Post-GFC Regulatory Reforms – Selected Topics

QF622 Credit Risk Models

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The Aftermath of GFC

London G20 Summit, April 2009

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Regulatory Capital & Complementary Measures

Basel Committee on Banking Supervision reforms – Basel III

Source: www.bis.org

Strengthens microprudential regulation and supervision, and adds a macroprudential overlay that includes capital buffers

Capital

Pillar 1

Capital

Quality and level of capital

- **Raising minimum common equity** to 4.5% of risk-weighted assets, after deductions.
- **A capital conservation buffer** comprising common equity of 2.5% of risk-weighted assets brings the total common equity standard to 7%. Constraints on a bank's discretionary distributions will be imposed when it falls into the buffer range.
- **A countercyclical buffer** within a range of 0–2.5% comprising common equity will apply when credit growth is judged to result in an unacceptable build-up of systematic risk.

Capital loss absorption at the point of non-viability
Allowing capital instruments to be written off or converted to common shares if the bank is judged to be non-viable. This will reduce moral hazard by increasing the private sector's contribution to resolving future banking crises.

Risk coverage

Revisions to the standardised approaches for calculating

- **credit risk;**
- **market risk;**
- **credit valuation adjustment risk;** and
- **operational risk**

mean greater risk-sensitivity and comparability.

Constraints on using internal models aim to reduce unwarranted variability in banks' calculations of risk-weighted assets.

Counterparty credit risk
More stringent requirements for measuring exposure; capital incentives to use central counterparties for derivatives; a new standardised approach; and higher capital for inter-financial sector exposures.

Securitisations
Reducing reliance on external ratings, simplifying and limiting the number of approaches for calculating capital charges and increasing requirements for riskier exposures.

Capital requirements for exposures to central counterparties (CCPs) and equity investments in funds to ensure adequate capitalisation and support a resilient financial system.

A **revised output floor**, based on Basel III standardised approaches, limits the regulatory capital benefits that a bank using internal models can derive relative to the standardised approaches.

Containing leverage

A non-risk-based **leverage ratio** including off-balance sheet exposures is meant to serve as a backstop to the risk-based capital requirement. It also helps contain system-wide build-up of leverage.

Pillar 2

Risk management and supervision

Supplemental Pillar 2 requirements address firm-wide governance and risk management, including the risk of off-balance sheet exposures and securitisation activities, sound compensation practices, valuation practices, stress testing, corporate governance and supervisory colleges.

Interest rate risk in the banking book (IRRBB)
Extensive guidance on expectations for a bank's IRRBB management process: enhanced disclosure requirements; stricter threshold for identifying outlier banks; updated standardised approach.

Pillar 3

Market discipline

Revised Pillar 3 disclosure requirements

Consolidated and enhanced framework, covering all the reforms to the Basel framework. Introduces a dashboard of banks' key prudential metrics.

Liquidity

Global liquidity standards and supervisory monitoring

The **Liquidity Coverage Ratio** (LCR) requires banks to have sufficient high-quality liquid assets to withstand a 30-day stressed funding scenario that is specified by supervisors.

The longer-term, structural **Net Stable Funding Ratio** (NSFR) is designed to address liquidity mismatches. It covers the entire balance sheet and provides incentives for banks to use stable sources of funding.

The Committee's 2008 guidance ***Principles for Sound Liquidity Risk Management and Supervision*** takes account of lessons learned during the crisis. It is based on a fundamental review of sound practices for managing liquidity risk in banking organisations.

Supervisory monitoring
The liquidity framework includes a common set of intraday and longer-term monitoring metrics to assist supervisors in identifying and analysing liquidity risk trends at both the bank and system-wide level.

Large exposures

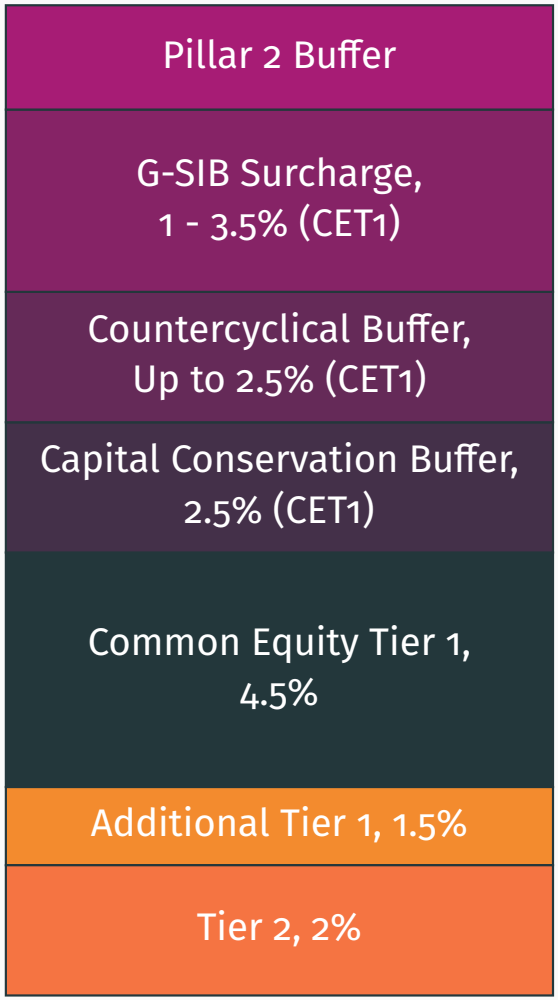
Large exposures regime established to mitigate systemic risks arising from interlinkages across financial institutions and concentrated exposures.

All Banks

SIBs

The Committee identifies global systemically important banks (G-SIBs) using a methodology that includes both quantitative indicators and qualitative elements. In addition to meeting the Basel III risk-based capital and leverage ratio requirements, G-SIBs must have higher loss absorbency capacity to reflect the greater risks that they pose to the financial system. The Committee also developed principles on the assessment methodology and the higher loss absorbency requirement for domestic systemically important banks (D-SIBs).

Capital ratio



$$\text{CAR} = \frac{\text{Qualified Capital}}{\text{RWA}}$$

Risk types

Risk weighted asset (RWA) is made up of components corresponding to:

- Credit risk, including CCR.
- Market risk, including CVA risk.
- Operational risk.

Market risk capital – Basel 2.5

Market risk IMA under Basel 2

- VaR for general risk and specific risk.

Market risk IMA under Basel 2.5 (2009)

- VaR for general risk and specific risk.
- Stressed VaR (SVaR) calibrated to one year of stress (a countercyclical measure).
- Incremental risk charge (IRC) to capture traded credit risk, including migration and default risk.
- Comprehensive risk measure (CRM) to capture the risk of correlation trading portfolio.

CCR IMM – Basel 3 (I)

Stress EEPE

- CCR capital charge is based on the max of EEPE using current market data and EEPE using a stress calibration.
- The stress calibration should be a single consistent stress calibration for the whole portfolio of counterparties.

Wrong-way risk

- To identify, monitor and control cases of SWWR.
- Trades with SWWR should be taken out of the netting set and be capitalised on its own assuming zero recovery.

CCR IMM – Basel 3 (II)

MPoR

- For daily margined netting sets, MPoR cannot be lower than 10 business days for bilateral derivative portfolios.
- Increased MPoR for large netting sets, netting sets with illiquid collateral or trades hard to replace, and netting sets subject to persistent and long margin disputes.

Market risk capital – CVA

CVA risk under Basel 2

- Not capitalised.

CVA risk under Basel 3 since 2011

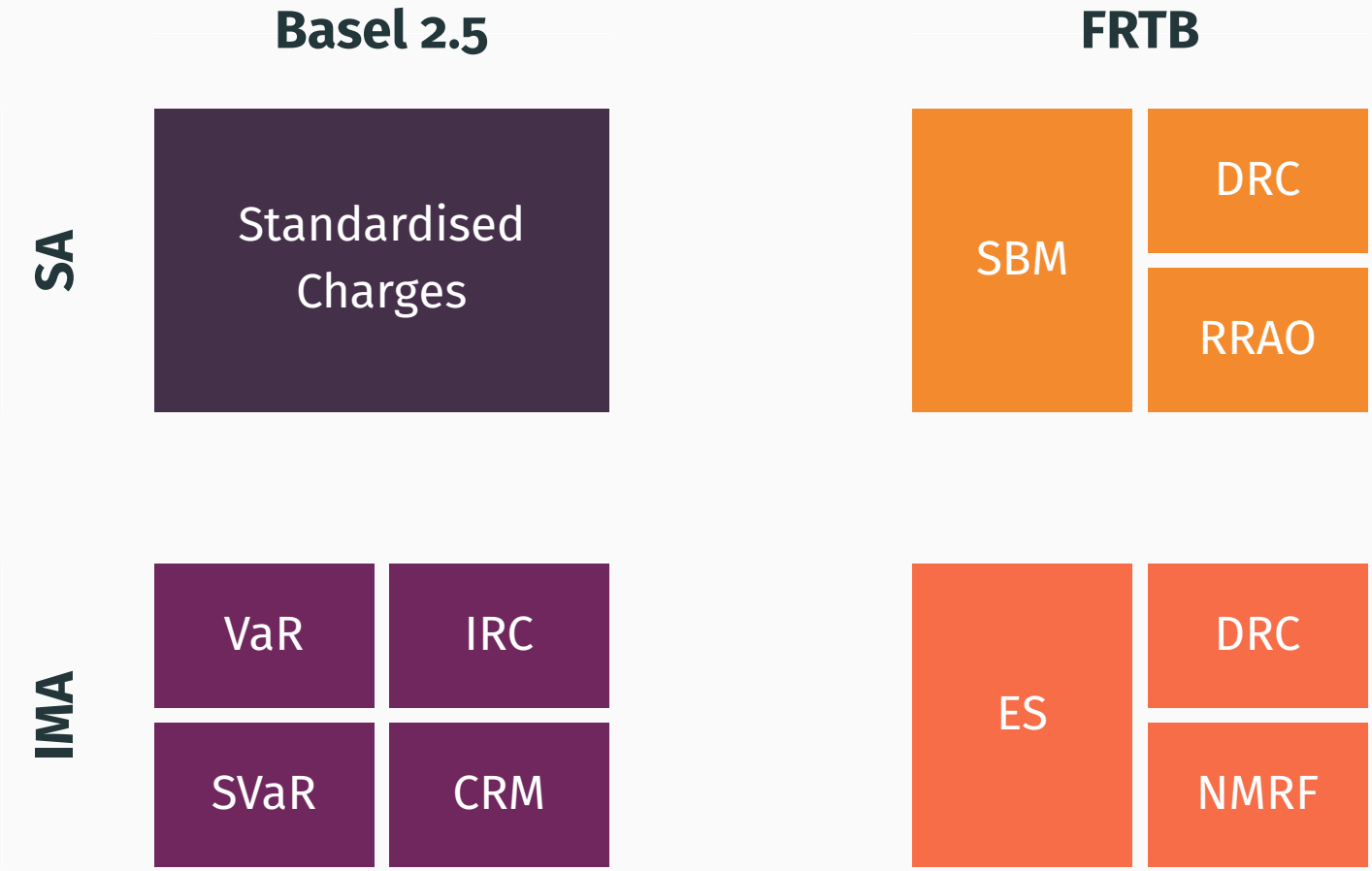
- Standardised CVA risk charge – an analytical approximation of CVA VaR at 99% and 1y horizon, not recognising proxy hedge.
- Advanced CVA risk charge – only eligible if on IMM for CCR **and** IMA for specific risk for bond.

Market risk capital – FRTB

Objectives

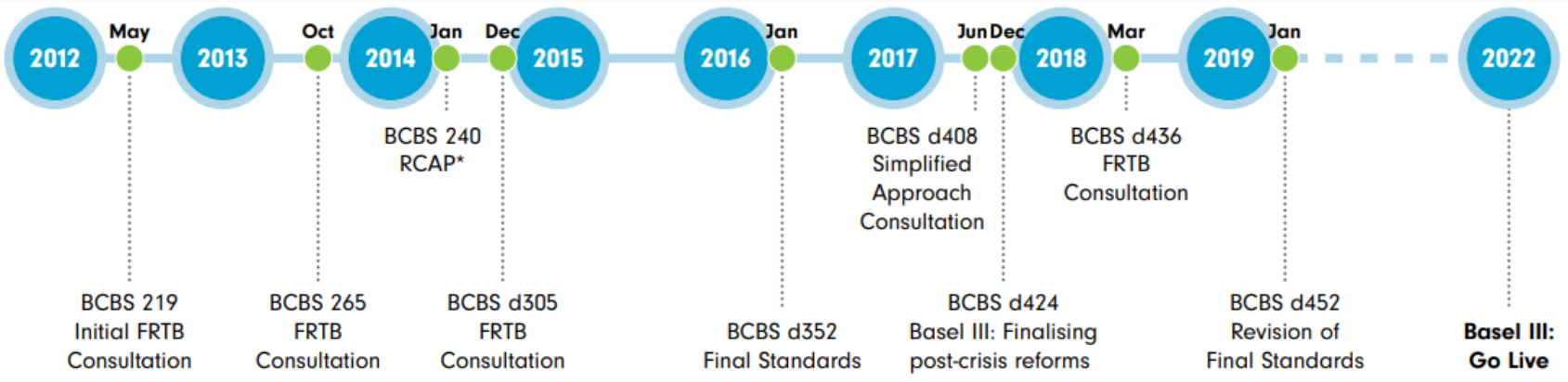
1. Create a clear regulatory boundary between the trading and banking books;
2. Replace the VaR approach to risk measurement with ES;
3. Revise SA to make it more risk-sensitive and allowing it to act as a credible fallback for IMA;
4. Replace the static 10-day liquidity horizon assumed under the VaR framework with varying liquidity horizons in the IMA;
5. Introduce a new capital add-on for risk factors that fail modelability tests, known as NMRFs; and
6. Create a new and more robust approvals processes – firm-wide vs. desk-level.

FRTB – overview



FRTB – timeline

Source: The Fundamental Review of the Trading Book and Emerging Markets, ISDA 2019.



- The FRTB rules are highly complex and not without contention.
- Its implementation has been postponed for multiple times.
- It did not go live in 2022. Implementation is in progress across jurisdictions.

Market risk capital – CVA-BA and CVA-SA

- The standardised approach and advanced approach for CVA introduced in 2010 are to be decommissioned.
- The standardised approach is to be replaced by
  1. a basic approach (CVA-BA) is an improved version of the original standardardised approach, and
  2. an FRTB-style sensitivity-based approach (CVA-SA), which is more advanced and risk sensitive.
- The modelled approach is to be scrapped completely.

Recap on SA-CCR

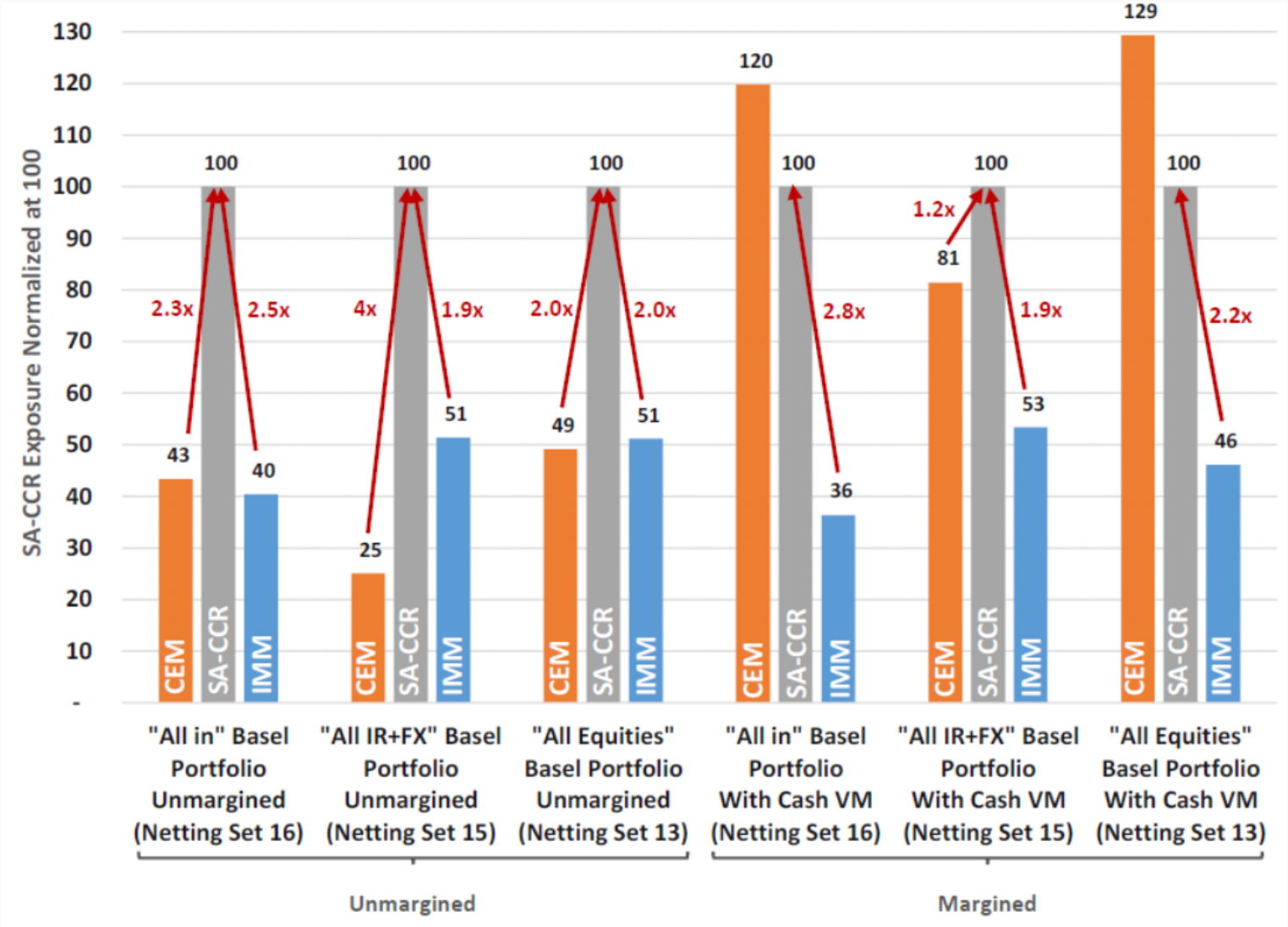
$$\text{EAD} = 1.4 \times (\text{RC} + \text{PFE})$$

It is to be used for leverage ratio and large exposure frameworks even for IMM banks.

- Finalised in 2014 by BCBS with planned implementation in 2017, which was delayed across jurisdiction.
- Intended to be a more granular, risk-sensitive methodology to differentiate between margined and non-margined trades, while recognising netting benefits.
- Designed to be credible fallback to IMM.

SA-CCR – a glimpse of industry responses

Source: SA-CCR: Why a Change is Necessary, ISDA & FIS, May 2017



Higher loss absorbency requirement for G-SIBs

1. Banks are scored by size, cross-jurisdictional activity, interconnectedness, substitutability / financial institution infrastructure and complexity.
2. G-SIBs are placed, according to their scores, into five buckets, each subject to a difference level of surcharge.
3. If a G-SIB cannot meet the surcharge, it needs to return to compliance over a time frame agreed by the regulator. In the meantime, it may be subject to limitations on dividend payout.

Current G-SIBs – as of 2023

Buckets	G-SIBs
5 (3.5%)	(Empty)
4 (2.5%)	JP Morgan Chase
3 (2.0%)	Bank of America, Citigroup, HSBC
2 (1.5%)	Agricultural Bank of China, Bank of China, Barclays, BNP Paribas, China Construction Bank, Deutsche Bank, Goldman Sachs, Industrial and Commercial Bank of China, Mitsubishi UFJ FG, UBS
1 (1.0%)	Bank of Communications, Bank of New York Mellon, Groupe BPCE, Groupe Crédit Agricole, ING, Mizuho FG, Morgan Stanley, Royal Bank of Canada, Santander, Société Générale, Standard Chartered, State Street, Sumitomo Mitsui FG, Toronto Dominion, Wells Fargo

Large expsoure framework (I)

Objectives

1. Microprudential objective of protecting banks from the default of a single counterparty or group of connected counterparties.
2. Macroprudential objective of reducing the interconnectedness between systemically important banks.

Definition and limits

A large exposure: the exposure to a single counterparty or to a group of connected counterparties $\geq$ 10% of Tier 1 capital.

1. Exposure to a single counterparty or to a group of connected counterparties must be $\leq$ 25% of Tier 1 capital.
2. A G-SIB's exposure to another must be $\leq$ 15% of Tier 1 capital.

Large expsoure framework (II)

Exemptions

- Sovereigns and entities connected with sovereigns.
- Exposures to qualifying CCPs related to clearing activities.
- Intraday interbank exposures.

Connected counterparties

- A control relationship, where one of the counterparties has direct or indirect control over the other.
- Economic interdependence, if one were to experience financial problems, the other would also encounter financial difficulties.

Leverage ratio

Leverage ratio is another complementary measure:

$$\text{Leverage Ratio} = \frac{\text{Tier 1 Capital}}{\text{Exposure}}.$$

Note the measure is not sensitive to credit quality, i.e., PD and LGD do not enter into the picture. Businesses and transactions with good-quality counterparties may be leverage-ratio-constrained rather than capital-constrained.

Minium requirements

- Leverage ratio must be $\geq 3\%$.
- Additional requirement at 50% of a G-SIB's higher loss-absorbency risk-based requirements.

Output floor

Banks' RWA must be calculated as the higher of

1. total risk-weighted assets calculated using the approaches that the bank has supervisory approval to use in accordance with the Basel capital framework, and
2. 72.5% of the total risk-weighted assets calculated using only the standardised approaches.

The Collins floor in the US, introduced as part of Dodd-Frank Act, which limits overall RWAs to 100% of the standardised outputs, predates the Basel treatment.

Let bygones be bygones

The curtail of the use of internal models is not limited to the output floor. Some internal model approaches have been completely removed.

1. CVA risk "cannot be modelled by banks in a robust and prudent manner".
2. All existing approaches for operational risk, including Advanced measurement approach (AMA), are replaced with a single risk-sensitive standardised approach to be used by all banks.

Liquity risk measures

Liquidity risk

- Maturity transformation – short-term borrowing vs. longer-term lending.
- Liquidity transformation – funding relatively illiquid assets with more liquid liability.
- Liquidity of assets can decline and funding cost of banks can increase quickly and sharply during a crisis.

Measures

- Liquidity coverage ratio (LCR) ensures banks have resources to survive a 30-day liquidity squeeze.
- Net stable funding ratio (NSFR) creates long-term funding stability over one-year period.

High quality liquid asset

Unencumbered high-quality liquid assets (HQLAs) refer to assets that can be readily converted into cash to meet liquidity needs.

- Level 1: most liquid, cash, central bank reserves, etc., which may comprise an unlimited share of the pool with no haircut.
- Level 2A: less liquid, certain securities guaranteed by sovereigns, corporate and covered bonds, commercial paper, etc., which cannot comprise more than 40% of the pool and are subject to a 15% haircut.
- Level 2B: certain corporate bonds, covered bonds and equities, which cannot comprise more than 15% of the pool and are subject to a 25% or 50% haircut.

Liquidity coverage ratio

$$\text{LCR} = \frac{\text{HQLAs}}{\text{Net cash outflow over the next 30 days}} \geq 100\%$$

- The requirement can be breached during periods of stress.
- Expected cash outflows are calculated by multiplying the outstanding balances of liabilities by supervisory rates of run-off or draw-down.
- Expected cash inflows are calculated by multiplying the outstanding balances of receivables by the rates at which they are expected to flow in.
- The 30-calendar-day is the minimum period deemed necessary for action taken by management or supervisors.

Net stable funding ratio

$$\text{NSFR} = \frac{\text{Available amount of stable funding}}{\text{Required amount of stable funding}} \geq 100\%$$

Available amount of stable funding (ASF)

- ASF is the portion of its capital and liabilities that will remain with the institution for more than one year.
- An ASF factor of 100% means fully available in one year and 0% means funding is unreliable.

Required amount of stable funding (RSF)

- RSF is the amount of stable funding required to hold the liquidity characteristics and residual maturities.
- An RSF factor of 100% means that the asset is illiquid and needs to be entirely financed by stable funding while 0% applies to fully liquid and unencumbered assets.

Some common themes

1. Enhancing risk sensitivity and credibility of standardised approaches.
2. Constraining the use of internal models.
3. Limiting procyclicality and introducing countercyclicality.
4. Building capital reserves.
5. Introducing liquidity risk measures.

Clearing and Margining

Central clearing

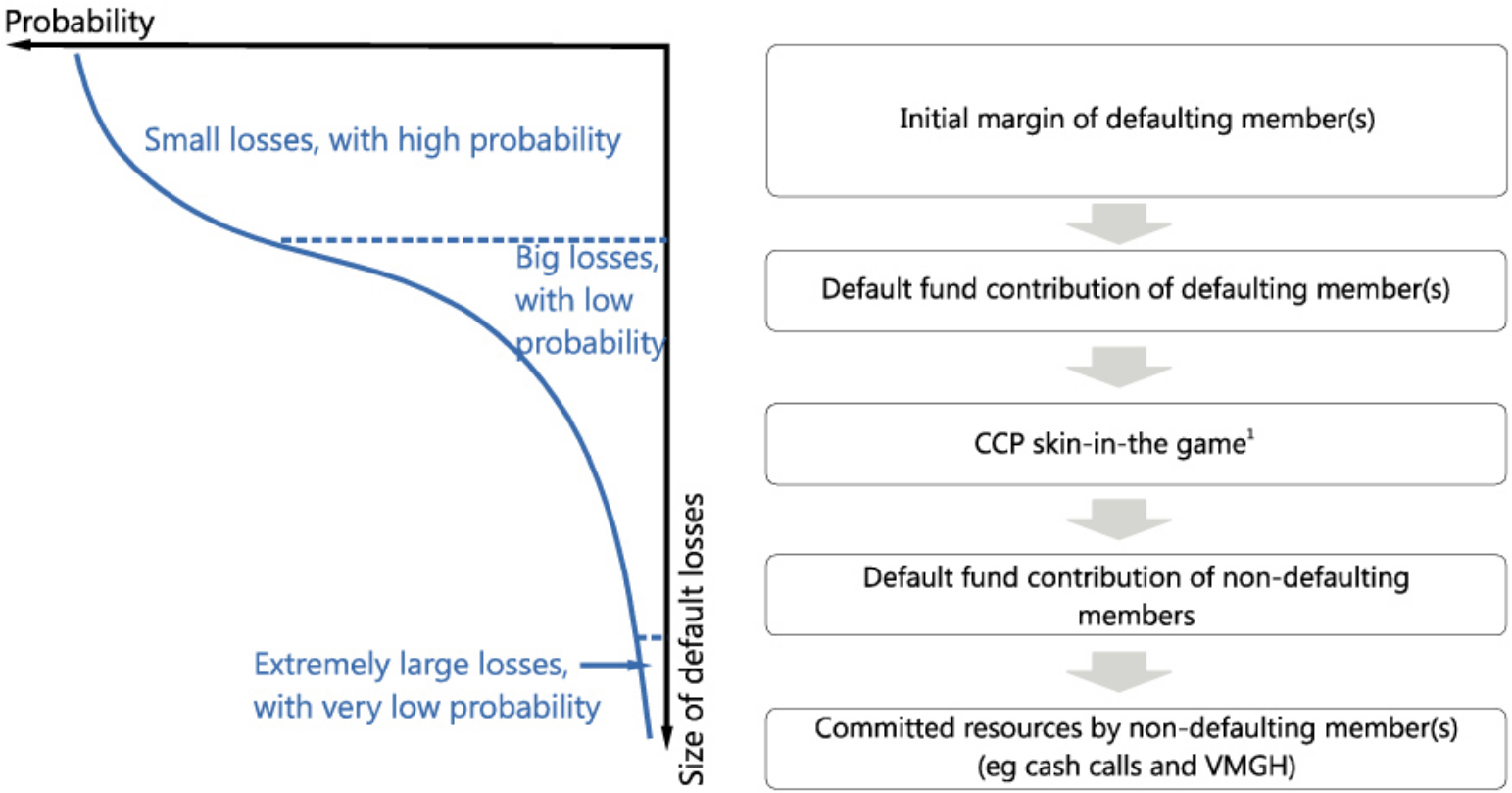
G20 Leaders' Statement, Pittsburgh, September 2009

Improving over-the-counter derivatives markets: All standardized OTC derivative contracts should be traded on exchanges or electronic trading platforms, where appropriate, and cleared through central counterparties by end-2012 at the latest. OTC derivative contracts should be reported to trade repositories. Non-centrally cleared contracts should be subject to higher capital requirements. We ask the FSB and its relevant members to assess regularly implementation and whether it is sufficient to improve transparency in the derivatives markets, mitigate systemic risk, and protect against market abuse.

Loss Waterfall

Source: Clearing risks in OTC derivatives markets: the CCP-bank nexus, BIS 2018.

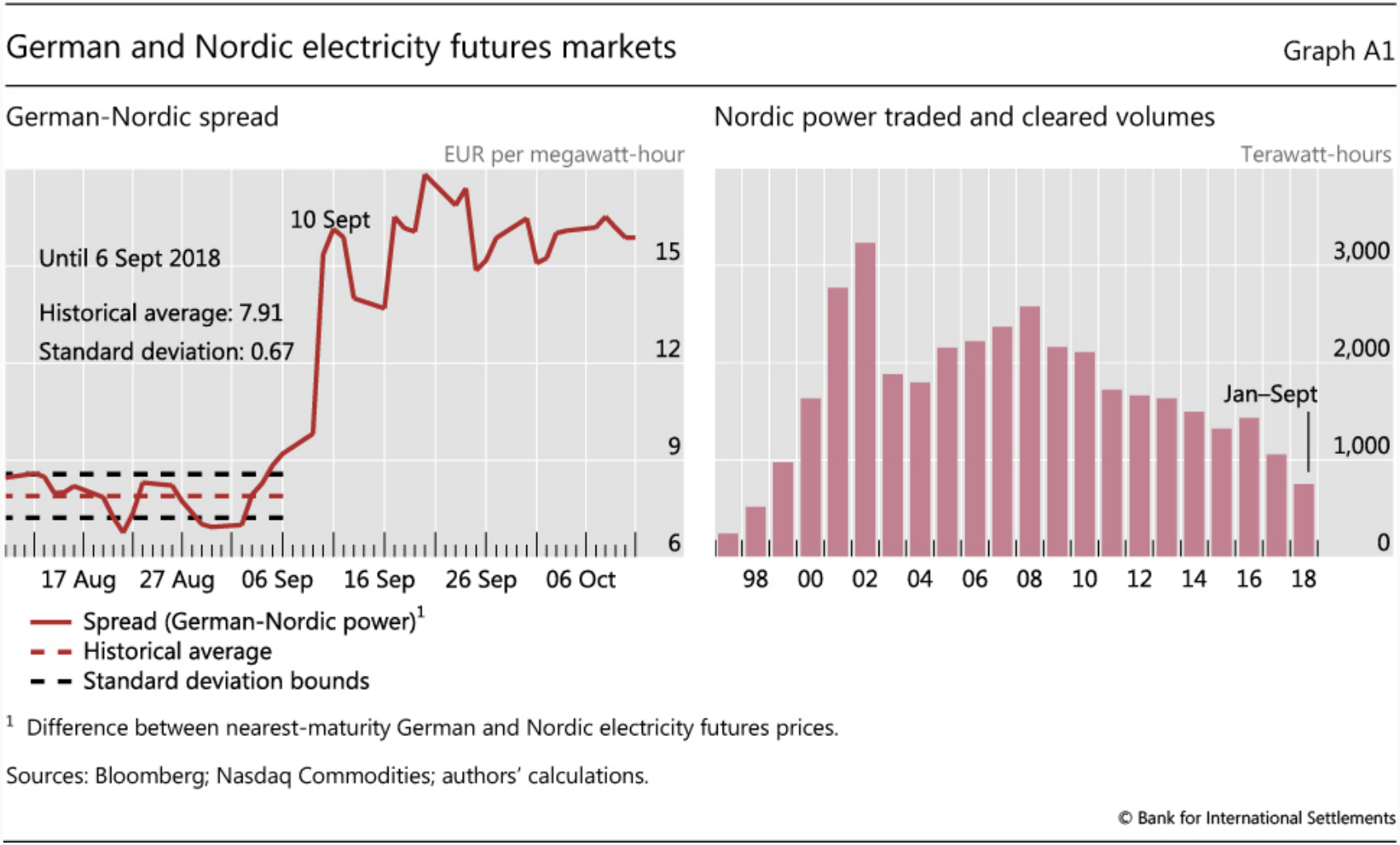
CCP default waterfall — Graph 5



[1] CCP skin-in-the-game (SITG) can come before, along with, and/or after the default fund contributions of non-defaulting members, depending on the CCP's specific rules. Here, we present the typical sequence of CCP SITG. See also Domanski et al (2015).

The 2018 Nasdaq case (I)

Source: Clearing risks in OTC derivatives markets: the CCP-bank nexus, BIS 2018.

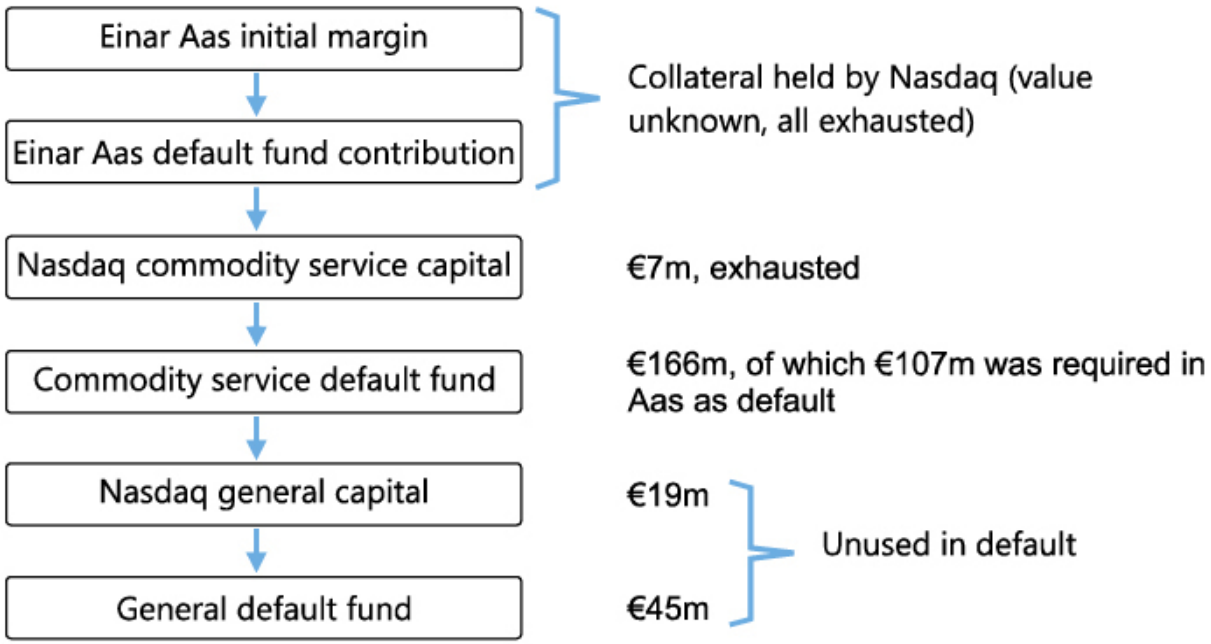


The 2018 Nasdaq case (II)

Source: Clearing risks in OTC derivatives markets: the CCP-bank nexus, BIS 2018.

Nasdaq collateral and the default waterfall

Graph A2



Bilateral margining

Key requirements in uncleared margin rules (UMR)

- VM to cover current exposure with zero threshold.
- IM to cover PFE with 99% confidence level and 10-day MPoR.
- IM should be segregated, i.e., posting it should not lead to CCR.
- Margin should be liquid and be subject to haircut.

Exemptions

- Entities: sovereigns, central banks, multilateral development banks, BIS, end users that are not systematically important.
- Transactions: physically settled FX forwards, swaps, and the notional exchange in CCS.

Model Risk Management

Model risk management pre-GFC

- The concept of model risk was not consistently defined. Its interpretation was typically narrow.
- There was not clear regulatory expectation on model risk management. The only regulatory text was OCC 2000-16, which focused on model validation.
- Model risk management as a function did not exist. Mandates varied in banks' model validation teams.
- Model validation processes were not heavily audited.

The role of models and quants in GFC

Ben Bernanke on May 15,2008

Sophisticated quantitative tools and models play an important role in good risk management, and they will continue to do so. But no model, regardless of sophistication, can capture all of the risks that an institution might face. Those institutions faring better during the recent turmoil generally placed relatively more emphasis on validation, independent review, and other controls for models and similar quantitative techniques. They also continually refined their models and applied a healthy dose of skepticism to model output.

The seminal SR 11-7 / OCC 2011-12

Definition of model

A quantitative method, system, or approach that applies statistical, economic, financial, or mathematical theories, techniques, and assumptions to process input data into quantitative estimates.

Definition of model risk

The potential for adverse consequences from decisions based on incorrect or misused model outputs and reports:

1. a model may have fundamental errors and produce inaccurate outputs when viewed against its design objective and intended business uses;
2. a model may be used incorrectly or inappropriately or there may be a misunderstanding about its limitations and assumptions.

SR 11-7 – key components (I)

Model development, implmentation, and use

- Model development is driven by its intended use.
- Models should be conceptually sound.
- Assessment of data quality and relevance.
- Model testing is an integral part of development.
- Data and reporting integrity rely on proper implementation of models in the information systems.
- Model use is ongoing testing of model while conditions change.
- Model users' feedback is valuable but may be asymmetric.

SR 11-7 – key components (II)

Model validation

- Validation should be independent from development to provide effective challenges.
- Effectiveness is a function of incentive, culture, competence, and influence.
- Scope and rigour of validation should be commensurate with the perceived level of model risk.
- Validation should be ongoing rather than one-off.
- Three core elements in an effective validation framework: evaluation of conceptual soundness, ongoing monitoring, and outcome analysis.

SR 11-7 – key components (III)

Governance, policies, and controls

- The awareness and oversight should be coming from the top.
- Policies and procedures consistent with the regulatory expectation should be in place.
- Roles and responsibilities should be well defined, for the three lines of defense.
- Model identification and model inventory.
- Model development documentation and model validation reports must be adequate.

Impacts on banks

The changes were revolutionary

- US banks were the first to be hit from early-mid 2010s, followed by European banks.
- Establishment of bureaucracy for model risk management, with updated mandate and reporting lines.
- Re-branding of model validators into model risk managers, with significantly more influence.
- Higher cost related to staff, including outsourcing.
- Enhanced rigour in model development, model validation, ongoing monitoring, etc.
- The build-out of enterprise-level model inventory.

Catching up by other regulators

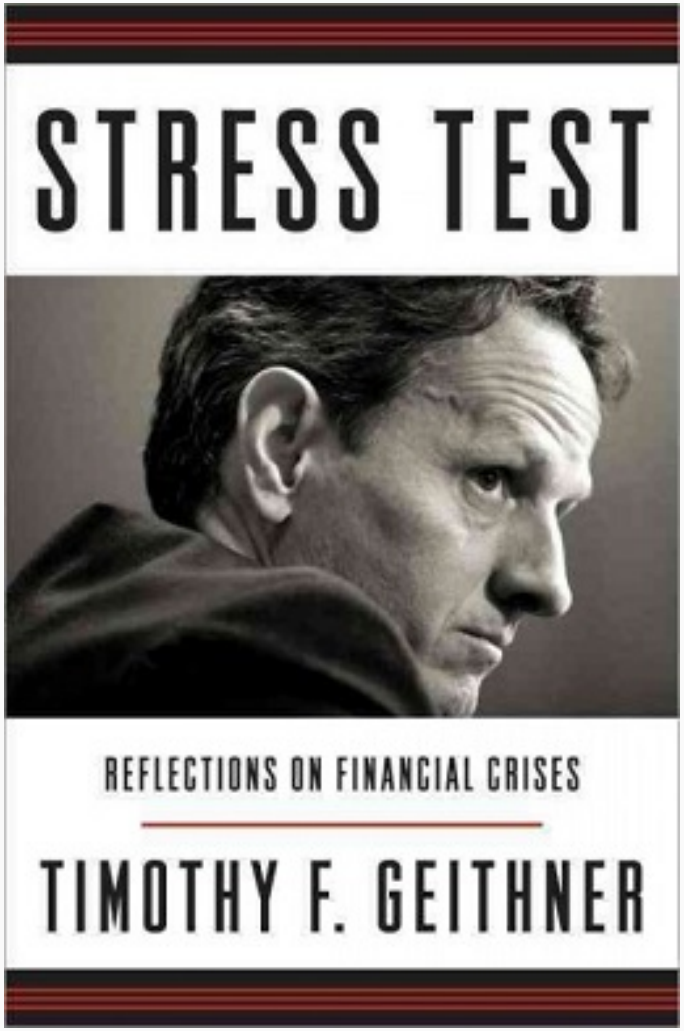
Some of the written ones

- ECB Targeted review of internal models.
- PRA SS3/18 Model risk management principles for stress testing.
- JFSA Principles for model risk management.
- PRA CP6/22 Model risk management principles for banks.

Many regulators who have not published written expectations have nevertheless raised the bar in day-to-day supervision.

Stress Testing

Stress Test by Timothy Geithner



Supervisory Capital Assessment Program & Capital Assistance Program

- Established in 2009 to ensure big US banks had adequate capital buffers.
- SCAP was a stress test of 19 largest US BHCs to determine their health. CAP was to provide assistance as required.
- Ten banks were found to require additional capital, which was raised through private investments. CAP was untapped.

Soul-searching

Principles for sound stress testing practices and supervision, 20 May 2009

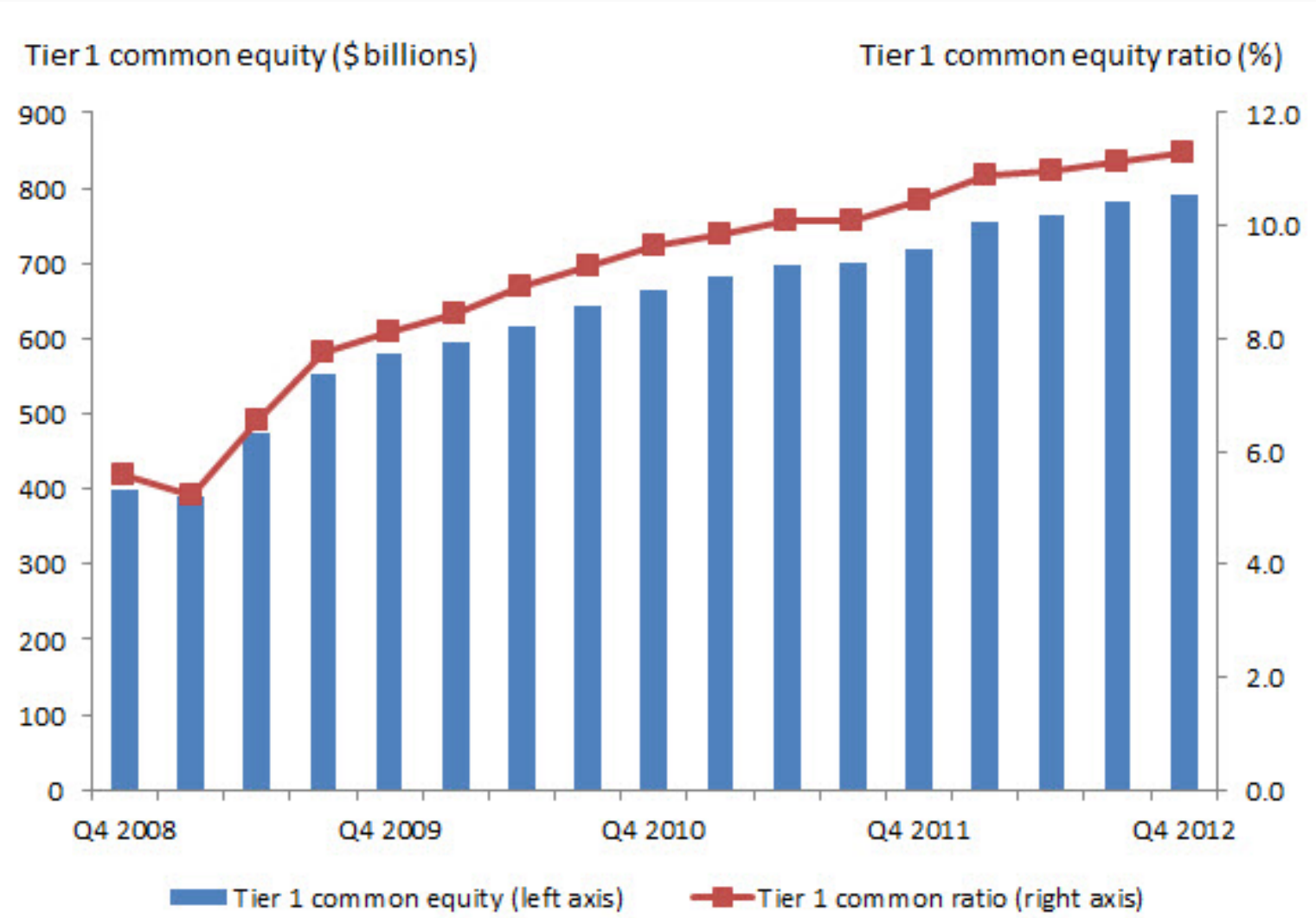
The depth and duration of the financial crisis has led many banks and supervisory authorities to question whether stress testing practices were sufficient prior to the crisis and whether they were adequate to cope with rapidly changing circumstances.

The financial crisis has highlighted weaknesses in stress testing practices employed prior to the start of the crisis in four broad areas: (i) use of stress testing and integration in risk governance; (ii) stress testing methodologies; (iii) scenario selection; and (iv) stress testing of specific risks and products.

Comprehensive Capital Analysis and Review (CCAR)

- Federal Reserve initiated CCAR in late 2010 to assess the capital adequacy and the internal capital planning processes of large and complex BHCs.
- Dodd-Frank Act required the Federal Reserve to conduct annual supervisory stress tests under three scenarios, baseline, adverse, and severely adverse.
- The Federal Reserve published the post-stress capital ratios under CCAR and disclosed the decision (and the basis for the decision; qualitative or quantitative) to object or not object to a BHC's capital plan.

CCAR – some historical facts (I)



Source: Federal Reserve

Note: Aggregate capital ratio for 18 participating BHCs, based on Y-9C filings. The tier 1 common ratio in the fourth quarter of 2008 includes the tier 1 common capital and risk-weighted assets for Ally Financial Inc. as of the first quarter of 2009, as Ally did not file a Y-9C report with the Federal Reserve in the fourth quarter of 2008.

CCAR – some historical facts (II)

Year	BHC	Outcome
2013	Ally Financial, Inc.	Objection
2013	BB&T Corporation	Objection
2013	Goldman Sachs Group, Inc.	Conditional Non-Objection
2013	JP Morgan Chase & Co.	Conditional Non-Objection
2014	Citigroup Inc.	Objection (Qualitative)
2014	HSBC North America Holdings Inc.	Objection (Qualitative)
2014	RBS Citizens Financial Group, Inc.	Objection (Qualitative)
2014	Zions Bancorporation	Objection (Quantitative)
2015	Deutsche Bank Trust Corporation	Objection (Qualitative)
2015	Santander Holdings USA, Inc.	Objection (Qualitative)
2015	Bank of America Corporation	Conditional Non-Objection

CCAR – some historical facts (III)

Year	BHC	Outcome
2016	Deutsche Bank Trust Corporation	Objection (Qualitative)
2016	Santander Holdings USA, Inc.	Objection (Qualitative)
2016	Morgan Stanley	Conditional Non-Objection
2017	Capital One Financial Corporation	Conditional Non-Objection
2018	DB USA Corporation	Objection (Qualitative)
2018	Goldman Sachs Group, Inc.	Conditional Non-Objection
2018	Morgan Stanley	Conditional Non-Objection
2018	State Street Corporation	Conditional Non-Objection
2019	Credit Suisse Holdings (USA), Inc.	Conditional Non-Objection

CCAR – some historical facts (III)

Year	BHC	Outcome
2016	Deutsche Bank Trust Corporation	Objection (Qualitative)
2016	Santander Holdings USA, Inc.	Objection (Qualitative)
2016	Morgan Stanley	Conditional Non-Objection
2017	Capital One Financial Corporation	Conditional Non-Objection
2018	DB USA Corporation	Objection (Qualitative)
2018	Goldman Sachs Group, Inc.	Conditional Non-Objection
2018	Morgan Stanley	Conditional Non-Objection
2018	State Street Corporation	Conditional Non-Objection
2019	Credit Suisse Holdings (USA), Inc.	Conditional Non-Objection

Basel stress testing principles

Stress testing principles, 17 October 2018

The 2009 principles were designed to address key weaknesses in stress testing practices as highlighted by the global financial crisis. Since then, the role of stress testing has rapidly evolved and grown in importance in many jurisdictions. The principles published today have been updated to reflect that stress testing is now both a critical element of risk management for banks and a core tool for banking supervisors and macroprudential authorities.