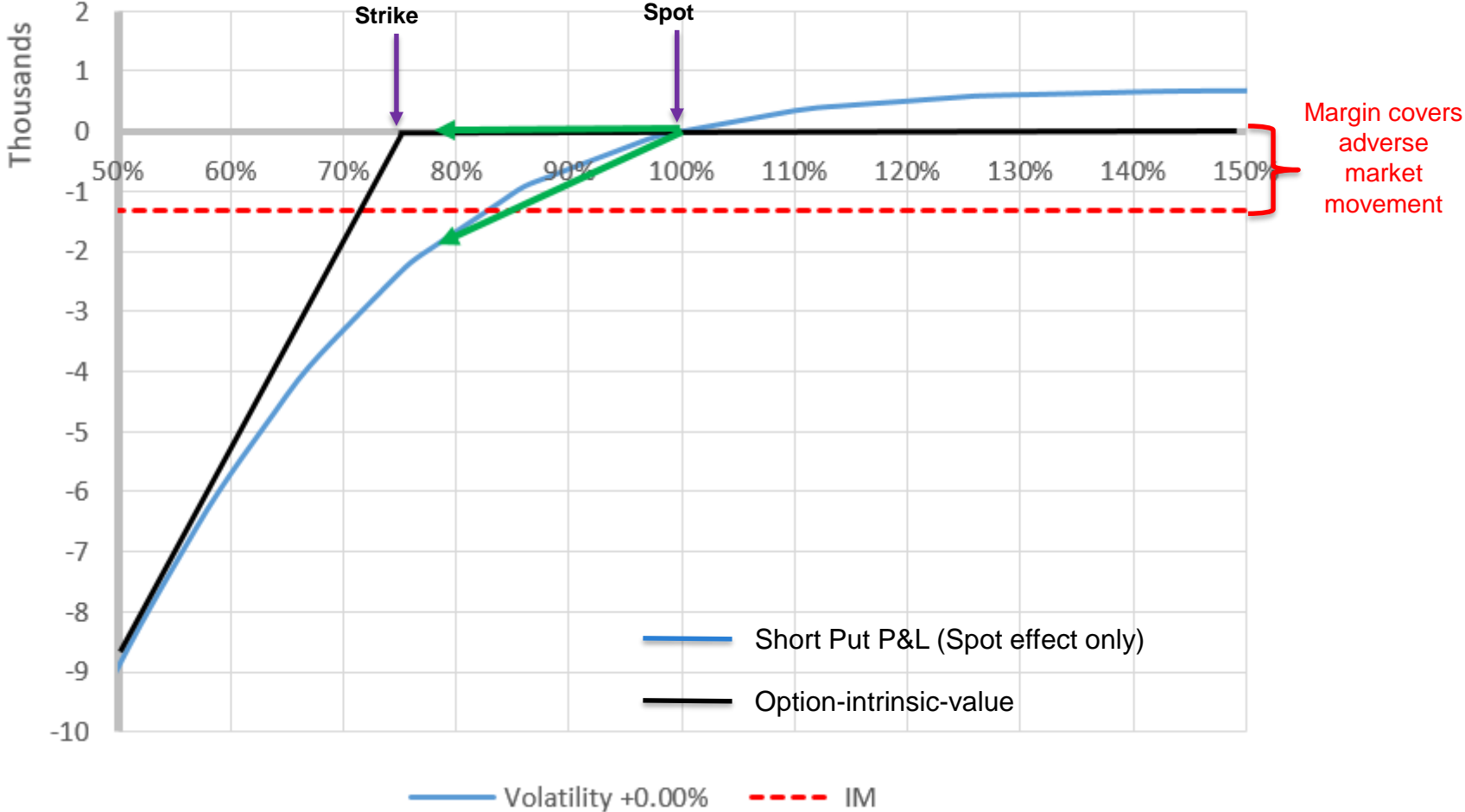


**Market-to-Market loss is hard to predict as it subjects to multiple risk factors (volatility, spot, maturity)  
=> Must have proper Stress Testing applied regularly to access the potential loss at client & firm level**



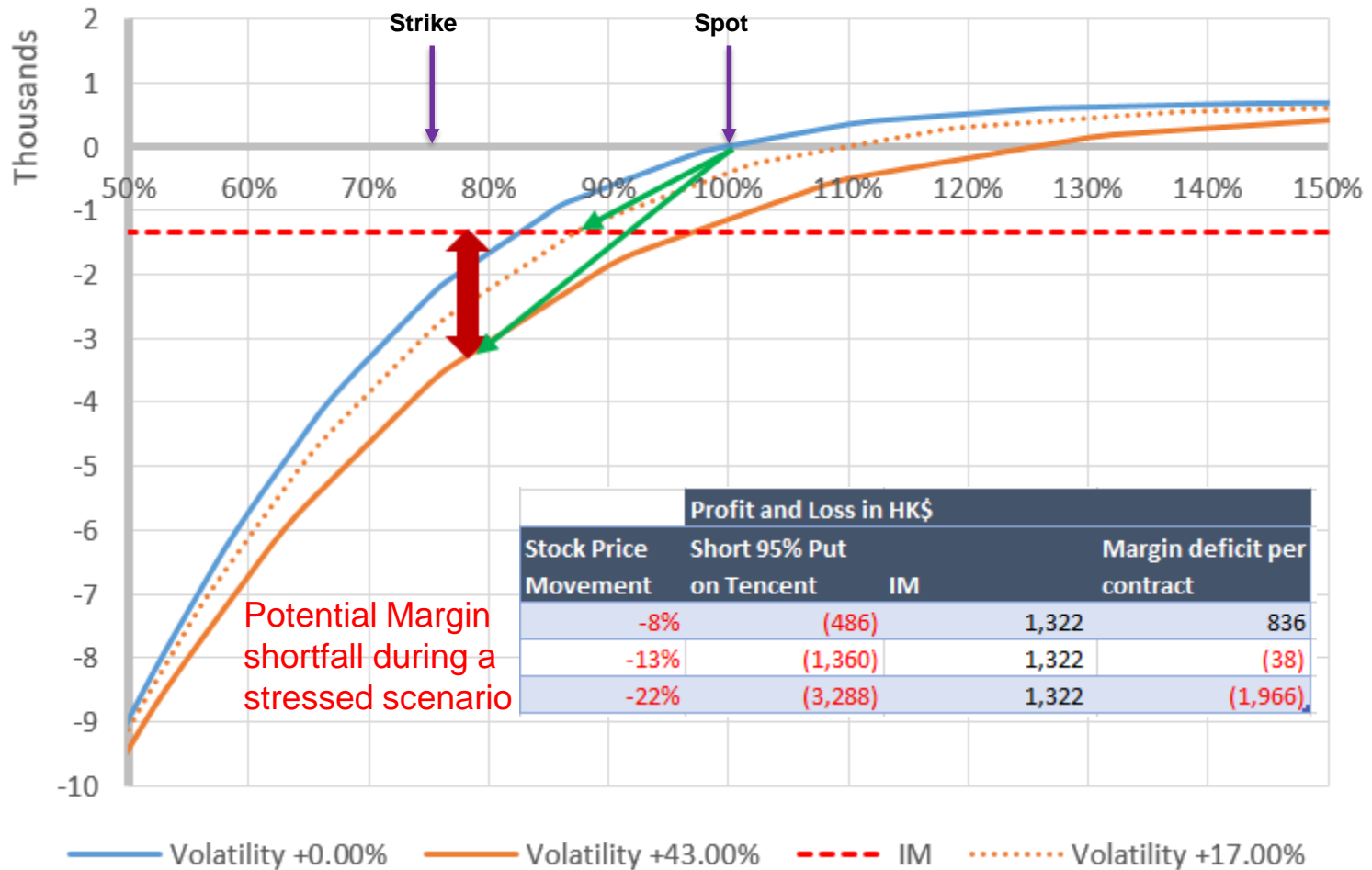
# Margin shortfall under sharp market drop

Option-Intrinsic-Value vs Option-P&L



# Margin shortfall under sharp market drop

## MtM Evolution of 1Y 75% Strike Put Option on Tencent



**Volatility should be included in the stress scenario**

# Guideline on Stress-Testing Monitoring and Escalation

Deals re-valuation with stressed market parameters  
(e.g. Price +/- 5%, 10%, 20% & Volatility -24%/+43%)



Methodology / tools (Span Manager, Bloomberg, Reuters), focus on option

- Delta, Gamma, Vega effect
- Frequency

Expected-Uncollateralized-Loss<sub>(1)</sub> vs Firm's Liquid Capital Ratio

If ratio above 3 times, it should trigger Alert



Any concentrated risks and escalation procedure

Further review on Stress-test at client account level

## Governance

- Alert level / limit on stress test
- Run per client / firm level
- Compare with LC
- Liquidity crisis management mechanism



(1) Expected-Uncollateralized-Loss = [Stress-loss at firm level – Collateral posted]



# Sample Stress-Testing Reports at client account level

Downside Scenarios											
Client Account	Account Balance	Margin Require	Excess	Projected P/L Effect Price -5%	Margin Shortfall	Projected P/L Effect Price -10%	Margin Shortfall	Projected P/L Effect Price -22% Volatility +43%	Margin Shortfall	Sufficient Excess Bal to Cover Projected P/L	
A000001	12.2	12.1	0.1	(1.2)	(1.1)	(3.2)	(3.1)	(9.4)	(9.3)	No	
A000002	9.3	5.5	3.8	1.0	-	(0.9)	-	(0.6)	-	Yes	
A000003	18.4	9.1	9.3	2.0	-	(0.5)	-	(3.8)	-	Yes	
A000004	7.1	1.3	5.8	0.8	-	(0.5)	-	(1.5)	-	Yes	
A000005	13.4	6.7	6.7	(1.7)	-	(3.3)	-	(7.3)	(0.6)	No	
A000006	75.3	56.2	19.1	(12.0)	-	(28.0)	(8.9)	(75.6)	(56.5)	No	

Upside Scenarios											
Client Account	Account Balance	Margin Require	Excess	Projected P/L Effect Price +5%	Margin Shortfall	Projected P/L Effect Price +10%	Margin Shortfall	Projected P/L Effect Price +22% Volatility -24%	Margin Shortfall	Sufficient Excess Bal to Cover Projected P/L	
A000001	12.2	12.1	0.1	0.3	-	0.6	-	1.2	-	Yes	
A000002	9.3	5.5	3.8	1.5	-	(1.8)	-	(5.4)	(1.6)	No	
A000003	18.4	9.1	9.3	1.8	-	(4.5)	-	(10.3)	(1.0)	No	
A000004	7.1	1.3	5.8	0.4	-	0.1	-	(0.1)	-	Yes	
A000005	13.4	6.7	6.7	0.4	-	0.8	-	2.0	-	Yes	
A000006	75.3	66.2	9.1	(5.0)	-	(8.0)	-	(32.3)	(23.2)	No	



## Stress Testing Implementation

	Expectation	Common observation
Frequency	CPs with significant activities in non-linear products are expected to implement and conduct stress testing regularly and at least on a <b>weekly basis</b>	<ul style="list-style-type: none"> <li>Stress scenario not frequently conducted</li> </ul>
Stress scenarios	<ul style="list-style-type: none"> <li>Price and volatility are key parameters</li> <li>Underlying movement is <math>\pm 20\%</math> (<i>for index options</i>) and <math>\pm 22\%</math> (<i>for stock options</i>).</li> </ul>	<ul style="list-style-type: none"> <li>Stress scenario not stressed enough</li> <li>key parameters (e.g. volatility)</li> </ul>
Policy and procedure	<p>Should include</p> <ul style="list-style-type: none"> <li>Methodology</li> <li>Frequency</li> <li>Review and escalation mechanism (e.g. further analysis on client's exposure and proper follow-up is expected if there is an increasing trend in the potential loss.)</li> </ul>	<ul style="list-style-type: none"> <li>Absence of escalation mechanism</li> </ul>
Use of stress test	<ul style="list-style-type: none"> <li>Result should be compared with its latest liquid capital and liquidity to evaluate whether its latest positions are within its risk appetite.</li> <li>Such comparison should be documented in report or communications.</li> </ul>	<ul style="list-style-type: none"> <li>Absence of analysis/ follow up</li> <li>Lack of recordkeeping</li> </ul>



# Stress Testing Implementation

Stress testing can be implemented through

- (1) in-house developed system,
- (2) SPAN Risk Manager or
- (3) some common market terminals.

You can also contact your third party vendor for further information.

Option Pricer (OPR) save the strategy

Trade Date: Dec-19, 2018

Trade Idea Generator | Generate Strip | Reset | **Open/Save** | Template 1 | Filters | Show Scenario | Show Settings

User Defined Strategy | Log 1 | Log 2 | Log 2

add multiple options to simulate the portfolio

Underlying/Option Code	HSI26000A9.HF	HSI25800A9.HF	HSI25000M9.HF
Name	HFE HSI JAN9 26000 CALL	HFE HSI JAN9 25800 CALL	HFE HSI JAN9 25000 PUT
Underlying Name	HANG SENG INDEX	HANG SENG INDEX	HANG SENG INDEX
Leg Type	Vanilla	Vanilla	Vanilla
Deal Type	Buy	Sell	Buy
Ccy / Unit	HKD / 50 INDEX	HKD / 50 INDEX	HKD / 50 INDEX

Underlying Price: Manual / 26000.0000 / Manual / 26000.0000 / Manual / 26000.0000

Option Style & Type: Euro / Call / Euro / Call / Euro / Put

Expiry / Tenor: Jan 30, 2019 / 42D / Jan 30, 2019 / 42D / Jan 30, 2019 / 42D

Strike / Moneyess(%): 26000.000 / 100 / 25800.000 / 100.7759375 / 25000.000 / 96.153846153

Volatility: Implied / 22.0676 / Implied / 22.1550 / Implied / 23.7853

Premium (HKD): Auto (Ask) / 808.0000 / Auto (Bid) / -915.0000 / Auto (Ask) / 387.0000

Total Premium (HKD): 40,400.0000 / -45,750.0000 / 19,350.0000

Total Premium (%): 3.1077 / -3.5192 / 1.4885

Currency / Currency Rate: HKD / 1.0000 / HKD / 1.0000 / HKD / 1.0000

INTEREST RATES AND DIVIDENDS

Risk Free Rate (%): 2.6201 / 2.6201

Dividend: Implied (%) / 0.0000 / Implied (%) / 0.0000 / Implied (%) / 0.0000

GREEKS

	0.5305	-0.5714	-0.2856
Delta	0.5305	-0.5714	-0.2856
Gamma	0.0002	-0.0002	0.0002
Vega	34.8280	-34.3690	29.7576
Theta	-10.1995	10.1809	-7.9989
7D Theta	-71.3964	71.2663	-55.9920
Rho	14.7244	-15.8099	-8.8612

adjust these to simulate the influence of the underlying and the expiry closure over the greeks

Multicommodity Analysis for ABC- C1 - N/A - (HKD)

Main Variable: Price

Step Size specified as: % of value

Number of Steps: 1

Secondary Variable: Volatility

Step Size specified as: % of value

Number of Steps: 1

Maint./Init Margin: 1,382,740.00 / 1,382,740.00

Buttons: Load | Save | **Calculate Risk** | Export Data | Risk Graph

	-1	+0	+1
HKEX - FHHI	-21,038.00	0.00	21,038.00
HKEX - FHSI	289,436.00	0.00	-69,917.00
Total Risk	268,398.00	0.00	-48,879.00
Volatility -1	271,711.00	4,830.00	-47,739.00
Volatility +0	268,398.00	0.00	-48,879.00
Volatility +1	264,728.00	-4,860.00	-50,129.00

GRAB

期权情景分析

投资组合(持有)

12/18/18

名称	Delta	Gamma	Vega	Theta	7D Theta	Rho
HSI Index						
HSI 12/28/18 P25200						
HSI 12/28/18 P25000						
HSI 12/28/18 P25400						
HSI Index						

50 情景选项

名称	Delta	Gamma	Vega	Theta	7D Theta	Rho
损益	-104.1M	-38.94M	-0.96M	16.6M	8.71M	8.92M
Delta	-1.17%	-436.52	-111.07	62.04	97.67	99.95
Gamma	25.35%	24.8%	18.47%	17.54%	583.71	14.13
Vega	-0.1	-341.63	-2.2%	-5.99%	-344.77	-13.26
Theta	7.54%	54.55%	382.09%	1.1%	59.26%	2.03%
7D Theta	-77	-49.8%	-337.2%	-978.02%	-57.97%	-2.33%
Rho						

