Prudential Regulation of Market Risk: From Basel I to Basel III

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Presentation outline

1. The rationale for capital requirements for market risk
2. Treatment of market risk under Basel Capital Accord (1988) and Market Risk Amendment (1996)
3. FED ‘precommitment’ approach (1998)
4. Revisions to the market risk capital requirements under Basel II framework and Basel III amendments (2009)
5. Agenda for future research

Capital requirements for market risk: Rationale

As long as expected loss due to market risk is generally NOT covered by specific provisions or fully hedged, capital is required to cover *any* loss in excess of expected return (including P&L from hedging).

Possible objectives of a bank:

- Maximize or reach target ROE given the portfolio size and structure
- Be solvent at a specified confidence level consistent with its risk appetite

Which objective is right for a regulator?

- Make sure the bank is solvent in normal times (has enough capital to absorb a (unusually long) series of 'normal-size' losses)?
- Make sure the bank is solvent in a one-off firm-specific loss (e. g. Barings, SocGen)?
- Make sure the bank survives a severe banking crisis (e.g. UBS, RBS)?
- Make sure bank's owners bear the bulk of loss in case of financial distress (i.e. minimize payout from government funds)?
- Cover (a percentage of) total loss induced by systemic risk?
- …

Market risk in Basel Capital Accords

- 1988: Basle Capital Accord did not account for market risk
  - Market risk was only marginally recognized as a magnifier of credit risk (risk weight of 100% for FX-denominated claims on central governments, e.g. eurobonds)
- 1993: Two *alternative* approaches were proposed by the Basel Committee:
  - Standardized approach (SA)
  - Internal-models approach (IMA)
- 1996: Both SA and IMA adopted by the Basel Committee in the Amendment to the Basel Capital Accord to incorporate market risk
- 1998: Implementation of SA and IMA in G-13 countries
- 1999: SA adopted by the Central Bank of Russia in a simplified way (Reg. 89-П)
- 2000: SA implemented by eligible Russian banks
- 2001: IMA-based methodology proposed by the Federal Securities Market Commission in Russia
- 2004: SA and IMA incorporated into New Basel Capital Accord (Basel II)
- 2007: Revised version of SA adopted by the Central Bank of Russia (Reg. 313-П)

Market risk in Basel Capital Accords

- **Standardized approach** to setting market risk capital charge:
  - Interest risk rate in the trading book (sum of general and idiosyncratic 'name' risk)
  - Equity risk in the trading book (sum of general and idiosyncratic 'name' risk)
  - Currency risk across the bank
  - Commodity risk across the bank
- Equity risk in the banking book is covered either through deductions from total capital (for non-consolidated equity holdings in subsidiaries) or by credit risk capital charge (100% risk weight for other equity investments)
- **Caveats:**
  - Rigid 'one-size-fits-all' framework
  - Aggregation of risks using simple summing: Non-perfect correlations inside and across risk types are not recognized
  - Interest rate risk in the banking book is not covered by regulatory capital

Market risk in Basel Capital Accords

- Under internal models approach, market risk capital charge is based on bank's internal VaR estimates:

$$MRC = \max\left(k \cdot \frac{1}{60} \sum_{i=1}^{60} VaR_{t-i}, VaR_{t-1} \right)$$

- … subject to the following quantitative requirements:
  - Both VaR and MRC computed daily
  - 99% one-tail confidence level
  - 10-day holding period (scaling from shorter holding periods using $\sqrt{T/t}$ possible)
  - 250 days minimum historical observation period
  - Multiplier *k* is set based on backtesting results and equals 3 for adequate ('green-zone') models, 3.4 to 3.85 for 'yellow-zone' models and 4 for inadequate ('red-zone') models
  - Backtesting of VaR model conducted quarterly based on sample of past 250 trading days
- Specific risk interest rate and equity risk should be captured by VaR model, otherwise capital surcharge applies
- No model type is prescribed; model must not be used solely for capital calculations!
- Stress-testing scenarios and results must be regularly reported to the regulator

Market risk in Basel Capital Accords

- **What does the minimum multiplier (3x) reflect?**
  - 'Objective' model risk: Estimation error due to the high confidence level?
  - 'Subjective' model risk: 'Penalty' imposed to counterbalance incentives to underestimate VaR and minimize regulatory capital?
  - Long-run historical average ratio of stress-test results to average VaR (Monet 2001): *Capital cushion to absorb losses from sharp market movements or prolonged periods of high volatility?*
  - Scaling up to 1-year returns volatility? (strong mean-reversion presumed?)
  - Market liquidity risk?
  - Absent or ineffective corrective action of bank's management to reduce its exposure to market risk (e.g. missing or lax stop-loss limits)?
- **Is the multiplier 3x–4x too high or too low?**
  - Kupiec and O'Brien (1997): Multiplier is redundant under the precommitment approach
  - Lucas (1998): Maximum multiplier should be *at least* 8 to mitigate 'gaming' incentives
  - Monet (2001): In the 'real-world', the multiplier should be perhaps 12
  - Federal Securities Market Service (Russia, 2001): Maximum multiplier of 5 proposed

Market risk in Basel Capital Accords

- **Caveats of internal models approach:**
  - Information asymmetries between banks and regulators coupled with strong 'gaming' incentives for banks: Regulators must ensure that banks avoid model-related abuses (e.g. second model used only for the purpose of capital calculation)
  - If VaR-based capital requirement is higher than that under the standardized approach, banks are not incentivized to use IMA and improve their models
  - Financial institutions may prefer to use overly conservative models only to avoid regulatory action!
  - Supervisory add-ons based on backtesting results may be too conservative: Banks may quickly improve their VaR models after model risk has been recognized; VaR-model live-testing as per Lobanov, Kaynova (2005) not allowed!
  - 'Clear' vs. 'dirty' backtesting may yield conflicting results
  - Only increase in exposure to market risk over the holding period is presumed

Precommitment approach: Glimpse into the future?

- Kupiec and O'Brien (US Federal Reserve Board, 1997)
  - Management may effectively reduce risk exposure through trading over the holding period
  - Banks may pre-commit to any specific loss amount due to market risk over the reporting period (e.g. a quarter) and fully cover it with available capital up-front
  - Equivalent to setting market risk capital equal to VaR
  - Regulator fines the banks if actual loss at the end of the period exceeds the precommitted amount
  - No regulatory oversight on the model structure, usage and quality
- Attractive for large dealer banks: Successful 'dry run" by 20 member banks of NY Clearinghouse in 1998 (Rattaggi 2000)
- Actively debated in the industry but not implemented on the system level
  - Considered to be too risky by many regulators
  - Only well-capitalized banks would be eligible for the approach
- Partially implemented by some large US banks on a firm level for calculating economic capital (e.g. Miller, J. P. Morgan Chase 2001)

Market risk in Basel Capital Accords

- Both SA and IMA in 2004 incorporated into Basel II with some technical amendments:
  - If specific risk on interest rate and equity positions in the trading book is not fully captured by VaR model, banks must calculate it using standardized methodology and add it to the VaR-based capital charge as a surcharge (without scaling)
  - To capture specific risk, the model MUST (BCBS, 2006):
    - explain the historical price variation in the portfolio (e.g. in-sample $R^2 \geq 90\%$)
    - capture concentrations (magnitude and changes in composition)
    - be robust to an adverse environment (e.g. full-cycle historical observation period, simulation, scenario worst-case analysis)
    - capture name-related basis risk (idiosyncratic differences between similar but not identical positions)
    - capture event risk (e.g. migration risk for debt, mergers/takeovers for equity)
    - be validated through backtesting
  - Event risk beyond 99% confidence level and 10-day holding period not captured by the model must be factored in e.g. through stress-testing
  - Market liquidity risk must be reflected through scenario analysis and conservative proxies
  - New capital requirement for ‘incremental’ risk (regulatory capital default risk of trading book)

Expansion of the Basel Committee

13 member countries of the Basel Committee prior to expansion:

- Belgium
- Canada
- France
- Germany
- Italy
- Luxembourg
- Netherlands
- Spain
- United Kingdom
- USA
- Switzerland
- Sweden
- Japan

In March 2009, 11 newcomers were invited to join the Basel Committee:

- Argentina
- Brazil
- China
- Hong-Kong
- India
- Indonesia
- Mexico
- **Russian Federation**
- Saudi Arabia
- South Korea
- Turkey

Basel III: That's what it meant to be…

In the late 1990s and early 2000s, "Basel III" was used to dub mainly the next frontier in transition from the IRB approach to a full-blown "internal models-type" approach under which banks might base regulatory capital calculations on their own credit *VaR* models, such as

- *CreditMetrics* (RiskMetrics Group, 1997)
- *CreditRisk*+ (CSFB, 1997)
- *CreditPortfolioView* (McKinsey, 1997)
- *Portfolio Manager* (KMV, 1991) etc.

However, banks in G-13 countries may choose to use internal models for calculating market risk capital (under IMA) since 1998 and for operational risk capital (under AMA) since 2005.

Basel III: That's what it meant to be...

Why internal models approach to market risk has not been extended also to credit risk in Basel II?

- Credit VaR models were new and lacked credible performance history
- Test run over at least one full credit cycle (10–15 years) required
- No robust backtesting methodology applicable to credit VaR models (credit risk reveals itself over a holding period of 1 year or longer)
- Chief bank supervisors often distrusted incentive-compatible regulation altogether

Basel III: That's what it meant to be…

„Many have associated Basel III with a move towards full credit models. In light of this crisis, where financial institutions clearly didn't have a handle on the modelling of correlations, especially in the mortgage markets, I don't think that we should go down that route."

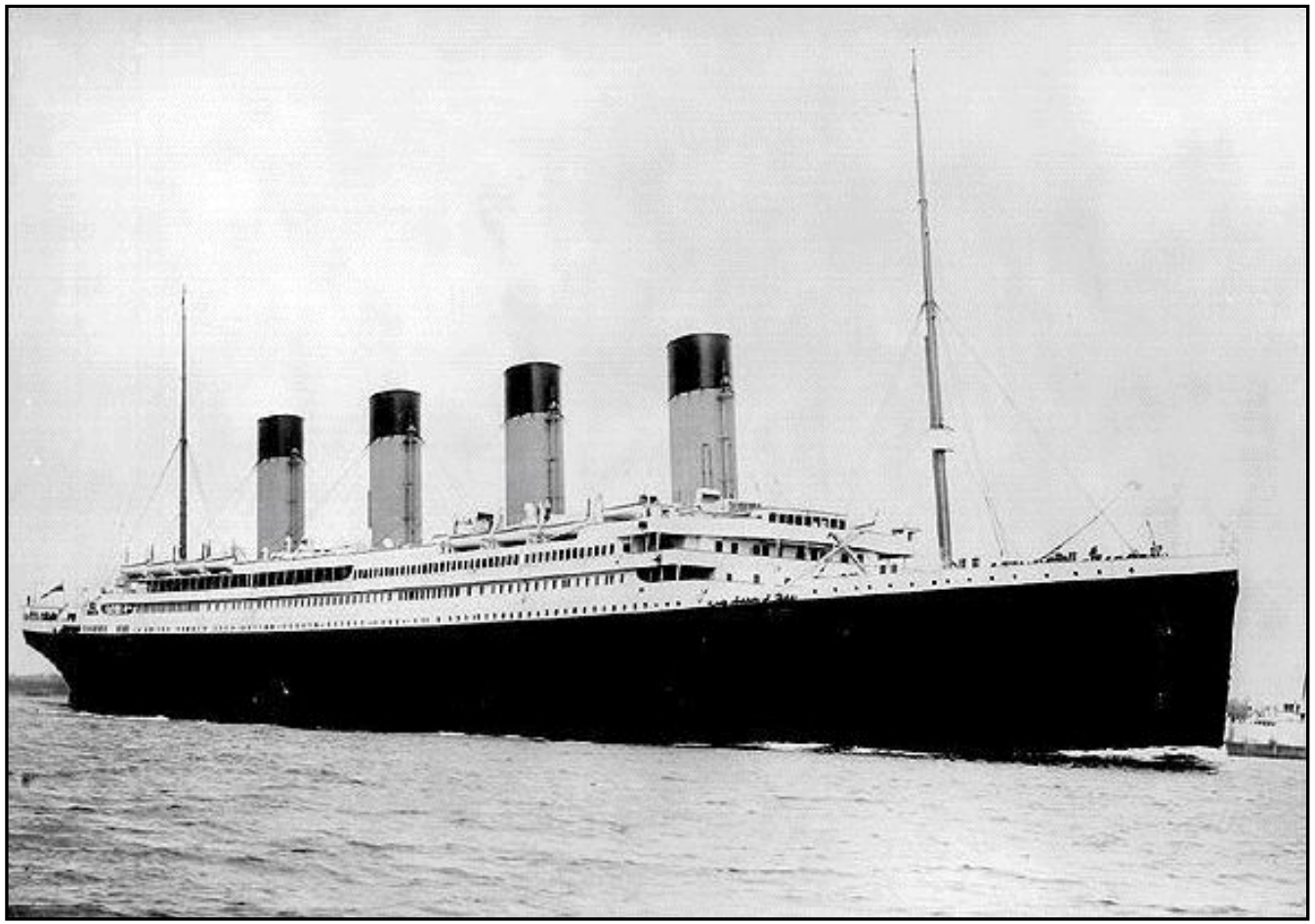
Stefan Walter
Secretary General of the Basel Committee on Banking Supervision

Source: Risk Magazine, June 17, 2009

Which route should we go down then???

Implications of Basel III treatment of market risk

Was her hull not THICK enough to parry an iceberg?!



Implications of Basel III treatment of market risk

Does an icebreaker guarantee safety of passengers against any plausible collision?

Implications of Basel III treatment of market risk

Must the ship stay afloat after *any* impact?

Basel III = Basel II+?

Basel III reform pack

Increased Tier I and total capital requirements

1. **Tier I Capital ³ 6%** of risk-weighted assets, with common equity and retained earnings ³ **4,5%**
2. **Capital conservation buffer = 2,5%** of risk-weighted assets
3. **Countercyclical capital buffer £ 2,5%** of risk-weighted assets (imposed at regulatory discretion as addition to capital conservation buffer)
4. **Tier I Capital / Total Assets** (Tier I leverage ratio) ³ **3%***

*Can be further revised

Amendments to treatment of credit and market risks

1. Increased capital charges for specific interest rate risk of (re)securitized assets
2. Uniform capital charge of **8%** for specific equity risk
3. **Stressed VaR** add-on under internal models approach: Same VaR model with 12-month period of financial stress as observation period
4. Capital requirements for incremental risk (default risk and rating migration risk) for trading book positions subject to specific interest rate risk capital charge

New minimum liquidity requirements

1. **Liquidity coverage ratio ≥ 100%**
   - § Stock of high quality liquid assets / net cash outflows over 30 days
   - § Liquidity buffer (mainly cash and government bonds) to survive a 30-day liquidity crunch
2. **Net stable funding ratio ≥ 100%**

§ Available amount of stable funding / Required amount of stable funding

§ Ensure stable funding in an extended firm-specific stress scenario over 1 year

Pillar 1

Pillar 2

Basel III implementation timeline

Basel II fixes and Basel III workout kick-off

Increased capital charges for specific interest rate risk of (re)securitized assets

Tier I capital ≥ 6% of risk-weighted assets, of which ≥ 4,5% must be common equity and retained earnings

Capital conservation buffer = = 2,5% of risk-weighted assets

Tier I capital to total assets (leverage ratio) ≥ 3%

Countercyclical capital buffer ≤ 2,5% of risk-weighted assets

2009 **2010** **2011** **2012** **2013** **2014** **2015** **2016** **2017** **2018** **2019** **…**

Basel III adopted by the Basel Committee

Amendment to internal models approach to include Stressed VaR add-on

Capital requirements for 'incremental' risk (default risk and rating migration risk) for trading book positions subject to specific interest rate risk capital charge

Liquidity coverage ratio ≥ 100%

Net Stable Funding Ratio ≥ 100%

Market risk treatment under Basel III

- Basel III capital enhancement:

$$MRC = \max\left(k_1 \cdot \frac{1}{60}\sum_{i=1}^{60} VaR_{t-i}, VaR_{t-1}\right) + \max\left(k_2 \frac{1}{60}\sum_{i=1}^{60} SVaR_{t-i}, SVaR_{t-1}\right)$$

- … subject to the following requirements:
  - Same VaR-model, confidence level and holding period are used, various techniques can be used to translate the 'normal' VaR-model into a 'stressed' model (e.g. 'antithetic' data, absolute instead of relative volatilities etc.)
  - Stressed VaR computed at least *weekly*
  - Multipliers k_1 and k_2 are set by national supervisors subject to an absolute minimum of 3
  - Backtesting of Stressed-VaR model not performed!
- Specific risk interest rate and equity risk should be captured by VaR model
- Default and migration risks need not be captured for positions subject to incremental risk capital charge
- Event risk beyond 99% confidence level and 10-day holding period need not be captured
- 'Incremental' risk (default & migration risk for positions with specific interest rate risk) must be captured

Industry Precursors of 'Stressed VaR'

Example: J. P. Morgan Chase's Risk Index

$$Economic\ Capital = K \cdot Risk\ Index$$

$$Risk\ \ Index = 50\% \cdot Multiplier \cdot VaR(1\ day,\ 99\%) + 50\% \cdot Stress\ Loss$$

- K = 2 for portfolio positions managed to an index
- K = 4 for other market risks
- Multiplier for each business is set based on long run historical ratio of stress test to VaR
- Stress loss is historical or prospective, based roughly on worst month in last 15 years
- Multiple stress scenarios: choose worst
- Stress scenario examples: 1987 stock market crash, 1998 debt market crisis
- Risk Index was about 1.2 annual standard deviations of revenue (varied by business)
- Motivated managers to focus on both stress loss and VaR
- Caveat: Assumed all stresses had equal probability

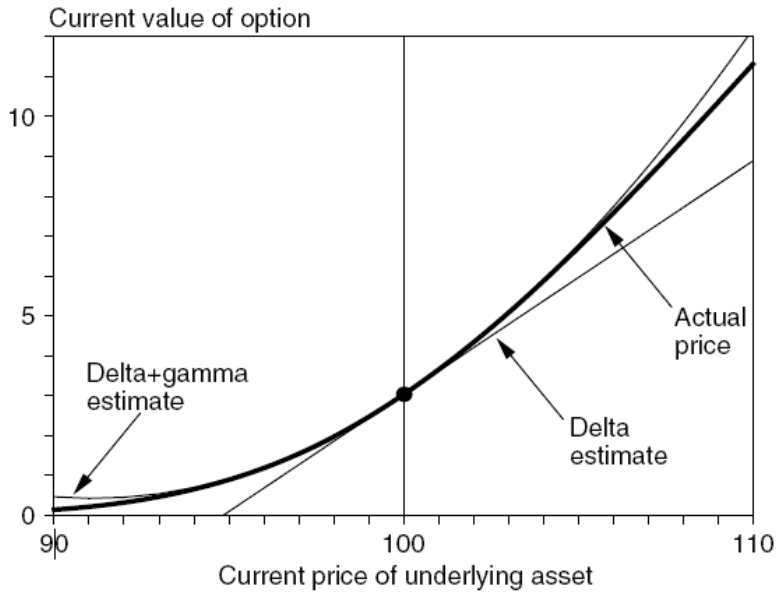
Source: Monet (2001)

Industry Precursors of 'Stressed VaR'

Example: Stressing VaR

- Covariance and simulation (Monte-Carlo) VaR-models
- Stressing volatilities
- Stressing correlations
- Stressing volatilities and correlation in various combinations

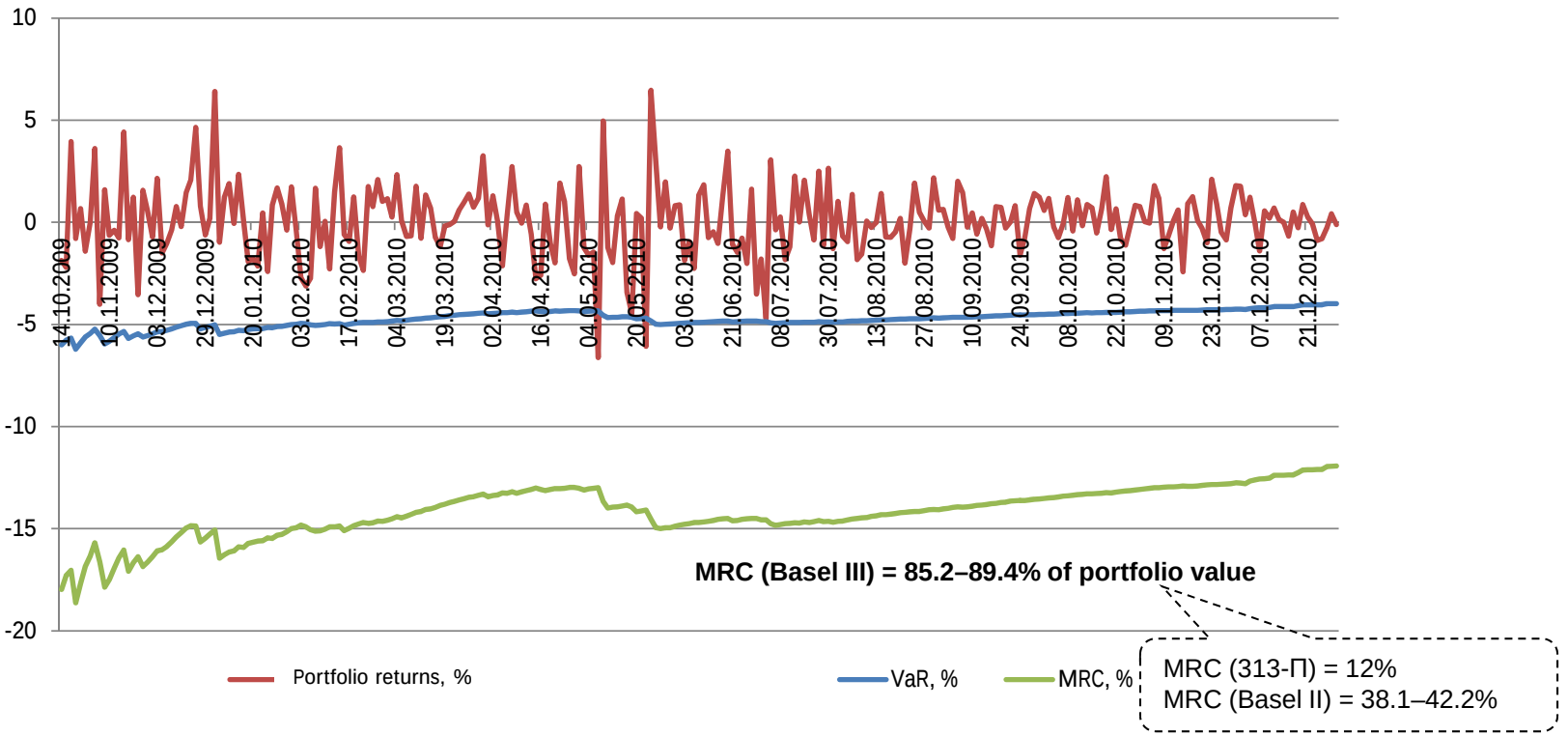
Is it correct to stress volatilities assuming constant deltas for non-linear positions?



Source: Best (2000)

Market risk treatment under Basel III

Market risk capital charge under Basel III for MICEX 10 index portfolio



- Weights of individual stocks in the portfolio are inverse proportional to their price as of Dec. 30, 2010
- VaR-model used: delta-normal and Monte-Carlo simulation, both with zero expected return, green zone (computed using Prognoz. Market Risk®)
- Stressed VaR calculated over a 12-month period of 2009

Source: Ivliev, Prognoz (2011)

Market risk treatment under Basel III

- **Key concerns:**
  - Both k_1 and k_2 are obviously NOT a long-run historical average ratio of stress-test results to average VaR (as per Monet 2001)
  - Restrictions on eligible model types: Marginal sensitivity-based models (e.g. delta-normal, delta-gamma, delta-gamma-vega) applied to non-linear positions are NOT suitable for calculating stressed VaR under large increments of risk factors)
  - Minimum value of 3 for k_2 seems arbitrary and is apparently NOT well-reasoned
  - Banks get incentives to select a period of financial stress with lower volatility for calculating 'stressed' VaR
  - Internal models method for calculating capital for equity risk in the banking book has NOT been changed:

$$MRC = \max \{VaR(99\%, (r\text{-}r_f), E \times k\},$$

r – quarterly returns on equity

r_f – long-term risk-free rate

A – exposure at risk

k – minimum risk weight (200% for publicly traded equity, 300% for other equity holdings)

Market risk treatment under Basel III

Agenda for future research:

- Develop a coherent and actionable methodology for stressing VaR-models
- Investigate market risk capital requirements rules for portfolios with various risk profile according to Basel III rules
- Investigate the relevancy of capital calculations for equity investments under the internal models method relative to the new trading book rules
- Verify Basel III market risk capital requirements using benchmarks from economic capital calculations (e.g. estimate the ‘true’ confidence level)
- …

QUESTIONS???