ZANDERS
Treasury and Finance Solutions

TopQuants

Integration of Credit Risk and Interest Rate Risk in the Banking Book

Table of Contents

Introduction

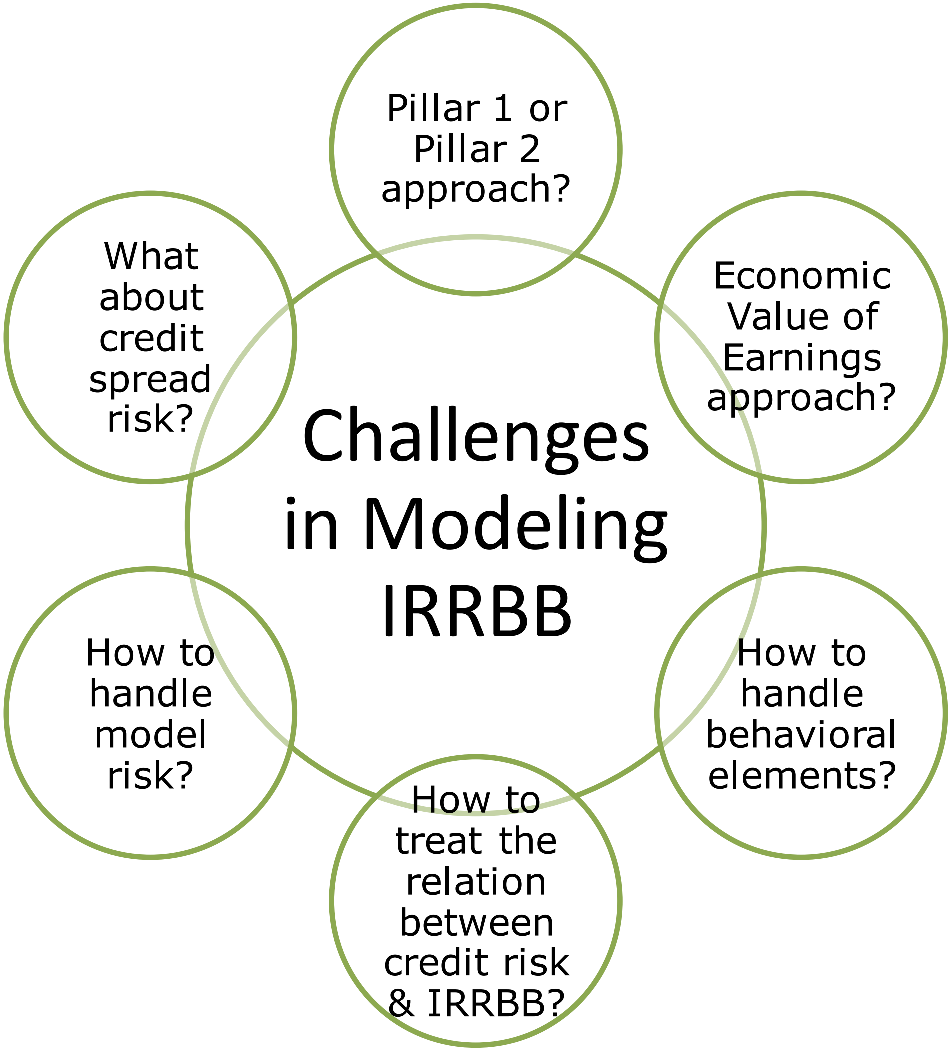
As already addressed in the B2 Accord (art.762), IRRBB is considered a potentially significant risk

Due to the heterogeneity across internationally active banks, it was then concluded that IRRBB should be captured under Pillar 2

In the Fundamental Review of the Trading Book the possibility of a transfer to Pillar 1 is mentioned

Currently, a task force on interest rate risk (TFIR) is given the mandate to investigate whether IRRBB can be transferred to Pillar 1

Introduction



Introduction

Market survey

<To be inserted, pending the results of the survey>

Introduction

Today's focus

- Today's focus is on how to model the **integration** of the capital charge for credit risk and IRRBB

- The following **starting points** are thereby relevant:
  - Focus is on credit risk and IRRBB
  - Operational risk is omitted in this analysis
  - No trading book positions assumed

Proposed Case

Lets consider a Dutch Bank

- Or more specific a banking portfolio
- Grain the portfolio per product group and repricing period
- Expected net earnings of 4,5 billion EUR

Assets	Mortgages	80%
	Corporate loans	15%
	Sovereign bonds	5%
Liabilities	Funds entrusted	75%
	Other funding	25%
Specifics	Low repricing periods	
	Leverage ratio	7.0%
	Duration of equity	2.7

Quantifying Our Case

We want to be able to control the coming year’s net earnings

- Credit losses
- Interest rate gross earnings

How to measure interest rate risk?

Earnings at Risk ⟷ **Economic Value**

Comparable to credit risk

- Holding period one year
- Directly affect the P/L

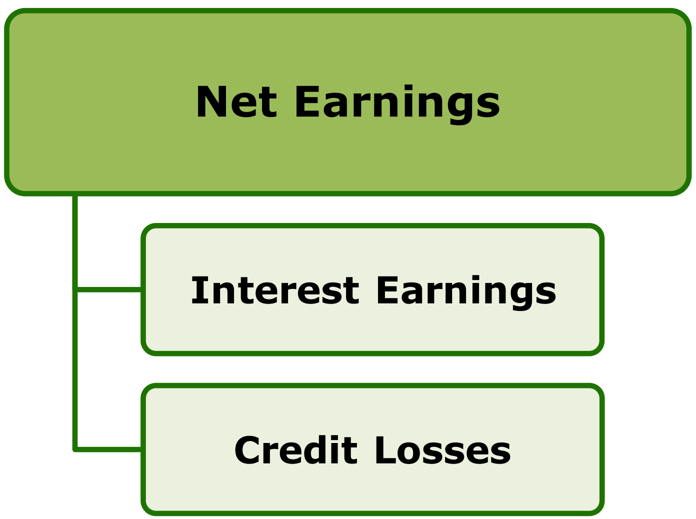
Not useless!

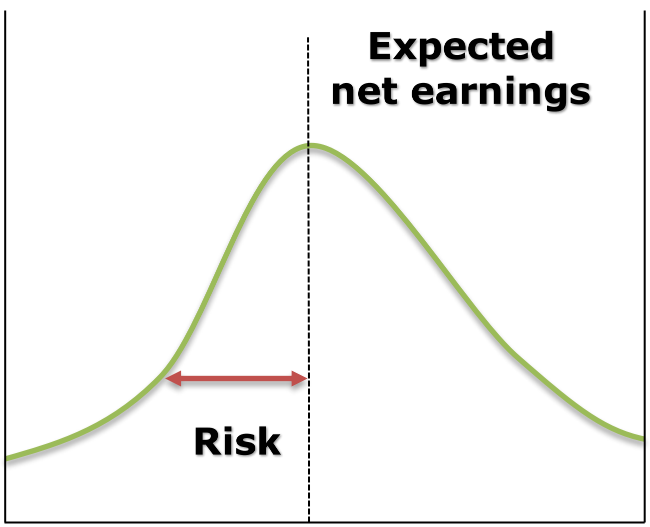
- Complimentary
- Not considered here

Quantifying Our Case

Net earnings as a risk measure

- Constructed from interest earnings and credit losses
- Evaluated per simulation
- Determining the banking book risk
  (interest rate risk + credit losses)





Quantifying Our Case

How can we model the P/L of the bank?

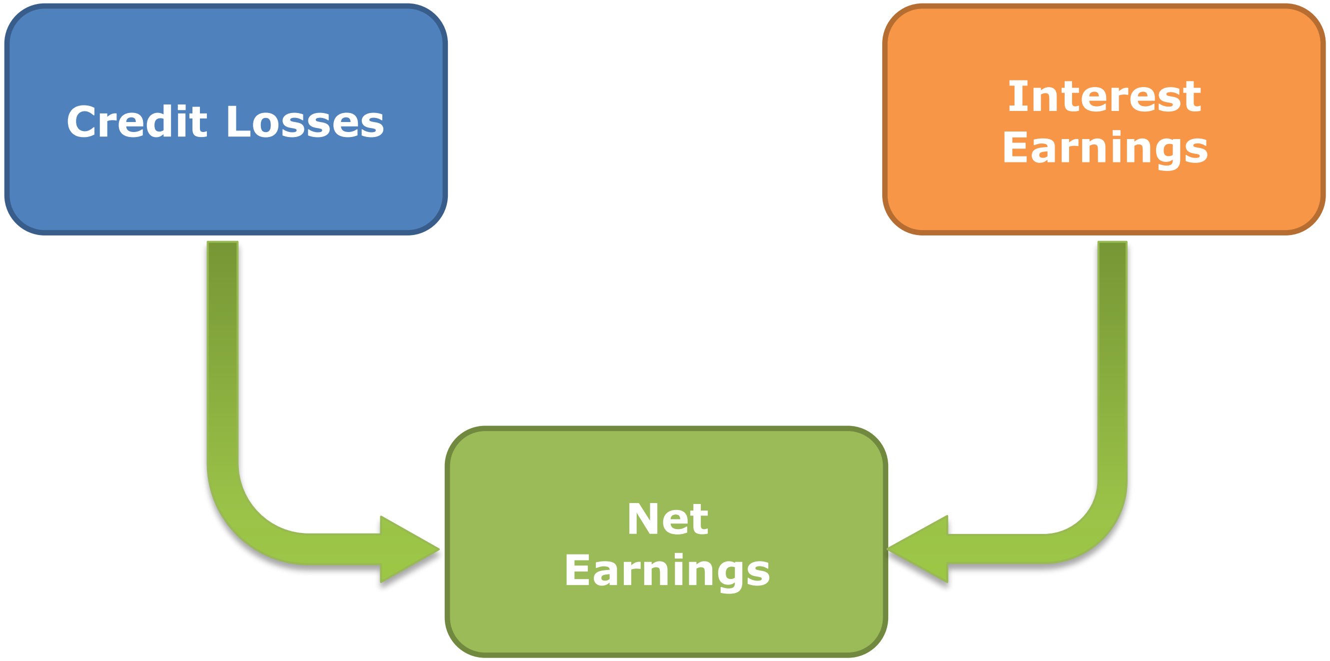
First Method	Second Method
• Form two departments • Separating interest and credit risk • Simulate the contributions • Results in net earnings • Defined: **Aggregated approach**	• Only one department • Collin-Dufresne model • Simulate their behavior • Results in net earnings • Defined: **Integrated approach**

The difference lies in the interaction of the risk contributions

Aggregated Approach

We form 2 separate departments

- Credit loss modeling
- Interest earnings modeling



Assuming no correlation

Aggregated Approach

Credit losses

- PD from rating model
- Simulated defaults
- LGD assessment per product
- No migration or concentration

Earnings at risk

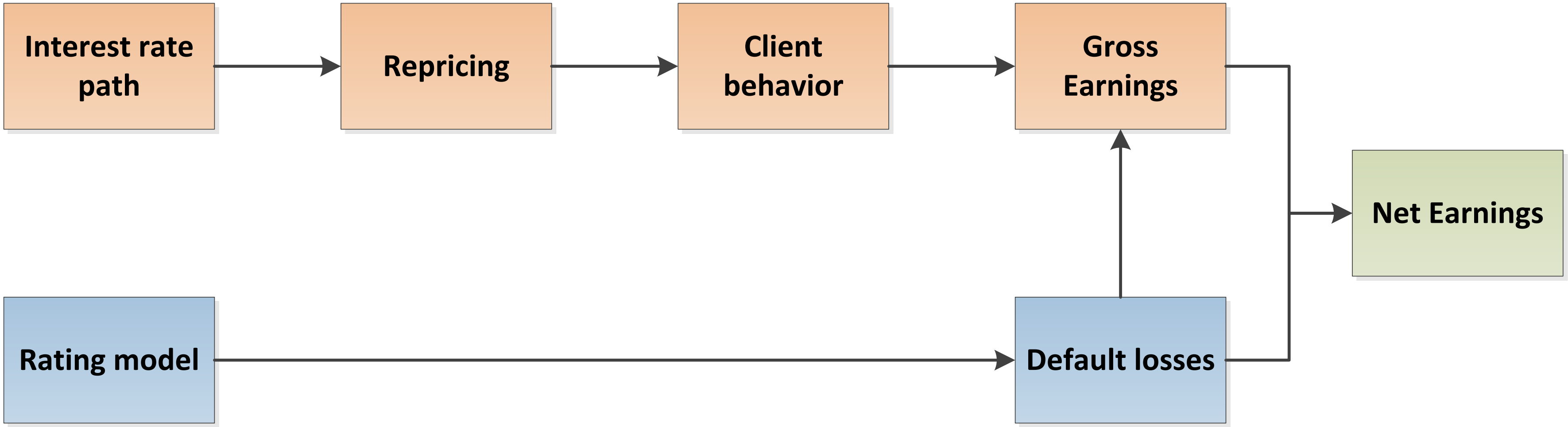
- Simulated interest rate path (historical Vasicek model)
- Behavioral prepayments and savings models
- Defaults impact coupon payments
- Interest income and expenses at each period
- Cumulative over one year

Net Earnings

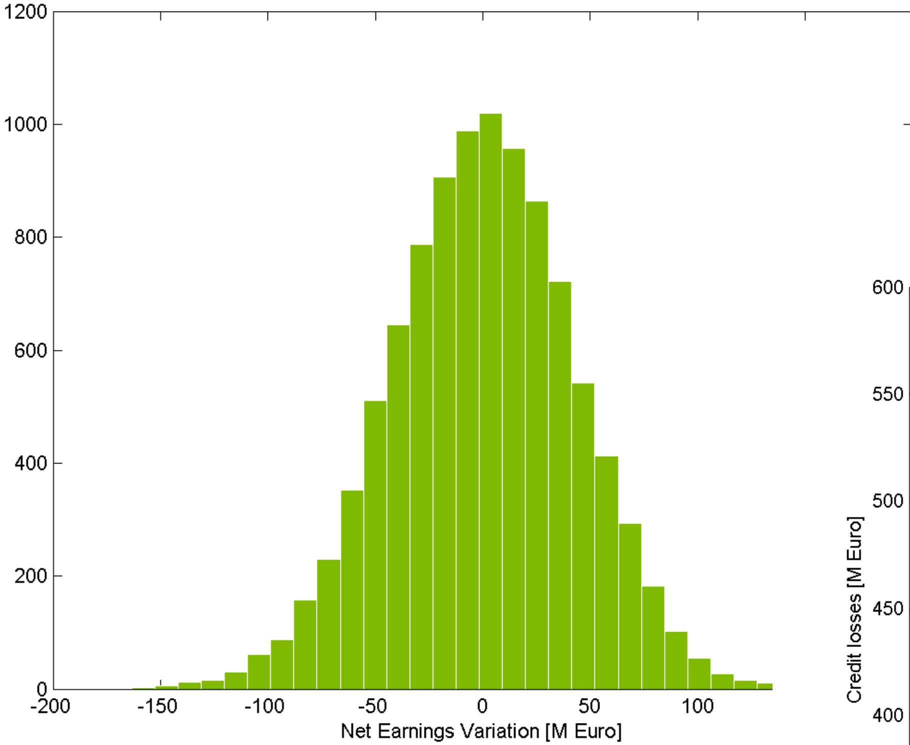
- Positive gross earnings
- Losses have a negative impact
- Combined per simulation
- Repeated 10.000 times to find the distribution

Aggregated Approach

Model flow chart



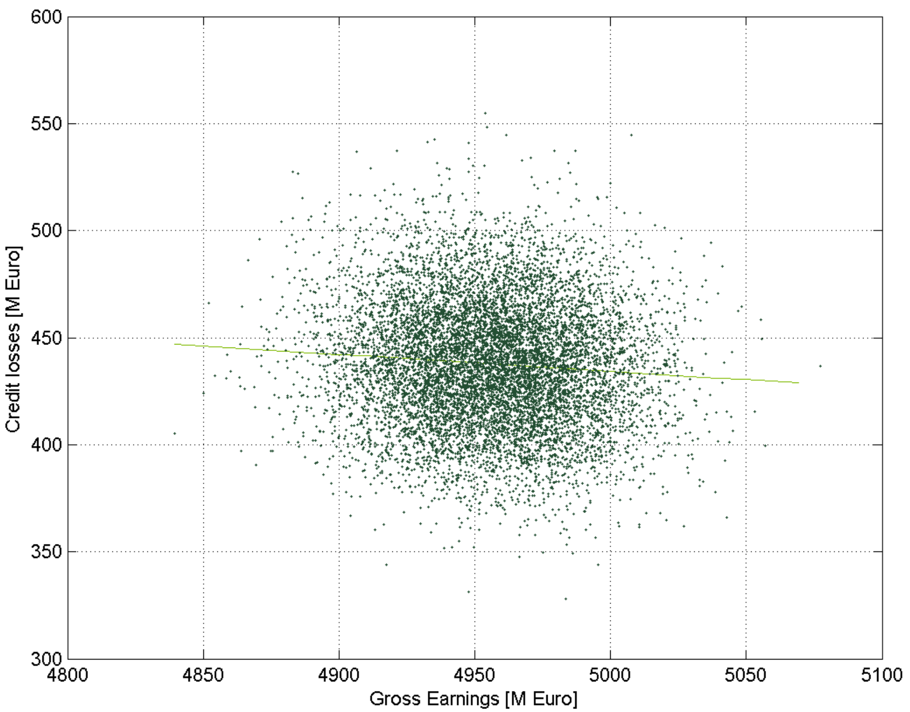
Aggregated Approach



95%-VaR: -156 bp

Contribution to variance

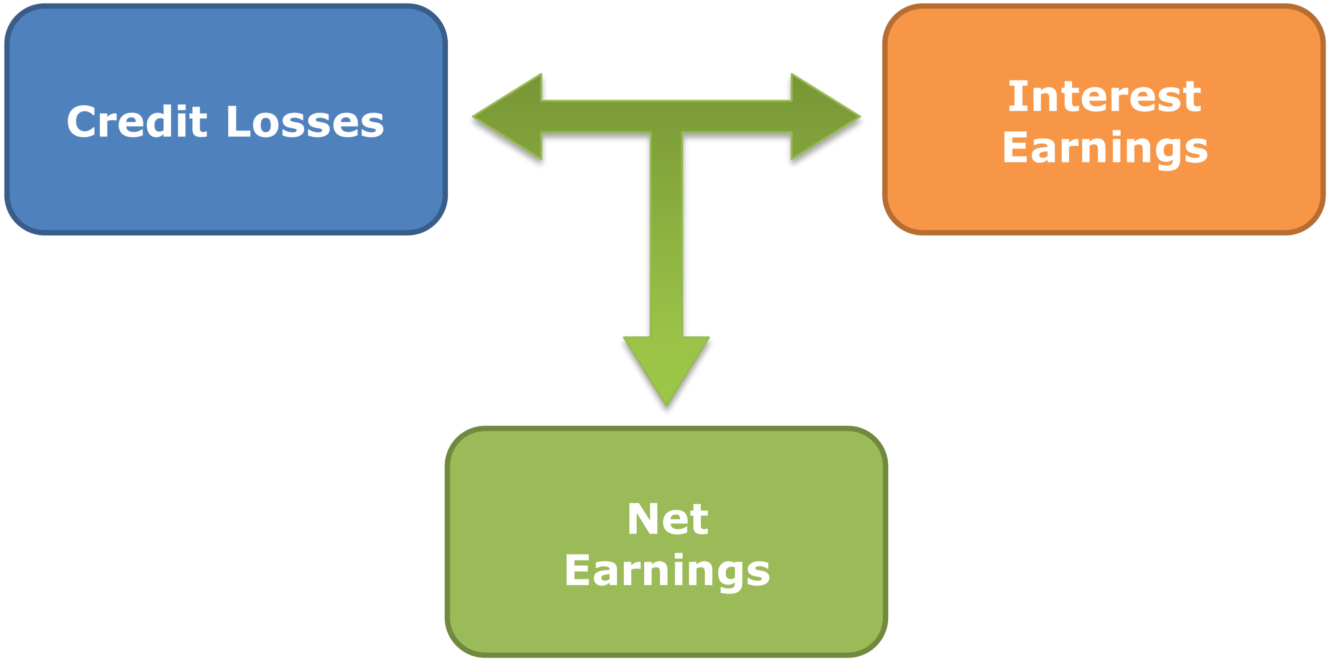
CR	EaR	Interaction
45%	48%	7%



Integrated Approach

Lets consider one assessment

- Combination of dependent defaults and interest rate path
- Default frequency is dependent on interest rate (Collin-Dufresne)



Empirical correlation

Integrated Approach

Collin-Dufresne and Goldstein (2001)

Merton-type counterparty model under stochastic interest rates:

$$dr = \kappa(\theta - r)\,dt + \eta\,dW_1$$

Defining log-firm value: $$d{y_t}^Q = \left(r_t - \delta - \frac{\sigma^2}{2}\right) dt + \sigma\,dW_2$$

and log-default boundary: $$dk_t = \lambda\,[y_t - \nu - \varphi(r_t - \theta) - k_t]\,dt$$

Evaluating over a r and t grid gives the probability of default (under risk-neutral or real-world measure)

Calibration done using MLE on CDS data

Integrated Approach

Credit losses

- Simulated interest rate path (historical Vasicek model)
- Collin-Dufresne assessment mapped to PD
- Migration is possible
- Simulated defaults
- LGD assessment per product

Earnings at risk

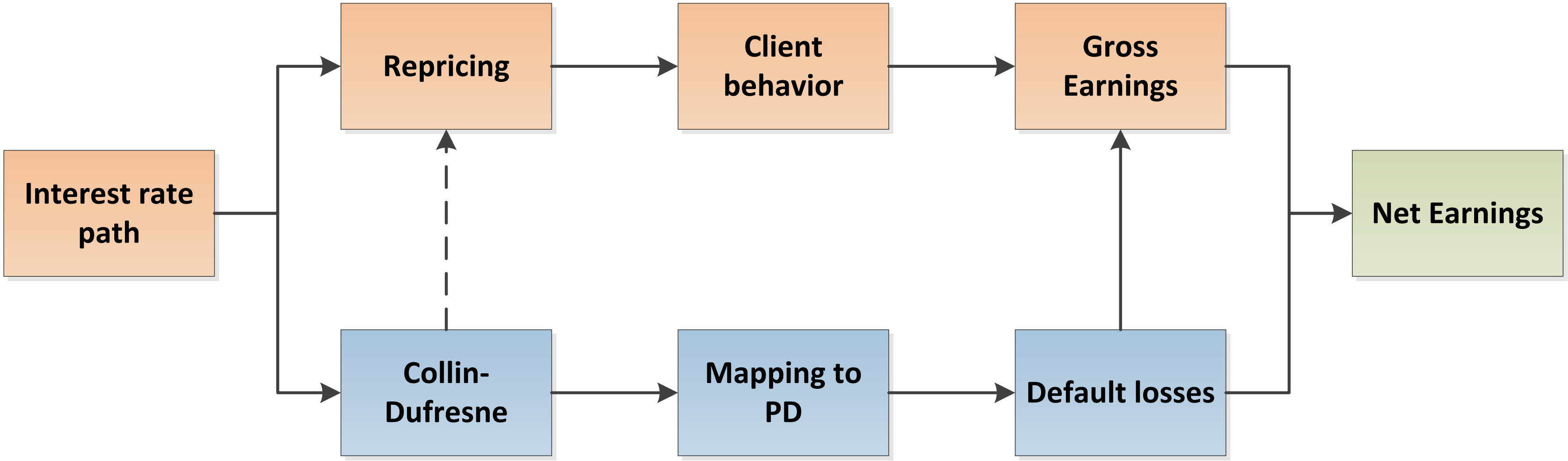
- Simulated interest rate path (historical Vasicek model)
- Behavioral prepayments and savings models
- Defaults impact coupon payments
- Interest income and expenses at each period
- Cumulative over one year

Net Earnings

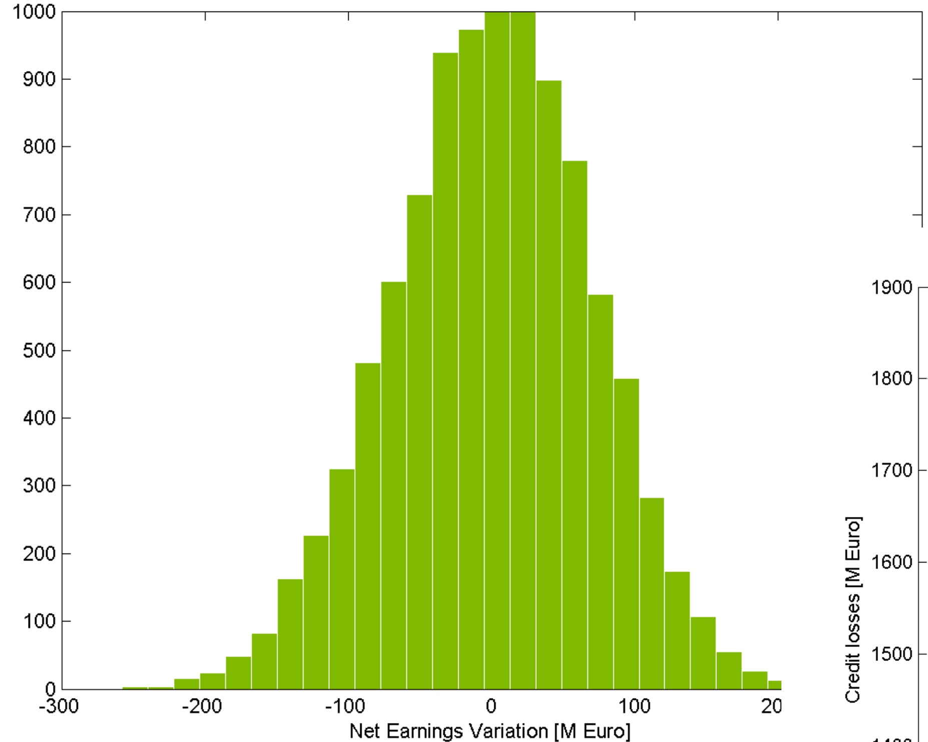
- Positive gross earnings
- Losses have a negative impact
- Combined per simulation
- Repeated 10.000 times to find the distribution

Integrated Approach

Model flow chart



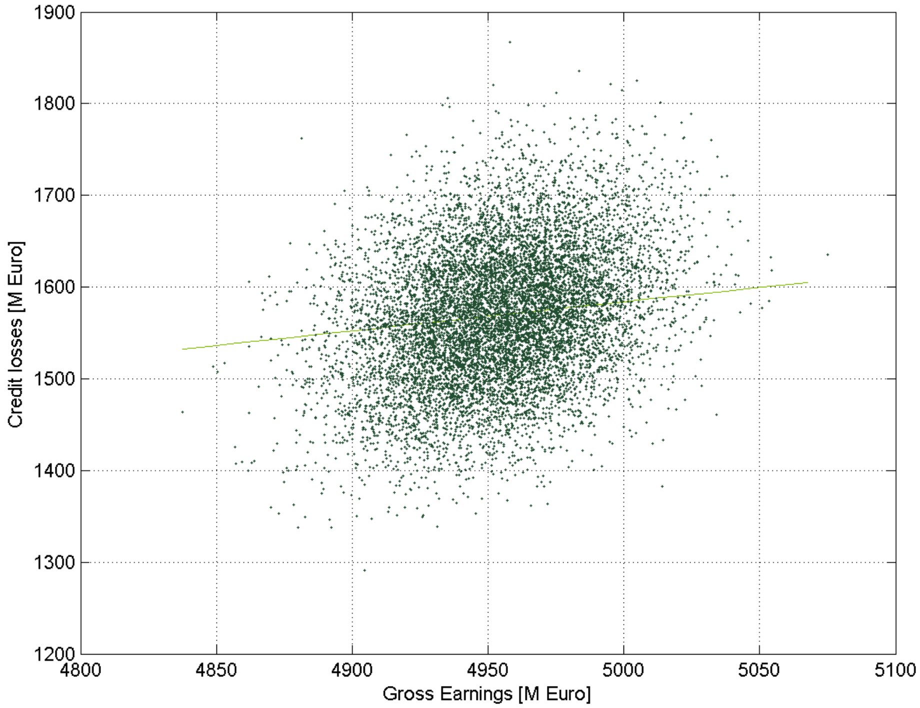
Integrated Approach



95% VaR: -261 bp

Contribution to variance

CR	EaR	Interaction
111%	18%	-29%



ZANDERS
Treasury and Finance Solutions

Comparison

How do both models compare on net earnings?

Net Earnings Variance

- Integrated modeling increases variance
- In our Case:
  67% difference in VaR

Caused by:

- Migration of assets
- Hedging effect

Expected Net Earnings

- 25% decrease in integrated model

Caused by:

- Concentration of defaults in the integrated model

Solutions for aggregated method:

- Mechanically add migration and concentration
- Assume a correlation

Influential Factors

Varying the client rates by means of credit spreads

Client rates

- In the aggregated model they inflate risk
  - Higher variance and no benefits
- In the integrated model we can use credit spreads to steer the interaction
  - In our case the correlation between gross earnings and credit losses varies from: +32% to +46%

Reduces the VaR by up to 10%
(Whilst preserving expected net earnings)

Influential Factors

Repricing periods

Repricing

- In our case we choose low repricing periods
- This shows a large interaction
  - Decreases with increased repricing periods
- Less compensation for riskier times
  - Correlation can vary from -8% to +40%

ZANDERS Treasury and Finance Solutions

Influential Factors

Products

Products

- Portfolio risk
  - Risky assets are more affected by interest rates
  - More interaction between risk types
  - Increased influence client rates
- Weight of mortgages
  - Mortgage defaults are less influenced by interest rates
  - Latent or no effect at all
  - In our case we ignore the effect on mortgages
  - Interaction decreases with larger mortgage weight

Conclusions

Conclusions

What can we learn from this?

- Correlation factors are a significant influence
- Resulting capital is very sensitive to the interaction
- Interest rate shocks influence the defaults

Which model is better?

- Aggregated approach relies on assumption
- Integrated approach relies on calibration
- Both have their flaws

How would you apply it in practice?

- Reconsider the risk aggregation process
- Reassess the impact of credit spreads
- Assess the correlation of risk types

Not covered here but: take into account the Economic Value

Questions

Contact Details

Erik Vijlbrief
Executive Consultant

T: + 31 35 692 89 89
E: E.Vijlbrief@zanders.eu

Pim Stohr
Intern

T: + 31 35 692 89 89
E: P.Stohr@zanders.eu

Appendices

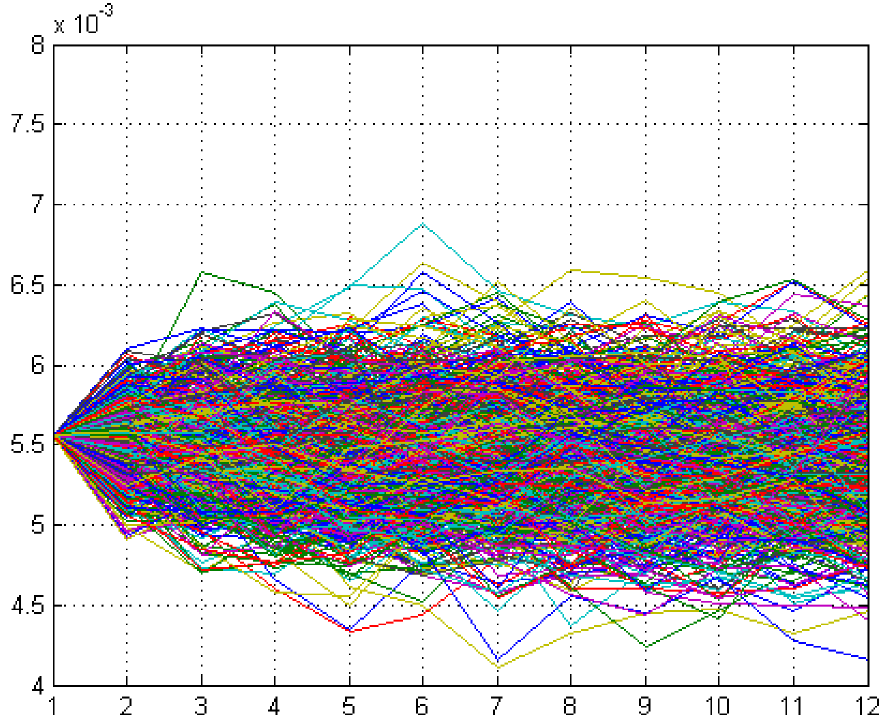
Integration of Credit an Interest Rate Risk
in the Banking Book

Appendix I:

Vasicek specification

- Mean-reverting to θ
- Constant volatility η

$$dr = \kappa(\theta - r)\,dt + \eta\,dW_1$$



ZANDERS Treasury and Finance Solutions

Appendix I:

Collin-Dufresne Goldstein (2001)

Stochastic process describing log-leverage ratio

- Log-firm value: $dy_t = \left(r_t - \delta - \frac{\sigma^2}{2}\right) dt + \sigma\, dW_2$
- Log-default boundary: $dk_t = \lambda \left[y_t - \nu - \varphi(r_t - \theta) - k_t\right] dt$
- Additionally: $\rho dt = dW_1 dW_2$

The model allows for very exotic behavior but
is difficult to implement and estimate

Stochastic interest rates are used from Vasicek

Appendix III:

Calibration slide

Performed on CDS spread data using MLE

Both the term structure and the time series

- 3 on term structure (σ, ν and l_0)
- 2 on time series (φ and ρ)

Parameter	Class I	Class II	Class III	Gov
σ	0.267	0.081	0.038	0.145
ν	0.653	0.213	0.000	0.307
ϕ	-205.568	-206.604	-619.100	-206.785
ρ	0.017	0.031	0.080	0.015
l_0	0.578	0.843	0.935	0.741
Log-Likelihood	-955.160	-633.679	-307.097	-883.572
In-Sample R^2	0.859	0.715	0.542	0.813