

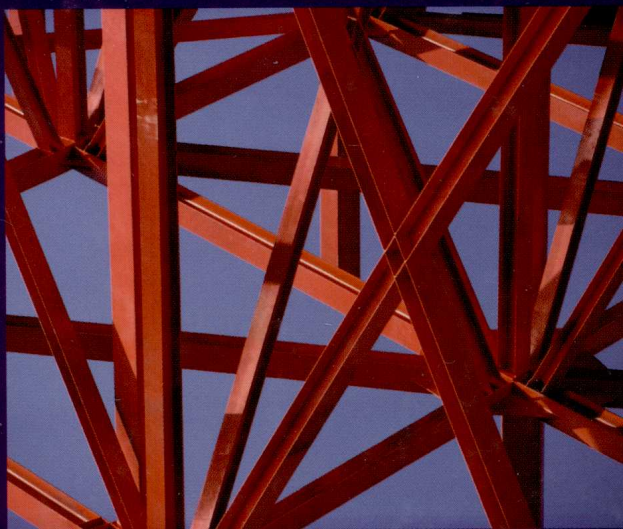
THE FRANK J. FABOZZI SERIES

Collateralized Debt Obligations

Second Edition

Structures and Analysis

WILEY FINANCE



Douglas J. Lucas, Laurie S. Goodman, and Frank J. Fabozzi

Collateralized Debt Obligations

*Structures and Analysis
Second Edition*

DOUGLAS J. LUCAS
LAURIE S. GOODMAN
FRANK J. FABOZZI



WILEY

John Wiley & Sons, Inc.

Copyright © 2006 by John Wiley & Sons, Inc. All rights reserved

Published by John Wiley & Sons, Inc., Hoboken, New Jersey
Published simultaneously in Canada

No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, scanning, or otherwise, except as permitted under Section 107 or 108 of the 1976 United States Copyright Act, without either the prior written permission of the Publisher, or authorization through payment of the appropriate per-copy fee to the Copyright Clearance Center, Inc., 222 Rosewood Drive, Danvers, MA 01923, (978) 750-8400, fax (978) 750-4470, or on the web at www.copyright.com. Requests to the Publisher for permission should be addressed to the Permissions Department, John Wiley & Sons, Inc., 111 River Street, Hoboken, NJ 07030, (201) 748-6011, fax (201) 748-6008, or online at <http://www.wiley.com/go/permissions>.

Exhibits sourced to Moody's Investors Service are © Moody's Investors Service, Inc. and/or its affiliates. Reprinted with permission. All Rights Reserved.

Exhibits sourced to Standard & Poor's and S&P LCD are copyright © 2006 Standard & Poor's, a division of The McGraw-Hill Companies, Inc. ("S&P"). Reproduction in any form is prohibited without S&P's prior written permission.

Limit of Liability/Disclaimer of Warranty: While the publisher and author have used their best efforts in preparing this book, they make no representations or warranties with respect to the accuracy or completeness of the contents of this book and specifically disclaim any implied warranties of merchantability or fitness for a particular purpose. No warranty may be created or extended by sales representatives or written sales materials. The advice and strategies contained herein may not be suitable for your situation. You should consult with a professional where appropriate. Neither the publisher nor author shall be liable for any loss of profit or any other commercial damages, including but not limited to special, incidental, consequential, or other damages.

For general information on our other products and services or for technical support, please contact our Customer Care Department within the United States at (800) 762-2974, outside the United States at (317) 572-3993 or fax (317) 572-4002.

Wiley also publishes its books in a variety of electronic formats. Some content that appears in print may not be available in electronic books. For more information about Wiley products, visit our web site at www.wiley.com.

ISBN-13 978-0-471-71887-1
ISBN-10 0-471-71887-4

Printed in the United States of America

10 9 8 7 6 5 4 3 2

The first edition of this book proclaimed “the market for collateralized debt obligations (CDOs) is the fastest growing sector of the asset-backed securities market.” Those words are still true four years later as we offer this second edition. In fact, with \$200 billion of cash CDOs issued in 2005, another \$200 billion of synthetic CDOs issued, and an incalculable amount of tranches referencing credit default swap (CDS) indices traded, the CDO market is probably the fastest growing financial product not only among asset-backed securities, but among *all* financial products.

As we also said four years ago, “there have been numerous and dramatic changes within the CDO market as it has evolved.” Since that statement, credit protections on CDOs have been tightened, high-yield loans have replaced high-yield bond collateral, and structured finance collateral, including high-grade collateral, has come to dominate issuance. Among synthetic CDOs, arbitrage and managed arbitrated CDOs have replaced balance sheet transactions, single-tranche CDOs have been created and have risen to dominance, and tranches referencing CDS indices have been created.

This second edition reflects the growing and evolving nature of the CDO market: It contains an additional one-third of text and three-quarters of the book contains new material.

This book covers many different aspects of CDOs and collateral underlying CDOs. Its 24 chapters are divided into eight parts:

- Part One: Introduction to Cash CDOs
- Part Two: Loans and CLOs
- Part Three: Structured Finance CDOs and Collateral Review
- Part Four: Other Types of Cash CDOs
- Part Five: Synthetic CDOs
- Part Six: Default Correlation
- Part Seven: CDO Equity
- Part Eight: Other CDO Topics

Below we provide an overview of each chapter.

PART ONE: INTRODUCTION TO CASH CDOs

In Chapter 1 (“Cash CDO Basics”), we first make the case that it is worth taking the time to understand CDOs. Then, to properly explain CDOs, we break them down into their four moving parts: assets, liabilities, purposes, and credit structures. We explain each building block in detail and create a framework for understanding CDOs that puts old and new CDO variants in context and cuts through confusing financial jargon. Finally, we define the roles of the different parties to a CDO.

In Chapter 2 (“Cash Flow CDOs”), we detail the cash flow credit protection structure, explaining the distribution of cash flows to CDO tranches, the cash flow waterfall, overcollateralization tests, the restrictions imposed on CDO managers, and key factors considered by the rating agencies in the CDO debt rating process. In doing so, we make use of lots of examples from actual CDOs.

PART TWO: LOANS AND CLOs

This section discusses three types of loans underlying collateralized loan obligations (CLOs): U.S. broadly syndicated loans, European broadly syndicated loans, and U.S. middle market loans.

The focus of Chapter 3 (“High-Yield Loans: Structure and Performance”) is on U.S. broadly syndicated loans. We discuss the loan market, loan seniority, and lender’s control over borrowers, including loan terms and conditions that cover preservation of collateral, appropriation of excess cash flow, control of business risk, performance requirements, and reporting requirements. We conclude the chapter with a discussion of loan default and recovery rates and CLO credit quality.

We begin Chapter 4 (“European Bank Loans and Middle Market Loans”) by comparing the U.S. and European markets for broadly syndicated loans. We look at issuance by country, industry, and loan purpose; and at trends in leverage, spreads, and covenant protections. Given the lack of European loan default and recovery studies, the focus of the chapter is on calibrating European loans to default and recovery rates on U.S. loans. We then move on to middle market loans. In the face of tighter spreads for large broadly syndicated loans, some arbitrage CLO managers have delved into these loans to obtain higher spreads. We address the characteristics of middle market loans with particular focus upon their credit quality.

PART THREE: STRUCTURED FINANCE CDOs AND COLLATERAL REVIEW

In Chapters 5 and 6 we describe the collateral underlying structured finance CDOs (SF CDOs). The focus of Chapter 5 (“Review of Structured Finance Collateral: Mortgage-Related Products”) is on real estate-related collateral such as residential mortgage-backed securities, mortgage-related asset-backed securities, commercial mortgage-backed securities, and real estate investment trusts. Nonmortgage collateral is the focus of Chapter 6 (“Review of Structured Finance Collateral: Nonmortgage ABS”) and includes a discussion of credit card receivable-backed securities, auto loan-backed securities, student loan-backed securities, SBA loan-backed securities, aircraft lease-backed securities, franchise loan-backed securities, and rate reduction bonds.

Some of the difficulties in calculating structured finance defaults and recoveries are described in Chapter 7 (“Structured Finance Default and Recovery Rates”). We then detail S&P’s and Moody’s default and recovery methodologies and results, as well as our methodology for combining their results. We conclude the chapter by considering the best way to use this default and recovery information for *high-grade* SF CDOs.

The similarities of and differences between SF CDOs structures and high-yield corporate CDO structures are explained in Chapter 8 (“Structured Finance Cash Flow CDOs”). A review of the relative credit quality of structured finance debt versus corporate debt as CDO collateral is presented. We conclude the chapter by demonstrating that by using the same criteria to rate all types of CDOs, the rating agencies impose an extra burden on those backed by structured finance collateral. As a result, we argue that ratings on SF CDOs are conservative.

PART FOUR: OTHER TYPES OF CASH CDOs

In Chapter 9 (“Emerging Market CDOs”), we look at CDOs backed by sovereign emerging market bonds, focusing on the differences (that matter) between emerging markets and high-yield corporate deals. We conclude that the rating agencies are far more conservative in their assumptions when rating emerging market deals than in rating high-yield corporate deals.

Market value CDOs are the subject of Chapter 10 (“Market Value CDOs”). While the number of market value deals is small relative to cash flow deals, they are the structure of choice for collateral where the cash flows are difficult to predict. We open the chapter with an overview of the differences between cash flow and market value structures and

then examine the mechanics of market value CDOs, focusing on advance rates. An advance rate is the percentage of a particular asset that may be issued as rated debt and is the key to protecting CDO debt holders. Our investigation of market price volatility suggests that the advance rates used by the rating agencies are conservative.

PART FIVE: SYNTHETIC CDOs

In Chapter 11 (“Introduction to Credit Default Swaps and Synthetic CDOs”), we build upon a description of credit default swaps to explain the workings of synthetic CDOs. Synthetic CDOs have evolved from vehicles used by commercial banks to offload commercial loan risk to customized tranches where investors can select the names they are exposed to, the level of subordination that protects them from losses, or the premium they are paid. In the chapter we also explain how the rise of standardized tranches on CDS indices has increased trading liquidity, thereby allowing long-short strategies based on tranche seniority or protection tenor.

In Chapters 12 and 13, we look at two types of synthetic CDO structures. The basic structure and structural nuances of synthetic balance sheet CDOs, the unique challenges confronting the rating agencies in rating them, and the key differences between synthetic and cash transactions are described in Chapter 12 (“Synthetic Balance Sheet CDOs”). In Chapter 13 (“Synthetic Arbitrage CDOs”), we describe the advantages of this structure over its cash counterpart. These advantages explain why synthetic arbitrage CDO issuance has grown dramatically and is expected to do so in the future. The advantages are (1) the super-senior piece in a synthetic CDO is generally not funded, (2) there is only a short ramp-up period, and (3) credit default swaps often trade cheaper than the cash bond of the same maturity. We also demonstrate in Chapter 13 how these advantages impact the economics of CDO transactions.

We explain an empirically driven methodology that uses historical default and loss-given-default data to determine how a specific trade would have performed if entered into in the past in Chapter 14 (“A Framework for Evaluating Trades in the Credit Derivatives Market”). More specifically, we show how single name, portfolio, and CDO positions would have performed had they been entered into each year from 1970 through 2000.

The coverage in Chapter 15 (“Structured Finance Credit Default Swaps and Synthetic CDOs”) falls neatly into two topics. First, the evolution of structured finance CDS documentation, the competing dealer, and end user templates, and the structured finance CDS terms that best

replicate the economics of owning a cash structured finance bond. Second, we address the effect of structured finance CDS on SF CDOs, including managers' newfound flexibility in accessing credit risk, the creation of new SF CDO structures, the outlook for more tiering among CDO managers, and the effect on SF CDO credit quality.

PART SIX: DEFAULT CORRELATION

We define default correlation, discuss its drivers, and show why CDO investors care about it in the first of our two chapters on default correlation, Chapter 16 ("Default Correlation: The Basics"). We provide pictorial representations of default probability and default correlation and derive mathematical formulas relating default correlation to default probability. The difficulty of the problem becomes evident when we show that pairwise default correlations are not sufficient to understand the behavior of a credit risky portfolio and introduce "higher orders of default correlation."

In the second of our chapters on default correlation, Chapter 17 ("Empirical Default Correlation: Problems and Solutions"), we survey the meager work done on historic default correlation. We show that default correlations within well-diversified portfolios vary by the ratings of the credits and also by the time period over which defaults are examined. But in that chapter we also devote a good deal of coverage to describe the major problems in measuring and even thinking about default correlation. The thorniest problem is that when looking at historical rates of default, it is impossible to distinguish default correlation from changing default probability. We compare different approaches of incorporating default correlation into portfolio credit analysis and opine that the approached suggested by Credit Suisse First Boston makes the most direct use of historical data and is the easier to understand, but feel that more work needs to be done on default probability.

PART SEVEN: CDO EQUITY

There are four reasons why investors should consider buying CDO equity: nonrecourse term financing, the forgiving nature of the cash flow CDO structure, two optionalities CDO equity holders enjoy, and the use of CDO equity in a defensive investment strategy. We set forth these reasons in Chapter 18 ("Why Buy CDO Equity?").

In Chapter 19 ("CDO Equity Returns and Return Correlation"), we take on the misguided practice of calculating CDO equity Sharpe ratios

and the correlation of CDO equity returns with the returns of other assets. The calculation of these variables is so fundamentally flawed that the results are useless. We delve into the usefulness of historical data in predicting future CDO equity returns and present a simple approach to understanding the relationship between CDO equity returns and the returns of CDO underlying asset portfolios.

PART EIGHT: OTHER CDO TOPICS

In Part Eight of the book we include six chapters that cover a smorgasbord of CDO topics.

A discussion of secondary market developments and pitfalls is provided in Chapter 20 (“Analytical Challenges in Secondary-Market CDO Trading”). However, the bulk of the chapter is on how to evaluate a secondary CDO offering. We show what to look for in a trustee report and what to get out of net asset value analysis. Our most important suggestion is a methodology for selecting default scenarios in cash flow modeling.

The factors that structurers consider in creating CDOs are the subject of Chapter 21 (“The CDO Arbitrage”). We show how to look at the CDO arbitrage and present a “quick and dirty” analysis for benchmarking CDO issuance and then focuses on how the arbitrage dictates deal structure. Spread configurations and the exact collateral used are important in determining optimal deal structure. We explain why the practice of simply looking at percent subordination or percent overcollateralization as an arbiter of tranche quality is misleading.

In Chapter 22 (“How to Evaluate a CDO and Manage a CDO Portfolio”), we look at evaluating CDOs individually and as part of a portfolio. One of the most important points to look for in a CDO purchase is the structural protections inherent in a CDO because there is a natural tension between the interest of debt holders and equity holders. Buyers of CDO debt should look at both the incentive structures in a CDO, as well as how the manager has done on outstanding CDOs. In picking managers, track record cannot be taken at face value. In the chapter we also make the case that investors should buy CDOs backed by different types of collateral and that low-diversity CDOs are not to be shunned.

In Chapter 23 (“Quantifying Single-Name Risk Across CDOs”) we quantify the extent of collateral overlap among a sample of CLOs and SF CDOs and propose a simple and consistent measure of single-name risk. We explain that there is little reason to be concerned about single-name risk except at the level of equity and the lowest debt tranche.

In the last chapter, the rating history of 1,000 CDOs and 3,000 CDO tranches across 22 types of CDOs in the United States, Europe, and emerging markets is provided. In that chapter (Chapter 24, “CDO Rating Experience”), we compare CDOs by type and vintage and assess both the frequency and severity of downgrades. Particular attention is paid to the severity of downgrades and a proxy CDO default study is offered.

ACKNOWLEDGMENTS

We gratefully acknowledge the expertise and participation of UBS research personnel. Bill Prophet, Greg Reiter, William Smith, and Tom Zimmerman reviewed drafts and made helpful comments. Wilfred Wong and Tommy Leung contributed analysis to several chapters. Vicki Ye was involved in every step, from background research and data gathering to reviewing and critiquing the final product.

We particularly thank the rating agencies, Moody’s Investors Service, Standard & Poor’s, and Fitch Ratings, for allowing us to draw upon the wealth of data and expertise they provide to CDO investors. Most specifically, we incorporated material on their rating methodologies, default and recovery studies, and rating transition studies into this book. Special thanks also to S&P LCD, for the variety of loan data and analysis they allow us to use.

Douglas J. Lucas
Laurie S. Goodman
Frank J. Fabozzi

About the Authors

Douglas J. Lucas is an Executive Director at UBS and head of CDO Research. He is ranked top three in CDO research in the *Institutional Investors* fixed income analyst survey. His prior positions include head of CDO research at JPMorgan, co-CEO of Salomon Swapco, and analyst at Moody's Investors Service. While at Moody's he authored the rating agency's first default and rating transition studies, quantified the expected loss rating approach, and developed the rating methodologies for collateralized debt obligations and triple-A special purpose derivatives dealers. He is known for doing some of the first quantitative work in default correlation. Currently Chairman of The Bond Market Association's CDO Research Committee, Douglas has a BA magna cum laude in Economics from UCLA and an MBA with Honors from the University of Chicago.

Laurie S. Goodman is cohead of Global Fixed Income Research and manages U.S. Securitized Products (RMBS, ABS, CMBS, CDO) and Treasury/Agency/Swap Research at UBS. As a mortgage analyst, Laurie has long dominated *Institutional Investor's* MBS categories, placing first in four categories 30 times over the last eight years. In 1993, Laurie founded the securitized products research group at Paine Webber, which merged with UBS in 2000. Prior to that, Laurie held senior fixed income research positions at Citicorp, Goldman Sachs, and Merrill Lynch and gained buy-side experience as a mortgage portfolio manager. She began her career as a Senior Economist at the Federal Reserve Bank of New York. Laurie holds a BA in Mathematics from the University of Pennsylvania, and MA and PhD degrees in Economics from Stanford University. She has published more than 160 articles in professional and academic journals.

Frank J. Fabozzi is an Adjunct Professor of Finance and Becton Fellow in the School of Management at Yale University. Prior to joining the Yale faculty, he was a Visiting Professor of Finance in the Sloan School at MIT. Frank is a Fellow of the International Center for Finance at Yale University and on the Advisory Council for the Department of Operations Research and Financial Engineering at Princeton University. He is the edi-

tor of *The Journal of Portfolio Management* and an associate editor of *The Journal of Fixed Income*. He earned a doctorate in economics from the City University of New York in 1972. In 2002 Frank was inducted into the Fixed Income Analysts Society's Hall of Fame. He earned the designation of Chartered Financial Analyst and Certified Public Accountant. He has authored and edited numerous books in finance.

Contents

Preface	xiii
About the Authors	xxi

PART ONE

Introduction to Cash CDOs	1
----------------------------------	----------

CHAPTER 1

Cash CDO Basics	3
Why Study CDOs?	3
Understanding CDOs	4
Credit Structures	10
A CDO Structural Matrix	13
CDOs Being Offered Today	14
Parties to a CDO	14

CHAPTER 2

Cash Flow CDOs	17
Distribution of Cash Flows	17
Restrictions on Management: Safety Nets	20
Credit Ratings	23
Call Provisions in CDO Transactions	38

PART TWO

Loans and CLOs	41
-----------------------	-----------

CHAPTER 3

High-Yield Loans: Structure and Performance	43
The Loan Market	44
The Syndication Process	46
Loan Structure and Leaders	48
Loan Interest Rates and Upfront Fees	49

Loan Credit Quality	51
Lender's Liability	52
Overview of Loan Terms	53
Loan Terms versus Bond Terms	58
A Tale of Two Loans	58
The Secondary Market	60
Loan Recovery Rates	61
Loan Default Rates	63
High-Yield Loan CLO versus High-Yield Bond CBO Performance	67
Conclusion	74

CHAPTER 4

European Bank Loans and Middle Market Loans	75
European Bank Loans	75
Middle Market Loans	91
Conclusion	99

PART THREE

Structured Finance CDOs and Collateral Review	101
--	------------

CHAPTER 5

Review of Structured Finance Collateral: Mortgage-Related Products	103
Residential Mortgage-Backed Securities	103
Commercial Mortgage-Backed Securities	125
Real Estate Investment Trust Debt	129

CHAPTER 6

Review of Structured Finance Collateral: Nonmortgage ABS	135
Credit Card Receivable-Backed Securities	135
Auto Loan-Backed Securities	137
Student Loan-Backed Securities	139
SBA Loan-Backed Securities	141
Aircraft Lease-Backed Securities	142
Franchise Loan-Backed Securities	145
Rate Reduction Bonds	148

CHAPTER 7

Structured Finance Default and Recovery Rates	153
Structured Finance versus Corporate Default Rates	154
S&P Rating Transition Studies and the Matrix Multiplying Approach	156
Results of Multiplying S&P Rating Transition Matrices	158
S&P on Structured Finance Loss Given Default	159
S&P Constant Annual Default and Recoveries	159
Moody's Material Impairment Study	160

Comparing and Reconciling Structured Finance Default Rates	162
Moody's on Structured Finance Historical Loss Rates	164
Moody's Constant Annual Default and Recoveries	166
Blending S&P and Moody's Studies	167
Applying CDRs and Recoveries to SF CDOs	167
Conclusion	170

CHAPTER 8

Structured Finance Cash Flow CDOs	171
SF CDOs versus High-Yield CDOs	172
Rating Agencies on Structured Finance CDOs	174
Structured Finance Assets' Negative Convexity	182
Extension Risk	183
Conclusion	185

PART FOUR

Other Types of Cash CDOs	187
---------------------------------	------------

CHAPTER 9

Emerging Market CDOs	189
EM Sovereign Bond Defaults	190
Why the Better Track Record?	192
CDO Rating Differences: EM versus High Yield	193
Conclusion	198

CHAPTER 10

Market Value CDOs	201
Cash Flow versus Market Value Deals	201
The Rating Process	202
How Advance Rates Are Derived	212
Conclusion	215

PART FIVE

Synthetic CDOs	217
-----------------------	------------

CHAPTER 11

Introduction to Credit Default Swaps and Synthetic CDOs	219
Credit Default Swaps	219
Synthetic CDOs	229
Conclusion	239

CHAPTER 12

Synthetic Balance Sheet CDOs	241
Cash CLOs for Balance Sheet Management	241
Partially Funded Synthetic CDOs	249
Conclusion	253

CHAPTER 13

Synthetic Arbitrage CDOs	255
Full Capital Structure Synthetic Arbitrage CDOs	256
Single-Tranche CDOs	260
Standard Tranches of CDS Indices	261
Conclusion	262

CHAPTER 14

A Framework for Evaluating Trades in the Credit Derivatives Market	265
Assessing Single-Name and CDO Tranching Exposures	266
Assessing CDO Equity versus a Basket Swap	274
Conclusion	280

CHAPTER 15

Structured Finance Credit Default Swaps and Synthetic CDOs	281
Differences between Corporate and Structured Finance Credit	282
Difficulties in SF CDS	284
SF CDS Effect on SF CDO Management	294
Two New Types of SF CDOs	295
Effects of SF CDS on CDO Credit Quality and Spreads	296
Conclusion	297

PART SIX

Default Correlation	299
----------------------------	------------

CHAPTER 16

Default Correlation: The Basics	301
Default Correlation Defined	301
Default Probability and Default Correlation	305
Conclusion	321

CHAPTER 17

Empirical Default Correlations: Problems and Solutions	323
Empirical Results	323
Problems with Historical Default Correlations	327
Proposed Solutions	330
Conclusion	344

PART SEVEN**CDO Equity 345****CHAPTER 18****Why Buy CDO Equity? 347**

Nonrecourse Term Financing 347

The Forgiving Nature of CDO Financing 354

CDO Options 356

CDO Equity as a Defensive Strategy 359

Conclusion 360

CHAPTER 19**CDO Equity Returns and Return Correlation 361**

Flawed Methodologies 362

The Appropriate Lesson from History 365

Loan Defaults and Recoveries 367

Cash Flow Modeling Defaults and Recoveries 370

Structured Finance Defaults and Recoveries 371

SF CDO Cash Flow Modeling 372

Return Correlation and Nonrecourse Leverage 374

Conclusion 378

PART EIGHT**Other CDO Topics 379****CHAPTER 20****Analytical Challenges in Secondary CDO Market Trading 381**

Important Developments: Spread Tightening, Increased Activity 382

Pitfalls in Secondary CDO Trading 384

Eight-Point Checklist in Evaluating a CDO in the Secondary Market 387

Prescription for Making Primary Issuances Conducive to

Secondary Trading 408

Conclusion 409

CHAPTER 21**The CDO Arbitrage 411**

Building Blocks 411

Impact of CDO Arbitrage on Structure 422

Conclusion 425