Financial regulation in the post-model world:
A case of market risk and high-frequency trading

Alexey Lobanov, Ph. D., FRM

Deputy Director

Banking Regulation Department

Bank of Russia

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The views and opinions expressed herein are those of the author and do not necessarily reflect the official position of the Bank of Russia nor the Trading Book Group of the Basel Committee on Banking Supervision

Outline

1. “Post-modelism”: setting the scene of the “ice age” of modeling?
2. Towards the “brave new world”: Should the freedom for modeling be restricted? Analysis of RWA for market risk by the Basel Committee
3. Emerging regulation of high-frequency trading
4. Q&A

Post-modelism: Setting the scene of the “ice age”

After the crisis, people tend to blame internal risk models that have allegedly FAILED to …

… Capture risk shifted onto the “tails” of the P&L distributions

… Anticipate spikes in correlations across different asset classes

… Predict jumps in liquidity premia

… Account for a “death spiral” of MTM losses from unwinding positions in OTC derivatives markets

… Measure the losses from value adjustment of OTC derivatives due to counterparty credit risk

… Gauge the credit quality of (re-)securitized asset-backed securities (e. g. CDO, CDO-squared)

… Incorporate systemic risk repercussions

… Prevent overreliance of firm management on quantitative models and model abuse!

Post-modelism: Setting the scene

Retracement from internal models: a crisis-driven reaction or a fundamental loss of faith?

"Although the Basel [Committee] does allow using the Expected Shortfall measure, it can be said that the publication of the "Fundamental Review of the Trading Book" has marked the end of the golden age of internal models for market risk that lasted since the mid-1990s."

Sergey Ivliev

Deputy Director, Prognoz

Source: Ivliev, S. et al. (2013), *Market risk management: Methodology, practice, recommendations.* – Moscow: Reglament-Media

«Несмотря на то, что Базелем предполагается возможность использования меры Expected Shortfall, можно считать, что с выходом «Фундаментального пересмотра торгового портфеля» закончилась эпоха расцвета внутренних моделей рыночного риска, продолжавшаяся с середины 90-х годов.»

Сергей Ивлиев

Заместитель генерального директора ЗАО «Прогноз»

Источник: Ивлиев С. В. и др. (2013)

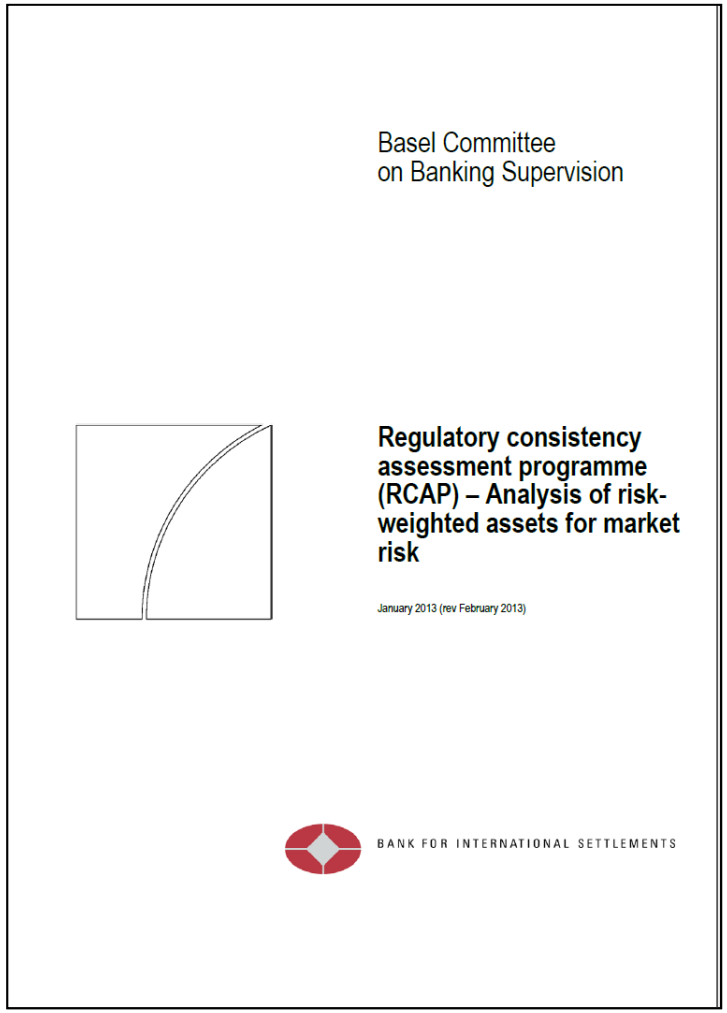
Post-modelism: Setting the scene

Policy issue 1

Do you think the “regulatory models” (e.g. IRB single-factor model) are more suitable for setting capital requirements than bank internal models?

- YES, as losses from credit risk per dollar of assets at IRB banks were lower than those from market risk at IMA banks
- NO, as losses from credit risk per dollar of assets at IRB banks were higher than those from market risk at IMA banks
- YES, as the IRB model was calibrated to full cycle data while internal market risk models were built on shorter data samples
- YES, as the IRB model was calibrated to 99.9% confidence level while internal market risk models were based on 99% confidence level
- NO, as losses from credit risk were mostly due to the failed external ratings used in the standardized approach
- UNABLE TO DETERMINE

Analysis of RWA for market risk



Regulatory consistency assessment programme – Analysis of risk-weighted assets for market risk

(Basel Committee on Banking Supervision, Jan. 2013)

1. Analysis from observed variation for mRWAs from public disclosures
   - ü Variation in mRWA across banks
   - ü Variation in mRWA over time
   - ü Disclosure of factors driving mRWA
   - ü Key contributing factors to mRWA variation
2. Hypothetical test portfolio exercise
   - ü Equity portfolios
   - ü Interest rate portfolios
   - ü FX and commodity portfolios
   - ü Credit spread portfolios
   - ü Diversified portfolios

G Full text available at:
http://www.bis.org/bcbs/publ/bcbs240.pdf

Analysis of RWA for market risk

Objectives

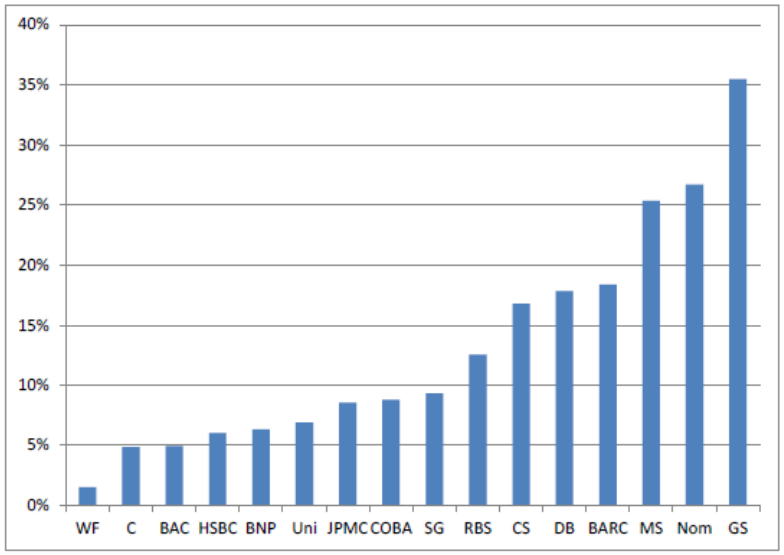
- ü Identify key drivers of variation in mRWA
- ü Optimal level of variation in mRWA not to be determined
- ü Consider possible policy decisions

Key inputs and assumptions

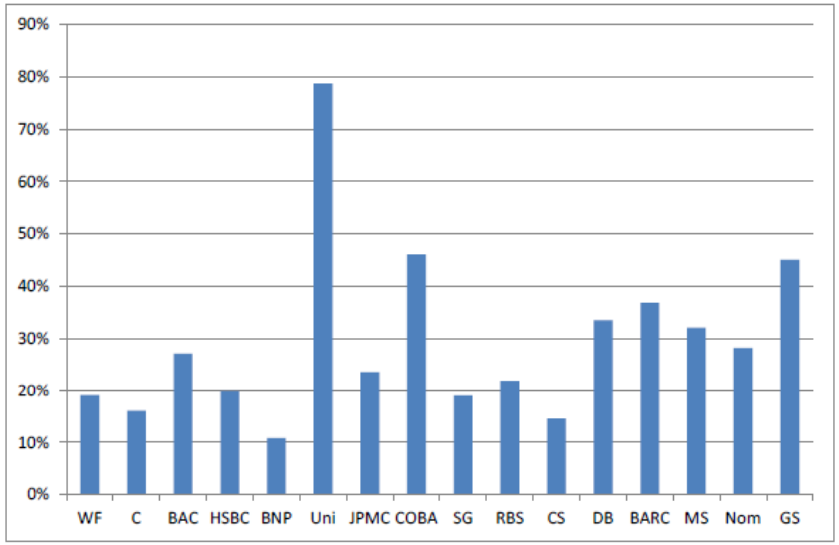
- § 16 global banks with significant trading activity (names not disclosed)
- § 9 banks reported results based on Basel 2.5 standards
- § Disclosures of real portfolio mRWA by some banks
- § Hypothetical portfolios of simple long and short positions designed by Basel Committee
- § Samples of banks used for analysis of disclosures and HPE partly overlap
- § Adjusted for differences in accounting standards

Analysis of RWA for market risk

Key findings from public disclosures



mRWA, % of total RWA (as of end-2011)



Average mRW, % of trading assets (as of end-2011)

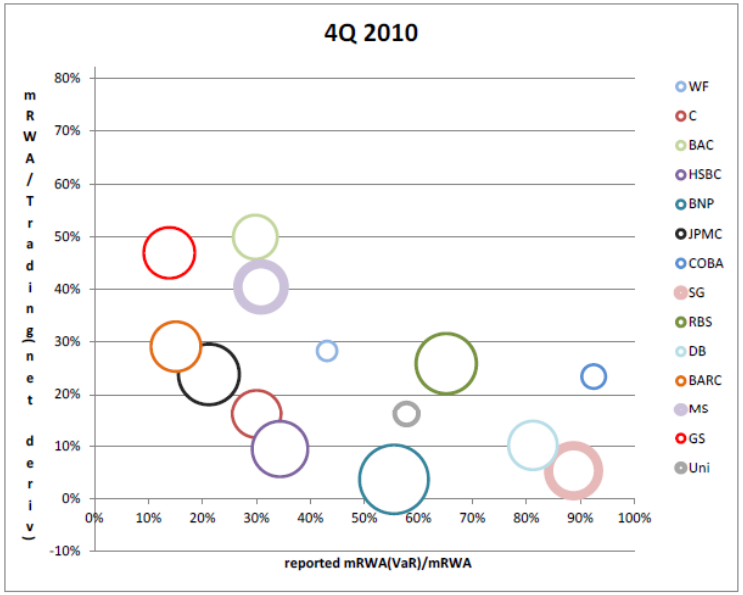
- Investment banks tend to have higher mRWA

- Average mRW varies: 10-80%, for most banks: 15-45%
- Variation in mRWA is attributable to different …
  - ü Business models?
  - ü Portfolio composition?
  - ü Market risk methodology?
  - ü Supervisory approaches?

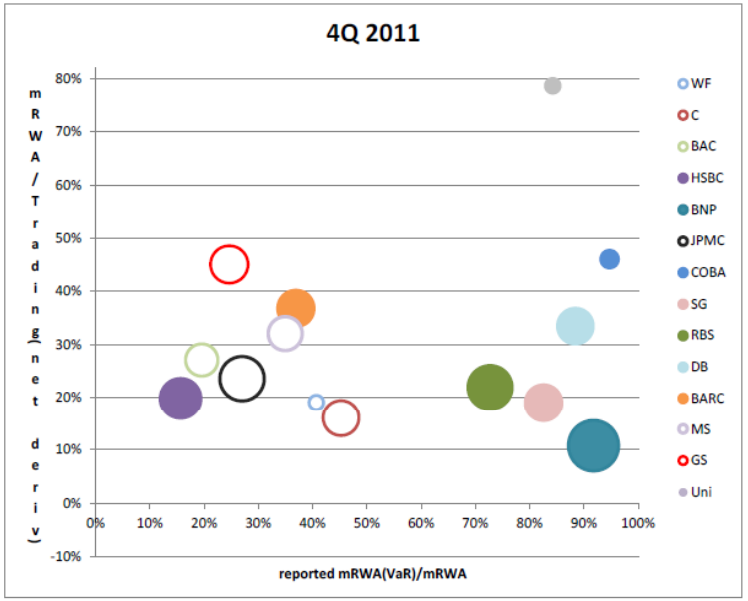
Source: Basel Committee on Banking Supervision (2013b)

Analysis of RWA for market risk

Key findings from public disclosures



Relationship between mRWA and reliance on internal models (as of end-2010)



Relationship between mRWA and reliance on internal models (as of end-2011)

§ Banks with same degree of reliance on internal models may have very different levels of mRWAs!

§ Basel 2.5 has increased market risk capital charges specifically for banks that use internal model approaches

Source: Basel Committee on Banking Supervision (2013b)

Analysis of RWA for market risk

Key findings from public disclosures: Drivers of variation in mRWA

1. Differences in business models?
   - § Weak relationship between the business model and the average mRW, with retail and universal banks on average reporting slightly lower mRWAs than investment banks
2. Differences in composition of trading assets?
   - § Low correlation between portfolio compositions and mRWA (insufficient public data)
3. Differences in market risk methodology?
   - § Inconsistent relationship between mRWA and reliance on internal models
4. Differences in modeling choices?
   - û Cannot be observed in public disclosures, HPE required
5. Differences in accounting requirement and practices?
   - û Not observed in public disclosures, can be adjusted in HPE

Source: Basel Committee on Banking Supervision (2013b)

Analysis of RWA for market risk

Hypothetical portfolio exercise

Objectives

- ü Provide an understanding of internal models based on simple products
- ü Investigate the contribution of modeling choices and supervisory approaches

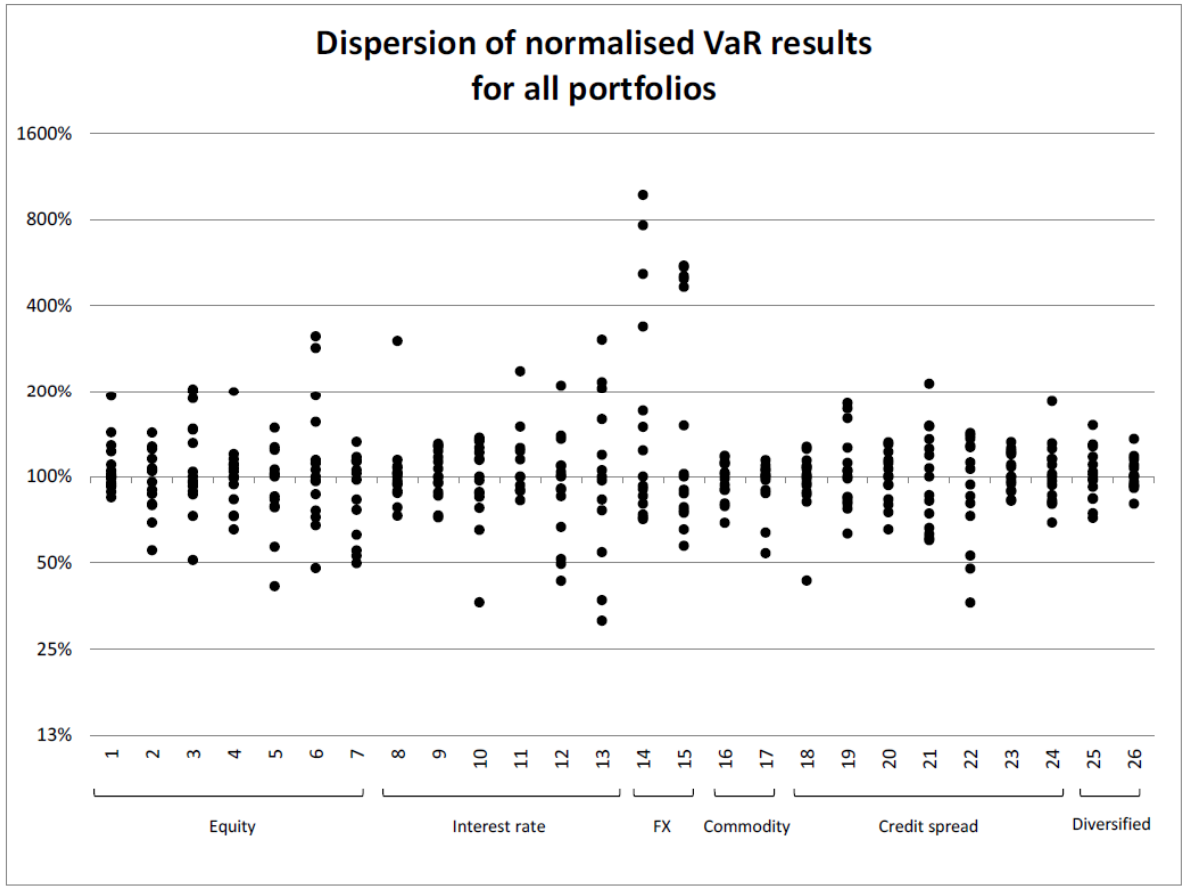
Key inputs and assumptions

- § 26 hypothetical portfolios
- § 5 major risk factors: equity, interest rate, FX, commodity, credit spread
- § Mostly simple vanilla products
- § Internal model risk metrics: VaR, Stressed VaR, IRC over 20 days
- § 15 banks, on-site visits to 9 banks

Source: Basel Committee on Banking Supervision (2013b)

Analysis of RWA for market risk

Key findings from HPE: VaR variability across hypothetical portfolios



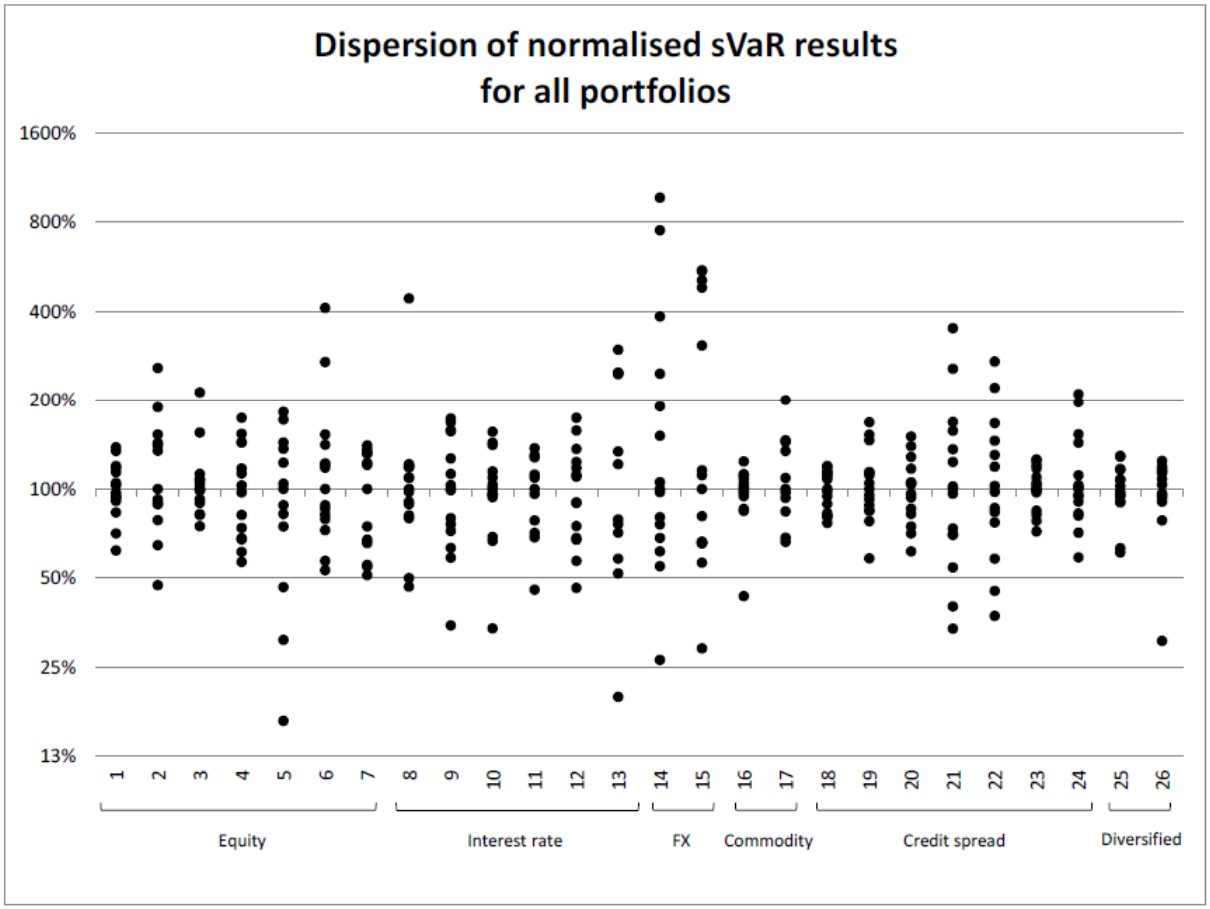
Conclusions

- Highest dispersion for FX portfolios followed by equity and credit spread
- Dispersion falls for diversified portfolios
- Integral impact of all key drivers
- Multiplier ranged from 3 to 5.5 (≈27% of total variation)

Source: Basel Committee on Banking Supervision (2013b)

Analysis of RWA for market risk

Key findings from HPE: Stressed VaR variability across hypothetical portfolios



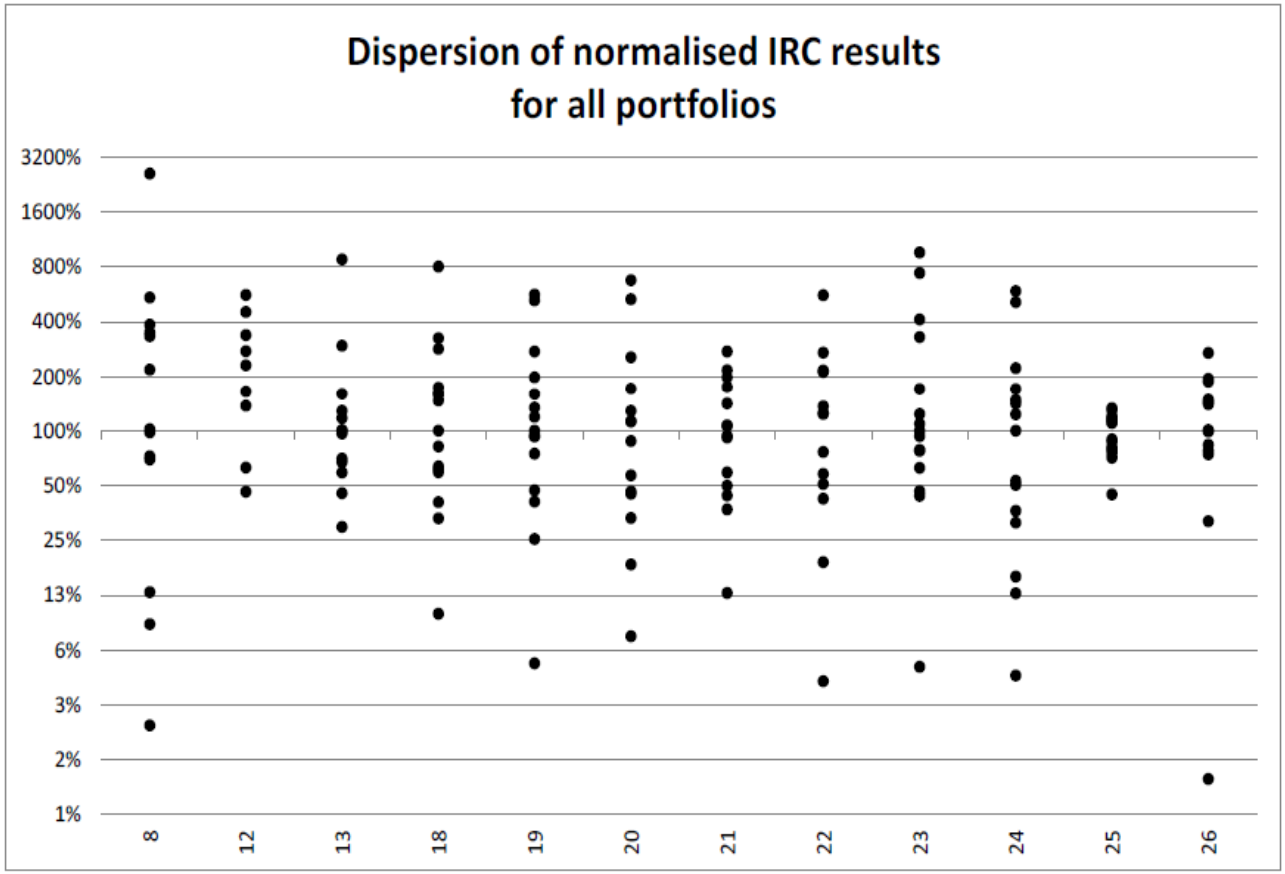
Conclusions

- Higher variation than inVaR results
- Highest dispersion for FX portfolios, equity and credit
- Dispersion falls for diversified portfolios
- Integral impact of all key drivers
- Multiplier ranged from 3 to 5.5 (≈27% of total variation)

Source: Basel Committee on Banking Supervision (2013b)

Analysis of RWA for market risk

Key findings from HPE: IRC variability across hypothetical portfolios



Conclusions

- Higher variation than in VaR and stressed VaR results
- Variability drivers:
  - Longer time horizon (1 year vs 10 days in (s)VaR)
  - Higher confidence level (99.9% vs 99% for s(VaR)
  - Less industry practice than for (s)VaR

Source: Basel Committee on Banking Supervision (2013b)

Analysis of RWA for market risk

Key findings from HPE: Sources of variability due to modeling choices

The impact of modelling choices on variability of the VaR model result

Low impact	Moderate impact	Strong impact
Modelling approach (historical simulation versus Monte Carlo)	Valuation approach (full revaluation or use of approximations)	Length of data period for calibration and the weighting scheme applied
Calibration methodology (use of absolute versus relative returns)	Risk factor granularity	Scaling approach to calculate 10-day measure / use of overlapping periods
Data updating frequency		Aggregation approach (aggregation across positions and aggregation of specific and general risk)
Calculation of VaR percentile		

The impact of modelling choices on variability of the sVaR model result

Low impact	Moderate impact	Strong impact
	Use of antithetic data	Scaling approach to calculate 10-day measure / use of overlapping periods
		Approach to choose stress period, and the resulting stress period calibration

Source: Basel Committee on Banking Supervision (2013b)

Conclusions

- Model type, data calibration, and sample updating frequency have low impact on VaR variability
- Lookback period, data weighting scheme, and time scaling have strong impact on VaR dispersion

Analysis of RWA for market risk

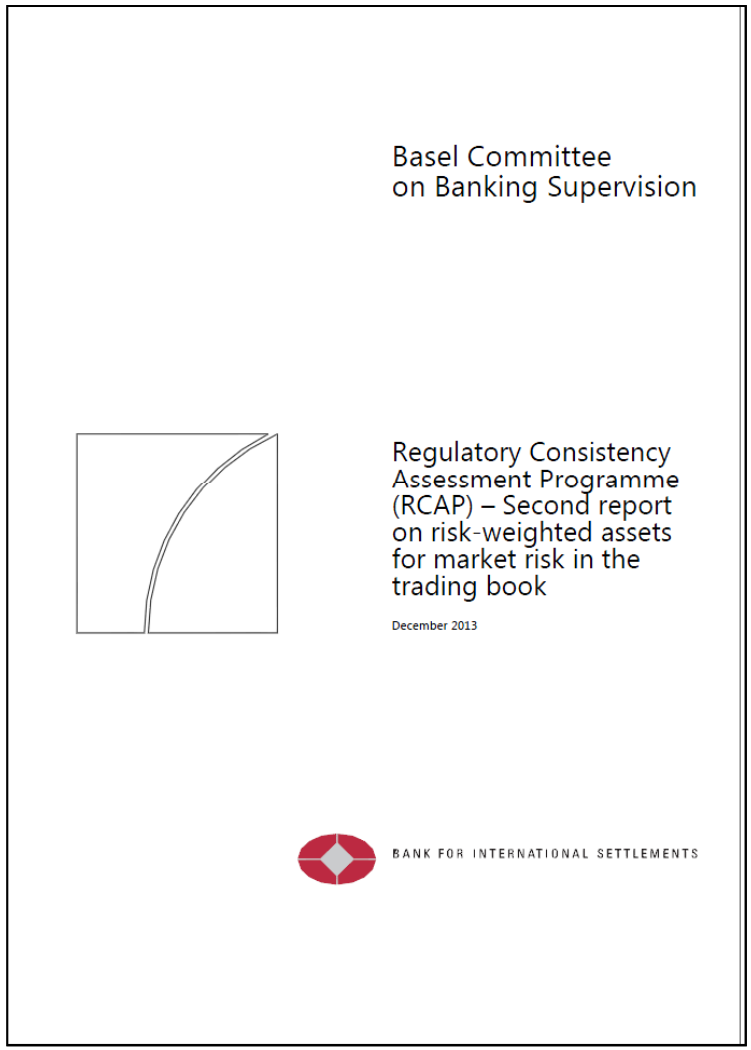
Key findings from HPE: Sources of variability due to modeling choices

The impact of modelling choices on variability of the IRC model result

Low impact	Moderate impact	Strong impact
Modelling approach for basis risk when included in the model	**Single factor vs multi-factor model approach**	**Calibration of the transition matrix**
	Inclusion of basis risk in the model	**Correlations among obligors**
	Liquidity horizon assumptions	**Model approach (spread models vs transition matrix based model)**
	Recovery rate assumptions	
	Calculation of profit / loss on migration events	

Source: Basel Committee on Banking Supervision (2013b)

Analysis of RWA for market risk



Regulatory consistency assessment programme – 2nd report on risk-weighted assets for market risk in the trading book

(Basel Committee on Banking Supervision, Dec. 2013)

Hypothetical test portfolio exercise:

- Re-run of some portfolios from Phase 1
- More complex portfolios including
  - Equity
  - Interest rate
  - FX and commodity
  - Credit spread
- Correlation trading portfolios (CTP)

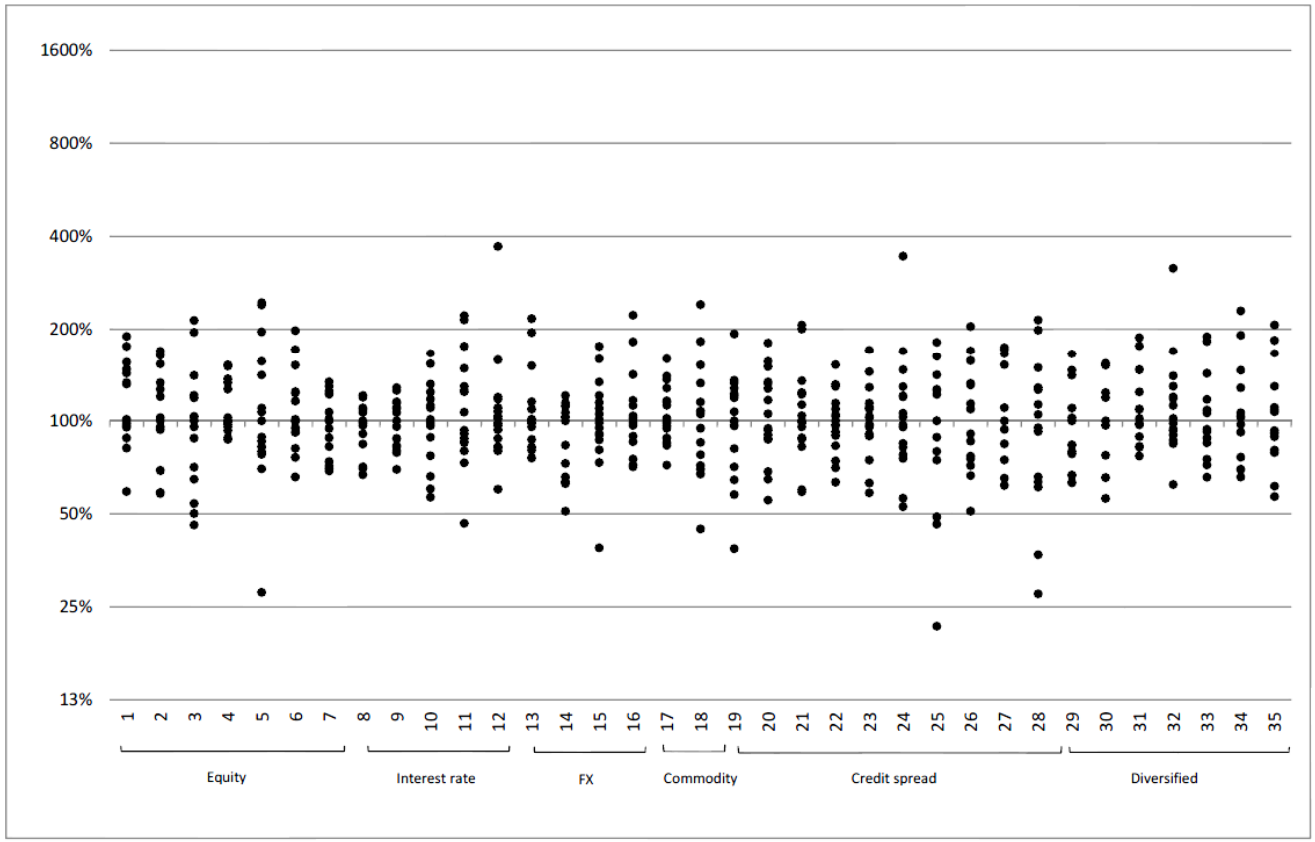
17 banks from 9 countries, on-site visits to 9 banks

Full text available at:
http://www.bis.org/bcbs/publ/bcbs267.pdf

Analysis of RWA for market risk

Key findings from HPE: VaR variability across hypothetical portfolios

Panel A - Dispersion of normalised VaR results for all portfolios



Source: Basel Committee on Banking Supervision (2013c)

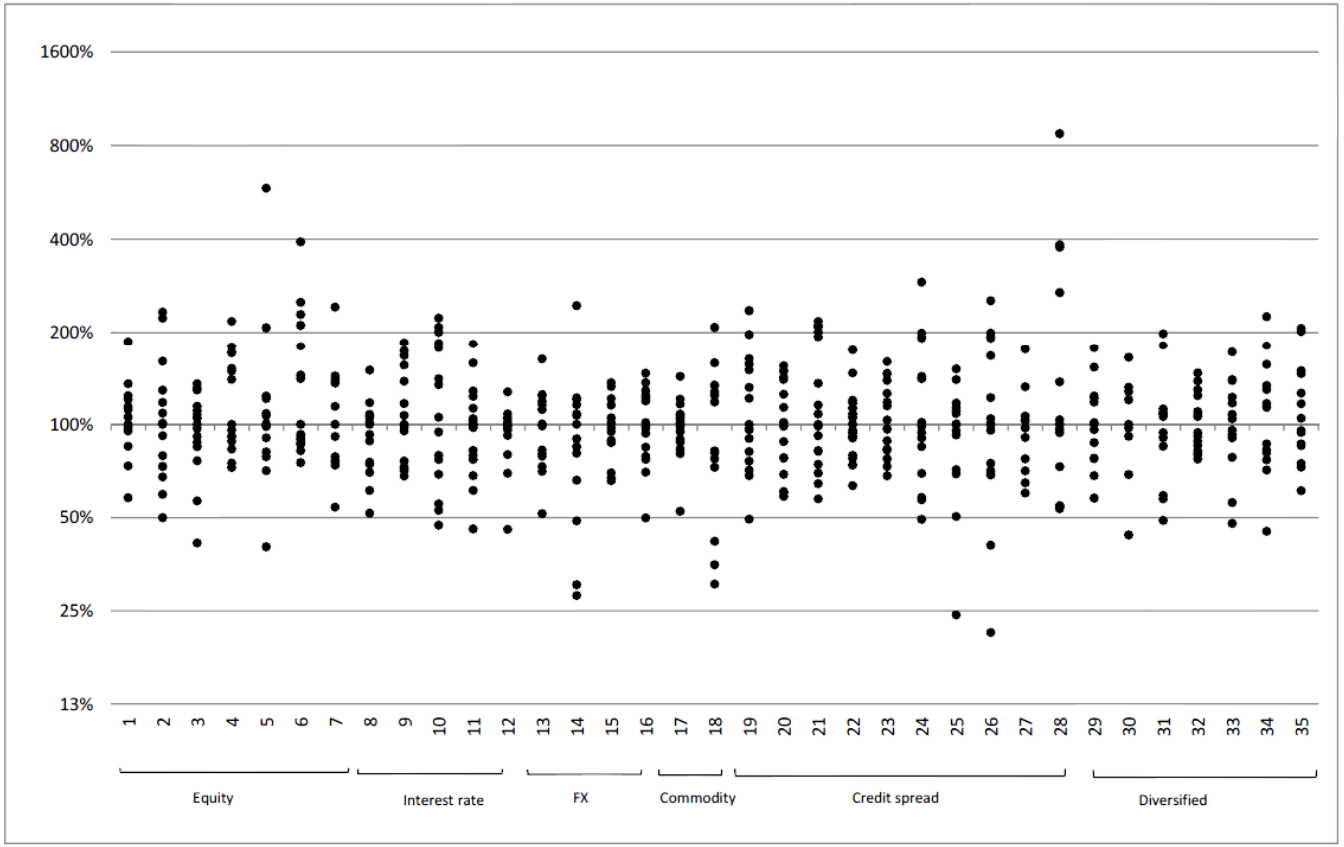
Conclusions

- Variability of VaR models similar to that in Phase 1 for re-run portfolios
- Variablity of VaR for diversified portfolios slightly lower than for single-factor portfolios
- Contribution of supervisory multipliers to variation in mRWA decreased due to lower range of multipliers in 2013 relative to 2012

Analysis of RWA for market risk

Key findings from HPE: Stressed VaR variability across hypothetical portfolios

Panel B - Dispersion of normalised SVaR results for all portfolios



Source: Basel Committee on Banking Supervision (2013c)

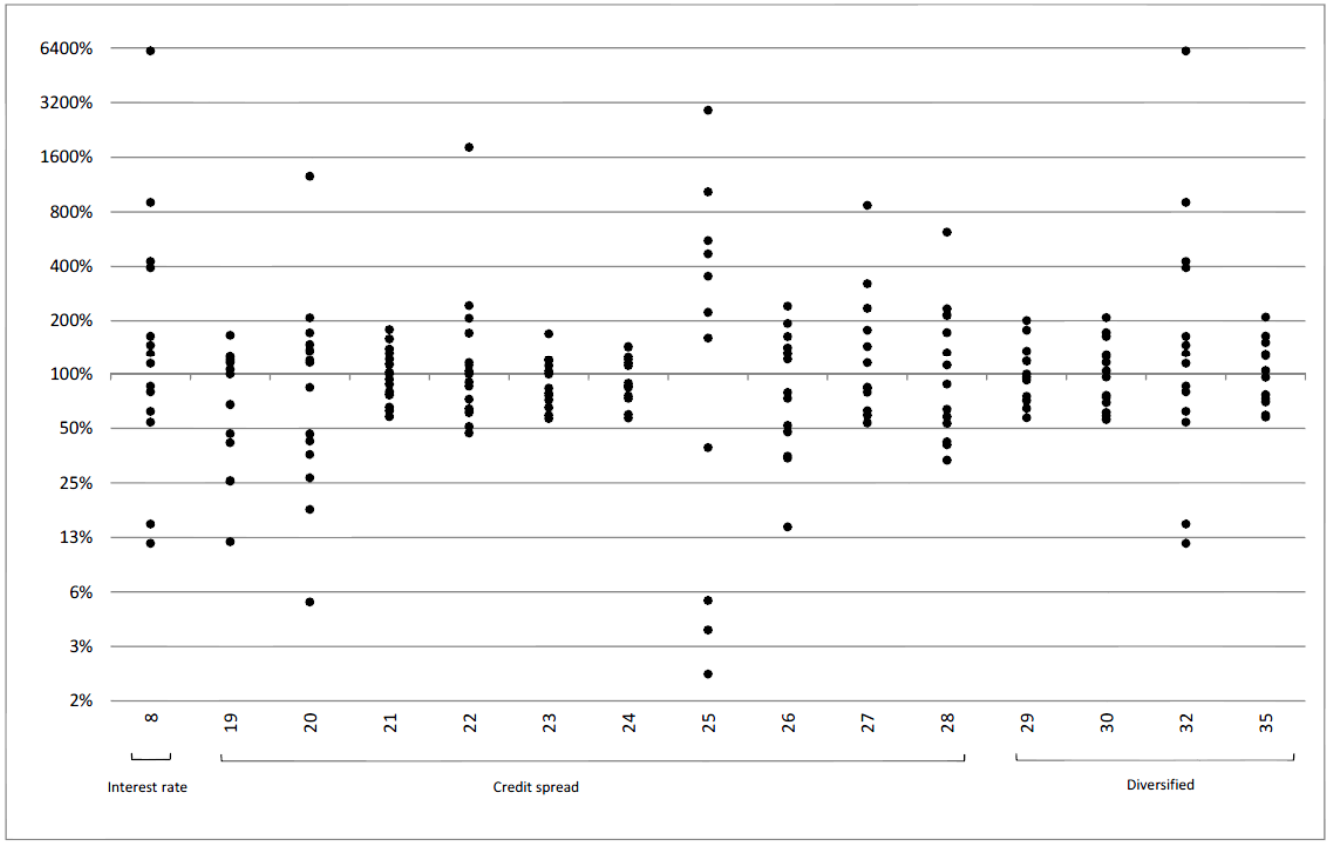
Conclusions

- Variability of stressed VaR models similar to that in Phase 1 for re-run portfolios
- Variablity of sVaR for diversified portfolios slightly lower than for single-factor portfolios
- Contribution of supervisory multipliers to variation in mRWA decreased due to lower range of multipliers in 2013 relative to 2012

Analysis of RWA for market risk

Key findings from HPE: IRC variability across hypothetical portfolios

Panel C - Dispersion of normalised IRC results for all portfolios



Source: Basel Committee on Banking Supervision (2013c)

Conclusions

- Variation in IRC decreased relative to Phase 1 due to more mature models and Basel 2.5 implementation
- Larger outliers for interest-rate and credit-spread portfolios compared to Phase 1
- Lower range of supervisory multipliers in 2013 relative to 2012

Analysis of RWA for market risk

Key findings: Sources of variability due to modeling choices

Model type	Low significance	Moderate significance	Strong significance
VaR	Calibration methodology (use of absolute versus relative returns)	**Valuation approach (full revaluation or use of approximations)[1]**	**Length of data period for calibration (taking into account weighting scheme)**
		Risk factor granularity	**Aggregation approach (across specific and general risk)**
		Approach to 10-day measure: square root of time vs 10-day overlapping returns[2]	
sVaR		**Calibration of stress period and resulting stressed period used for risk metric**	
		Approach to 10-day measure: square root of time vs 10-day overlapping returns[1]	
		Use of antithetic data	
IRC	**Single vs multi-factor model[3]**	**Liquidity horizon assumptions**	**Correlation among obligors**
	Number of simulations[3]	**Calibration of transition matrix (internal/external)**	**PD for obligors**
		Calculation of P&L on migration events (full versus partial repricing)	**Modelling approach – spread models vs transition matrix**
		Sovereign risk modelling	

Source: Basel Committee on Banking Supervision (2013c)

Analysis of RWA for market risk

Key findings: Sources of variability due to modeling choices in Phase 1 not identified in Phase 2

VaR	IRC
Modelling approach (historical simulation vs Monte Carlo) – low impact in Phase 1	Recovery rate assumptions –moderate impact in Phase 1
Calculation of VaR percentile – low impact in Phase 1[1]	Inclusion of basis risk in the model –moderate impact in Phase 1

Source: Basel Committee on Banking Supervision (2013c)

Properties of regulation

In the ideal world, the regulation of risk-taking activities should be …

- Neutral (ensure a fair compensation for risk) or stimulating (provide incentives for a desirable behavior of market players)
- Fair (not create undeserved competitive advantages for some market players)
- Simple (be possible to implement by all or most market players)
- Sensitive to risk (differentiate regulatory action commensurate with risk taken)
- Uniform (enable a regulator and the market to compare the impact)
- Efficient (be possible to administer)

What about the real world???

Analysis of RWA for market risk

Policy issue 2

Do you think variability in the outcomes in market risk models should be restricted?

- YES, because it is excessive (given the objective differences in business models and risk appetite)
- NO, because it will reduce the flexibility of risk measurement, disable the model use test, and induce high correlation between bank capital adequacy levels and pro-cyclical behavior
- UNABLE TO SAY, as the socially optimal level of variation is not known

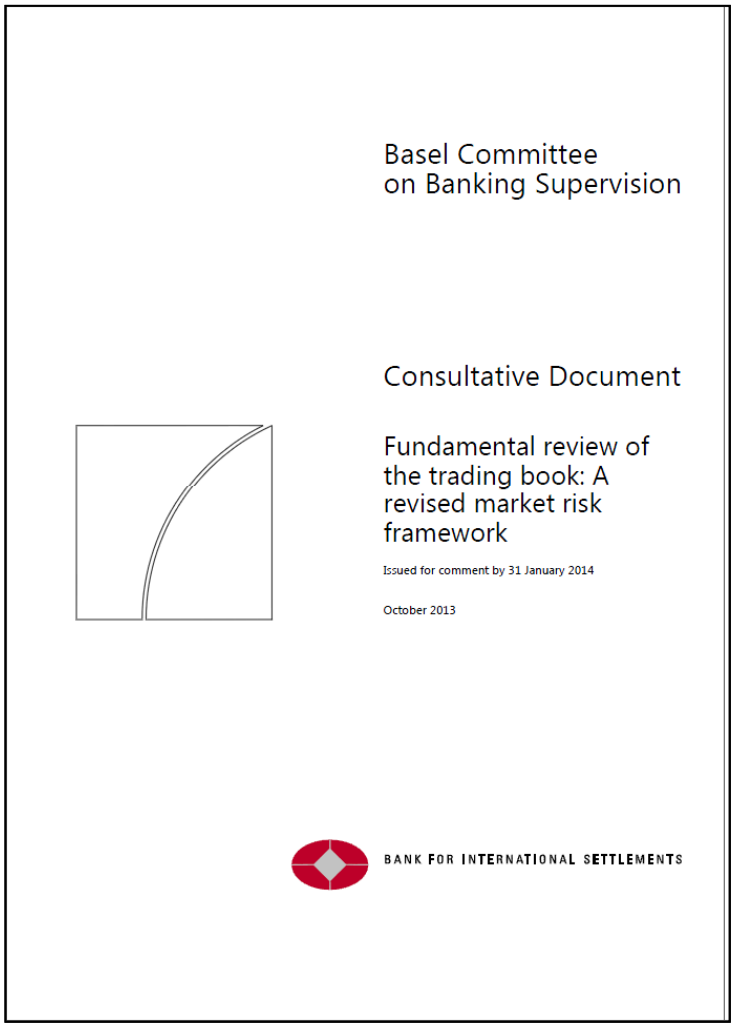
Analysis of RWA for market risk

Policy issue 3

If the variability in the outcomes in market risk models should be restricted, what is the best way to achieve it?

- ENHANCE PUBLIC DISCLOSURE REQUIREMENTS?
  - Common frequency of reporting
  - Common standards for explanations of the drivers of mRWAs variation over time
  - More granular and consistent segmentation of mRWAs components
  - Disclosure of key modeling choices (driving the greatest variation in the results of models)
  - Disclosure of differences in models used for internal purposes and those for mRWA calculation
- NARROW DOWN MODELING CHOICES FOR BANKS?
  - Less flexibility in choosing the length of historical data to calibrate VaR models
  - A single scaling approach to obtain a 10-day VaR and sVaR measures
  - A specified approach for modeling the IRC, including the assumptions used for migration and default probabilities and the correlation structure
- HARMONIZE SUPERVISORY PRACTICES, e.g. capital multipliers?

Fundamental review of the trading book



Fundamental review of the trading book: A revised market risk framework

(Basel Committee on Banking Supervision, Oct. 2013)

I. Shortcomings of the present market risk framework
II. Reassessment of the boundary
III. Relationship between standardized and internal models approaches
IV. Choice of risk metric and stress calibration
V. Factoring in market liquidity
VI. Treatment of hedging and diversification
VII. Revised internal models approach
VIII. Revised standardized approach

- Full text available at: http://www.bis.org/bcbs/publ/bcbs265.pdf
- Published for comments till January 31, 2014

Fundamental review of the trading book

Identifying eligible trading desks (Basel Committee 2013a)

- "*For the purposes of market risk capital calculations, a trading desk will be defined as a group of traders or trading accounts that implements a well-defined business strategy operating within a clear risk management structure.*
- *The structure of trading desks will be defined by the individual bank, but will be subject to supervisory approval.*"
- Key attributes of a trading desk:
  - Unambiguously defined group of traders or trading accounts with a clear reporting line to senior management and a compensation policy linked to its pre-established objectives
  - Well-defined business strategy, including an annual budget and regular management information reports
  - Clear and formal risk management structure, including trading limits and regular risk management reporting processes

Is high-frequency trading (HFT) a trading desk?

Fundamental review of the trading book

Example of a trading desk structure at a large financial firm (Basel Committee 2012, p. 33)

Equity

- Domestic cash equity
- Domestic equity derivatives
- Quantitative equity strategies
- Foreign equities
- Emerging market equities

Fixed income/currency

- Domestic interest rate & derivatives
- International interest rate & derivatives
- Spot FX
- FX derivatives
- Domestic structured products
- Global structured products
- Distressed debt
- High grade credit
- High yield credit
- Syndicated loans

Commodity

- Commodities – agricultural
- Commodities – energy
- Commodities – metals

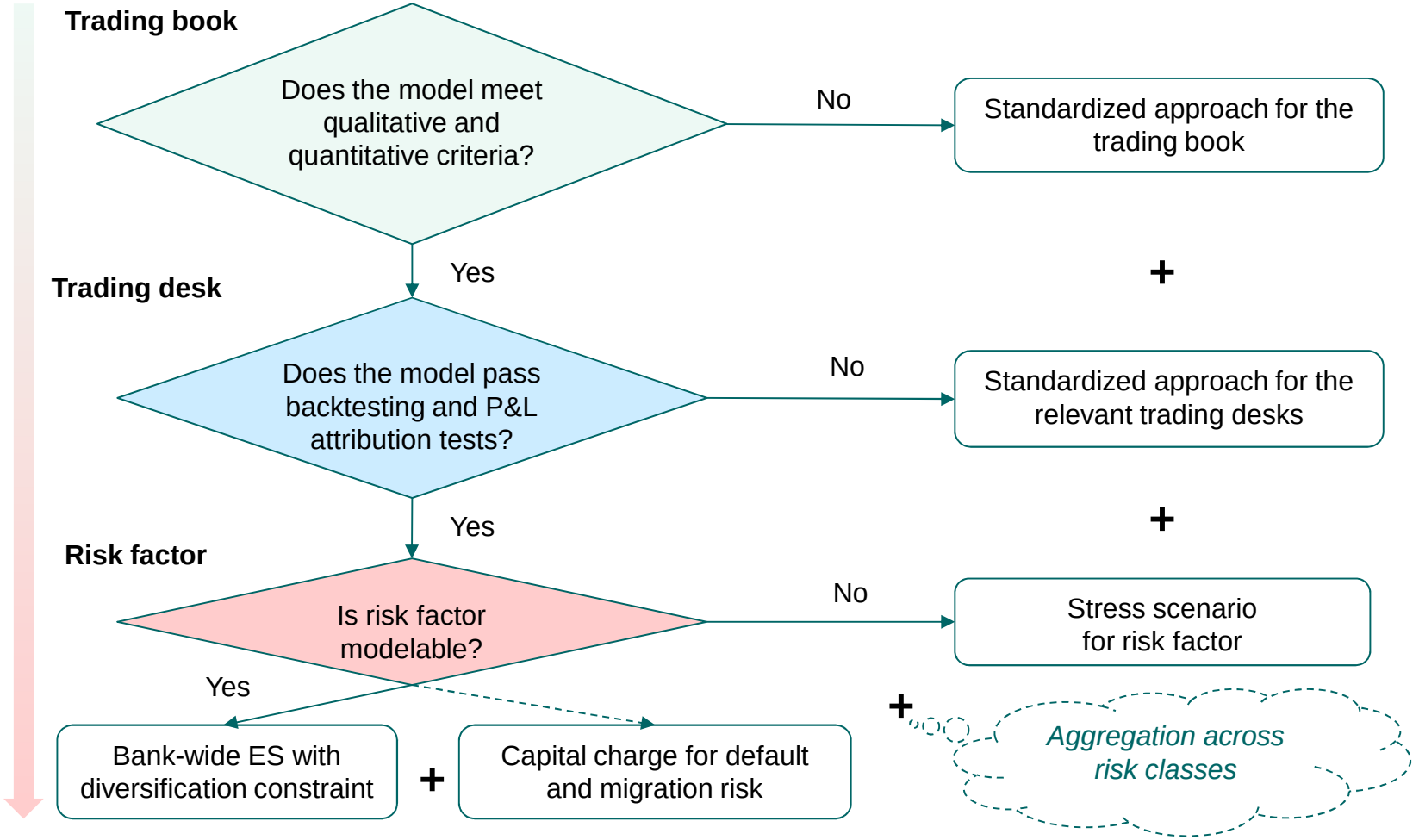
Multi-asset trading units

- Special opportunities
- Strategic capital
- Quantitative strategies ?

Fundamental review of the trading book

Determining eligibility of trading desks for the internal models-based approach

(Basel Committee on Banking Supervision 2013, p. 24)



Regulation of high-frequency trading

Changes in financial markets caused by HFT

Benefits

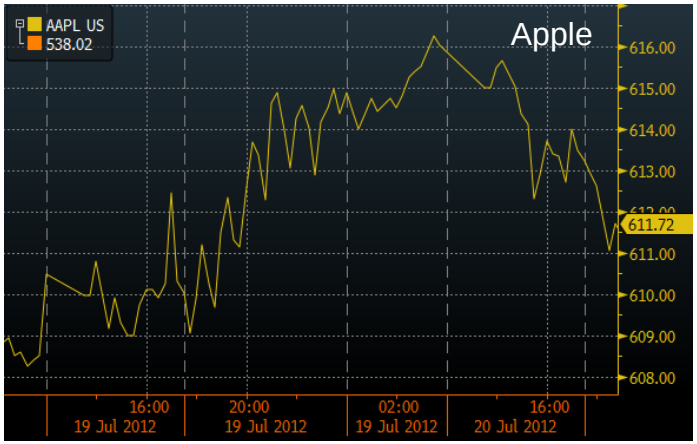
- Increased speed of generating, routing, and executing orders
  - Joint venture of Chicago Mercantile Exchange and NASDAQ: transmitting messages by microwaves with an edge of 4 milliseconds compared to ground cable! (Linton, O'Hara, and Zigrand 2013)
- Lower transaction costs (i.e. smaller spreads, deeper order books)
- More accurate price discovery
- Less inter-market arbitrage opportunities

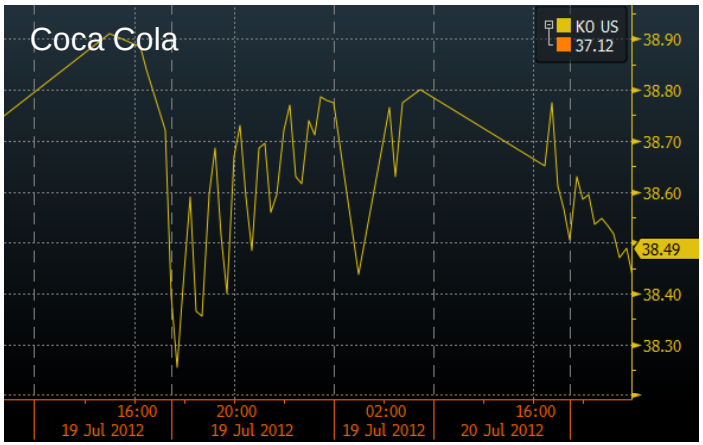
Costs

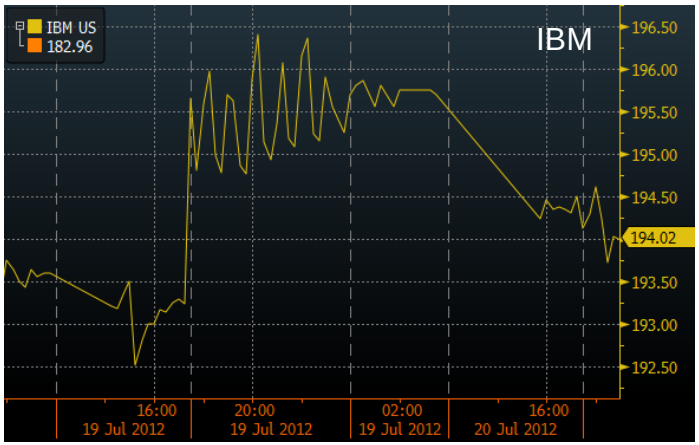
- Patterns of anomalous price behavior driven by HFT traders
- "Flash crashes" as new types of market instability
- Increased linkages between different markets

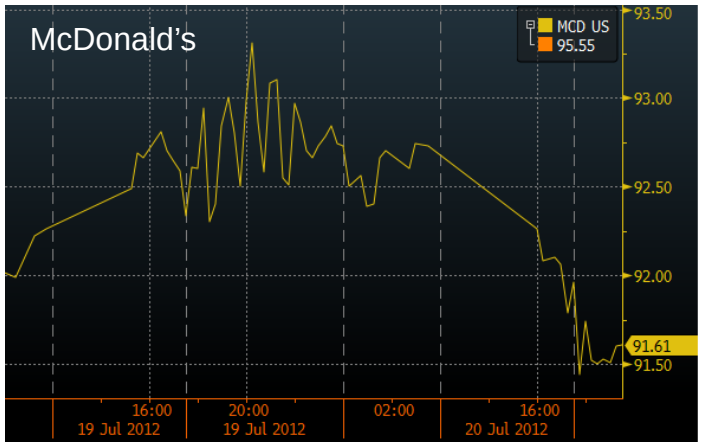
Regulation of high-frequency trading

Example of anomalous stock price behavior (U.S., July 19, 2012)









Source: Linton, O'Hara, and Zigrand (2013), Bloomberg

Regulation of high-frequency trading

Regulatory approaches

- **USA (CFTC & SEC, USA)**
  - Rules for halting the markets: single-stock (limit-up / limit-down) and market-wide "circuit breakers"
  - Increased data collection, trade analytics, and market surveillance (MIDAS, CAT)
  - Changes in trade priority rules
- **European Union**
  - Annual reporting of algorithmic trading strategies, details of trading parameters and limits, compliance and risk controls, and HFT system testing details (MiFiD II)
  - Market-maker obligations (MiFiD II)
  - Minimum order resting time
  - Financial transaction tax of 0,1% of the notional value

Regulation of high-frequency trading

Regulatory approaches

- **Individual markets**
  - Minimum tick size (USA, Australia, France, Italy)
  - Liquidity maker-taker pricing (including time-varying) (USA)
  - Minimum order resting time (e. g. 500 milliseconds)
  - Maximum order-to-execution ratio (UK, Italy)
  - Financial transaction tax (UK, France, Italy)
- **Germany (Hochfrequenzhandelsgesetz, 15 May, 2013)**
  - Licensing requirement for HFT firms (both domestic and international)
  - Minimum capital adequacy requirements for HFT firms
  - Standardized minimum tick size

Regulation of high-frequency trading

Policy issue 4

Given the properties of ideal regulation, should HFT be curtailed as undesirable activity?

- YES, because it will reduce excess price volatility and the risk of market bubbles
- YES, because it will limit unproductive financial activity
- YES, because other regulations do not exist or difficult to administer
- NO, because it will increase transaction costs and reduce market liquidity
- UNABLE TO DETERMINE
- WE'LL SEE …

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QUESTIONS???