
INVESTING IN MORTGAGE SECURITIES

Laurence G. Taff

INVESTING IN



MORTGAGE SECURITIES

Laurence G. Taff, M.S., Ph.D.



St. Lucie Press

Boca Raton London New York Washington, D.C.

AMACOM

American Management Association

New York • Atlanta • Brussels • Buenos Aires
Chicago • London • Mexico City • San Francisco • Shanghai
Tokyo • Toronto • Washington, D.C.

Library of Congress Cataloging-in-Publication Data

Taff, Laurence G., 1947-

Investing in mortgage securities / by Laurence G. Taff.
p. cm.

Includes bibliographical references.

ISBN 1-57444-338-0 (alk. paper)

1. Mortgage-backed securities—United States. I. Title.

HG4655 .T34 2002

332.63'23—dc21

2002069848

CIP

This book contains information obtained from authentic and highly regarded sources. Reprinted material is quoted with permission, and sources are indicated. A wide variety of references are listed. Reasonable efforts have been made to publish reliable data and information, but the author and the publisher cannot assume responsibility for the validity of all materials or for the consequences of their use.

Neither this book nor any part may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, microfilming, and recording, or by any information storage or retrieval system, without prior permission in writing from the publisher.

The consent of CRC Press LLC does not extend to copying for general distribution, for promotion, for creating new works, or for resale. Specific permission must be obtained in writing from CRC Press LLC for such copying.

Direct all inquiries to CRC Press LLC, 2000 N.W. Corporate Blvd., Boca Raton, Florida 33431.

Trademark Notice: Product or corporate names may be trademarks or registered trademarks, and are used only for identification and explanation, without intent to infringe.

Visit the CRC Press Web site at www.crcpress.com

© 2003 by CRC Press LLC

St. Lucie Press is an imprint of CRC Press LLC

No claim to original U.S. Government works

International Standard Book Number 1-57444-338-0

Library of Congress Card Number 2002069848

Printed in the United States of America 1 2 3 4 5 6 7 8 9 0

Printed on acid-free paper

Preface

This is a book about residential mortgage-backed securities and investing in them. Mortgages are financial instruments whose main features are their face amounts and their associated interest rates. In the good old days, the 1950s to 1960s, interest rates were stable and mortgage-backed securities did not exist because there was no need for them. Over the last 30 years interest rates have gone from about 5%/year to roughly 18%/year and back down. The volatility associated with interest rates — that is, a measure of the amplitude of their changes — has gone from a quiet 2% to a raucous 25% at times. This has made all fixed-income instruments, including mortgages and the securities based on them, much more electrifying investment vehicles. Adding further importance, the U.S. housing debt market is now the largest nongovernmental market in the world. Indeed, it is second only to the U.S. federal debt. Today it stands at over four trillion dollars (that is, \$4,000,000,000,000.00 plus). It is far larger than the combination of all the American stock markets. Mortgages and mortgage-backed securities play a very large role in today's investment mix.

This text is more numerical and mathematical than most books on the subject. Mortgages are fixed-income securities that are priced based on their note rates and their cash flows. The latter need to be predicted —or at least understood. These and other market-related factors depend in a quantitative fashion on the other parameters of mortgages and the securities derived from them. When mortgages are packaged together to form a pool of assets backing a mortgage-backed security, the numerical and financial complications only increase and become even more subtle and intricate. To truly understand the nature of the individual whole loan and its many financially engineered investment vehicles, and to truly understand the ways and wherefores of how and why their prices can change, one must become proficient at the basic arithmetical components or elements of fixed-income securities.

The first four chapters of this book allow you the opportunity to master these arithmetical aspects. Many numerical examples are worked through and many more exercises and problems, always with answers, are incorporated. All of the problems can be solved with a standard business calculator. If your interest is not in the quantitative subtleties of these securities, then the material surrounding the mathematical parts of the text is mandatory for understanding fixed- and floating-rate securities, alternative investment possibilities (to evaluate competing places for your funds), how to evaluate what others are telling you about mortgages and mortgage-backed securities, and how and why you should partition your monies among them.

The material covered in the first four chapters includes simple, compound, and continuous interest, the time value of money in the context of present and future value, annuities, and the composition of a nominal interest rate. Also discussed are various types of short- and long-term fixed-income securities and their pricing,

fixed- and adjustable-rate mortgages and their properties (and their less obvious value-related aspects), other common types of mortgages found in the U.S., and a thorough verbal, pictorial, and mathematical exploration of Macaulay duration, modified duration, and convexity. These concepts are absolutely critical to understanding the price risk in mortgages and mortgage-backed securities and to managing a portfolio of mortgage-related securities successfully. Mathematical developments of duration beyond the norm are included at the end of Chapter 3. Finally, a brief overview of automated underwriting ends Chapter 4.

In addition to discussing the financial and numerical aspects of mortgages and mortgage-backed securities, I have tried to place them in their historical setting as the U.S. financial markets have evolved over the last 60 years. The major developments were the creation of government-affiliated institutions, from the FHA and Ginnie Mae to Fannie Mae and Freddie Mac. The special roles that these organizations play, and their overall success at it, have been crucial to the development and growth of the U.S. mortgage markets and their products.

Chapters 5 and 6 are devoted to exploring the types of mortgage-backed securities most frequently encountered. These include pass-through, mortgage-backed securities, stripped mortgage-backed securities, and REMICs (formerly CMOs). The more widespread REMIC tranches — classes such as sequential pay, residual interest, accrual or Z, planned amortization, targeted amortization, reverse TACs, support or companion, floating-rate, inverse floating-rate, and about a half-dozen others — are defined and their pricing vulnerabilities explained. Not only are interest rate sensitivity and its relationship to prepayments covered, but also price variability stemming from alterations in the shape of the yield curve. Naturally, option-adjusted spread methodology and other pricing algorithms for mortgages are covered too. Finally, nonconforming, private-label issuances, their credit enhancement mechanisms, and their risks and rewards are thoroughly dealt with relative to their conforming brethren. It becomes more difficult to perform meaningful numerical computations by hand between Chapters 1 to 4 and 5 to 6; therefore, the number of exercises and problems declines rapidly.

The book turns more mathematical in Chapters 7 and 8. These two chapters cover the term structure of interest rates, the yield curve, forward, spot, and short rates, the probabilistic and financial bases for interest rate modeling, binomial lattices, interest rate swaps, floors and caps and their theoretical pricing, portfolio construction and diversification, and the complete mathematics of mean-variance theory for a two-component portfolio. Chapter 7 also contains the only explanation I have ever seen of why an interest rate swap really works to the benefit of both counterparties. Chapter 8 concludes with a unique, concrete suggestion on how to increase profitability without relying on mostly statistical interest-rate prediction concepts. I am expert in the mathematical content of these two chapters; my feelings with regard to the success, or faults, of commonly used methods are plainly expressed. Because it is relatively easy simply to criticize, whenever I can I offer definite suggestions on how to do better with today's knowledge and technology.

Commercial mortgage-backed securities in our country and investment opportunities overseas are two other growing components to the mortgage-backed securities markets. The largest non-U.S. market is in Germany, but the British have made

significant progress too. Commercial mortgage-backed securities, which really deserve their own book, and non-U.S. markets are briefly covered in Chapter 9.

For the mortgage professional, or aspiring mortgage professional, this book provides a solid grounding in the industry. Those of you with a mathematical bent can ponder some very nice examples and extensions of the usual material.

The Author

Laurence G. Taff has an M.S. in Finance from The Johns Hopkins University. He is employed by one of America's leading financial institutions. As an internal business consultant, Dr. Taff's primary expertise is in the mortgage markets, fixed-rate securities, and risk modeling. He has consulted and delivered papers on financial modeling, portfolio management, and interest rate and credit risk analyses nationally and internationally. Dr. Taff specializes in translating theoretical and abstract concepts into actionable, tangible, profitable results. This is his first business textbook.

Prior to his business career, Dr. Taff worked as a highly accomplished astrophysicist (Ph.D. Physics and Astronomy, University of Rochester; M.S., B.S. Physics and Mathematics, City College of New York). His academic appointments include being the principal research scientist at The Johns Hopkins University. Moreover, he worked for several years at both the Space Telescope Science Institute (where he was in charge of pointing the Hubble Space Telescope) and at M.I.T.'s Lincoln Laboratory.

Dr. Taff's computing experience includes decades of software design, development, and the implementation of procedural and object oriented language programs (e.g., FORTRAN, C, C++, Objective C, etc.) De novo, he conceived, coded, and implemented his discipline's first real-time calibration program. He also constructed the largest astrometric catalog (18 million data points), allowing its users a 300% increase in accuracy. Another project involved melding optimal search techniques, real-time analysis, and correlation resulting in an increased capability by 20-fold. His work typically includes the conceptualization, development, and implementation of unique mathematical "tools."

Dr. Taff has published three other books. Two are standards in classical astronomy, the third a text on scientific statistical data adjustment. In addition, he has published over 100 papers in scientific journals and conference proceedings.

Contents

Chapter 1	Interest and the Time Value of Money	1
I.	Basic Interest Concepts	1
A.	What Is Interest?	1
1.	Simple Interest and the Time Value of Money	2
2.	Multiple Simple Interest Payments	4
3.	Compound Interest	4
4.	Continuous Compounding	8
5.	Discounted Interest	9
6.	Holding Period Return	10
B.	Fixed-Income Mathematics	10
1.	An Example	10
2.	The Geometric Mean	11
3.	The Arithmetic Average Value or Mean	13
C.	Inflation and Interest Rates	17
1.	The Risk-Free Rate	17
2.	The Nominal Interest Rate	17
D.	Annuities	18
1.	The Formula for the Future Value	18
2.	The Geometric Series	19
3.	The Fixed-Income Form for Geometric Series	21
4.	The Present Value of an Annuity	22
II.	Net Present Value	23
A.	The Concept	23
1.	Arbitrage-Free Pricing	23
B.	The Term Structure of Interest Rates: An Introduction	24
Problems	25
Chapter 2	Money and Bond Market Overview	29
I.	Introduction	29
II.	Short-Term Securities	30
A.	Notes	30
B.	Other Short-Term Securities	31
1.	Repurchase Agreements	32
III.	Long-Term Securities and Their Valuation	33
A.	Definitions	33
1.	Simple Bond Evaluation and Pricing	34
2.	More on Yields	38
B.	The Reinvestment Issue and Zero Coupon Bonds	39

1. An Alternative Interpretation of a Standard Bond	40
2. More on the Yield-to-Maturity	40
3. Perpetual or Consol Bonds	42
IV. U.S. Government Bills, Notes, and Bonds	42
A. T-Bills	42
1. Bond-Equivalent Yield	43
2. When-Issued Trading	44
B. Treasury Notes and Bonds	44
1. Pricing Formula	45
2. Day Count	45
C. Other Related Topics	46
1. Municipal Bonds	46
2. Bond Ratings	46
V. Bond Pricing Maxims	47
Problems	50
 Chapter 3 More Advanced Fixed-Income Topics	 53
I. Duration	53
A. Macaulay Duration	53
1. Duration and Portfolio Management	53
2. Definitions	54
3. What Duration-Matching Does for You	56
4. Duration Maxims	58
B. Modified Duration	59
1. The Formula for Modified Duration	60
2. The Relationship between the Two Durations	61
3. Modified Duration and the Float Toy	62
4. The Duration of a Floating-Rate Security	64
5. Portfolio Duration	64
II. Convexity	66
A. Word Examples of Duration and Convexity	67
1. The U-Haul® Example	67
2. The Airplane Fuel Tank Example	68
3. What Positive Convexity Really Means	70
B. The Formal Definition of Convexity	70
1. Price Change Usage	72
2. Convexity Maxims	72
C. Callable Bonds and Negative Convexity	72
1. Definition of an Option	72
2. Callable Bonds	73
3. Calculating the Yield-to-Call	75
4. Negative Convexity	75
D. The Option-Adjusted Spread	76
1. Callable Bond Pricing	76

III. A Portfolio Version of Duration	77
A. Introduction	77
B. The Average Discount Rate for a Mortgage.....	78
1. Mathematical Preliminaries.....	78
2. The General Solution for a Mortgage	81
C. The Average Discount Rate for a Bullet Bond.....	83
D. Extending the Usefulness of Modified Duration	84
1. Arbitrary Cash Flows	85
Problems	86
 Chapter 4 Overview of Common U.S. Mortgage Types.....	89
I. The U.S. Mortgage Markets Today.....	89
A. The Components	89
1. What the Secondary Market Does	91
2. Mortgage-Backed Bonds.....	92
B. Some History.....	93
1. Further Developments	95
2. The Federal Home Loan Bank System	95
3. More Recent History	96
4. More on Amortization.....	97
5. Default Generalities.....	98
II. Fixed-Rate Mortgages	100
A. Fixed-Rate Mortgage Mathematics.....	100
1. Derivation of the Formulas	101
2. Macaulay Duration for a Mortgage	104
3. The Negative Convexity of Mortgages.....	105
4. 50% Tables	106
B. Bi-Weekly Payment Mortgages	106
1. The Mathematics.....	106
C. Mortgage Valuation Techniques.....	107
1. Twelve-Year Average Life.....	107
2. Static OAS Computation.....	107
III. Other Types of Common Mortgages.....	112
A. Background.....	112
1. Adjustable-Rate Mortgages.....	112
2. Definitions	112
3. Valuation Considerations.....	115
B. Adjustable-Rate Mortgage Mathematics	116
C. Other Common Types of Mortgages in the U.S.	117
1. The Graduated Payment Mortgage.....	117
2. Growing Equity Mortgages.....	117
3. Fixed-Rate, Tiered-Payment Mortgages	117
4. Pledged-Asset Mortgages.....	118
5. Balloon Re-set Mortgages.....	118
6. Two-Step Mortgage	118

7. Reverse Mortgages	118
8. Shared-Appreciation Mortgages	119
9. Hybrid Mortgages	119
10. Prepayment Penalty Mortgages	119
11. Relocation Mortgages	119
IV. Automated Underwriting	119
A. What Is Underwriting?.....	119
1. What Is Automated Underwriting?.....	120
B. Important Underwriting Factors.....	120
1. Credit Scoring	120
2. Equity	122
3. Liquid Reserves.....	122
4. Debt-to-Income Ratios	122
5. Loan Purpose.....	122
6. Mortgage Type	123
7. Mortgage Term.....	123
8. Property Type	123
9. Borrower Employment Category	123
Problems	123

Chapter 5 Mortgage Securitization in the U.S. 127

I. What Is a Mortgage-Backed Security?	127
A. Background.....	127
1. Definitions	127
2. Some History.....	130
3. Why Securitize?	131
4. More on the Benefits of Securitization.....	132
5. From the Originator to the Conduit.....	134
6. Private Conduits	135
B. Operational Issues	135
1. Servicing.....	135
2. To-Be-Announced Trading.....	135
3. Specified Pool Trading	137
4. Dollar Rolls	138
C. Statistics That Characterize MBSs	140
1. The (Gross) Weighted Average Coupon	140
2. The Weighted Average Maturity	141
3. The Weighted Average Loan Age	142
4. WAC Dispersion Effects	143
5. WAM Dispersion Effects	143
6. Bond-Equivalent Yield and Mortgage-Equivalent Yield.....	144
7. More on Risks and Pricing	145
8. GSE Activities	145
II. Prepayments.....	146
A. Editorial	146

B.	Overview of Prepayments	148
1.	Definition	148
2.	Other Factors	148
3.	Does Better Analysis Imply Better Prediction?.....	150
C.	Prepayment Mathematics	151
1.	The Single Monthly Mortality Rate	151
2.	The Conditional Prepayment Rate	152
D.	More Generalities on Prepayments.....	153
1.	Generalities.....	153
2.	More on Prepayments	153
3.	Government vs. Conforming MBSs	154
4.	15- and 30-Year MBSs.....	155
III.	Pricing MBSs.....	157
A.	Yield Curve Considerations	157
1.	The Main Yield Curve Effects	157
2.	More on Yield Curve Implications for MBSs	157
B.	Other Factors	159
1.	Seasoned MBS Characteristics	159
2.	Higher Coupon MBSs.....	160
3.	ARM Evaluation Considerations	160
IV.	More on MBS Pricing	162
A.	Simple Methods.....	162
1.	The 12-Year Average Life.....	162
2.	Static Cash Flow Yield.....	162
3.	Static Spread and Zero-Volatility Spread	163
B.	Outline of the Full OAS Method.....	163
1.	More Thoughts on OAS.....	164
Problem.....		165

Chapter 6 More Complicated Mortgage Securities..... 167

I.	History and Definitions	167
A.	Why REMICs?	167
1.	REMIC Class Prepayment Characteristics	167
2.	The History of REMICs.....	168
3.	Structuring a REMIC	169
B.	Stripped Mortgage-Backed Securities	169
1.	IOs and POs	169
2.	Valuation Considerations.....	171
3.	What Is a REMIC?.....	172
C.	The Basic REMIC Mechanism	173
1.	A Simple REMIC.....	173
2.	Recap	175
3.	The R Class	176
4.	Summary.....	176
5.	CMO Arbitrage.....	178

D.	Whole-Loan REMICs	178
1.	The Servicer's Role.....	179
II.	Other Common REMIC Classes	180
A.	Planned Amortization Classes.....	180
1.	PAC Bands and Effective Collars	180
2.	PAC Class Value Considerations.....	182
B.	Support Classes	182
C.	Targeted Amortization Classes.....	183
1.	Reverse TACs	183
2.	More on IOs and POs	183
D.	Floating-Rate and Inverse Floating-Rate Classes.....	184
1.	Duration and Yield Curve Considerations	185
2.	Yield Curve Risk.....	186
E.	Other Classes.....	187
1.	VADMs.....	187
2.	Jump Zs and Sticky Jump Zs.....	187
3.	Notional IOs	187
4.	WAC IOs	188
III.	Credit Enhancements	188
A.	External Forms of Credit Enhancements.....	189
1.	Pool Insurance	189
2.	Bond Insurance.....	190
3.	Other Forms.....	190
B.	Internal Credit Enhancements	190
1.	Senior/Subordinated Structures.....	190
2.	Reserve Funds	191
3.	Shifting Interest Structure	191
Chapter 7	Interest Rate-Related Topics	193
I.	The Term Structure of Interest Rates and the Yield Curve	193
A.	Definitions	193
1.	The Differences among Them	194
2.	Appearance	194
3.	"Explanations" for the Curves	194
B.	Types of Interest Rates.....	196
1.	Spot Rates (Discrete Compounding)	196
2.	Forward Rates (Discrete)	198
3.	Short Rates (Discrete).....	199
4.	Spot Rates (Continuously Compounded and Continuous).....	200
5.	Forward Rates (Continuous)	200
C.	Constructing the Term Structure.....	201
1.	Statistical Issues	202
2.	Using Zero Coupon Instruments.....	202
3.	Using Coupon-Paying Instruments	203

II.	Interest Rate Swaps, Caps, and Floors.....	204
A.	Interest Rate Swaps.....	204
1.	Basic Definitions	204
2.	Why Participate in One?.....	205
3.	Swap Dealers.....	205
B.	Why an Interest Rate Swap Really Works	206
1.	The Mathematics.....	206
C.	More on Interest Rate Swaps, Caps, and Floors.....	209
1.	Forward Rate Agreements.....	210
2.	The Mechanics of a Fixed- for Floating-Interest Rate Swap.....	211
3.	Pricing Considerations for an Interest Rate Swap	211
4.	Interest Rate Caps and Floors.....	212
III.	Interest Rate Modeling	213
A.	Basic Probability Ideas.....	213
1.	The Normal Distribution.....	213
2.	The Log-Normal Distribution	214
3.	The Volatility Parameters	215
B.	Statistical Properties of Financial Securities	217
1.	The Definition of a Random Walk.....	217
2.	The Definition of a Continuous Time Wiener Process	219
3.	An Ito Process	220
C.	The Relationship among Interest Rates and Statistics	221
1.	The Spot-Rate Version	221
2.	The Forward-Rate Version	221
3.	The Random Interest-Rate Version.....	222
4.	What Is Done in Practice.....	223
5.	Summary.....	224
D.	Binomial Lattices	224
1.	Parameter Specification.....	226
2.	Trinomial Lattices	227
3.	More on the Binomial Lattice.....	228
4.	The CIR Model	228
5.	Principal Component Analysis.....	229
E.	Editorial	230
F.	A Final Review of the OAS Method.....	230
1.	More Details.....	232
2.	Pros and Cons	233

Chapter 8 Portfolio Management..... 235

I.	Introduction.....	235
A.	Asset Allocation	237
1.	Model Fixed-Income Portfolios	238
B.	Market Timing.....	240
1.	Duration and Portfolios.....	240
2.	Callable Bonds	242

C.	Security Selection.....	242
1.	Model Mortgage Portfolios.....	243
2.	Yield	243
3.	On Diversification	244
II.	The Mathematics of Portfolio Risk.....	246
A.	A Two-Asset Portfolio	246
1.	Overview	246
B.	The Expected Rate of Return of a Portfolio of Assets	249
1.	The Expected Rate of Return for One Asset.....	249
2.	The Result for a Two-Asset Portfolio.....	249
3.	The Variance of an Asset	251
4.	The Minimum Variance Portfolio	253
5.	A Risk-Free Asset	257
C.	Multiple-Asset Portfolios	258
1.	Only the Covariance Really Matters.....	259
D.	Portfolio Construction Formulas.....	260
III.	A New Strategy for Optimizing Fixed-Income Portfolio Value.....	260
A.	The Equity Markets.....	261
B.	The Debt Markets.....	261
C.	The Underlying Problem.....	262
D.	Current Practice.....	263
1.	The Ideal.....	263
2.	The Essential Mathematics	265
3.	So What is New?.....	266
4.	Incorporating Macaulay Duration.....	268
Problem.....		269

Chapter 9 Other Topics 271

I.	Commercial Mortgage-Backed Securities.....	271
A.	Background.....	271
1.	More on the RTC	272
2.	CMBS Format	274
3.	Types of Commercial Property	275
4.	Key CMBS Financial Ratios.....	278
5.	CMBS Pool Types.....	278
II.	Non-American Mortgage Markets	279
A.	Overview	279
B.	Other North American Markets	280
1.	The Tradition of English Law.....	280
2.	The Canadian Mortgage Market	280
3.	The Mexican Mortgage Market	283
B.	The Major European Mortgage Markets	285
1.	The German Mortgage Market	285
2.	The British Mortgage Market	288
3.	The Irish Mortgage Market.....	293

4. The Austrian Mortgage Market.....	295
5. The French Mortgage Market.....	295
6. The Spanish Mortgage Market	297
7. The Danish Mortgage Market.....	298
8. The Swedish Mortgage Market.....	299
9. The Luxembourg Mortgage Market.....	299
C. Other West European Mortgage Markets	300
1. Belgium	300
2. Finland.....	300
3. Greece.....	300
4. Italy.....	300
5. The Netherlands	300
6. Norway	301
7. Switzerland	301
D. East European Mortgage Markets.....	301
1. The Czech Republic	301
2. Hungary	301
3. Latvia.....	301
4. Poland.....	302
5. The Slovak Republic	302
E. Other Foreign Markets	302
1. The Argentinean Mortgage Market.....	302
2. The Australian Mortgage Market.....	302

References.....	307
------------------------	------------

Index.....	309
-------------------	------------

1 Interest and the Time Value of Money

Mortgages in the U.S. are mostly *fixed-rate securities*. This chapter covers the basics of *simple*, *compound*, and *continuous interest* calculations and their usage in fixed-income securities with (mostly) constant cash flows. *Present value*, *future value*, and other aspects of fixed-income mathematics and definitions of key interest rate concepts are dealt with too. When we move on to mortgage-related derivatives, the importance of this and the next two chapters for valuation and portfolio management will become even more apparent. (The first time a financially important concept is mentioned it will appear in italics.)

I. BASIC INTEREST CONCEPTS

A. WHAT IS INTEREST?

“What is interest?” or, more properly put if you are a borrower, “what are *interest charges*?” is an important question. Interest charges are the cost to you of renting someone else’s money. We are so used to being colloquial about it that we tend to refer only to the *interest rate*, or just the interest, as the cost of renting money. It should not surprise you that a cost is associated with *borrowing* (renting) money because a cost is associated with renting most things. Alternatively, you could be the lender. Then the question “What is interest?” means “What are the interest payments you will receive for *lending* out your funds?” Put differently, if you are making an *investment* by lending money, what will the *rate of return* on your venture be?

You have some money. You could spend it now on goods or services. Another option is that you could lend it out to someone. Hence, a more sophisticated interpretation for the interest rate you are willing to accept is that the interest you charge is the price for your deferment of immediate consumption. With many tens of thousands of participants in the financial markets, “the” interest rate is the consensus market rate for the suspension of consumption. In reality various interest rates exist, each appropriate to a diverse customer segment (primarily separated by *credit* or *default risk* and the time span of the loan).

When you make an investment, your intention is to give up immediate possession of those funds for a larger, future amount. The greater quantity of money will then be available for procurement of goods, use of services, or further investment. It is the expected growth in the amount of money, over time, that induces you to defer expenditures for future consumption, that is, to *invest*. Some rate of exchange must exist between current dollars and future dollars (just as there is some rate of exchange