INTESA SANPAOLO

La costruzione e il backtesting di un modello interno per il rischio di controparte: aspetti metodologici

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Risk Management Department

Agenda

1	Introduction and new regulatory framework for CCR
2	The Internal Model Methodology
3	Computing and backtesting counterparty risk

Common language about counterparty risk

Credit Exposure depends from market risk factors changes over the life of a trades

Counterparty Exposure

The potential loss in a trade with a given counterparty when considering the possible event that counterparty might default prior to completing all agreed cash-flows exchanges.
It concerns:

- OTC derivatives (i.e. interest rates swaps, fx forward, credit default swaps)
- Securities Financial Transactions (i.e. repos, securities lending).

The OTC derivatives is the most significant group due to the size of the market and diversity of instruments.
From a regulatory point of view it is considered under the wider category of credit risk - being connected to counterparty default - and defined as the cost of replacing the transaction if the counterparty defaults.
The main difference with credit risk is the "bilateral" nature of exposure, due to its change in value with the evolution of underlying risk factors.

CVA

CVA : Credit Valuation Adjustment

It is the adjustment to the risk free value made by one counterparty to take into account that the other counterparty may default first

It is the present value of an expected future loss (impairment of assets)

DVA

DVA : Debit Valuation Adjustment

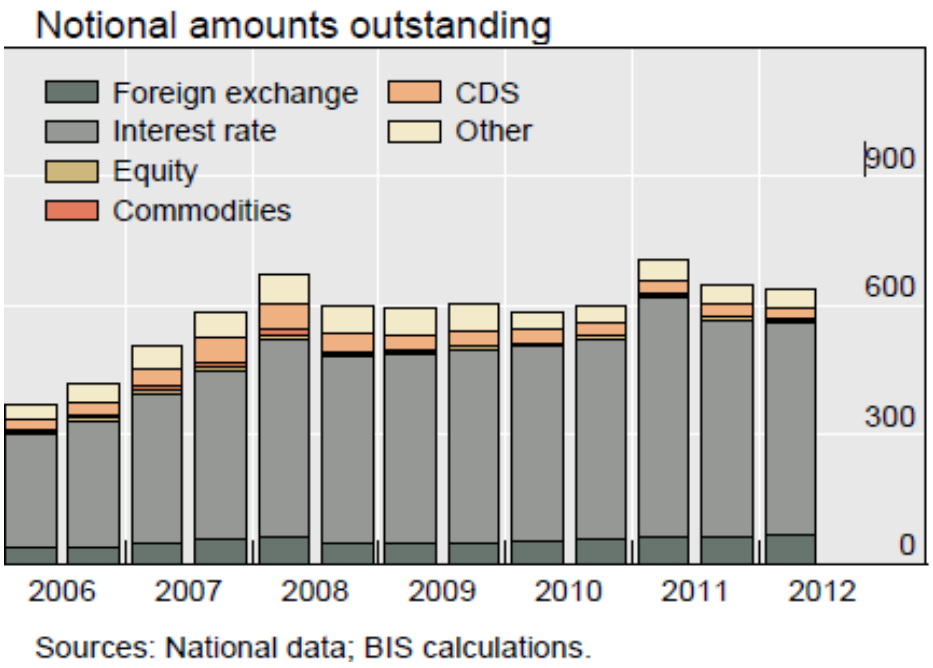
It is the adjustment to the risk free value made by one counterparty to take into account that it may default before the other counterparty

It is the present value of an expected future gain (revaluation of liabilities)

CVA / DVA depends on exposure and on creditworthiness of the counterparties and of the bank

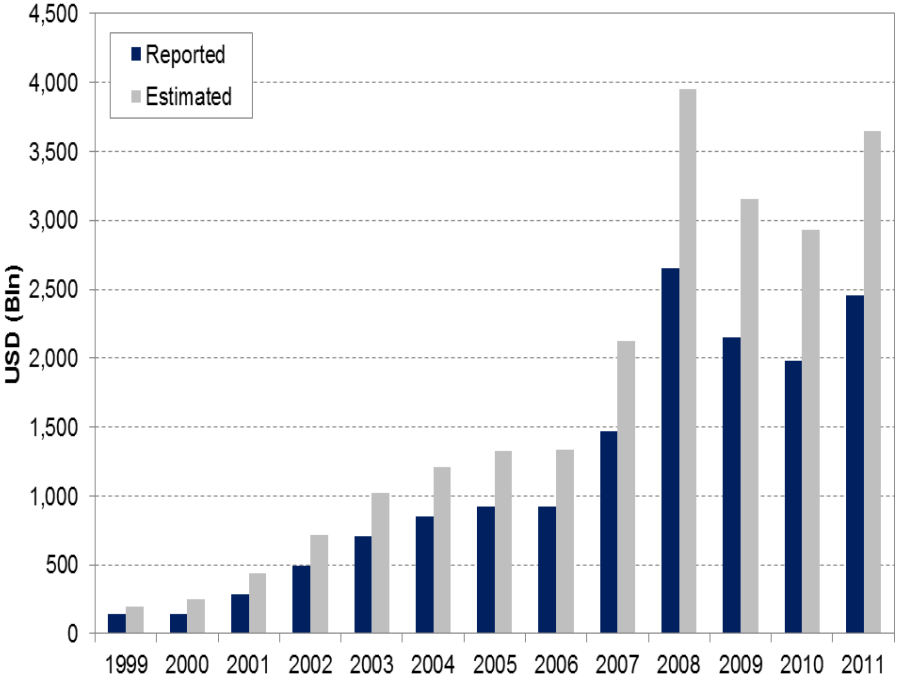
Growth of the OTC derivatives market

The financial crisis has brought over-the-counter (OTC) derivatives to the forefront of regulatory attention. The use of OTC derivatives has grown over the last decade. With the perceived risk of OTC derivatives, there has been also increase in collateral agreements



OTC Derivatives Notional Amounts (Trillions $)

Source: BIS: OTC Derivatives Statistics at end of june 2012

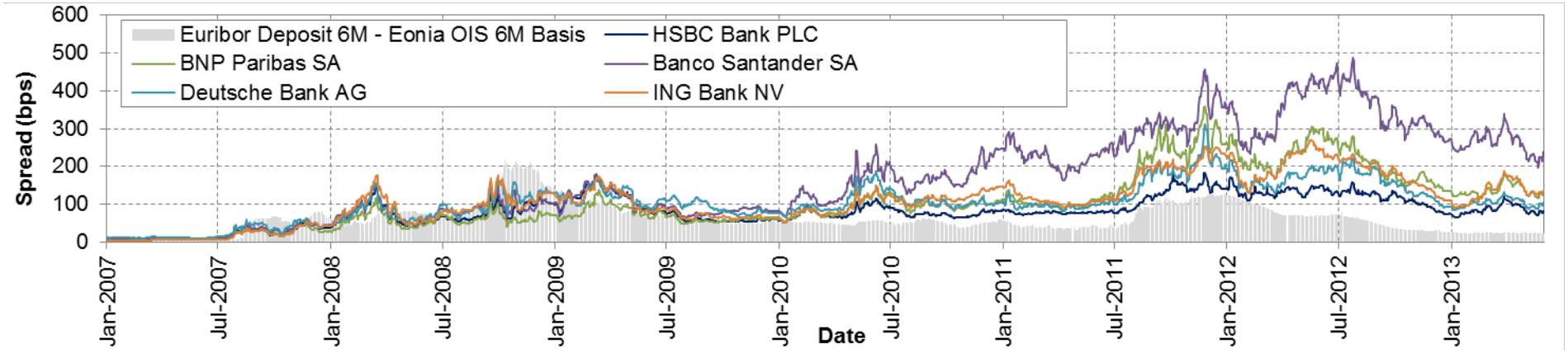


Number of outstanding bilateral collateral agreements
(Billions $)

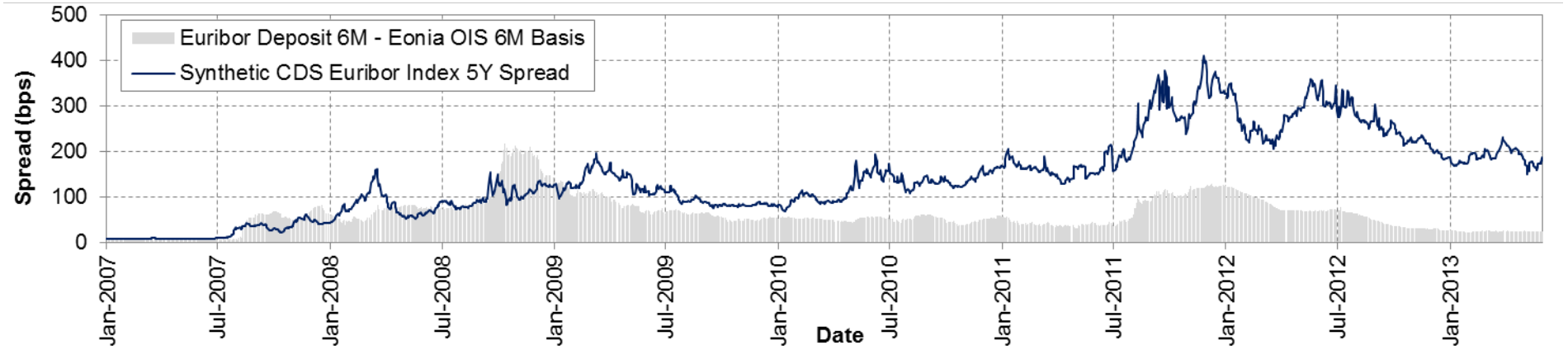
Source: ISDA Margin Survey 2012

The crisis and the new framework

The Market: CDS and Interest Rate Spread



CDS Spread 5Y (lines) for some European banks belonging to the Euribor panel and the spread between the Euribor Deposit 6M vs Eonia OIS 6M (grey area) (Jan. '07 – May '13 window, source: Bloomberg).



The Synthetic CDS Euribor Index 5Y (line) and the basis between the Euribor Deposit 6M vs Eonia OIS 6M (grey area) (Jan. '07 – May '13 window, source: Bloomberg). The Synthetic CDS Euribor Index reflects the average cost of protection against the default of a generic bank that belongs to the Euribor contribution panel.

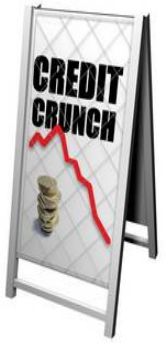
The new regulatory framework

Basel 3 — Capital requirement for OTC bilateral exposures and exposures to CCPs (from january 2014)

EMIR BCBS/ IOSCO — Mandatory Central Clearing for eligible OTC Derivatives
Margin requirement for non centrally cleared OTC

IFRS 13 — Accounting rules for CVA/DVA

- The paradigm "Too big to fail" considered the banks as default free.
- Many financial institutions used to consider counterparty risk as "unilateral" with no DVA to take into account own credit risk



- "Too Big to fail" is history: Lehman, AIG, RBS
- Pricing considers (bilateral) CVA and DVA
- Capital consumption for CCR is an issue for banks and end users

Basel III : main changes for capital requirements for CCR

All Banks

Introduction of the new «CVA Capital Charge»

Capital Charge = (8% * EAD * RW) + CVA Charge

Pillar I requirement for specific Wrong Way Risk (WWR)

IMM Banks

$$EAD = [MaX (EAD^{(current\ parameters)}; EAD^{(stressed\ parameters)})]$$

Increased Margin Period of Risk for some collateralized netting sets

CCPS Exposures

2% risk weight

CVA Capital Charge not applied

Client trades centrally cleared : lower margin period of risk (at least 5 days)

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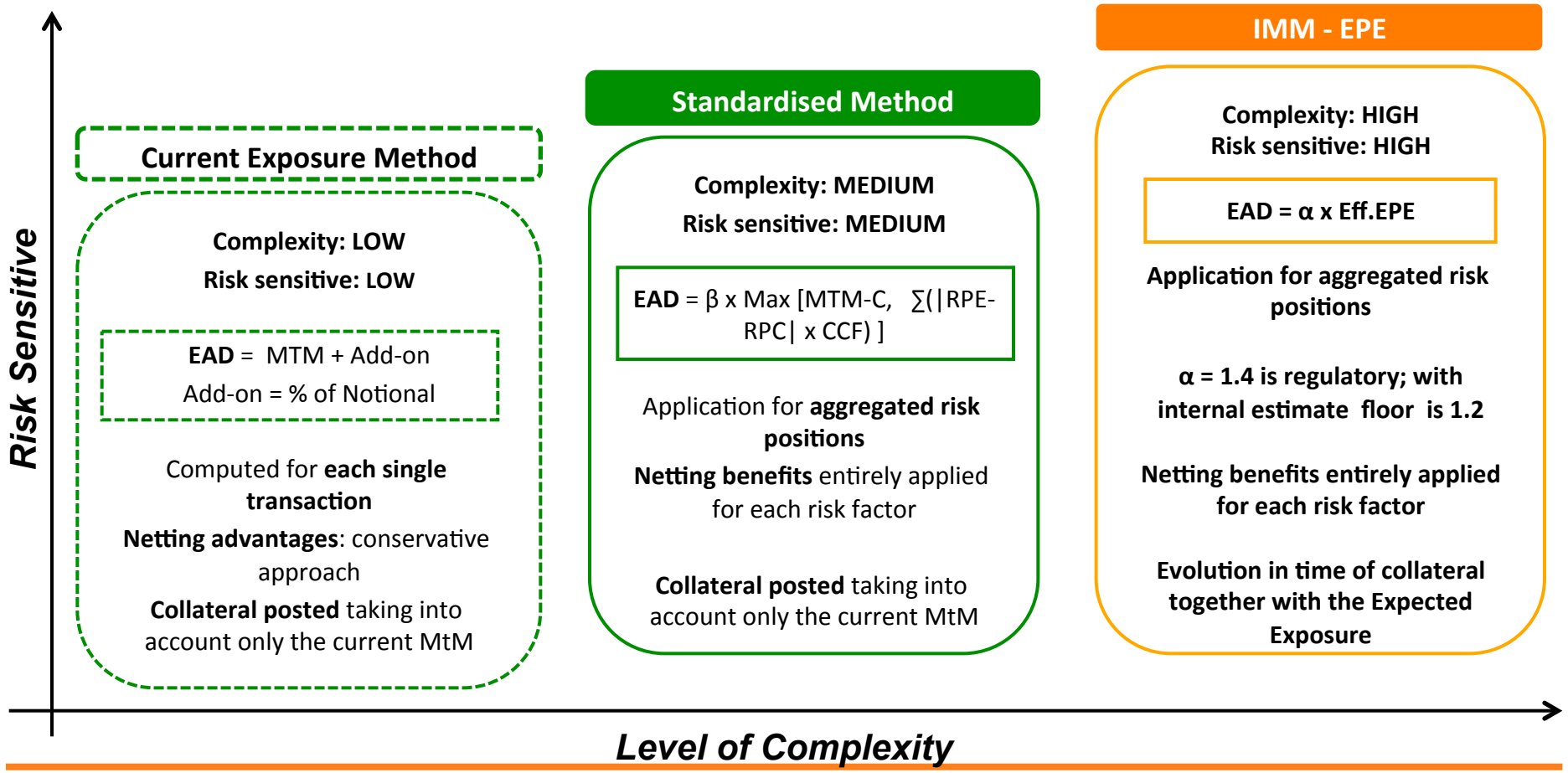
Capital requirements calculation methodologies for CCR

Banks need to comply with a capital requirement for Counterparty Credit Risk, using the regulatory formula for capital charge relating to credit risk (standardized or IRB), with different methodologies for computing Exposure at Default (EAD)



Exposure At Default under Internal Model Methodology and Basel III

EAD = α * Max [Eff. EPE; Stressed Eff. EPE]

EE: Expected Exposure – The average of the exposure for each time step and netting set

EPE: Time weighted average of Expected Exposure over one year

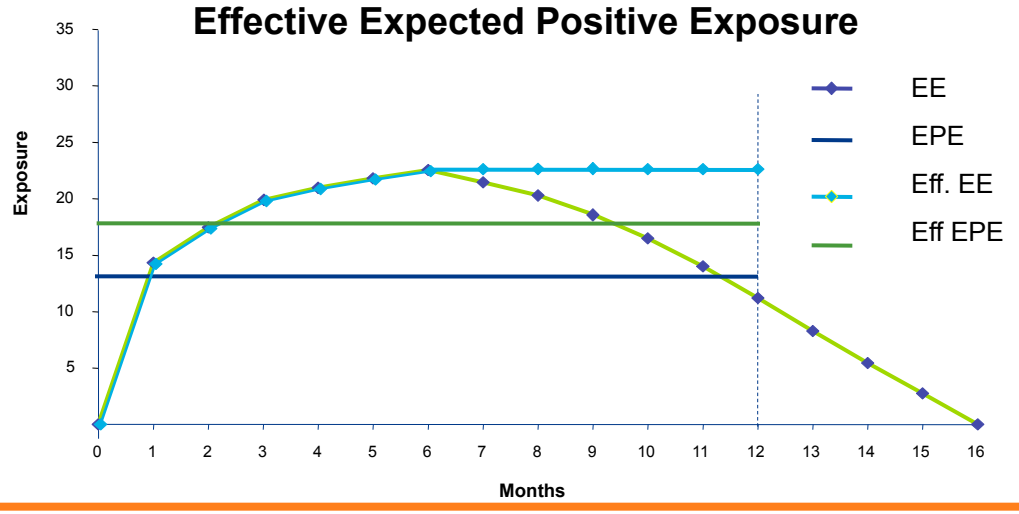
Eff EE: Effective Expected Exposure – The largest weighted exposure (non decreasing) to that date; intended to take into account rollover risk

Effective EPE: The time weighted average of the Effective EE over one year

Stressed Effective EPE: Effective EPE with scenarios of stress for the credit spreads of counterparties

α (Alpha) = multiplier for wrong way risk and model inaccuracy

Future Exposure is calculated through Montecarlo Multistep Simulation

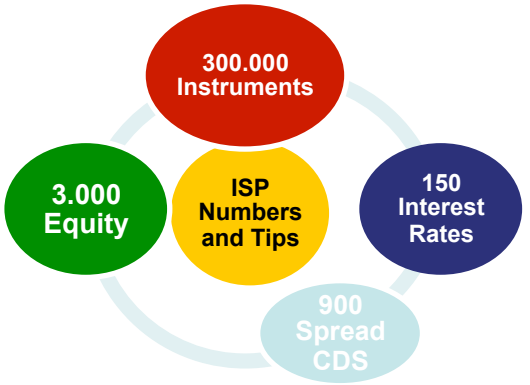


Integrated view of Market and Counterparty Risk internal models

Market & CCR Risk Framework

Risk Factor and Market Data Mgmt

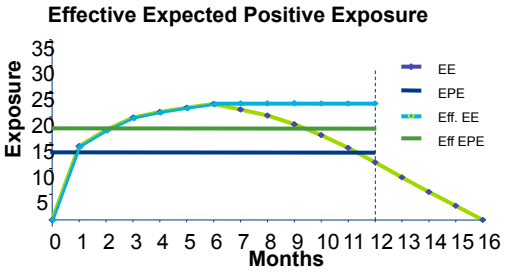
Scenarios estimation for market and counterparty risk



From Basel 2,5 to Basel 3

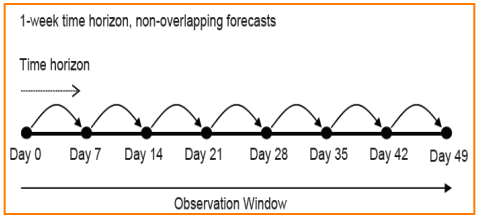
- Full evaluation approach
- VaR, **IRC**, and **Stressed VaR**
- EPE, **Stressed EPE**, PFE, **CVA VaR**

---- Basel 2,5
---- Basel 3



Model Performance

- Stress testing (sensy and scenario analysis)
- Backtesting program



To achieve regulatory approval banks must demonstrate “use test” of IMM for business decisions

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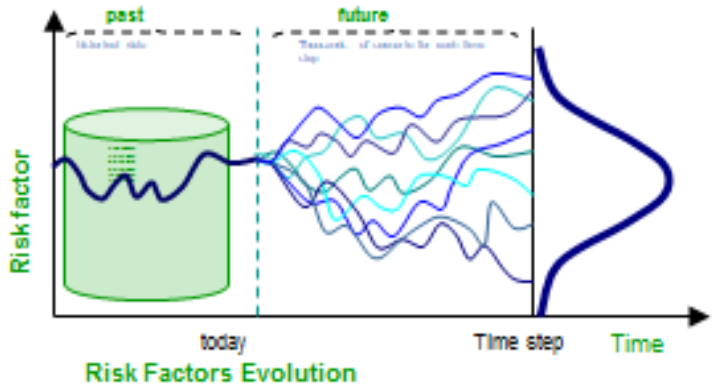
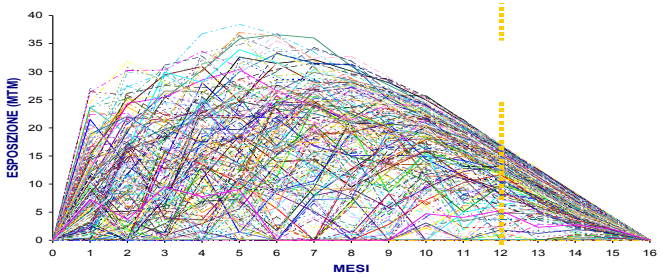
Counterparty Risk Modeling
Modeling Workflow and Risk Figures

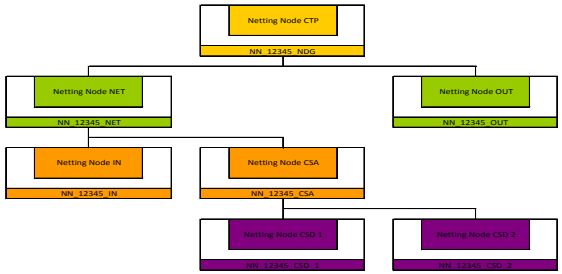
Risk factor evolution



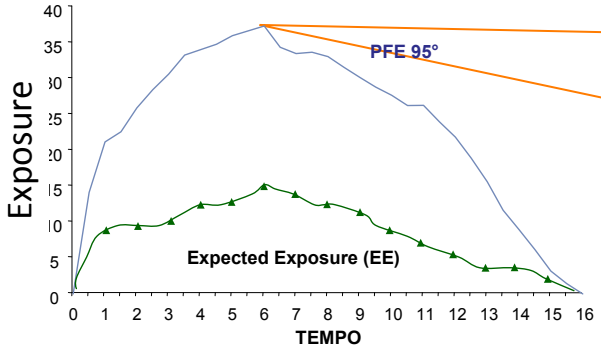
Instrument evaluation



Aggregation

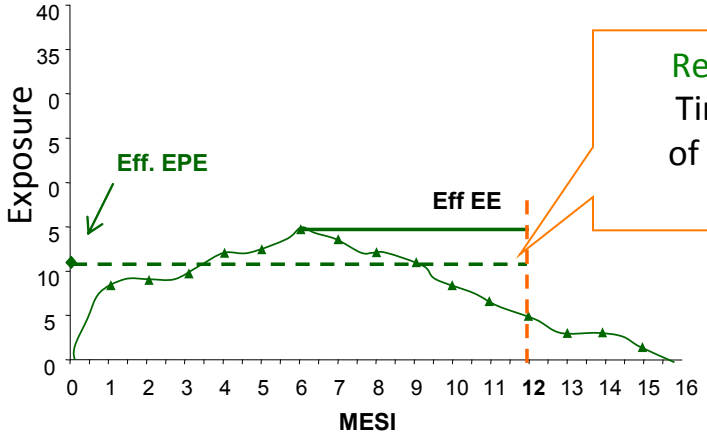


PFE: credit limit monitoring



Peak for Management View
Time weighted evolution of the expected exposure full life at a high percentile (i.e. 95°, 99°)

Eff EPE: capital charge calculation

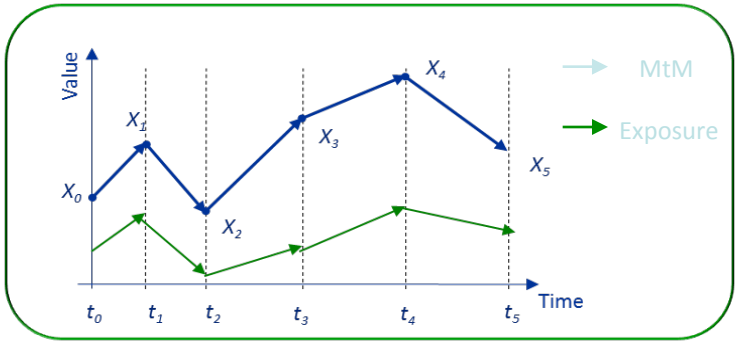


Regulatory View
Time weighted average of EE, over one year

Computing Counterparty Risk: Collateralized Exposures

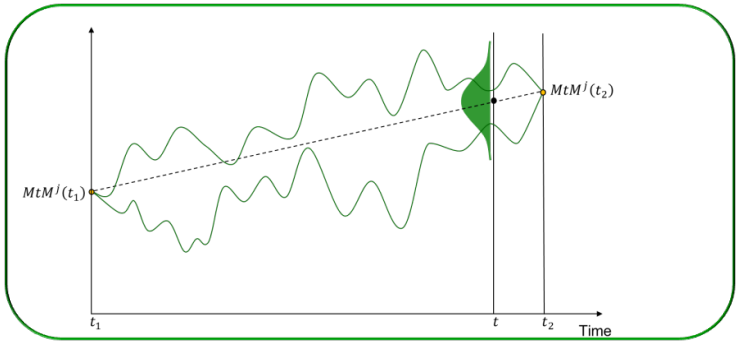
Full Simulation

- Full simulation requires daily revaluation of MtM values, Collateral and Exposure in all scenarios
- Full simulation fully takes into account path dependency but computational effort is very hard to manage



Brownian Bridge

- **Brownian Bridge** approximates path dependency with a reasonable computational effort
- Collateral is simulated through a stochastic interpolation of MtMs



Shortcut Method

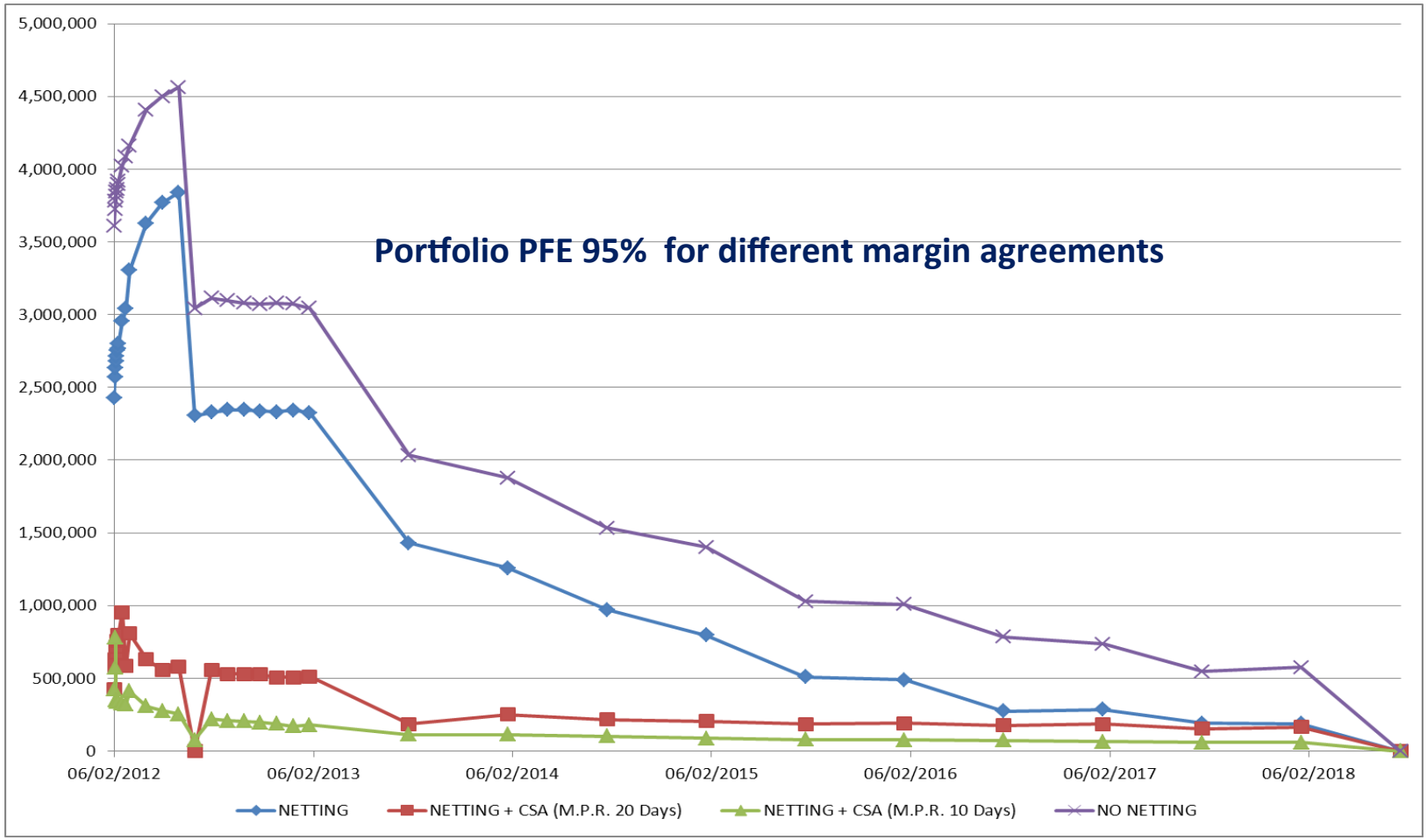
- **Shortcut Method** is a basic approximation that does not require collateral simulation
- It is based on a MtM simulation over the margin period of risk, considering only scenarios with positive differences

$$MIN\left\{\begin{array}{c}[Max(Exposure; Potential\ Exposure) + Addon] \\ Eff\_EPE\_NO\_CSA\end{array}\right\}$$

$$\text{Addon} = E[Max(\Delta MtM; 0)]$$

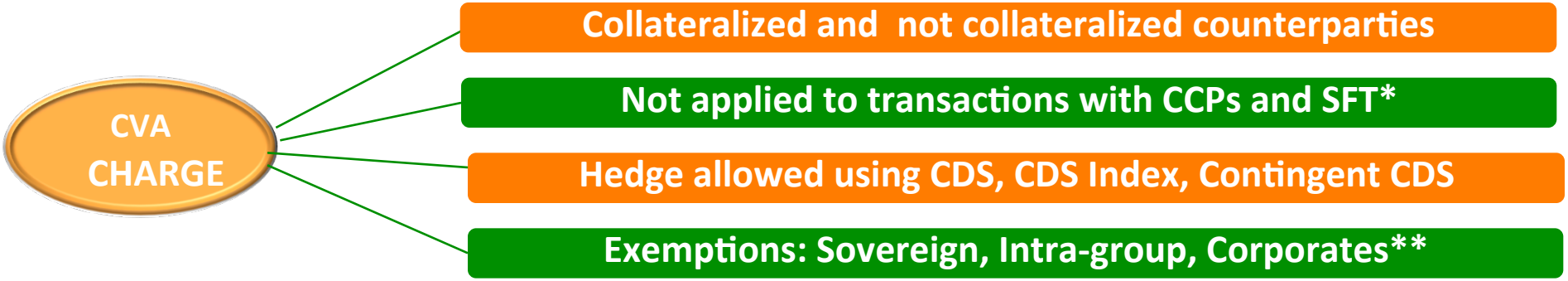
Computing credit exposure for credit line monitoring: case study

Management View



Bank Counterparty - MTA = 500K € - Net MTM of IR derivatives portfolio 2,4 mln; collateralized exposure computed using Brownian Bridge

Computing CVA Capital Charge under Basel III



Standardized CVA

Closed formula based on:

- **Counterparty's EAD (IMM or CEM)**
- **Effective Maturity (IMM or CEM)**
- **Risk weights based on counterparty's rating (mandate table)**

Applies to all banks

Advanced (CVA VaR)

Risk sensitive approach

$$3 * [\text{CVA VaR}^{(\text{current})} + \text{CVA VaR}^{(\text{stressed})}]$$

CVA VaR is calculated for a portfolio of CDS having each counterparty as reference entity and notional being:

- **Profile of Expected Exposure based on current market data**
- **Profile of Expected Exposure based on stressed parameters**

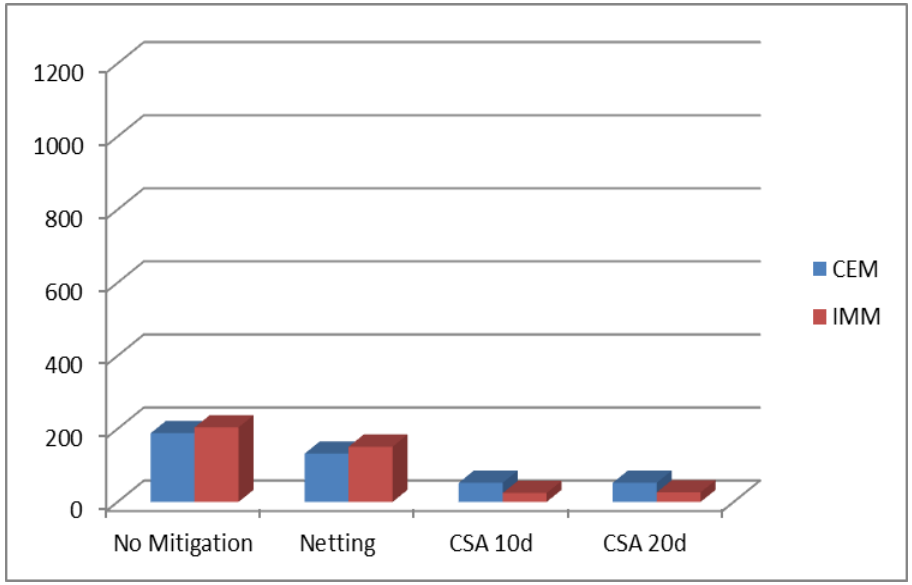
Applies to banks with approved IMM/EPE Model for CCR and Specific Risk Model (for bonds) for Market Risk

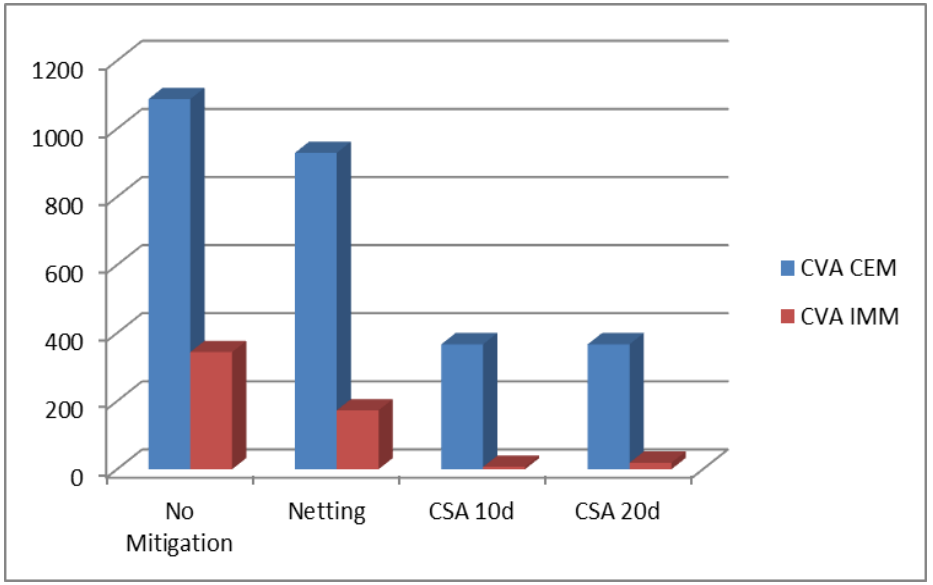
•Does not apply to SFT unless their supervisor determines that the bank's CVA exposures arising from SFT transactions are material – EU Approved Text
•** Corporate not subject to mandatory clearing under EMIR directive (purpose of hedging; under treshold for mandatory clearing)

Computing Capital Charge under Basel III - case study

Bilateral transactions on OTC derivatives with counterparties subject to CVA Capital Charge have a high impact in terms of capital charge under Basel III

Default Capital Charge (EAD * Risk weight * 8%) **+** **CVA Capital Charge**





Bank Rating A – MinTransferAmount = 500K € - Net MTM portfolio 2,4 mln € plain vanilla IR derivatives
EAD IMM = MAX(Stressed Effective EPE Current Effective EPE)*1,4**; EAD CEM =** MtM + AddOn – Collateral
CVA IMM = CVA VaR; **CVA CEM =** Closed Formula

Backtesting Counterparty Risk under Basel III

Backtesting is the comparison of forecasts to realized outcomes

Three level of Backtesting

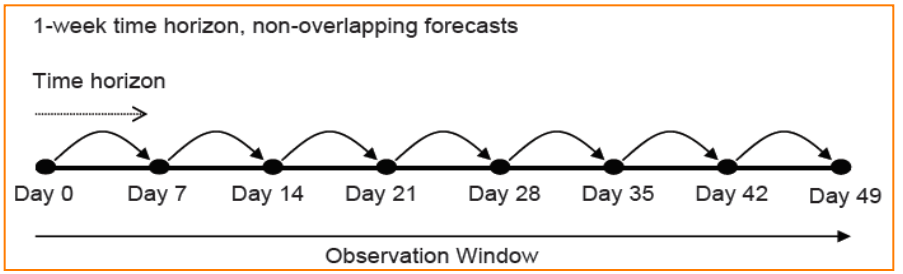
1. Risk factors
2. Mark-to-market
3. Exposure

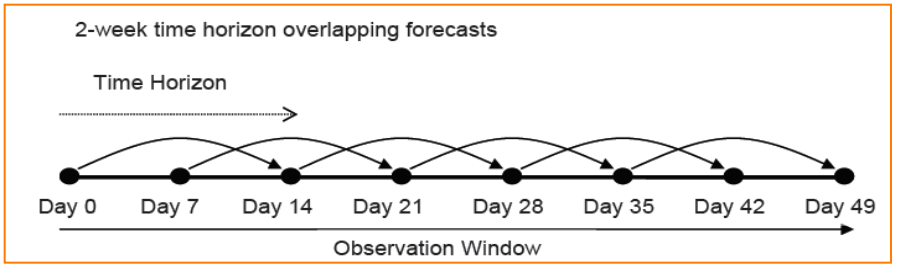
Time horizon

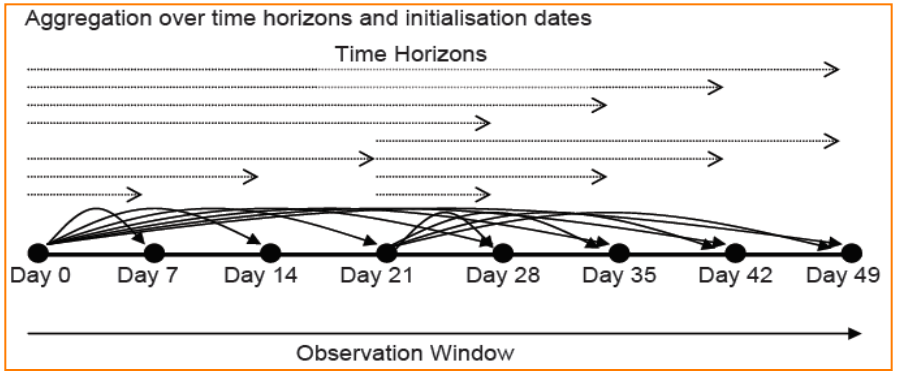
•Performed separate backtesting for a number of distinct time horizons with different forecast (day, weeks, months, year)

•Overlapping vs non-overlapping

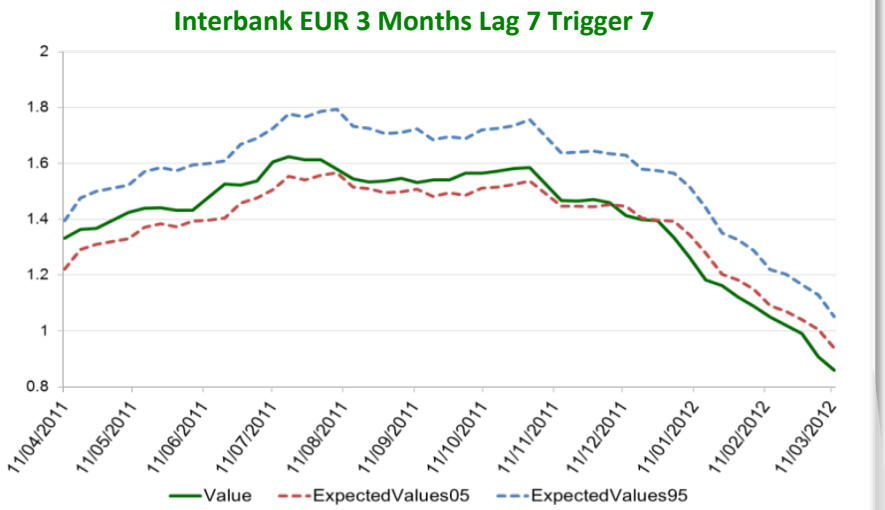
Backtesting the entire distribution, not only the tails

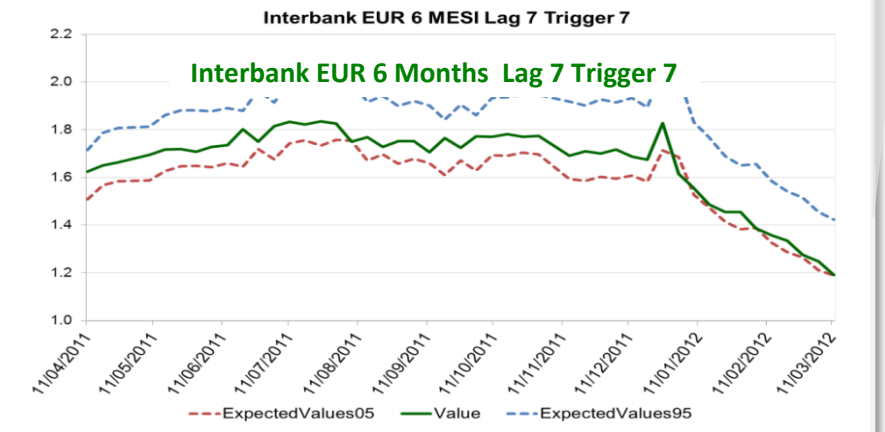


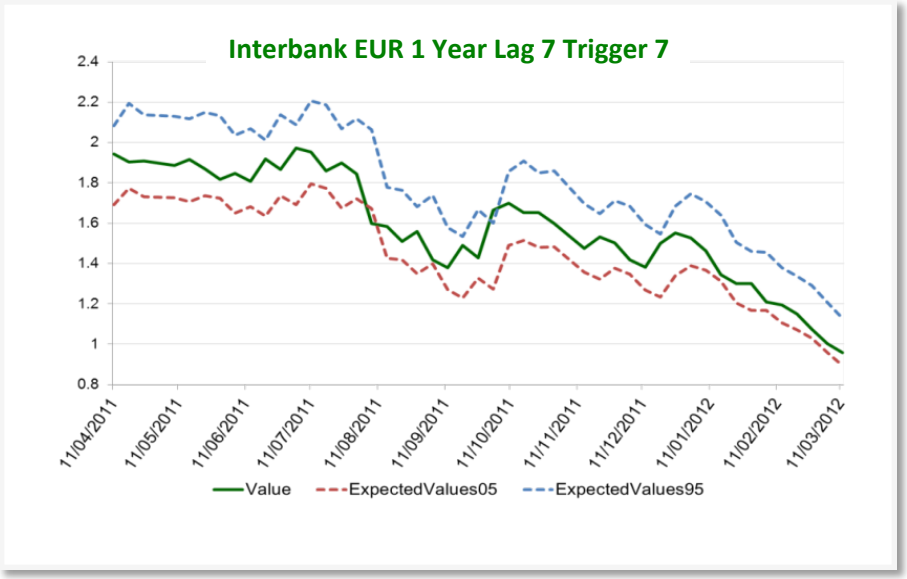




CCR Backtesting level I – Pratical example: Euribor



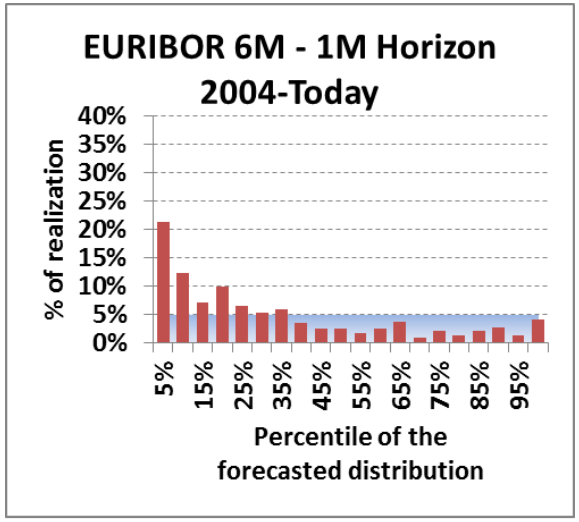


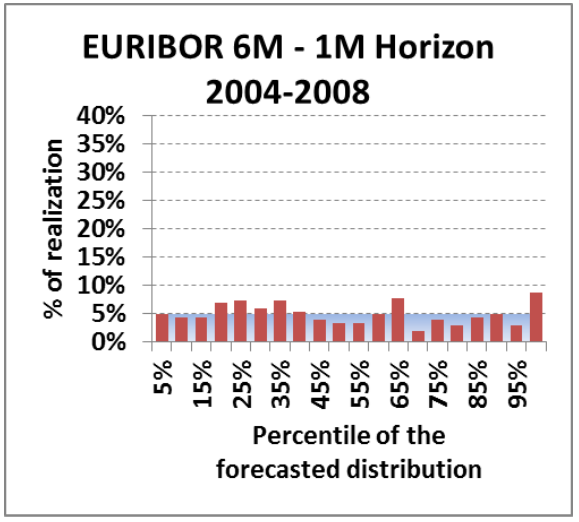


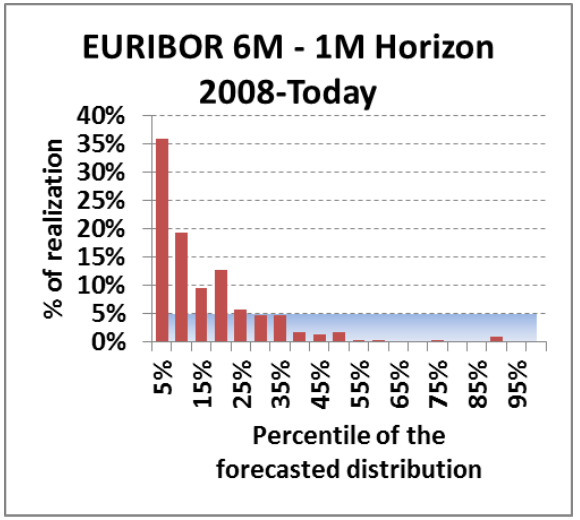
The three examples above reports a 7-day Simulation (lag 7) for 3 Month, 6 Month and 1 Year terms and the number of times when realized values were below 5-th or above 95-th percentile

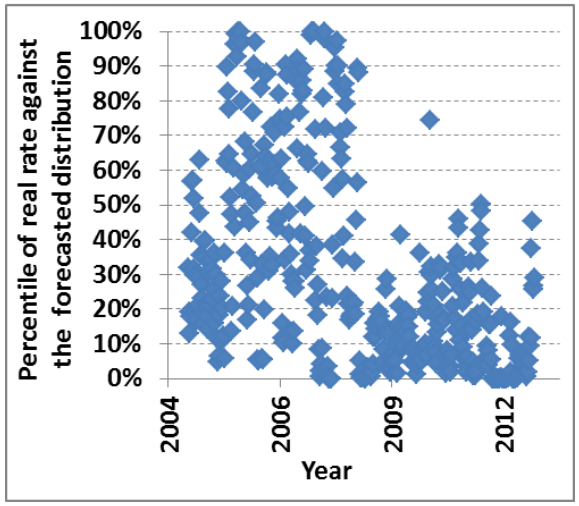
Remark: distributions in the charts are based on an non-overlapping sampling

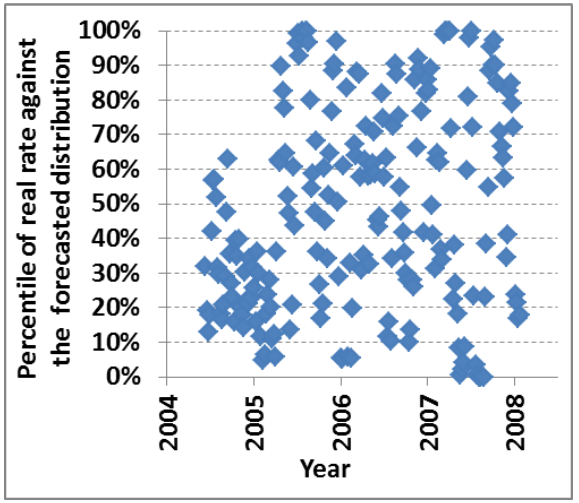
CCR Backtesting level I – interest rates and the crisis…

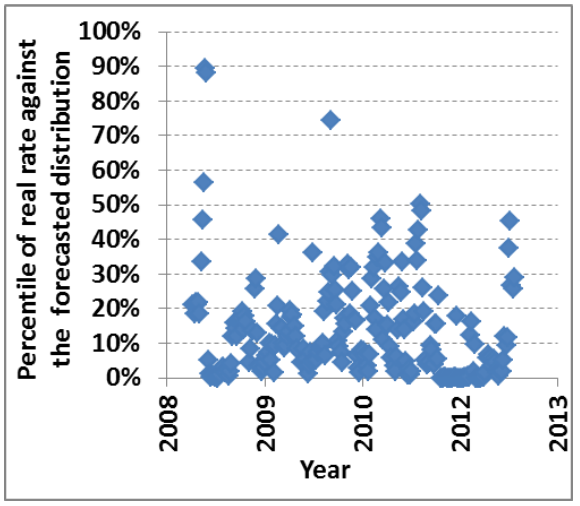












Remark: distributions in the charts are based on an overlapping sampling

Sum up – Internal Model in the new regulatory environment

Increased Complexity and Requirements

New risk figures, changes in EAD estimation, backtesting
Banks need to be compliant with Basel 2,5 under Market Risk; have specific risk approved for bonds to apply the Advanced CVA VaR

Old and new Issues: from counterparty risk to liquidity risk

High impact on RWA due to CVA Capital Charge
Mandatory clearing for standardized OTC and mandatory initial margin for bilateral OTC transactions: need for huge amounts of collateral

Use of Internal Model Methodology

Management view: Use Test for Limit Monitoring
Regulatory view: computing capital charge with a risk sensitive methodology
Liquidity Outflow estimation: if the bank has received approval of its EPE model for own funds calculation for CCR, it can use this model to quantify collateral outflow in adverse market scenarios

Main references

1. Basel III : *A global regulatory framework for more resilient banks and banking systems – BCBS (dec 2010 - Rev June 2011*
2. Basel III: *Capital requirements for bank exposures to central counterparties July 2012*
3. BCBS/IOSCO: *Margin requirements for non-centrally cleared derivatives – Consultative Document July 2012 - Second consultative document – Feb 2013*
4. BIS: OTC derivatives statistics at end of June 2012
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6. Basel Committee on Banking Supervision, Consultative Document "*Application of own credit risk adjustments to derivatives* " December 2011
7. Sound Practices for backtesting counterparty credit risk models – BCBS 185 – December 2010
8. Pykhtin – Modeling credit exposure for collateralized counterparties - The Journal of Credit Risk Volume 5/Number 4
9. EBA/CP/2013/19 – Consultation Paper: Draft Regulatory Technical Standards – May 2013

Thank you for your attention

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The views expressed are those of the author and do not necessarily reflect those of Intesa Sanpaolo

La costruzione e il backtesting di un modello interno per il rischio di controparte: aspetti d'architettura

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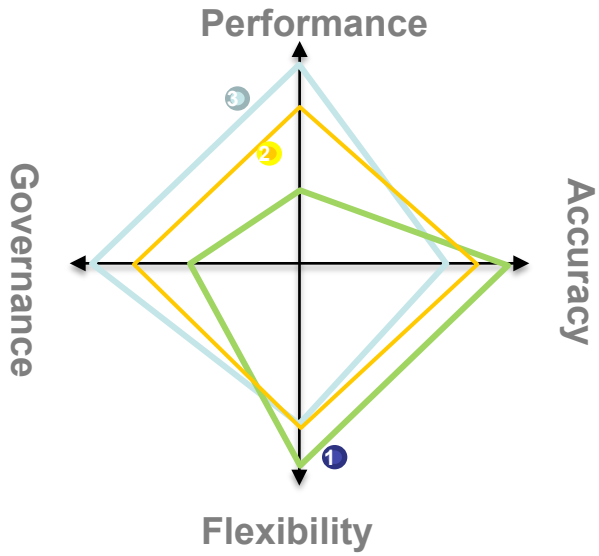
IBM Italia

Convegno ABI – Basilea III *28 Giugno 2013*

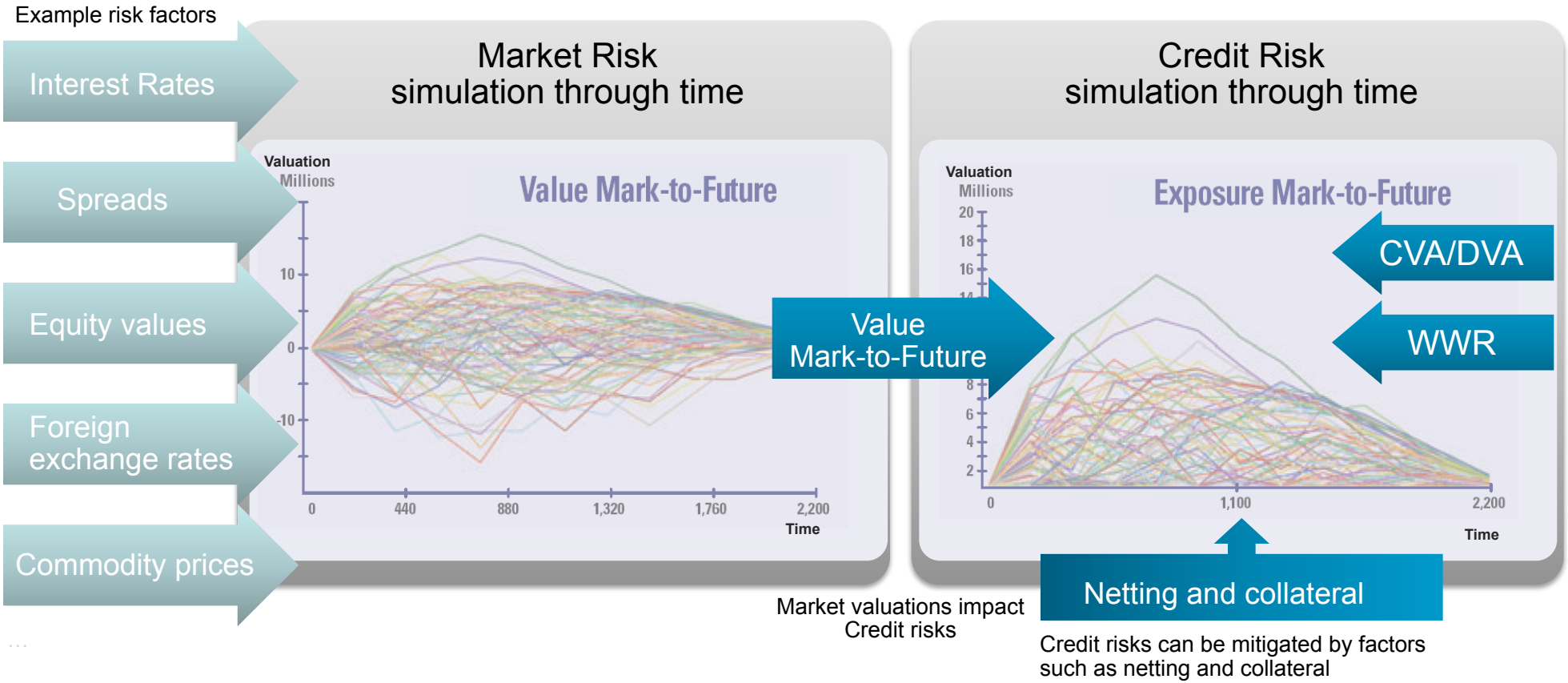
The Counterparty Risk Architecture is going to be reviwed against four key dimensions

	Description	Key factors
1. Flexibility	• It represents the ability to make changes to the model. One extreme is represented by open source vs pure configurability	• **Extensibility** • **Evolution** • **Robusteness**
2. Accuracy	• It represents the level of accuracy and the acceptance of proxies used in the system (e.g. risk calibration, liability modelling, aggregation)	• **Interpretability** • **Validity**
3. Performance	• It represents capabilities to support business decision with real-time or near-real time high-volume based information	• **Speed / calculation unit** • **Scalability** • **Technology impact**
4. Governance	• It represents the features around the control and the usage of the data and the system	• **Control** • **Transparency** • **Dataflow process**



1. Flexibility

The 2007/08 'credit crisis' demonstrated that approaches in place to manage Credit Risk are relatively inadequate compared to most Market Risk management approaches used by banks today. Credit Risk requires far more advanced solutions.

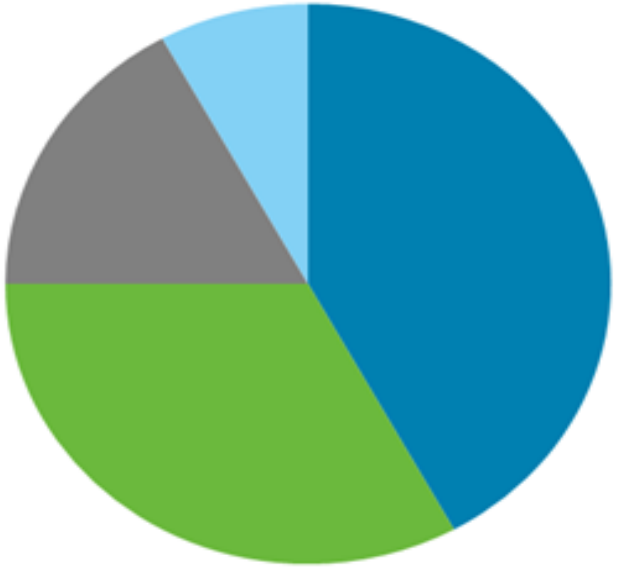


2. Accuracy matters...

...because the analysis that is used to adjust the pricing of highly valuable trades can be a competitive advantage

Of the banks that have already adopted CVA, most use simple add-ons, or apply CVA in a way that does not offer netting benefits.

This puts them at a competitive disadvantage on pricing trades versus firms using more advanced approaches.



Simple add-ons, look up tables or formulas

On a product by product basis ignoring netting

Full Monte Carlo system incorporating netting

Including a charge for unexpected losses

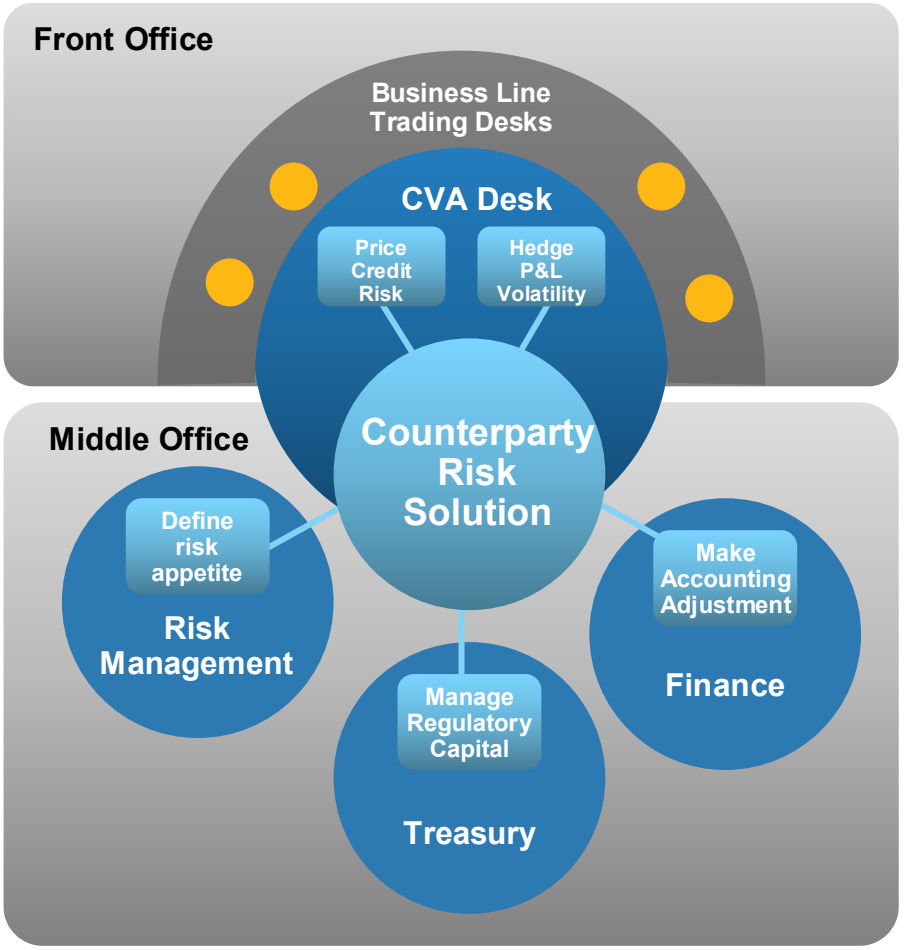
Source: Credit Value Adjustment: and the changing environment for pricing and managing counterparty risk, IBM/Algorithmics, December 2009

3. Performance.

Counterparty Risk solutions have now multiple stakeholders in the front office, the middle office, and back office IT. Real-time or Near-time capabilities are prerequisites

Risk processes require "real time Analytics" Capabilities:

- By performing a pre-deal check on potential trades with a what-if simulations of incremental CVA, a trader that can determine if a trade is risk-reducing or risk-increasing, and price the trade accordingly.
- This analysis requires an incremental Monte Carlo simulation that accurately assesses the incremental impact of the new trade within the entire portfolio.



4. Governance

Eleven crucial domains were identified and grouped based upon their primary relationships