

WHITE PAPER**CCAR and Beyond: Capital Assessment, Stress Testing and Applications – An Introduction****Author**

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Abstract

Comprehensive Capital Analysis and Review (CCAR) has quickly become one of the most dominant regulatory regimes for US banks in recent years. Of the new regulatory requirements BHCs must address, CCAR is widely considered to have the greatest influence on banks' risk management and business practices. Against the backdrop of CCAR's profound impact, there have been few, if any, systematic treatments of the subject. *CCAR and Beyond: Capital Assessment, Stress Testing and Applications*, a new book published by Risk Books, is designed as a unique source of information and insight from key figures involved in CCAR. This book, with fifteen contributed chapters, represents a timely, concerted and collective effort to provide comprehensive and authoritative coverage of CCAR and its implications. Expert contributors explain the context and evolution of CCAR and stress testing, showcase industry perspectives and best practices, and discuss CCAR's implications and impacts on risk management practices. The authors, with deep experience and expertise in their respective areas, represent leading experts from regulatory bodies, banks, consulting firms, and analytics providers. Collectively, their views and perspectives¹ are broad, complimentary, and insightful. Additionally, their efforts, while providing knowledge and sharing experiences, help initiate much-needed discussions and debates on the topics and provides ideas and insights for thought.

This paper serves as an introduction and overview to the book.²

¹ As indicated in individual chapters, their perspectives may not necessarily reflect those of authors' employers.

² A version of this introduction appears in *CCAR and Beyond: Capital Assessment, Stress Testing and Applications*, Jing Zhang, ed., London, UK: Risk Books, 2013

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1. Introduction

Stress testing, regulatory or internally-driven, was not new to banks before the onset of the financial crisis in 2008. Banks routinely conducted capital adequacy assessment and planning long before. However, the recent financial crisis made starkly bare the deficiencies in these practices and processes, as well as the opaqueness of risk in the balance sheet. In 2009, at the height of the crisis, the US Treasury and the Federal Reserve initiated the Supervisory Capital Assessment Program (SCAP) to assess the capital adequacies of the largest US bank holding companies (BHCs). These banks were subjected to rigorous review, which included stress testing to measure the potential loss and the resulting capital shortfall. Program results were announced publically. Banks deemed inadequately capitalized were required to raise capital in the marketplace, with the US Treasury as backstop. The financial markets and the public reacted positively to the program and the disclosure, which led to the gradual restoration of public confidence in the US banking system.³

Upon its success, SCAP has evolved into the Comprehensive Capital Analysis and Review (CCAR) for large and complex BHCs with \$50 billion or more in assets. This now-annual exercise strives to ensure these banks have robust, forward-looking capital planning processes that account for their unique risks and sufficient capital to operate under different stress levels. As part of the exercise, the Federal Reserve evaluates institutions' capital adequacy, internal capital adequacy assessment processes, and their plans to make capital distributions, such as dividend payments or share buybacks. A key part of CCAR is a supervisory stress test supporting the Fed's analysis of the firm's capital adequacy, in addition to qualitative assessment. Additionally, the Dodd-Frank Act requires the Federal Reserve to conduct annual supervisory stress tests under three scenarios — Baseline, Adverse, and Severely Adverse — and to publicly disclose results. Furthermore, the Dodd-Frank Act also requires all federally regulated financial companies with \$10 billion or more in consolidated assets to conduct their own internal stress tests annually and to publicly disclose the results of these tests under the severely adverse scenario.

Today, stress testing and CCAR profoundly impact large banks as well as regulators in the US. Since the first CCAR in late 2010, these banks have invested significant resources in the data, systems, models, processes, and governance needed to meet the challenges of fulfilling CCAR requirements. Additionally, senior management and boards of directors are required each year to review and approve capital plans before submitting them to the Fed. Regulators have shifted the focus of these programs from crisis management to forward-looking assessments of both individual bank's risk and systemic risk assessment and as a means of prodding banks to improve their risk management and internal controls. CCAR's impact is global. Similar supervisory stress testing and capital assessment programs have been conducted in other parts of the world, with varying degrees of success. As of late 2013, the UK PRA was preparing a stress testing regime similar to CCAR for large UK banks.⁴ In 2014, the European Union will conduct a fresh round of stress testing on 90-plus European banks, after concluding their Asset Quality Review (AQR) program.⁵ CCAR is emerging as the standard for supervisory programs, one that many regulators around the globe would like to emulate.

CCAR has quickly become the most dominant regulatory regimes for US banks in recent years. Of the new regulatory requirements BHCs must address, CCAR is widely considered to have the greatest influence on bank's risk management and business practices. Against the backdrop of CCAR's profound impact, there have been few, if any, systematic treatments of the subject.

CCAR and Beyond: Capital Assessment, Stress Testing and Applications, with fifteen contributed chapters, represents a timely, concerted and collective effort to provide comprehensive and authoritative coverage of CCAR and its implications. The book is designed as a unique source of information and insight from key figures involved in CCAR. Contributors explain the context and evolution of CCAR and stress testing, showcase industry perspectives and best practices, and discuss CCAR's implications and impacts on risk management practices. The authors, with deep experience and expertise in their respective areas, represent leading experts from regulatory bodies, banks, consulting firms, and analytics providers. Collectively, their views and perspectives⁶ are broad, complimentary, and insightful.

As CCAR is primarily regulatory-driven, regulators are uniquely qualified to provide insights from their policy work and supervisory experiences, observing the cross-sectional practices by banks. Banking contributors provide direct perspectives based upon their bottom-up and on-the-ground experience, while authors from consulting and analytics firms address the comparative landscape utilizing their experiences working with multiple banks on CCAR-related projects.

³ Ben S. Bernanke, *Stress Testing Banks: What Have We Learned?*
<http://www.federalreserve.gov/newsevents/speech/bernanke20130408a.htm>

⁴ See Bank of England discussion paper, *A framework for stress testing the UK banking system*, <http://www.bankofengland.co.uk/publications/Pages/news/2013/116.aspx>

⁵ Please see European Central Bank announcement, <http://www.ecb.europa.eu/press/pr/date/2013/html/pr131023.en.html>

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2. Subject Matter and Chapter Details

CCAR and Beyond: Capital Assessment, Stress Testing and Applications begins with an overview of the history and evolution of SCAP and CCAR. After laying out the regulatory context and supervisory expectations, subsequent chapters detail banks' perspectives on the challenges of meeting CCAR requirements and enterprise-wide stress testing, as well as the implications. Next, a number of chapters explore the implementation and practical aspects of CCAR and stress testing, including data and system infrastructure and modeling and quantification. A modeling section addresses loss estimation for major asset classes (corporate, CRE, and retail) and risk types (credit, market, and operational risk), as well as modeling revenue and expense. After covering implementation, we discuss the important topic of governance and control. A substantive chapter follows, a semi-summary, providing an overview and compares the different capital management initiatives that exist within large banks, in addition to CCAR. The book ends with a chapter adding international perspective on the subject. For readers primarily interested in capital planning and management and their business implications we recommend focusing on Chapters 1, 2, 3, 13, and 14. Readers interested in implementation and practical aspects can focus on Chapters 4 – 12. To help readers navigate the book, we next provide an overview of each chapter.

In opening, the Federal Reserve Board's Tim Clark and Lisa Ryu describe the evolution of stress testing and related supervisory capital assessment programs since SCAP in 2009 and provide historical context for CCAR. They also discuss key features of and considerations for supervisory stress tests and briefly discuss how supervisors assess BHC stress tests and capital planning in CCAR. Given the public nature of CCAR, they focus on the role of disclosure — a key feature of supervisory stress tests and CCAR. While stress testing is important, one of the main themes of the chapter is that CCAR should be viewed as a complement to, and not a substitute for, regulatory capital requirements that assess BHCs' capital adequacy at a given point in time.

Chapters 2 and 3 provide perspectives from financial institutions. In Chapter 2, Andy McGee and Ilya Khaykia discuss views on the evolving role of enterprise-wide stress testing. Their cross-sectional perspectives and insights draw from a survey on the existing and planned uses of enterprise-wide stress testing, conducted by the International Association of Credit Portfolio Managers (IACPM) and Oliver Wyman. Utilizing survey results, McGee and Khaykia describe the current state of enterprise-wide stress testing, with a focus on how financial institutions are using this new capability. On the current role of enterprise-wide stress testing, they report a wide range of applications, which includes capital adequacy and planning, risk measurement and reporting, risk appetite statement, contingency planning, limit setting, financial planning and budgeting, strategic planning, capital allocation, credit portfolio structuring, performance measurement, pricing, and origination strategy. In their report, they pay special attention to the various ways in which banks combine stress testing with economic capital measures. They also explore banks' aspirations for the next generation of stress testing. To achieve these goals, the authors highlight the areas banks must focus on: increased data and modeling granularity, improved data and modeling infrastructure, clear and effective governance, and robust and efficient processes.

In Chapter 3, Mich Araten traces the advancement of stress testing at banks from its precursors to its current application following the imposition of regulatory stress tests, drawing from his experiences across four decades working at a number of banks. The chapter begins with an analysis of the origins of stress testing, as firms first sought ways to measure risk beyond the simple sensitivity analyses applied to a base case set of assumptions underlying capital investment decisions. The application of simulated outcomes to probabilistic events led to capital modeling, which eventually led to the development of the concept of economic capital, providing banks with basic tools to assess risk-adjusted returns on capital. Araten uses a number of case examples to illustrate the earliest stress testing approaches banks used to explore the robustness of their economic capital models and loss estimates. While Basel II provided the impetus for regulators to push banks with more formalized approaches for estimating regulatory capital, it was only after the financial crisis that stress testing became an important regulatory tool for measuring capital adequacy. Due to the need for banks to adequately demonstrate their capital resiliency under severely adverse scenarios, the use of stress testing outcomes is likely to have a significant impact upon their portfolio management and capital planning. Impacts can be positive, as banks seek ways to better incorporate stress testing results into their decision-making. However, the author raises the important issue of whether or not the regulatory-driven stress testing regime will result in banks using less imagination and creativity in their risk analyses and, instead, have the testing become simply a compliance exercise.

After providing the context and laying the foundation, the next section of the book, Chapters 4 – 12, covers the implementation and practical aspects of CCAR and stress testing. This section begins with discussions on macroeconomic scenario design, followed by the coverage of data and system and the modeling and quantification of loss and revenue for various asset classes and risk types.

Given the central role macroeconomic scenarios play in CCAR and stress testing, we devote two chapters to discussion of scenario design, each with a different focus. In Chapter 4, Mark Zandi considers the appropriate design of the macroeconomic scenarios used for stress tests and some available tools and approaches. He begins by discussing the overarching criteria underpinning scenario design and illustrates them with the various modeling approaches used to implement scenarios. Specifically, Zandi presents a methodology for constructing baseline, alternative, and idiosyncratic scenarios and for determining the associated probabilities of these scenarios. In Chapter 5, Kapo Yuen focuses on determining the severity of macroeconomic stress scenarios.

He discusses the supervisory adverse scenario's severity and provides a simple methodology to compare the severities of different adverse scenarios. Yuen's methodology enables measurement of the severity of a bank-specified scenario and comparison to that of the supervisory scenario. These measurements and comparisons can serve as useful indications of the credibility and plausibility of the stress scenario.

As highlighted in Chapter 2, financial institutions must invest in data and infrastructure to meet the challenges of supervisory stress tests and to reap the benefits of their business use. Despite its critical importance for stress testing and capital assessment, little literature addresses the subject. John Haley and Tom Day address this void in Chapter 6. They begin by listing infrastructure challenges and discussing some of the issues related to legacy data and remediation requirements. They then cover data governance issues, the data required to meet US stress-testing mandates, and the basic elements of a sound data management infrastructure. Furthermore, using a practical example, Haley and Day look at some of the workflow challenges that may require banks to rethink existing business processes, which involves looking at how banks plan new business actions over a forecast horizon. Last, they profile a stylized system integration for a large, complex BHC and discuss how the new requirements will impact customers, concluding with some thoughts on the road ahead. While this chapter focuses on the data and technology implications of meeting the regulatory requirements, it also suggests that the most successful banks will be the ones that learn how to harness insights gained from CCAR work into better tools for business use.

While the data and technology represent some of the foundational aspects of CCAR, the quantification of loss and revenue and the dynamic modeling of the evolution of the balance sheet and income statement consume a large portion of the efforts involved with CCAR exercises. Subsequent chapters cover the topics of loss estimation for major asset classes (wholesale and retail) and major risk types (credit, market, and operational). Chapters 7 and 8 cover stress testing the wholesale portfolio. In Chapter 7, Jimmy Yang and Kenneth Chen present a multi-view framework for stress testing Commercial and Industrial (C&I) portfolios. After discussing the unique characteristics of C&I portfolios and the resulting challenges for stress testing, they present their multi-view approach, which consists of a number of models with different degree of granularity. The approach includes a top-down approach, based upon modeling net charge-off, and a very granular, bottom-up method that involves stressing the inputs of an internal rating model. They also present methods using varying degrees of granularity, such as modeling credit migration and changes in probability of default (PD). Besides PD, the authors also discuss several commonly used methodologies to stress loss given default (LGD) and exposure at default (EAD). Yang and Chen also illustrate how various components can be combined to arrive at the recommended results, from both quantitative and qualitative perspectives, in order to properly assess and hedge model uncertainties. One notable aspect of this discussion is the translation of PD, LGD, and EAD into the accounting metrics of net charge-off and allowances for loan and lease loss (ALLL).

In Chapter 8, Jun Chen covers the topic of stress testing commercial real estate (CRE) loans of the wholesale portfolio. He first provides a tutorial on the unique characteristics of CRE loans and how they differ by lender type (banks versus non-bank institutions). Chen then presents a coherent analytical framework for stress testing CRE loans, where a top-down, macro view is connected with bottom-up, loan-level specifics to derive reliable loss estimates for CRE loans. The key element of the framework involves translating macroeconomic scenarios into key measures of CRE markets and the quantification of the default and loss rates, given the CRE market measures. Chen illustrates how the framework can work for income-producing, as well as for construction loans. He also comments on the subject of model validation and suggests appropriate context for and ways to interpret scenario-based model outputs.

After discussing wholesale portfolios, Soner Tunay and Rosa Catala present a comprehensive and integrated framework for stress testing retail portfolios in Chapter 9. The framework is integrated, in that, it captures the simultaneous interaction between loss drivers and the factors influencing the revenue generation process. The framework incorporates product-specific characteristics and bank internal policy variables, such as underwriting standard. It also covers all retail products (i.e. mortgages, credit cards, auto loans, etc.) under the same macro scenario, using the same methodology, and has bank-wide implementation. They provide for multi-period and lifetime product views and capture the dynamic changes in a product's life and implications for revenue and loss realizations for each future point in time. Tunay and Catala also describe how multiple divisions within the bank — Risk, Treasury, Finance, and Business — collaborate to establish the framework. With buy-ins from all stake holders, the framework can be applied in business applications to help inform budgeting and planning, sales targets, capital utilization, etc.

Following the three chapters on stress testing loan portfolios, Chapter 10 focuses on the topic of market and counterparty credit risk of the trading book. Eduardo Canabarro discusses the fundamental characteristics of market and counterparty risks and how stress tests of those risks can be designed and linked to the macroeconomic scenario in an integrated and coherent way. He then discusses the specific risk characteristics and vulnerabilities of commercial and investment banks' business models and the stress tests most appropriate for them. Perhaps most importantly, Canabarro recommends specific improvement to the design of effective and realistic stress tests, especially for market and counterparty risks: emphasizing the need for explicit consideration of the hedging and liquidity dynamics of trading portfolios, systematic reverse stress testing for identification of market risk vulnerabilities in complex trading portfolios, and the simulation of dynamic hedging costs of CVAs.

In Chapter 11, Yakov Lantsman, Sabeth Siddique and Yan Shi introduce readers to operational risk, its evolution, and stress testing operational risk. They provide a systematic introduction to supervisory and bank idiosyncratic scenario structure and their implications for operational risk. The authors then discuss the general approach to modeling operational risk, especially within the context of Basel II, and explain why CCAR requirements are different. Their methodological focus highlights linking both operational loss frequency and severity to macroeconomic scenarios and how frequency and severity estimates can be aggregated to produce final operational loss estimates. In addition to the methodology discussions, the authors also provide advice on operational risk model capital buffer, reporting, and effective challenge of models.

While stress testing primarily concerns loss, the main focus of the previous five chapters, projecting revenue conditioning on macroeconomic scenarios is also an integral piece of the CCAR process, the topic of Chapter 12, Modeling Pre-Provision Net Revenue (PPNR). PPNR represents a large number of disparate income statement items, ranging from interest income, interest expenses, compensation expenses, trading revenue, and expenses related to operational risk. PPNR spans virtually every aspect of a financial institution, and the items can be disjoint, in that, available data, statistical properties, and sensitivity to macroeconomic conditions can vary significantly. In this chapter, Amnon Levy discusses various quantitative approaches for linking macroeconomic scenarios with PPNR items. Approaches range in granularity and depend upon the availability and quality of historical data, statistical properties of the line item, business use, and model consistency across balance sheet and income statement items. He discusses both quantitative granular approaches and top-down industry peer approaches to relating PPNR items with macroeconomic variables. Levy then comments on the applications of the models and consideration for an organization's strategic plans incorporating expert judgment. Relative to loss estimation, quantification of PPNR is a new field. Levy also provides an assessment of the evolution of modeling approaches into the future.

As seen in the prior chapters, the implementation of CCAR and stress testing is a large, complicated undertaking that requires data, systems, and modeling resources and efforts by multiple business units. The complexity and integrity of the process call for rigorous and appropriate governance and control, the subject of Chapter 13. David Palmer and Paul Sternhagen present the key elements of governance over a CAP: strong board and senior management oversight, evaluation of capital goals; assessment of the appropriateness of stress scenarios considered; regular review of any limitations and uncertainties in all aspects of the CAP; and approval of capital decisions. Furthermore, Palmer and Sternhagen outline the sound internal controls that help govern an institution's CAP and help to ensure CAP integrity. These controls cover policies and procedures change controls, model validation and independent review, comprehensive documentation and review by internal audit.

In Chapter 14, Dan Ryan and Pranjal Shukla provide an overview and comparison of the different capital management frameworks that exist within large banks, in addition to CCAR. The chapter can be considered a synthesis of the various aspects covered in the previous chapters. After presenting the evolution of capital management practices and related capital management initiatives, Ryan and Pranjal provide a detailed comparison from two different lenses: modeling approaches and governance and processes. They then describe how to leverage these different capital management practices and initiatives in an integrated manner for different capital management applications. The chapter ends with some insights on how banks should implement a target-state, comprehensive capital management framework that encompasses all of these initiatives, including CCAR.

As mentioned, CCAR's significant impact is also felt outside the US, with other regulators looking to the experiences and results of the Federal Reserve in developing their own capital adequacy assessment stress testing regimes. Chapter 15, by Piers Haben, Caroline Liesegang, and Mario Quagliarello contrasts the EU and the US experiences and attempts to disentangle why the two stress tests have been perceived so differently by market participants. The authors explain important differences along the following dimensions: governance, scope, severity of the stressed scenario, methodology, outcome, and discloser. Their explanations help readers understand and appreciate the significant challenges that European regulators and banks face in designing and executing stress testing programs. Their insights can be especially valuable to those non-US regulators in the process of designing their own capital and stress testing regimes. The chapter also suggests possible options for future system-wide stress tests on a global basis and contemplate the feasibility of a global stress test, at least for systemic institutions.

The book closes with a few summarizing observations. CCAR has the potential to profoundly impact how banks conduct their capital adequacy assessment and planning, as well as their risk management processes. As a number of contributors highlight throughout the book, banks can and should use the impetus and opportunity of CCAR and stress testing to strengthen and improve their data, IT, and system infrastructure, modeling, and governance and control for applications beyond regulatory compliance. However, it is also important to note that a regulatory-driven program such as CCAR may contribute to creating model and process monoculture and group-think across banks, which contradicts stress testing's spirit of assessing the unexpected and blind spots. How banks and regulators respond to these opportunities and challenges is a process still unfolding, just as CCAR has been and will continue to evolve. Thus, it is important to note that the objective of this book is not to provide definitive explanations for everything related to CCAR. We hope the collective efforts by the contributing authors, while providing knowledge and sharing experiences, helps initiate much-needed discussions and debates on the topics and provides ideas and insights for thought. We trust the reader will find the ideas within this book informative, insightful, and constructive.

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