Counterparty Risk

Salla Franzén,

Head of Counterparty risk

Lecture 1

AN INTRODUCTION TO COUNTERPARTY RISK

Financial risk management

Corporations need to manage risk carefully.

By understanding risks a firm can gain a strong competitive advantage since they are able to better assess the risk/reward profile of the business.

Many quantitative methods to understand risk exist and are constantly being reinterpreted and re-examined, to ensure that as much of the risk is captured and measured in a structured way.

Quantitative financial risk management

Market risk

Arises from short-term movement of market prices

Credit risk

A counterparty is unwilling or unable to make a payment

Liquidity risk

Asset and funding liquidity risk

Operational risk

People, systems and internal/external events

Counterparty risk

Counterparty risk is typically defined as arising from two broad classes of financial products:

- OTC (over the counter) derivatives, some well-known examples being:
  - Interest rate swaps;
  - FX forwards;
  - Credit default swaps.
- Securities financing transactions, for example
  - Repos and reverse repos;
  - Securities borrowing and lending

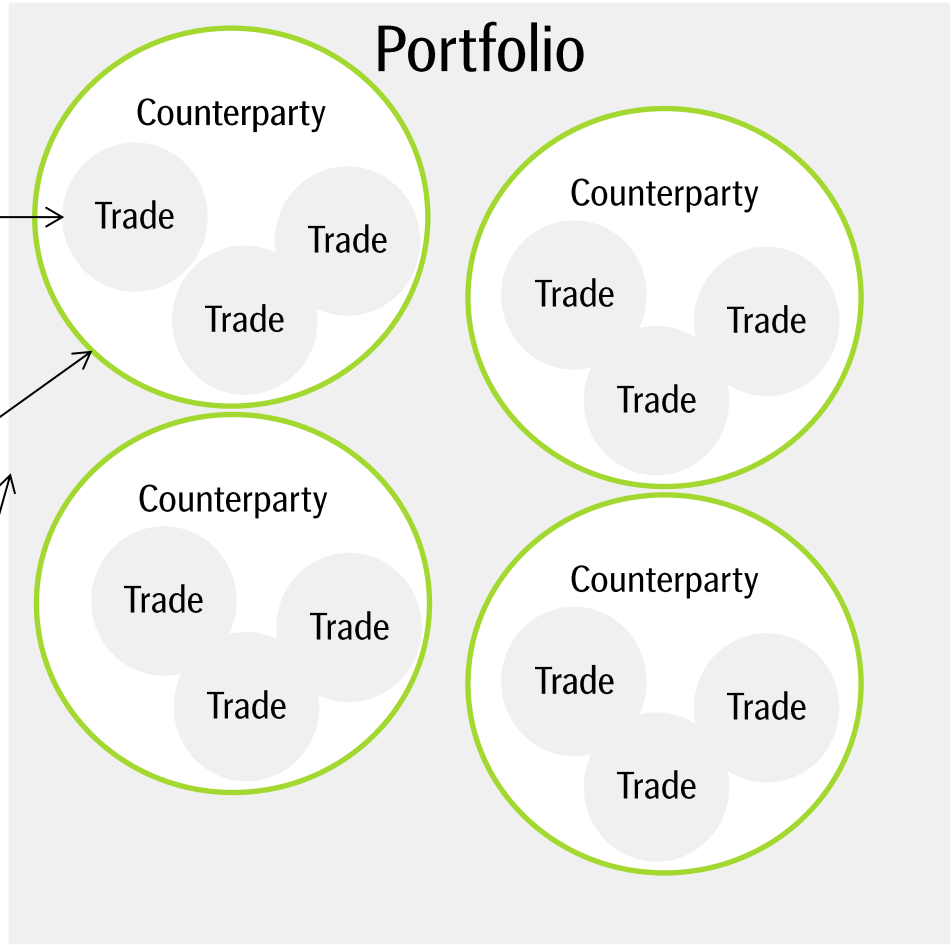
Counterparty risk is the most complex form of credit risk with systemic traits and the potential to cause, catalyse or magnify serious disturbances in the financial markets

Quantifying counterparty risk

Incorporating all characteristics of the trade and associated risk factors

Incorporating risk mitigants:
Netting
Collateral

Incorporating diversification:
Only a small fraction may default at the same time



Components of counterparty risk

1. Credit exposure: The loss in the event of a counterparty defaulting.
    1. What is the current exposure?
    2. What is the exposure in the future?
2. Default probability: The credit quality of the counterparty over the entire lifetime of the transactions.
    1. What is the probability of the cpy defaulting in a certain time horizon?
    2. Probability of the counterparty suffering a decline in credit quality over time?
3. Recovery: In the event of a bankcruptcy a certain percentage of the outstanding claim can be recovered. Netting and collateral agreements may mitigate the loss.
4. Mark-to-market: what could potentially be lost today. Depends on the netting ability.
5. Replacement cost: including bid-ask spreads.
6. Exposure: the potential losses with respect to MtM is asymmetric.
7. Potential Future Exposure (PFE): modelling what the MtM might be at some point in the future.

Models for exposure

The standard model for **equities** is a Geometric Brownian motion (with the implicit assumption that equity returns are normally distributed)

$$\frac{dS_t}{S_t} = \mu(t)\,dt + \sigma_E(t)\,dW_t$$

The traditional model for **FX rates** is to assume a standard Geometric Brownian motion , potentially adding some mean reversion rate *k* to a rate θ to avoid FX rates from becoming unrealistically large.

$$\frac{dX_t}{X_t} = k(\theta - \ln X_t)\,dt + \sigma_{\mathrm{FX}}(t)\,dW_t$$

Commodities are often modeled as

$$\ln S_t = f(t) + Z(t)$$

$$dZ(t) = (\alpha - \beta Z(t))\,dt + \sigma_C(t)\,dW_t$$

where *f* is a deterministic function that can be used to model periodicity in the underlying prices.

Models for exposure cont.

Interest rates are typically modeled using the one-factor Hull and White model, where the ”short rate” (short-term interest rate) is modeled as

$$dr_t = [\theta(t) - ar_t]\,dt + \sigma_r\,dW_t$$

The short rate follows a Brownian motion with time-dependent mean reversion level $\theta(t)$

The parameters a and σ_r can then be calibrated to fit market or historical data.

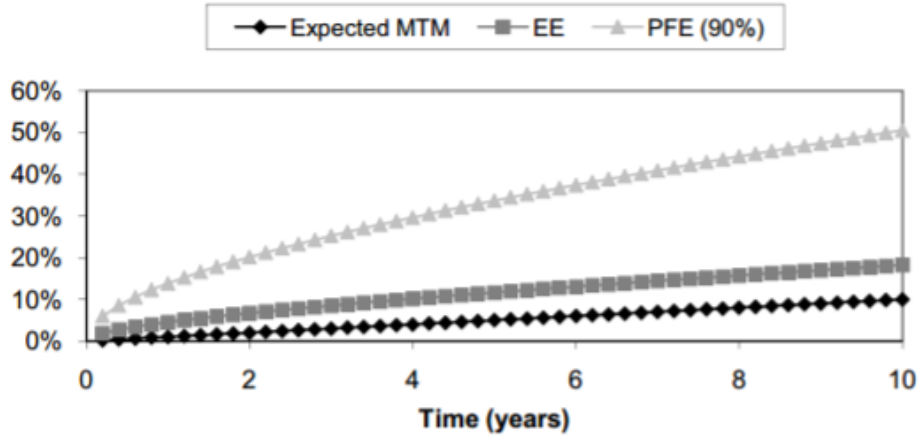
Modeling future counterparty exposures

Add-on approach:

$$\text{future exposure} \approx \text{current exposure} + \text{add-on}$$

Semi-analytical methods:

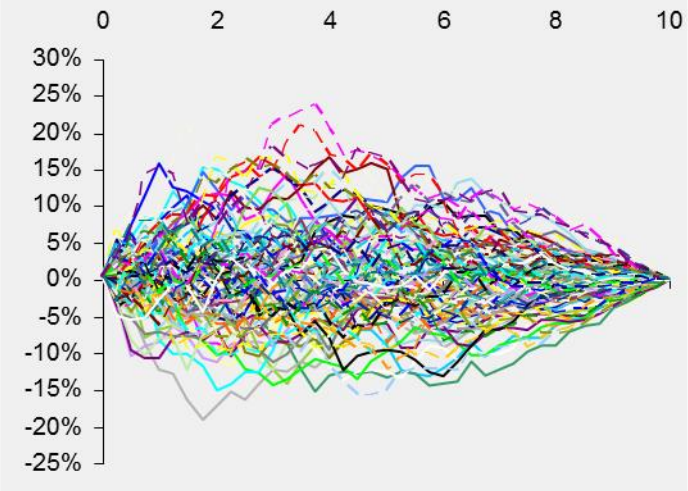
- Choose some risk factors that drive the exposure
- Find the distribution of the exposure as defined by the risk factors
- Calculate a semi-analytical approximation to a risk metric for that distribution, use it to calculate future exposure



Modeling counterparty risk – simulation method

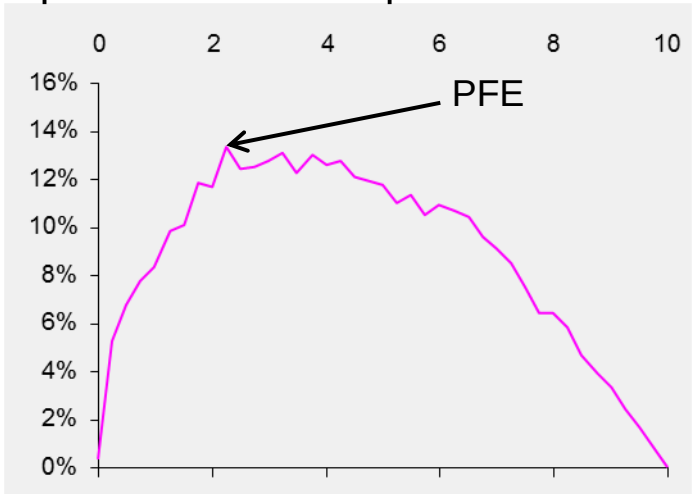
1. Choose risk factors that will influence the exposure of the transaction(s)
2. Generate scenarios by simulating the risk factors. Choose time grid for the simulation.
3. Revalue the individual positions at each point in time (in the time grid) using Monte-Carlo simulation
4. Aggregate: take into account netting sets to net trades over time.
5. Post-process: take into account collateral postings, other agreement specifics (such as minimum transfer amounts, margin call frequency, thresholds, haircuts…

Simulate possible future portfolio values -> potential future exposures



95th percentile of outcomes

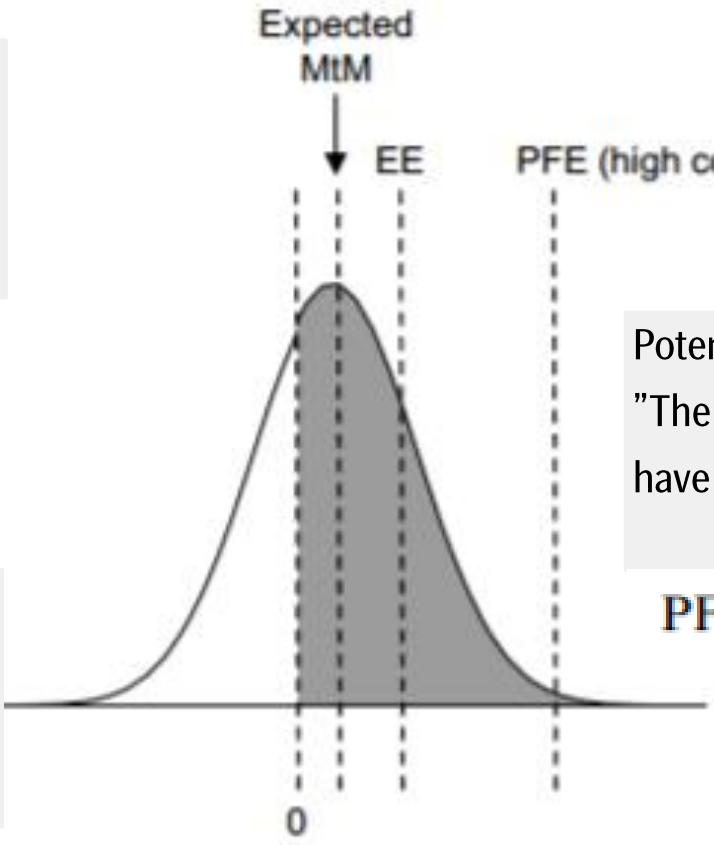
PFE is the maximum point of the PFE profile – occurs at a specific future date



Characterising exposure at a point in time for a normal distribution

Expected MtM:
The forward or expected value of a transaction at some point in the future

$$V = \mu + \sigma Z$$



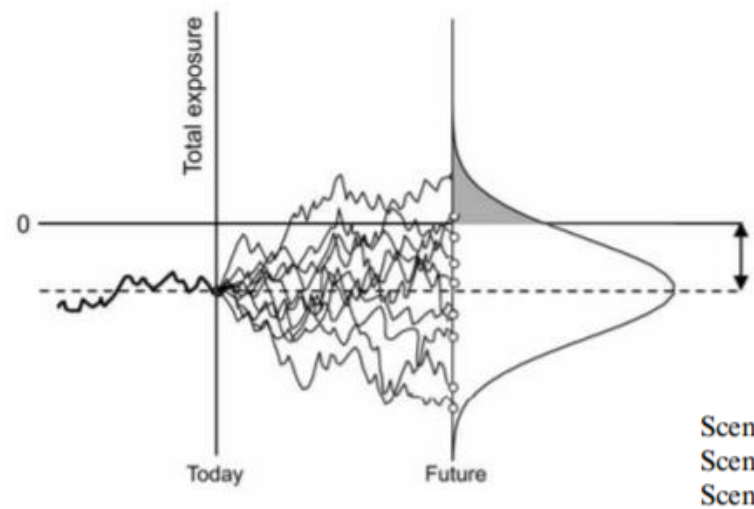
Potential Future Exposure:
"The worst exposure we could have at a certain time in future"

$$\mathrm{PFE}_\alpha = \mu + \sigma\Phi^{-1}(\alpha)$$

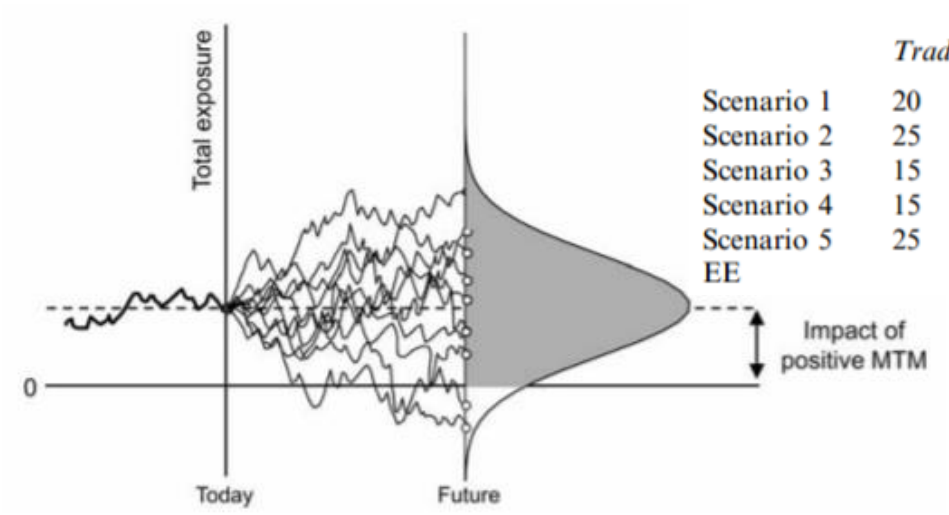
Expected exposure:
An institution typically cares only about positive MtMs

$$\mathrm{EE} = \int_{-\mu/\sigma}^{\infty} (\mu + \sigma x)\varphi(x)\,dx = \mu\Phi(\mu/\sigma) + \sigma\varphi(\mu/\sigma)$$

Positive and negative MtMs and the impact on PFE

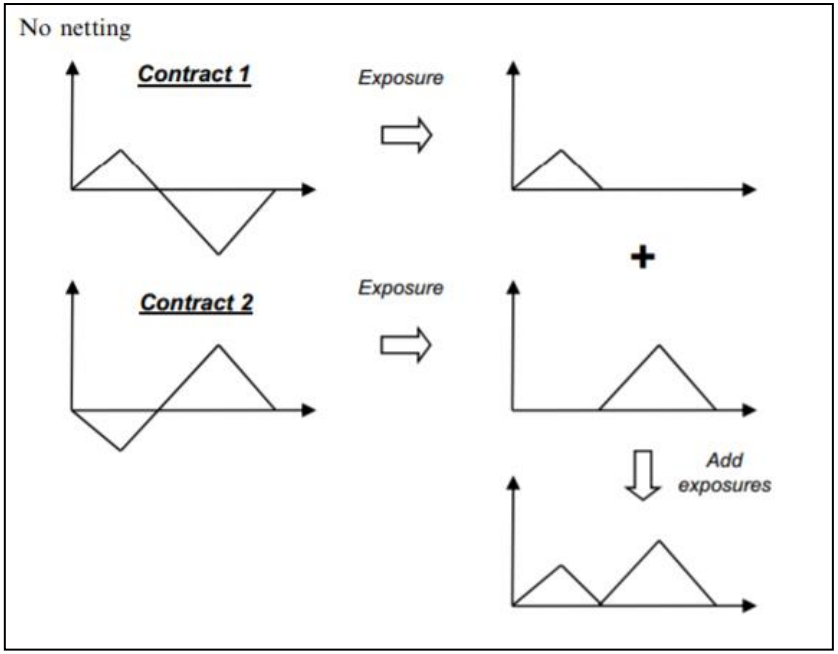


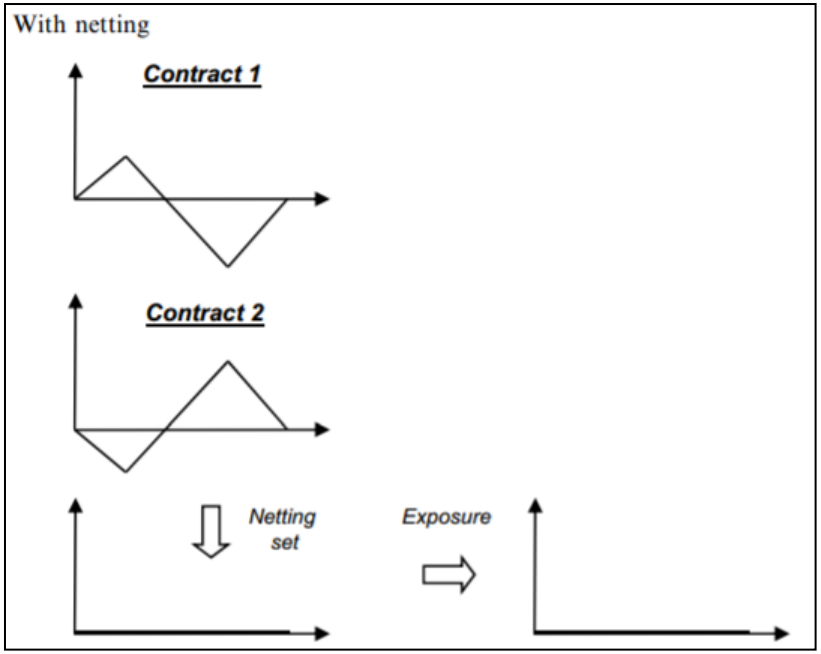
	MtM		*Total exposure*		
	Trade 1	*Trade 2*	*No netting*	*Netting*	*Netting benefit*
Scenario 1	−20	25	25	5	20
Scenario 2	−25	15	15	0	15
Scenario 3	−15	5	5	0	5
Scenario 4	−15	−5	0	0	0
Scenario 5	−25	−15	0	0	0
EE			9	1	8



	MtM		*Total exposure*		
	Trade 1	*Trade 2*	*No netting*	*Netting*	*Netting benefit*
Scenario 1	20	25	45	45	0
Scenario 2	25	15	40	40	0
Scenario 3	15	5	20	20	0
Scenario 4	15	−5	15	10	5
Scenario 5	25	−15	25	10	15
EE			29	25	4

Netting





$ millions	Institution	Counterparty
Trades with positive MtM	8	-8
Trades with negative MtM	-2	2
Exposure (no netting)	8	2
Exposure (netting)	6	0

Exposure is reduced

Unwinding positions can be done by offsetting trades

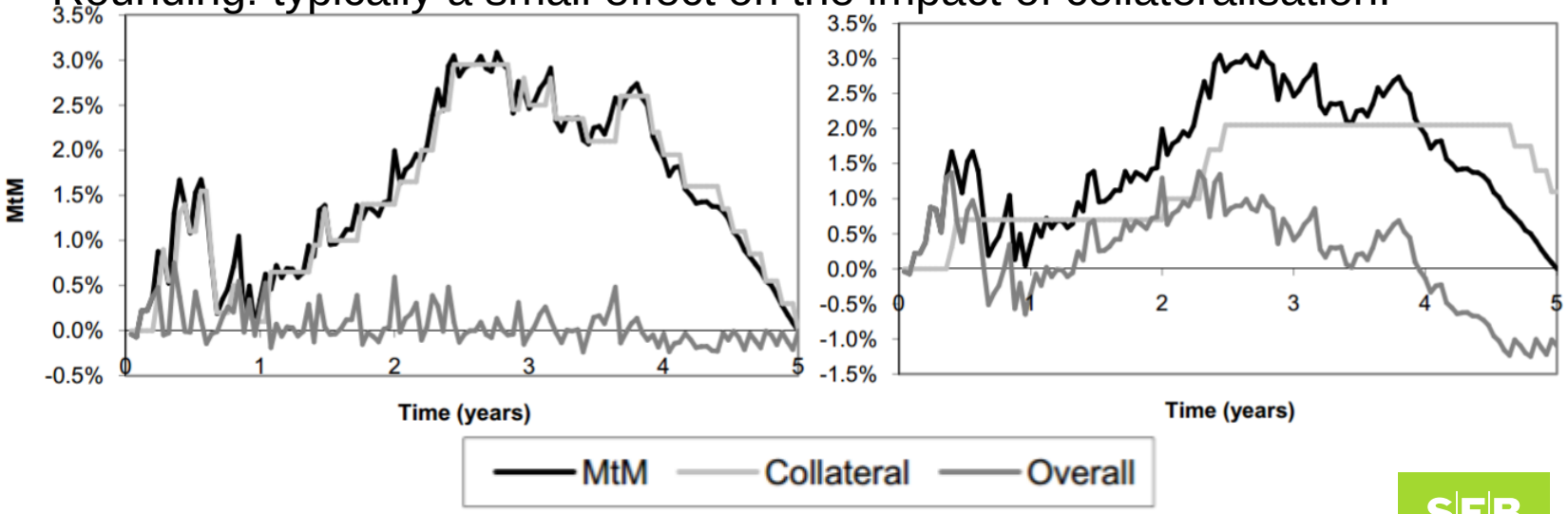
Multiple positions can allow for risk reduction

Increased stability in trading

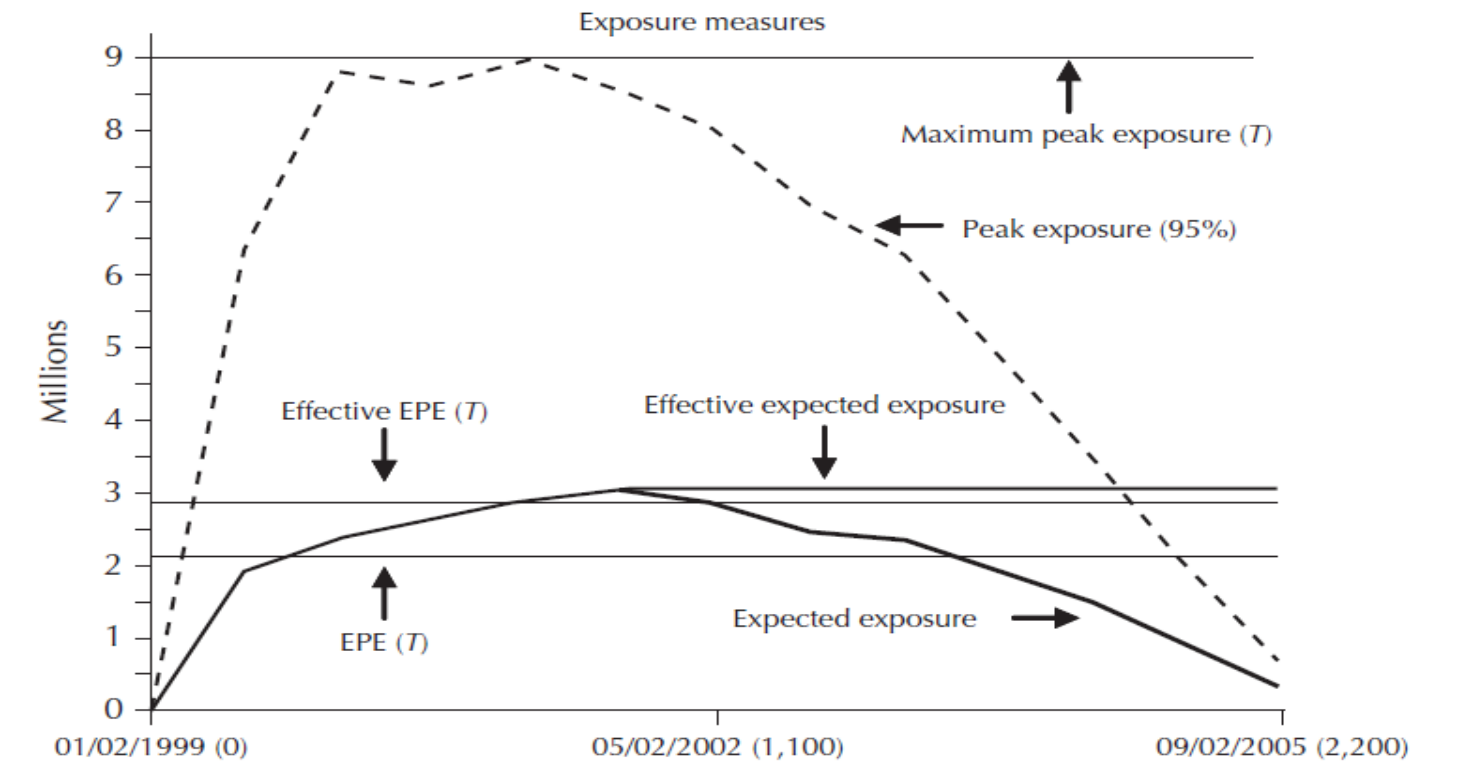
Modeling collateral

The parameters to take into account are:

- The remargining period: the effective time assumed between a collateral call and receiving the appropriate collateral
- The threshold: collateral cannot be called below the threshold
- Minimum transfer amount: Collateral cannot be transferred in blocks smaller than the MTA.
- Independent amount: held as a cushion against ”gap risk”
- Rounding: typically a small effect on the impact of collateralisation.



Exposure measures



- PFE (95%): quantile measure, peak used for limits
- EPE (often called EE): expected exposure
- Effective EPE used for capital: average of effective EPE up to 1 year (stressed calibration)

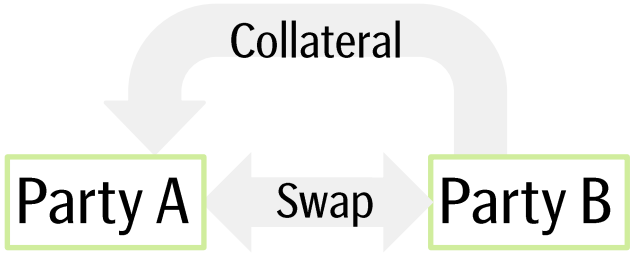
Mitigating counterparty risk

Trading with high-quality counterparties (monoline) – depends on the quality of counterparty rating.

Diversification – spreading exposure across different counterparties

Netting – depends on the underlying transactions involved and legal agreements

Collateralisation – operational costs, increased legal and liquidity risk



Hedging – spreads risk but at increased cost

Trading through Central clearing houses and exchanges – moral hazard and asymmetric information problems

Close-outs: permit the immediate termination of all contracts with netting of MtM values.

Walkaway features: an institution can cease payments and will not be obliged to settle money owed to a counterparty on a mark-to-market basis

PFE limit set at agreement level across several products

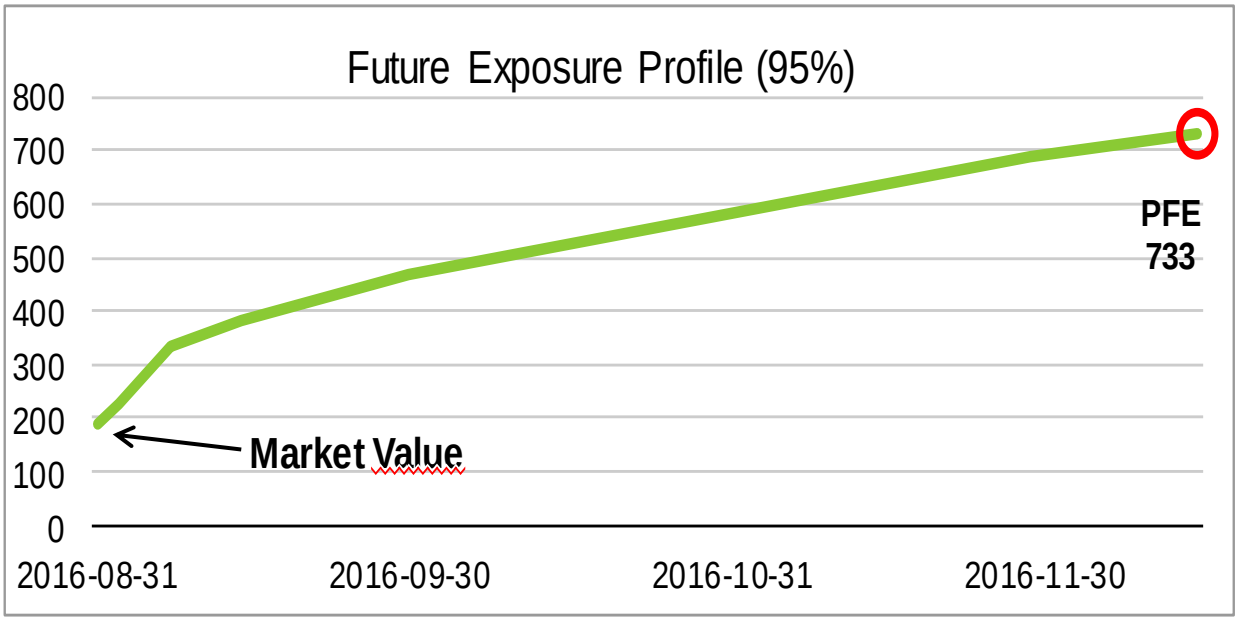
PFE limit at a level of product "**netting sets**" (based on Master agreements), this introduces a new way to control exposures **cross asset classes**

	LIMIT TYPE			
	PFE	NOMINAL	SETTLEMENT	TENOR
DERIVATIVES NETTING SET (e.g. ISDA)				
Interest Rate Derivatives	Y	Y		Y
Credit Derivatives		Y		Y
Commodity Derivatives		Y		Y
Equity Swaps		Y		Y
Equity Options		Y		Y
FX		Y	Y	Y
FX Options		Y		Y
REPO NETTING SET (e.g. GMRA)				
Repos	Y	Y		Y
SECLEND NETTING SET (e.g. GMSLA)				
Securities Lending/Borrowing	Y	Y		Y
Reverse Securities Lending		Y		Y

PFE for a single FX Forward

- PFE profile is today's view of the future, will differ tomorrow!

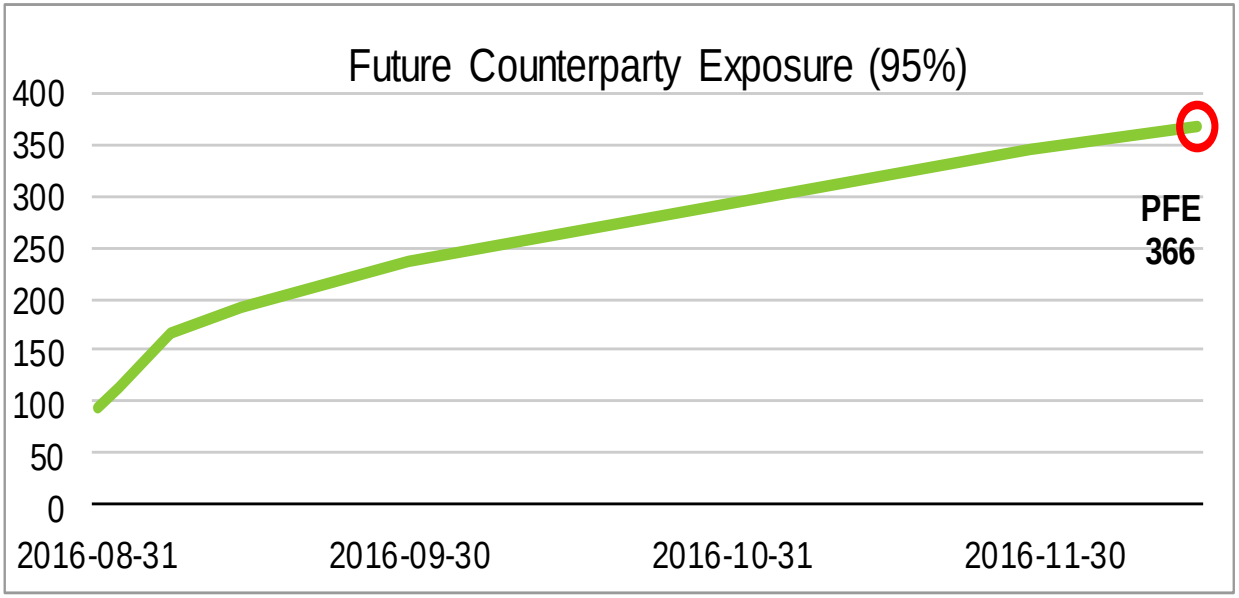
Trade	Nominal	Market Value of Contract
FX Forward	10 000	187



PFE for portfolio of FX Forwards

- **PFE** is the peak point of the future exposure profile for both trades
- Netting for current and future market values

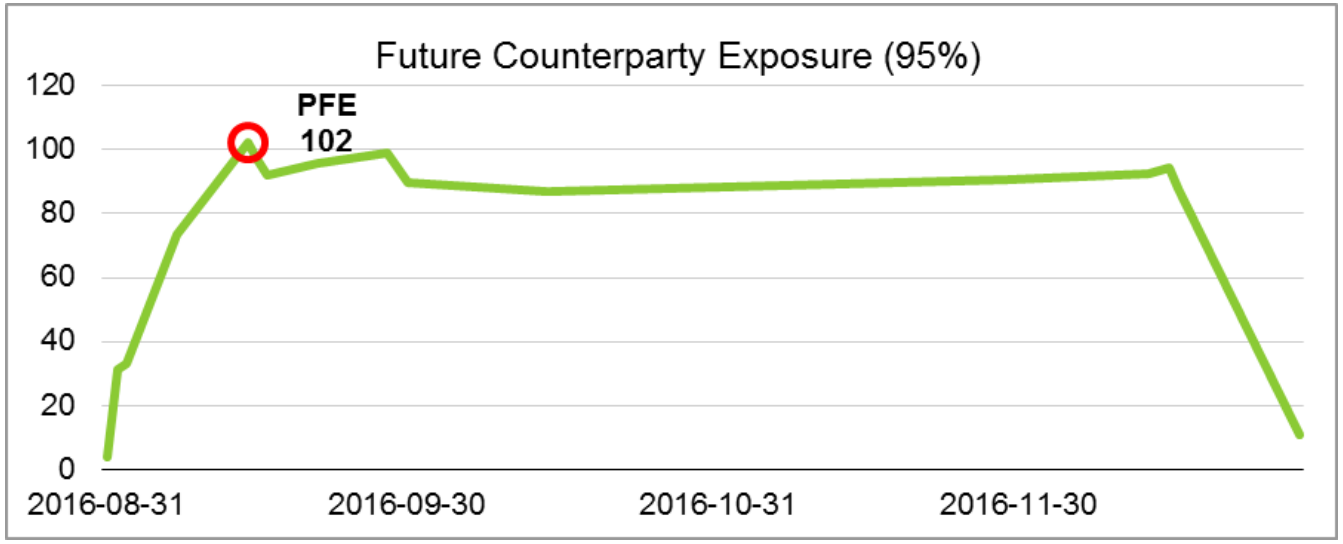
Trade	Nominal	Market Value of Contract
FX Forward	10 000	187
FX Forward	-5 000	-94
	Total	93



PFE for portfolio of FX Forwards - Collateralized

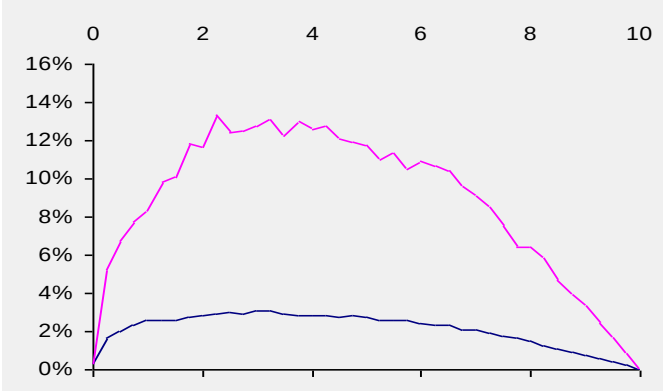
- **PFE** is the peak point of the future exposure profile considering daily margining
- Collateral reduces both current and future market values

Trade	Nominal	Market Value of Contract
FX Forward	10 000	187
FX Forward	-5 000	-94
Collateral		-90
	Total	3

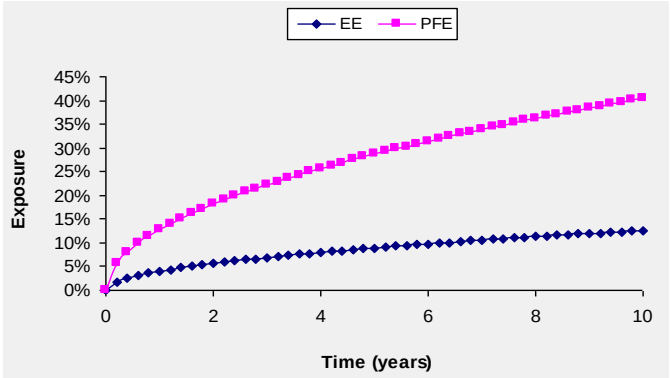


More exposure examples

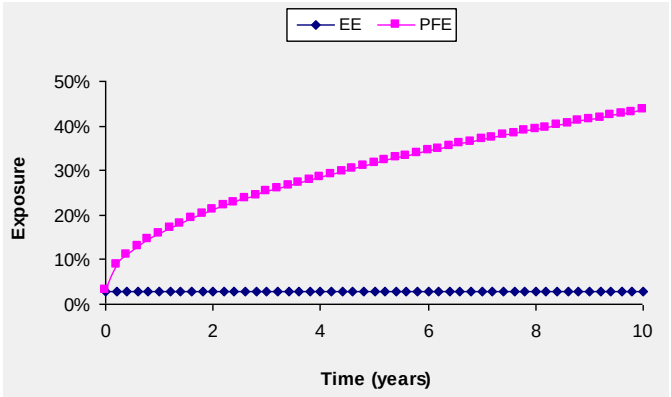
Swap type instruments: there are cash flows during the life of the transaction, which means PV is very close to zero immediately before expiry.



FX style instruments: expected exposure is at its greatest just before expiry. XCCY swaps fall in this category



Option style products: expected exposure is constant, increasing PFE



Lecture 2

COUNTERPARTY RISK: EXAMPLES

Forwards-

used by market participants to lock in an exchange rate on a specific date

Forward Contract Pros	Forward Contract Cons
No upfront cost	Counterparty risk i.e. failure to deliver funds at the delivery date
Entering into a forward exchange contract fixes the exchange rate for a future delivery date	Opportunity cost i.e. precludes any future benefit or cost from subsequent exchange rate movements.

FX Forward agreement

Definition:

Agreement to exchange a specified amount of different currencies at some future date, with the exchange rate being set at the time the contract is entered into.

Use:

Help investors manage the risk in the currency market by locking in the future exchange rate and date.

Parameters:

- Maturity time, T
- Nominal amount, K
- Forward exchange rate, r

PFE Add-on Basel factors

	Interest Rates	FX and Gold	Equities	Precious Metals Except Gold	Other Commodities
One year or less	0.0%	1.0%	6.0%	7.0%	10.0%
Over one year to five years	0.5%	5.0%	8.0%	7.0%	12.0%
Over five years	1.5%	7.5%	10.0%	8.0%	15.0%

Future Credit Risk Table based on PFE Add-on Factor outlined in the Basel Accord,

www.bis.org/publ/bcbsa.htm

Example (Single FX Forward)-

Buy 1 000 000 USD and sell 920 000 EUR

Parameters:

T = 4 Months

K = 920 000 EUR

r = 1,086957

Mark-to-Market value = -83 822 EUR

Structure:

Method: Add-on approach

Netting: No

Calculations:

Add on = 1%

Future Exposure = Max (-83 822, 0)+ 0.01* 920 000

= 9 200

Example (Single FX Forward)-

Buy 1 000 000 USD and sell 920 000 EUR

Parameters:

T = 4 Months

K = 920 000 EUR

r = 1,086957

Mark-to-Market value = 34 483 EUR

Structure:

Method: Add-on approach

Netting: No

Calculations (in Euro):

Add on = 1%

Future Exposure = Max (34 483, 0)+ 0.01* 920 000

= 43 683

Example (Single FX Forward)-

Buy 1 000 000 USD and sell 900 000 EUR

Parameters:

T = 4 Months

K = 900 000 EUR

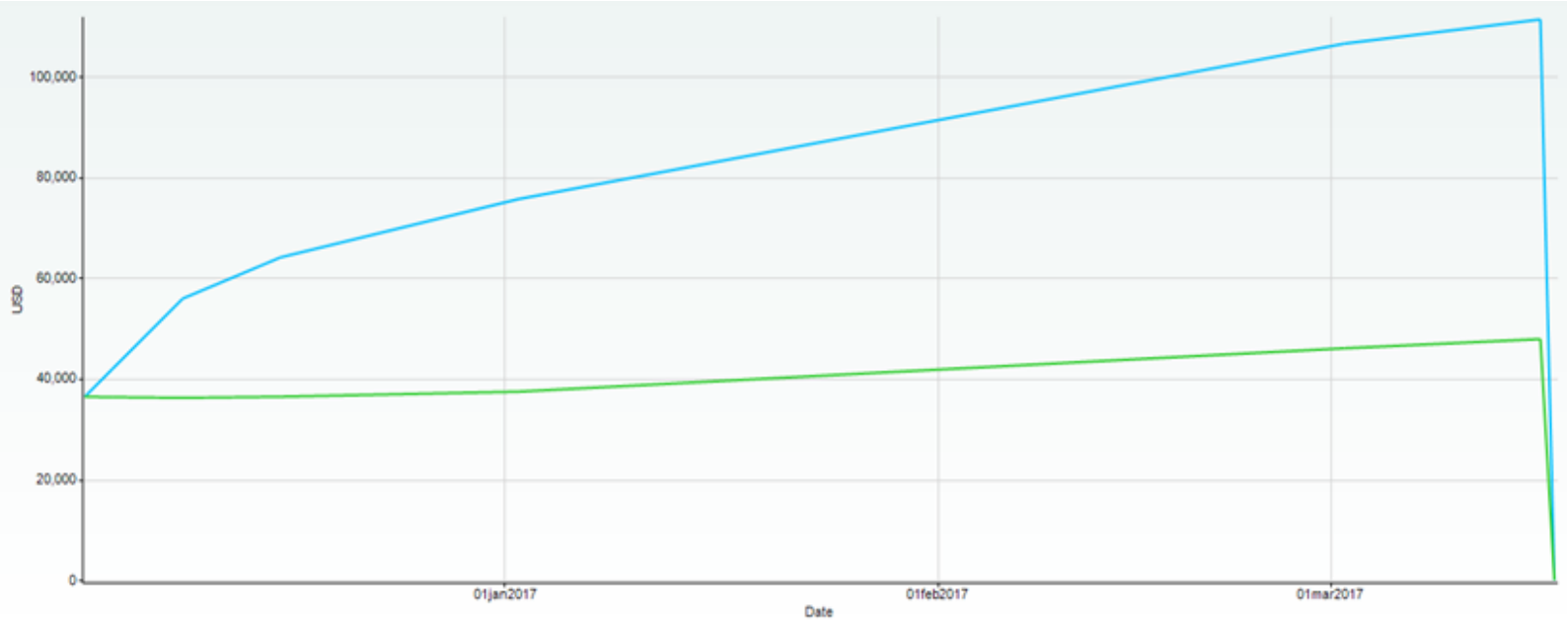
r = 1,086957

Mark-to-Market value = 34 483

Structure:

Method: Monte Carlo approach

Netting: No



Example (Portfolio FX Forwards)-

1. Buy 1 000 000 USD and sell 900 000 EUR
2. Buy 900 000 EUR and sell 1 000 000 USD

Parameters:

T = 4 Months

K1 = 900 000 EUR

K2= -900 000 EUR

r = 1,086957

Mark-to-Market value = 4 483 Euro

Structure:

Method: Add-on approach

Netting: No

Calculations (in Euro):

Add on = 1%

Potential Future Exposure = Max (4 483, 0)+ 0.01* 900 000 + 0.01*900 000

= 22 483

Example (Portfolio FX Forwards)-

1. Buy 1 000 000 USD and sell 900 000 EUR
2. Buy 900 000 EUR and sell 1 000 000 USD

Parameters:

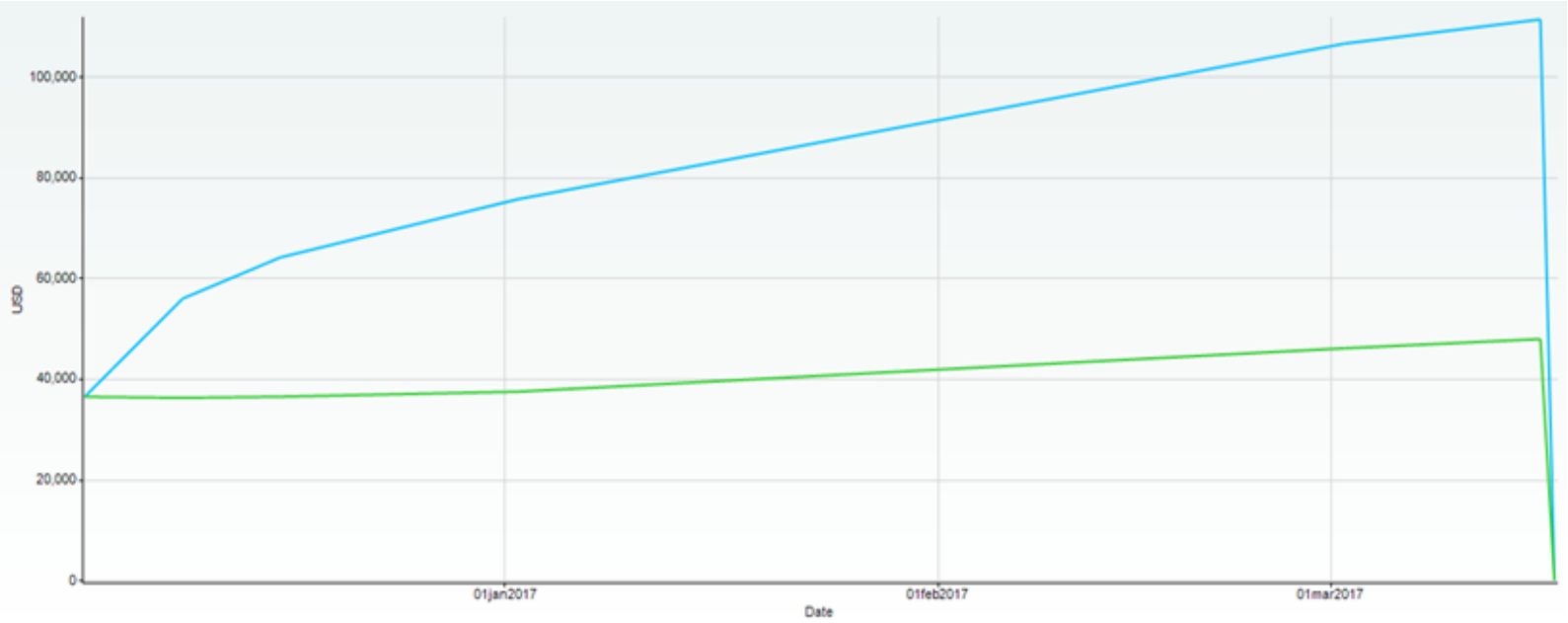
T = 4 Months

r = 1,086957

Structure:

Method: Monte Carlo approach

Netting: No



Example (Portfolio FX Forwards)-

1. Buy 1 000 000 USD and sell 900 000 EUR
2. Buy 900 000 EUR and sell 1 000 000 USD

Parameters:

T = 4 months

r = 1,086957

Structure:

Method: Monte Carlo approach

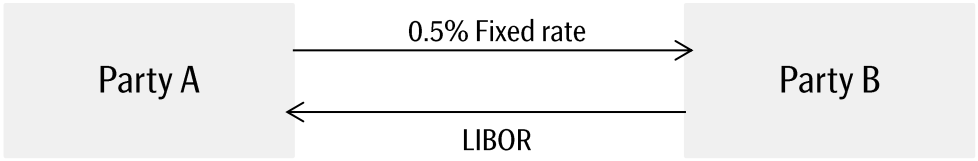
Netting: Yes

Swaps-

used by market participants to exchange financial instruments between two parties. The most common kind of swap is the interest rate swap

Definition:

Party A agrees to make payments to Party B based on a fixed interest rate, and Party B agrees to make payments to Party A based on a floating interest rate. e.g:



Parameters:

- Maturity time, T
- Notional amount, K
- Floating rate, r
- Fixed rate, R

Example (Single IR swap)-

Pay floating and receive fixed

Parameters:

T = 4 Years

K = 50 000 000 SEK

R = 2,81

Structure:

Method: Add-on approach

Netting: No

Calculations (in SEK):

Mark-to-Market value = -334 483

Add on = 0,5%

Future Exposure = Max (-334 483, 0)+ 0,005* 50 000 000

= 250 000

Example (Single IR swap)-

Pay fixed and receive floating

Parameters:

T = 4 Years

K = 50 000 000 SEK

R = 2,81

Structure:

Method: Add-on approach

Netting: No

Calculations (in SEK):

Mark-to-Market value = 980 296

Add on = 0,5%

Future Exposure = Max (980 296, 0)+ 0,005* 50 000 000

= 1 230 296

Example (Single IR swap)-

Pay floating and receive fixed

Parameters:

T = 4 Years

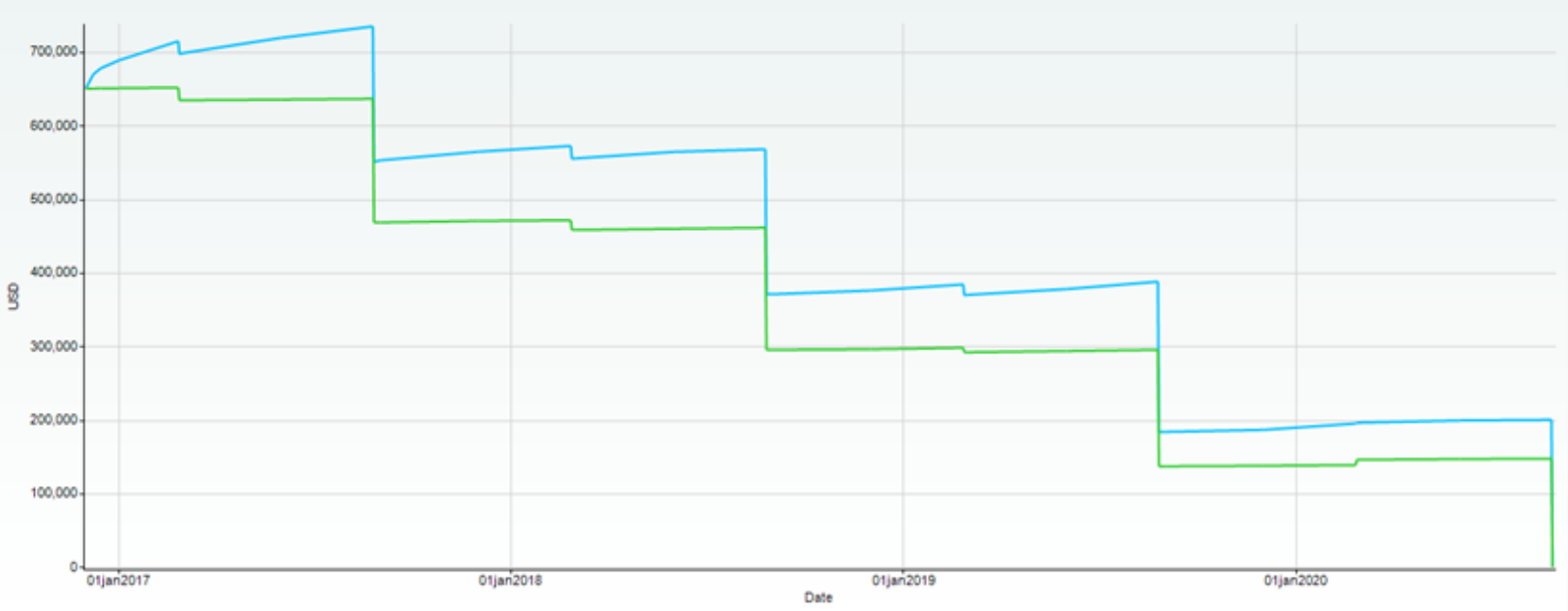
K = 50 000 000 SEK

R = 2,81

Structure:

Method: Monte Carlo approach

Netting: No



Disclaimer

The information presented in this document (this “Educational Presentation”) has been prepared by Salla Franzén (the “Author”), employee of SEB AB. It has been provided to you for educational purposes solely for your use and it may not be reproduced or distributed without the written permission of the author.

This Educational Presentation is not intended to give advice and so it should not be relied on. You should consult such financial, tax, accounting, legal, regulatory and other professional advisors as you consider appropriate to advise you in respect of any actions or decisions.

The Author and SEB AB make no representation and give no assurance as to (i) the completeness or accuracy of any information extracted or contained in this Educational Presentation; or (ii) the accuracy, completeness or reasonableness of any assumption, forecast, scenario analysis or financial model related information contained in this Educational Presentation.

Opinions expressed in the Educational Presentation may be subjective and do not necessarily represent the views and opinions of SEB AB.

Limitation of Liability:

Under no circumstances shall the Author or SEB AB have any liability whatsoever to any person or entity for any resulting loss or damage or other circumstances within or outside the control of SEB AB.