WILEY FINANCE

MODELING STRUCTURED FINANCE Cash Flows with Microsoft® Excel® +CD

A Step-by-Step Guide

CD-ROM includes modeling exercises and a final version of the model discussed in the text

Keith A. Allman

Modeling Structured Finance Cash Flows with Microsoft® Excel®

A Step-by-Step Guide

KEITH A. ALLMAN

John Wiley & Sons, Inc.

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

Wiley Bicentennial Logo: Richard J. Pacifico.

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.

Library of Congress Cataloging-in-Publication Data:

Allman, Keith A., 1977-
Modeling structured finance cash flows with Microsoft Excel : a step-by-step guide / Keith A. Allman.
p. cm.—(Wiley finance series)
Includes bibliographical references and index.
ISBN 978-0-470-04290-8 (paper/cd-rom)
1. Cash management—Mathematical models. 2. Cash flow—Mathematical models. 3. Microsoft Excel (Computer file) 4. Corporations—Finance—Mathematical models. I. Title.
HG4028.C45A454 2007
658.15'50285554--dc22

2006025757

Printed in the United States of America.

10 9 8 7 6 5 4 3 2 1

Preface

During my first analytics position after graduate school, I asked a vice president at our company what the best way was to learn how his group modeled transactions. He answered with a grin: "Trial by fire." From that point on, I could not have counted the gray hairs that I developed trying to figure out the most precise and efficient method of modeling a transaction. I am pleased to say those days are behind me and it no longer takes me hours to construct a powerful, accurate model. Nevertheless I am dismayed when I speak with finance peers who convey their desire to learn better financial modeling and are intimidated by the task or simply at a loss for where to begin. At those moments, I often think how I came to acquire the knowledge and skills necessary to model a diverse array of financial transactions.

I recalled hours spent poring over "how-to" books about Excel that were filled with hundreds of functions and formulas and left me feeling like I didn't have any idea where to start modeling a transaction. The how-to books provide excellent basics of application operation yet they do not offer any context for applying those skills. My next thought was graduate school, where many courses such as Statistics, Economics, Corporate Finance, Capital Markets, and Decision Making utilize Excel for assignments and examinations. Unfortunately, for everyday application, the graduate school classes provide context, but typically on very specialized subjects that still left me with no framework to build a financial model. The next step I took was to purchase more advanced books with the words "Financial Modeling" in the title. With these, I found the topics highly theoretical or applicable to extremely focused fields that do not translate into a practical model oriented towards cash flow analysis.

I realized that most of my knowledge, expertise, and fluidity in financial modeling came from working in analytics groups. There I focused on interpreting structures from documents and benefited by learning from others about how to convert the deal structure into a working model. Between the insurance and banking industries, I've seen and built numerous models—from the very basic that are little more than a balance sheet with formulas to incredibly complex models involving stochastic simulations. With every model on which I have worked, I have tried to take away what I have felt to be the best attributes and incorporate those features into my current modeling.

As my experience with financial models continues to grow, I definitely feel that I am at a point where I have worked with enough models to distinguish trends, common practices, and characteristics of exceptional financial modeling. My personal experience has been with cash-flow-based models seen in most fixed income, structured, asset-based, or project finance transactions. To avoid trial by

fire, this book teaches the framework and specifics of cash-flow-based modeling using structured finance as a context. If examples are followed from beginning to end, the result will be a fully operating cash flow model that the reader built step by step.

Aside from being able to create a model from the ground up, understanding how each component is built and interacts will aid a reader who needs to work with other peoples' models. I often find working with another person's model more difficult than building a new one from scratch. It takes time to discern the core components and functionality of the model. However, most well-thought-out models have similar basic elements that can be understood and manipulated. This book intends to cover each of those elements and provide the reader with enough depth to proficiently work with existing models.

Looking back at the moment when I had that trial-by-fire response, I certainly do not feel that has to be the standard that anyone should have to rely on. Regardless if the reader is a new finance professional who wants to learn how to build a model, a seasoned professional who works with others' models, a structured finance professional looking for analyses specific to the field, or simply anyone interested in understanding financial modeling better, I feel that passing on my experience in the form of a book with practical examples can help make the learning process easier and more efficient.

KEITH A. ALLMAN

New York, New York
December 2006

Acknowledgments

My career in finance began at MBIA, Inc., a leading financial guarantor and provider of specialized financial services. There three individuals provided an excellent introduction to financial modeling, namely Henry Wilson, William Devane, and Melissa Brice-Johnson. In particular, I would like to thank Henry for giving me the opportunity to work on a variety of transactions and William for showing me many fundamental techniques. After leaving MBIA, I wrote the first three chapters of this book as part of a proposal to John Wiley & Sons, where I would like to thank my peer editors Maria Costa for her in-depth review as well as Lionel Beehner for his editorial suggestions. Further editorial suggestions were made by Omar Haneef and Matthew Niedermaier as the book developed, both whom I would like to thank especially for their work on the text and Model Builder exercises. Also, this book could not possibly have been brought to market without the amazing support of William Preinitz, who read through, approved, and was a driving force in receiving Citigroup's compliance approval. Lastly, I am very grateful for Siobhan Devine, whose patience and encouragement kept me centered throughout everything.

Also at Wiley, I would like to thank Bill Falloon for working with me from taking the proposal to a signed contract, Emilie Herman for her consistent involvement in every aspect, Laura Walsh and her team for the cover and marketing work, and Mary Daniello and her team for copyediting such a detail-oriented book.

K. A. A.

About the Author

Keith Allman is currently a vice president in the Global Special Situations Group at Citigroup, where he focuses on emerging market analysis. He has created, audited, and used hundreds of cash flow models for mortgages, autos, equipment leases, credit cards, project finance, and multiple esoterics. Prior to his current role, he worked in the Structured Finance group at Citigroup modeling transactions for their conduits. Mr. Allman began his career in finance at MBIA, Inc., a leading financial guarantor, where he was a senior analyst in its quantitative analytics group. Outside of corporate work, Mr. Allman has written computer curriculum and provides instruction for low-income individuals through Streetwise Partners. His education includes a master's degree in international affairs with a concentration in finance and banking from Columbia University and bachelor degrees in political science and psychology from UCLA.

Contents

Introduction

The basic idea behind any financial model is to bring order and understanding to the numerous variables and complex information that financial transactions present. Learning to build one from a blank spreadsheet is often a daunting task to newcomers because of the sheer amount of information and nearly infinite methods of manipulating data. This book seeks to bring a systematic, well-explained method to constructing a particularly popular and adaptable type of model—the cash flow model. Through the use of thorough explanation, graphical examples, and the simultaneous application of learned methods featured in the *Model Builder* exercises, anyone with a background in finance and basic spreadsheet understanding can develop and understand a fully functioning financial model.

The most significant aspect of the model that will be created is that it is constructed within a real-world context focusing on the structured finance industry. Many other financial modeling books explain either application functions or specific theoretical concepts. These books are good for learning a program or understanding an academic topic, yet they are difficult to translate into a functioning financial model. By combining specific application instruction with theory, this book teaches skills that can be applied instantly to professional level modeling.

While the book focuses on structured finance analysis, the model created here can be adapted for use in other fields. A fundamental question is whether a cash flow model is the appropriate choice for the transaction under consideration. With cheap memory, powerful processors, and constant evolutions in financial analytics, a multitude of models are available ranging from real-time market value models to code-intensive Monte Carlo simulations. The cash flow model is primarily used for transactions that involve assets generating cash flow, which is applied against a set of liabilities. These transaction types are often encountered in structured, asset-based, and project finance and typically include the following asset classes:

- Automobile loans and leases
- Residential mortgages
- Commercial mortgages
- Equipment leases
- Credit card receivables
- Insurance/annuity arbitrage
- Emerging market remittances
- CBO/CLO/CDO
- Small business loans
- Timeshares

- Infrastructure (toll road, airport, etc.)
- Resources (oil, timber, etc.)

Naturally this list is not exhaustive. It covers a majority of asset classes that use a cash flow based model. It is possible to merge types of models such as using a Monte Carlo model to determine defaults and then running the results through a cash flow model. The key to deciding on whether a cash flow model is necessary depends on the desired result.

A cash flow model takes in asset assumptions, runs the generated cash through a series of liability assumptions, and determines where and how much cash was allocated over time. This type of modeling is used from many different perspectives, with many different results in mind.

One of the most common uses is an issuer that needs to fund the generation of assets. A company such as Toyota, which has a finance division, may want to fund leases for their own vehicles. Toyota needs to raise money to provide the leases. It could do so in the capital markets by asking a bank to loan funds against the leases by either having a bank directly issue money or sell debt in the term market. Toyota's cash flow analysis would have to focus on how much cash its leases would generate over time to determine the amount of debt that can be issued. A Toyota analyst would want to build a cash flow model to project the expected cash being generated by the leases over time and how that cash would be allocated in a structured financing. The purpose of his or her analysis would be to understand the cash flow well enough to make sure they are receiving as much money as possible for the lowest cost.

The bank would do a similar analysis in more detail. It would want to know how typical Toyota leases perform over time in terms of delinquency, default, and prepayment. No bank would want to issue a billion dollars only to find that the assets will pay back anything less. Also, transactions typically have to be structured to a certain credit rating level set by the three primary credit rating agencies (Standard & Poor's, Moody's, and Fitch). To do this, a transaction has to withstand a certain amount of stress as dictated by the rating agency. The only way to do this is to build a dynamic model and stress it according to rating agency standards. In the bank's cash flow model, it would want to see how much cash the assets generate under stressful situations and whether that is enough to cover the financing costs imposed either by the market or by the bank itself.

In addition, a surety provider might provide insurance on the issuance. It would be extremely analytical in its decision because, if an interest or principal payment is missed on the financing, it would have to pay an insurance claim. A surety would use a cash flow model to ensure that, when variables are stressed, the interest and principal of the debt they insured is paid.

Finally, there are many other related parties that need to know what the issuers and the banks are doing. Credit rating agencies need to model the transactions to make sure that they support certain ratings that the bank and issuer desire. An auditor may want to make sure all the data in a prospectus is correct by modeling

the deal on his or her own. A law firm may want to know if a certain legal structure works in practice. All of these parties need to build a cash flow model to complete such analyses.

THE THREE BASIC ELEMENTS OF A CASH FLOW MODEL

The cash flow model presented in this book can be parsed into three basic elements: inputs, cash flow structure, and outputs. A useful way to think about the three basic elements of financial modeling is to compare them to the elements of cooking. When preparing food, a chef has three basic elements: ingredients, method of preparation, and finished result. The ingredients all have different characteristics such as taste, smell, and texture. The chef then takes certain quantities of ingredients, mixes them in a particular way, and cooks them at a certain temperature for a set amount of time. The appearance, scent, and flavor of the finished food are entirely dependent on the ingredients and cooking process. Any alteration results in different qualities.

Likewise, in financial modeling, there are a number of inputs to start with, a cash flow structure that manipulates the inputs, and a final set of outputs that is reflective of both the selected inputs and structure. The simple pattern that should be realized from this comparison is that the first two elements are interconnected and integral in producing the defining characteristics of the third element.

Inputs

The general idea of an *input* is that it is any piece of data related to the transaction being modeled, factual or assumed, that is necessary to produce accurate results. Inputs can range from simple interest rate assumptions to more difficult concepts such as loss timing and severity. This book takes a model builder through the following inputs:

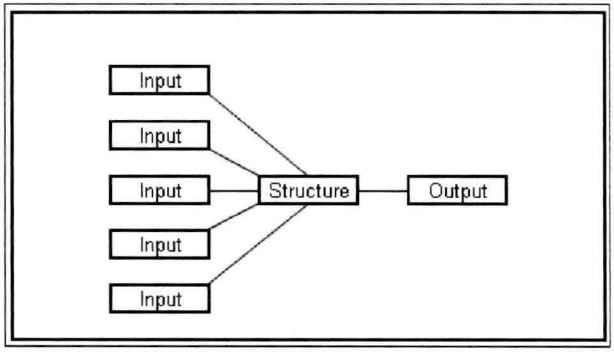

FIGURE I.1 Multiple inputs are passed through a structure to generate results.

1. Basic global inputs such as dates and timing.
2. Common asset inputs that cause and affect cash flow generation.
3. Common liability inputs that include interest rate vectors, fees, and basic liability structures.

Some of these inputs, such as prepayment and loss curves require additional explanation. Two chapters in the book explain the information and methodologies required to properly extrapolate and predict prepayment and loss curves. If questions arise regarding these two very important components, it may be worthwhile to jump to Chapters 3 and 4.

Cash Flow Structure

While inputs are the most familiar part to a model operator who is constantly changing them for different scenarios, the true heart of a cash flow model resides in the actual *cash flow structure*. This structure is created by using formulas, functions, and function/formula combinations to manipulate the inputs in a way that mirrors the transaction's agreed upon structure. The exact structure is dictated by the deal documents, but the cash flow section has a conventional flow.

Usually contained on one sheet, the cash flow structure "moves" cash in one direction for each period. Moving cash refers to the idea that as cash comes into a transaction from the asset inputs it is typically used in a very specific order that is determined by a term sheet, trust agreement, or indenture. The cash moves from one use to the next until the end of the priority of payments that designates where leftover cash, if any remains, should be distributed. Once this process is complete for an individual period, the process begins again for the next period until all cash is exhausted or the final term of the transaction is realized.

Some basic examples of uses of cash include:

- Transaction fees
- Taxes
- Senior interest and principal
- Subordinated interest and principal
- Equity payments due
- Reimbursements

Also, an interesting nuance in many transactions is that frequently the cash flow structure changes with differing assumptions. Using a basic mortgage-backed securities transaction as an example, often times the priority of payments will change if defaults increase to a certain level, breaching a preestablished limit—known as a *trigger*—set in the deal documents. The typical order may be to pay senior interest and principal then subordinated interest and principal. But if defaults breach the trigger, then all remaining cash may be directed to senior payments and the subordinated payments cutoff. This will be explained in much more detail in later

cash flow structure chapters. The idea to understand is that the model being created often has a dynamic cash flow structure.

Outputs

The final element, *outputs*, is equally important to the first two because it is what most likely is seen by people unfamiliar to the model. Most of us do not have the time to pick through the minutiae of a model, but we want to read about the assumptions and results quickly and detailed enough to make a decision. Even printing out the cash flows period by period is ineffective because a majority of managers want to look at a single piece of paper in a format that they are used to and garner enough information from the single sheet to make a decision. It would be highly inefficient to develop a sophisticated financial model if it is overlooked because the results it presents are not clear and easy to read.

THE PROCESS OF BUILDING A CASH FLOW MODEL

Although the primary purpose of this book is to guide a reader through the mechanics of constructing a cash flow model, there are some steps that should be taken before and after the model is created in Excel. In particular for readers new to financial modeling, it is important to go through each of these steps to save time. As one becomes more fluent in financial modeling, the steps can be combined, such as building both the basic and advanced framework at the same time rather than in two separate steps. However, it should be noted that a flaw, which even seasoned financial modelers make, is skipping the plan-and-design and testing steps. A major design problem encountered halfway through building a new model may have been prevented by investing even a minimal amount of time planning. Even worse is not realizing that the model has a problem before using it for final results.

Plan and Design

The first step, planning and design, is what good financial modelers and computer programmers spend most of their time doing. This is best accomplished by writing or drawing out the necessary inputs, the expected flow of cash, and the type of results that are necessary. Each sheet should be thought of with memory, space, cell, and function limitations in mind. For instance, it would be extremely frustrating to build a model only to realize that the inputs require more than 65,556 rows (Excel's row constraint). Since this book uses a preplanned model as the basis for discussion, not much time is spent on this topic; but the importance of planning a new model should not be understated.