CCAR Stressing Testing and Its Implications for Risk Modeling

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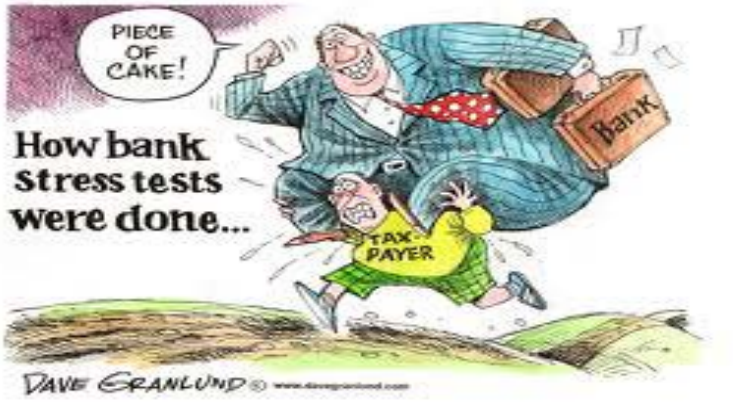
CCAR Stress Testing: An Overview

Moody's Analytics

What Is Stress Testing?

Stress testing is a form of testing that is used to determine the stability of a given system or entity. It involves testing beyond normal operational capacity, often to a breaking point, in order to observe the results. Stress testing may have a more specific meaning in certain industries, such as fatigue testing for materials. --- Wikipedia, the free encyclopedia



What Is Stress Testing? Basel Definition

BCBS 2009*:

"Stress testing is a tool that **supplements** other risk management approaches and measures."

"A stress test is commonly described as the evaluation of a bank's financial position under a severe but plausible scenario to assist in decision making within the bank. The term "stress testing" is also used to refer not only to the mechanics of applying specific individual tests, but also to the wider environment within which the tests are developed, evaluated and used within the decision-making process. "

Basel Committee on Banking Supervision: **Principles for sound stress testing practices and supervision, 2009*

CCAR Stress Testing

For banks in US, today “stress testing” is almost synonymous with “CCAR” (Comprehensive Capital Adequacy Review)

Objective: to assess the amount of capital (and liquidity) needed to support the business activities of the financial institution

History

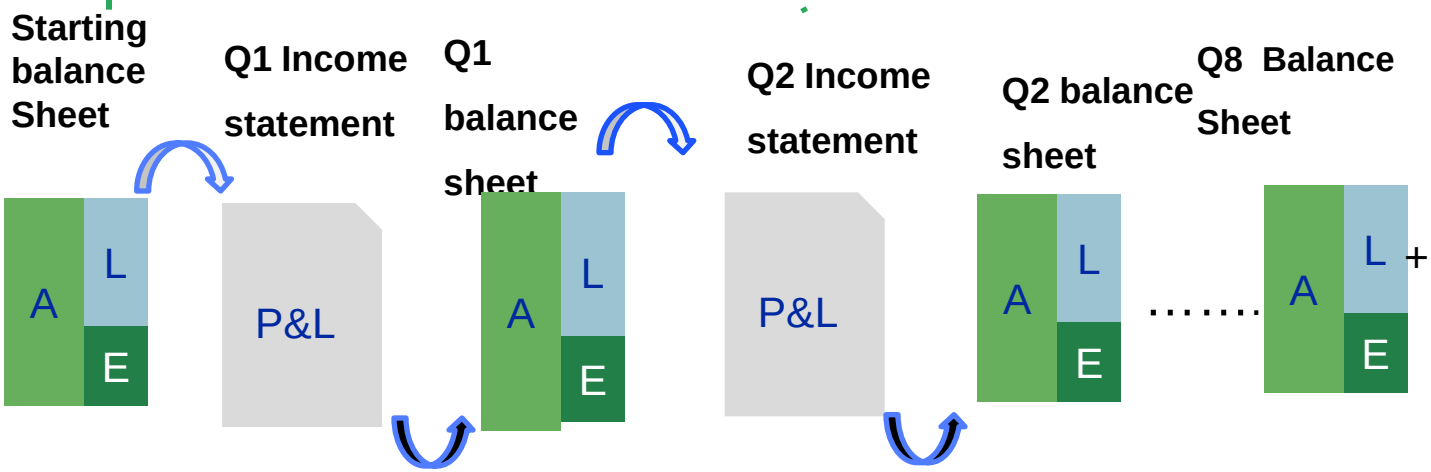
- SCAP (Supervisory Capital Adequacy Program) : Q1 / Q2 2009
- CCAR I : Nov 2010 – Feb 2011
- CCAR II: Nov 2011 – Feb 2012

Any banks with assets >$10B are subject to it, part of Dodd-Frank

Macro-scenario (dictated by regulators or internally) provided a focal point for discussion and communication, concrete guidance on “state of the world”

CCAR: The Analytic Flow---Dynamic View

Two (plus One) Year Dynamic Forecast



Capital and liquidity ratios

Capital and liquidity ratios

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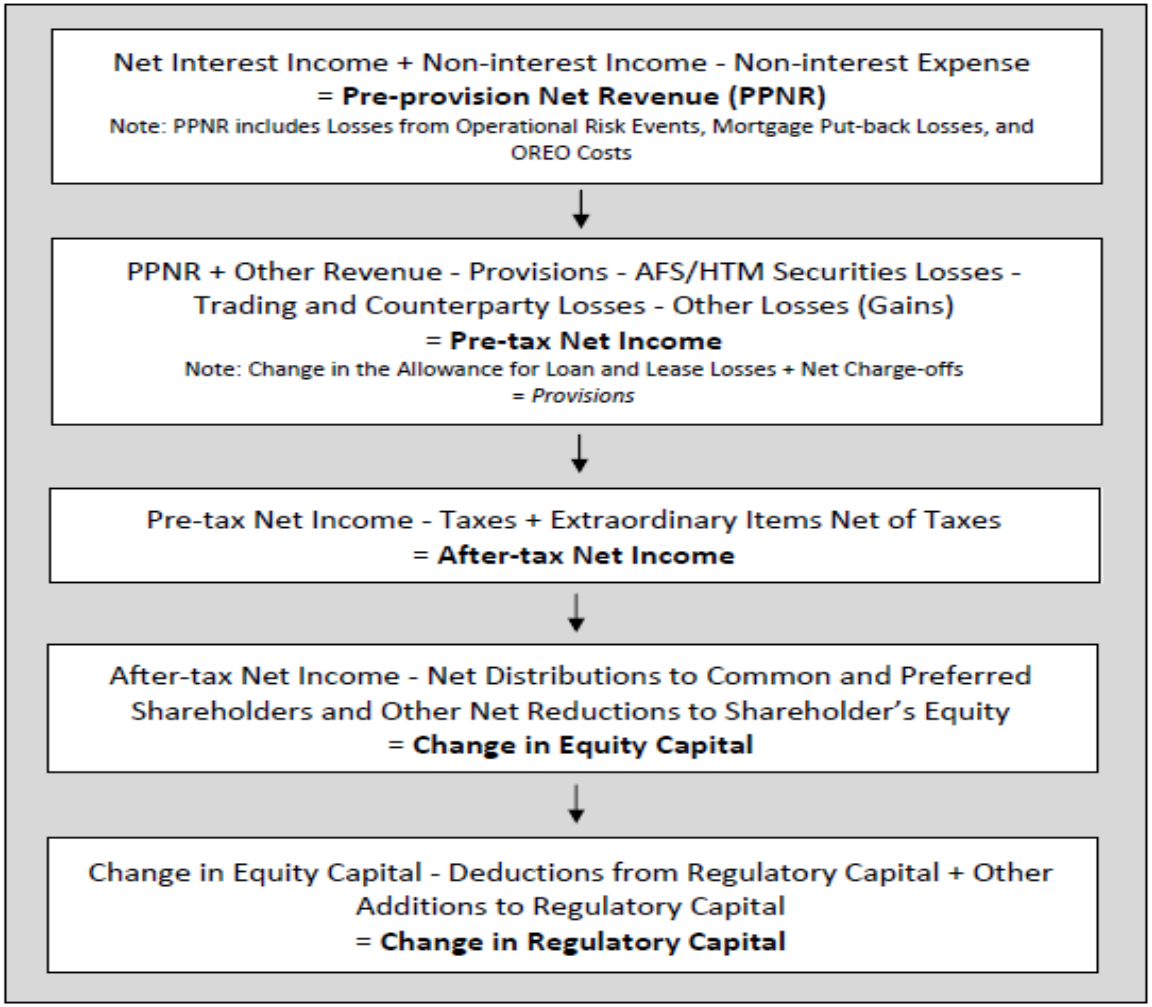
Capital Plan

The above calculations are a mixture of

» Loss forecasts for various asset classes (and/or business lines)

» Projections of balance sheet and income statements

CCAR: The Analytic Flow of One Quarter Analysis



CCAR vs Other Stress Testing Programs

More credible than other regulatory driven (i.e European) ones:

- Macro scenarios tend to be very severe, e.g. severity between the great recession and the great depression for the 2012 exercise
- A fair amount of transparency and information disclosure
- Market participants “can check the numbers”---at least in theory!

Relative to pre-crisis:

- Single shock → Broad macro scenario and market stress
- Portfolio or business unit level → Comprehensive, firm-wide
- Static →Dynamic and path dependent
- Not usually tied to capital adequacy → Explicit post-stress common equity threshold
- Losses only → Losses, revenues and costs

But There Are (Too) Many Models (and Assumptions)

Four type of models

1. Models to project losses on loans in the accrual loan portfolio;
2. Models to project other types of losses
3. Models to project revenues and non-credit related expenses); and
4. Model that projects capital ratios etc
5. And they are not necessarily consistent with each other…

Challenge: credibility of the models and assumptions

Modeling Challenges in CCAR Stress Testing: An Example

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Fed 2012 CCAR C&I PD Model: Estimation

"The first stage of the modeling process is estimation of a series of equations relating historical changes in the median probability of default for 12 different borrower industries, six credit quality categories, and countries of incorporation to macroeconomic variables, including changes in stock price volatility and the spread on BBB-rated corporate bonds. Default probability data are derived from expected default frequency estimates. "

"These equations are used to project quarterly changes in PD at the borrower industry-credit quality-country level over the stress scenario horizon..."

"The next stage is to use detailed, loan-level information submitted by the 19 BHCs to calculate expected losses as of September 30, 2011, for every loan. Probability of default for each loan is estimated by mapping its internal credit rating assigned by the BHC to a standardized rating scale and then linking these standardized ratings to default probabilities...

Source: ***Comprehensive Capital Analysis and Review 2012: Methodology for Stress Scenario Projections****, March 12, 2012*

Questions About the Fed Model

Let look at the numbers first:

9 Quarters Loss Rate	C&I	CRE
SCAP 2009	6.9	9.6
CCAR 2012	8.2	5.2

Is the modeling approach appropriate for banks' lending portfolio:

- Is it appropriate to apply a model built on large corporate universe to middle-market portfolios?
  - Smaller firms are less sensitive to macro shocks than the larger ones
  - Are market variables such as VIX, Baa Spreads and Equity market index most relevant for middle-market portfolios?
  - VIX were assume to be around 70 for CCAR 2012, the historical average is in 20's

Do 12 industry by 6 credit categories provide sufficient granularity?

How do you model change in median probability of default?

- Is the model a linear one?
- How to ensure PD is bounded between 0 and 1?

How Would You Improve Upon the "Fed Model"?

1. Divide the population between large corporate and middle-market
2. More granular and industry buckets
3. Econometric improvement
   - Transform "y"
     - » Change of Median EDF: $mEDF_{t+1} - mEDF_t$
     - » Change of Log-median EDF: $\ln(mEDF_{t+1}) - \ln(mEDF_t)$
     - » Change of Pseudo DD: $N^{-1}(mEDF_{t+1}) - N^{-1}(mEDF_t)$
     - » Change of Logit-median EDF: $\ln(\frac{mEDF_{t+1}}{1-mEDF_{t+1}}) - \ln(\frac{mEDF_t}{1-mEDF_t})$

How About the Model Specification?

For Both Public Firm EDF and Private EDF

$$y_{s,r,t} = \rho y_{s,r,t-1} + \alpha_s + \alpha_r + \sum_{i=1}^{M} (\beta_{i,s} + \beta_{i,r}) X_{i,t} + \varepsilon_{s,r,t},$$

$$\text{where } s = 1,\ldots,S, r = 1,\ldots,R, t = 1,\ldots,T$$

- *s* denotes sectors, *r* denotes ratings, *t* denotes time points.
- *Xs* are macroeconomic variables.
- Different variations of the main model: sector or rating effect only
- 1st lag of dependent variable: high persistency of dependent variable

Alternatively, run time-series regression for each sector/rating bucket

$$y_{s,r,t} = y_{s,r,t-1} + \alpha_{s,t} + \sum_{i=1}^{M} \beta_{i,s,r} X_{i,t} + \varepsilon_{s,r,t},$$

- Disadvantages:
  - Over fitting
  - limited time-series data (low degree of freedom)
  - No structure on sector/rating effects

Many Details to Worry About…

Model selection

- Relevant estimation sample
- How to select X variables
- What transformation do we need to do to X variables?
- Stationarity
- Robustness

How do we convert “pseudo-Distance-to-default” back to PD?

- Convexity adjustment

How do we bridge the model estimation and the application of the model?

- Short term dynamics(quarterly data) vs scenario horizon (9+4 quarters)

Model validation

- Validation dataset
- Validation criterion

Implications of CCAR Stress Testing for Risk Modeling

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Stress Testing: Revisiting the Definition

BIS Committee on the Global Financial System 2005*: *"Stress testing works as a **complement, rather than as a supplement**, to major risk management tools such as value-at-risk"*

Complement vs Supplement**:

- *Complement:*
  - something that completes or makes perfect: A good wine is a complement to a good meal.
- *Supplement:*

  1. something added to complete a thing, supply a deficiency, or reinforce or extend a whole;

  2. a part added to a book, document, etc., to supply additional or later information, correct errors, or the like.

**Stress testing at major financial institutions: survey results and practice,* *2005*

** Dictionary.com*

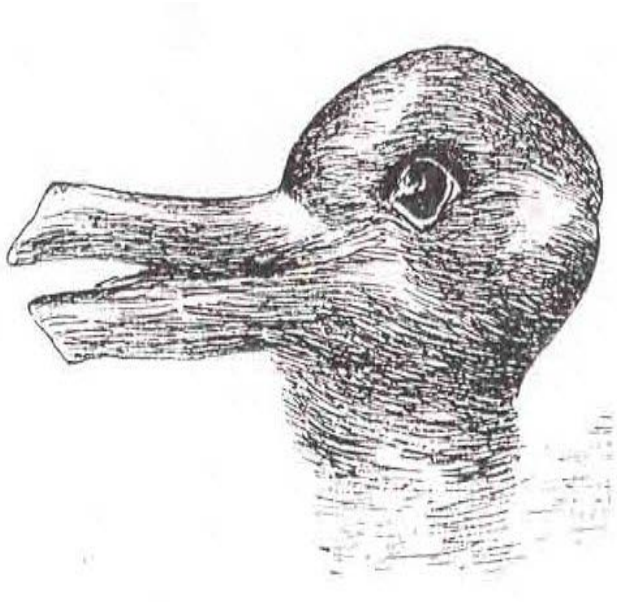
From Complement to Supplement, What Happened?

Objective of CCAR:

- to assess the amount of capital and liquidity needed to support the business activities of the financial institution.

Aren't Economic Capital modeling and Regulatory capital modeling supposed to achieve the same objective?

CCAR modeling is done on both side of the balance sheet, isn't this an ALM exercise?



Is it a duck or a rabbit?

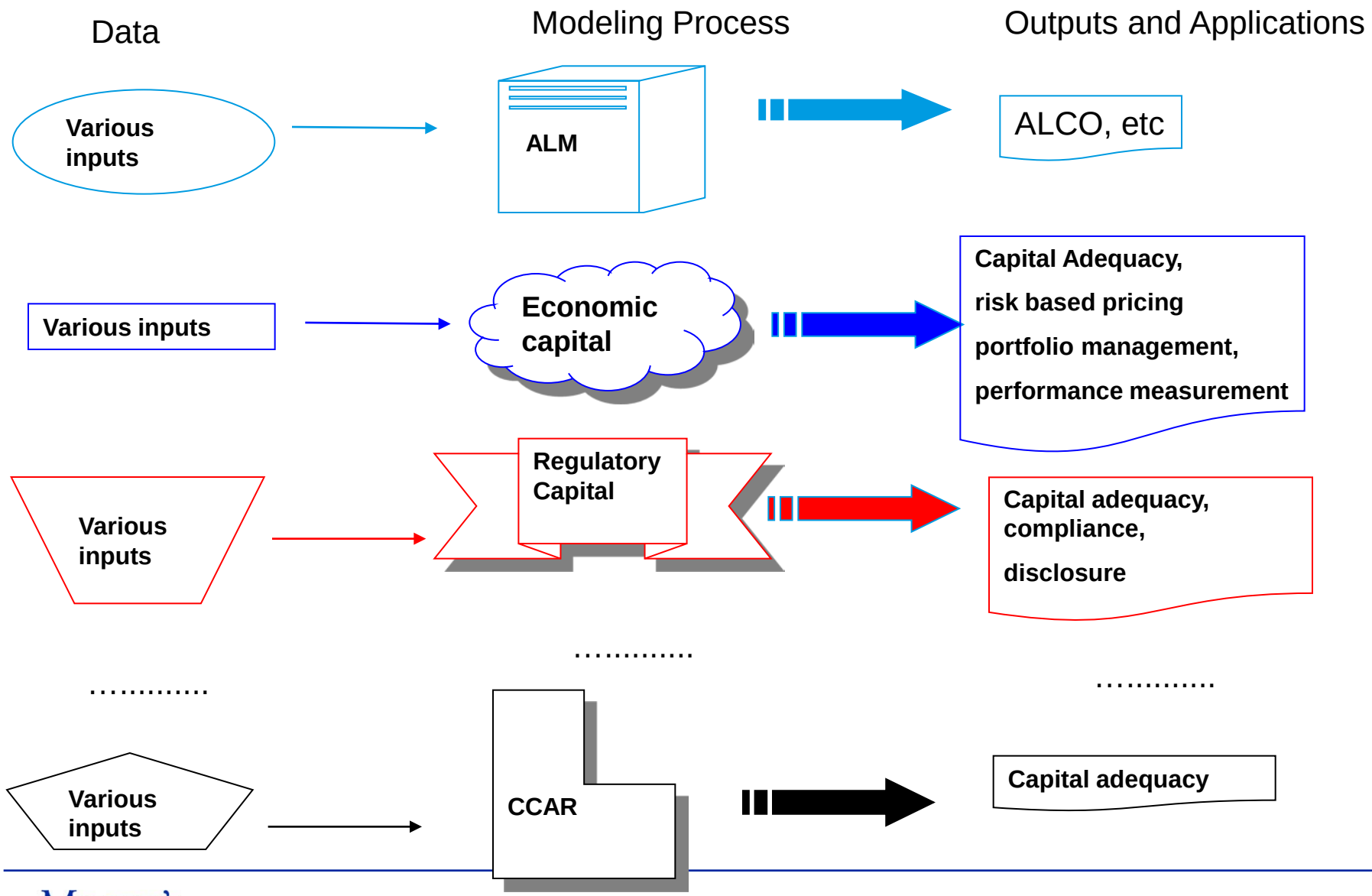
CCAR Stress Testing and Economic Capital Modeling

	CCAR	Economic Capital
Time Horizon	2.25 Year	1 Year (Usually)
Risk Type	Credit, Market and Operational	Credit, Market and Operational
Risk integration	Through the flow of balance sheet and income statement	Usually through Copula method
Balance Sheet	Both sides	Usually the asset side
Accounting /Economic Value	Accounting (and some economic)	Economic
Distribution	Scenario based, deterministic, a point on the distribution	Monte Carlo simulation, the whole distribution
Correlation	Not explicitly modeled	Explicitly modeled
Macro scenario	Direct inputs	Not always
Output	Capital Adequacy	Required EC

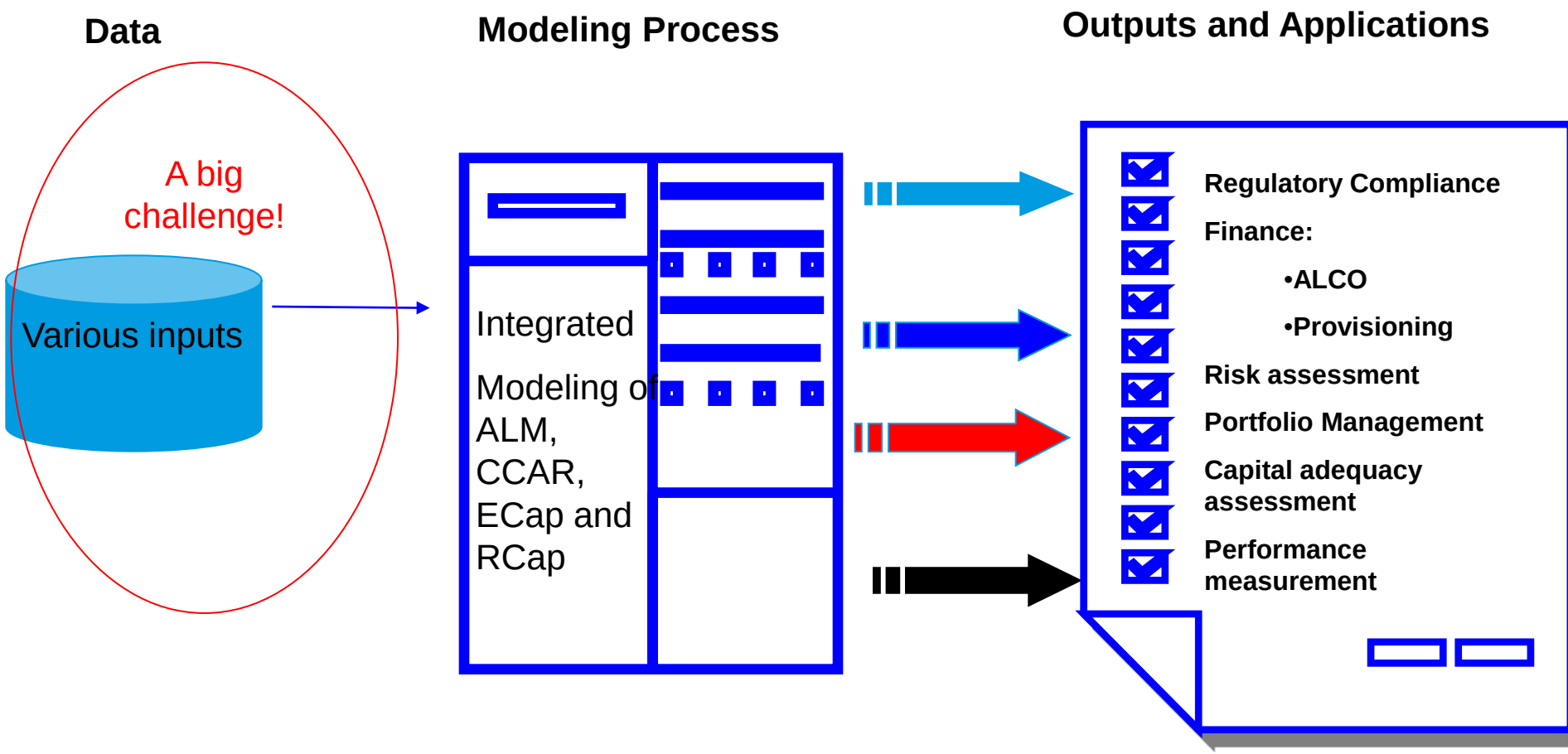
CCAR Stress Testing and ALM Modeling

	CCAR	ALM
Time Horizon	2.25 Year	Typically 1 to 2 years
Risk Type	Credit, Market and Operational	Mostly interest rate
Balance Sheet	Both sides	Both sides
Accounting /Economic Value	Accounting (and some economic)	Both
Distribution	Scenario based, deterministic, a point on the distribution	Mostly deterministic
Correlation	Not explicitly modeled	Explicitly modeled
Macro scenario	Direct inputs	Interest rate
Output	Capital Adequacy	NII distribution, GAP analysis etc

Currant State



Will There Be a "Convergence" in the Future?



Impacts of CCAR Stress Testing for Risk Modeling

Before the “convergence” happens, we need to

- Further develop various models used in CCAR stress testing (to reach similar maturity as those used in EC and ALM modeling)
- Make existing frameworks of EC and ALM evolve and learn from CCAR process

CCAR is here to stay and potentially has profound impacts on various aspects of risk modeling

- A “stimulus” package for risk modeling

Stress Testing: Some Remarks

The essence of a stress testing is about assessing unexpected, blind spot etc

» CCAR is really a scenario analysis

Stress testing should be a complement to the existing toolsets

» If it is a supplement, you should first focus on correct the deficiency
  – Eat more veggies and fruits before taking vitamin supplement

» The perils of quantitative models in stress testing: they tend to be based on historical patterns and impose certain structures, which may or may not repeat in the future stresses event that will get you

Sophistication in stress testing doesn't necessarily translate to complex models, or any quantitative models at all.

Appendix

Moody's Analytics' Solutions for Stress Testing

Solutions: Data + Models + Consulting Services + Software

Data

- Macro (historical and forecast)
- Historical default and loss data
- Historical EDF data for both large corporate and middle market portfolios
- Historical EAD and LGD data

Models

- EDF and LGD models at borrower/loan level

Consulting Services:

- Customized offering, e.g. translation between macro and micro for various asset classes

Software

- Automation of manual process

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