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# Fixed Income Securities

*Tools for Today's Markets*

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BRUCE TUCKMAN  
ANGEL SERRAT

# Fixed Income Securities

*Tools for Today's Markets*

Third Edition

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藏书章



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Additional Praise for  
*Fixed Income Securities: Tools for Today's Markets,*  
*3rd Edition*

"The coverage of fixed income markets and instruments is even better than in previous editions while the book retains the same clarity of exposition via extensive, carefully worked examples. An outstanding textbook that is extensively used by practitioners is something special. This is indeed the standout text on fixed income."

—Stephen M. Schaefer, Professor of Finance, London Business School

"This is a terrific reference text that combines a strong conceptual framework with real-world pricing and hedging applications. It is a must-read for any serious investor in fixed income markets."

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"This outstanding book achieves the perfect balance between presenting the foundational principles of fixed income markets and providing interesting and insightful practical applications. This classic is required reading for anyone interested in understanding fixed income markets."

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"This is a great book. It covers the most current issues in fixed income and reflects the authors' deep understanding of the markets grounded in the theory of finance and many years of practical experience."

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# Fixed Income Securities



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## Preface to the Third Edition

The goal of this book is to present conceptual frameworks for pricing and hedging a broad range of fixed income securities in an intuitive, mathematically simple, and applied manner. Conceptual frameworks are necessary so as to connect ideas across products and to learn new material more easily. An intuitive and mathematically simple approach is certainly useful to students and practitioners without very advanced mathematical training, but it is also really a good way for everyone to learn new material. Finally, an applied approach is crucial for several reasons. First, examples go a long way in solidifying conceptual understanding. The introduction of practically every concept in this book is followed by an example taken from the markets or, at the very least, by an appropriately calibrated example. Second, important details emerge from applications. Third, only by working through real or realistic examples can orders of magnitude be learned and appreciated. For example, a study of  $DV01$  is not complete without having absorbed that the sensitivity of a 10-year bond is about 8 cents per 100 face amount per basis point, as opposed to 0.8 cents, 80 cents, or 8 dollars.

The book begins with an Overview of global fixed income markets. This section provides institutional descriptions of securities and market participants along with data designed to illustrate absolute and relative sizes of markets and players. A well-informed fixed income market professional has some idea about how central banks around the world have reacted to the financial crisis of 2007–2009 and can say whether the size of the mortgage market in the United States is one-tenth the size of GDP, about equal to GDP, or 10 times GDP.

For securities with fixed cash flows, Part One of the book presents the relationships across prices, spot rates, forward rates, returns, and yields. The fundamental notion of arbitrage pricing is introduced and is central to the analysis. Part Two describes how to measure and hedge interest rate risk, covering one-factor metrics, namely,  $DV01$ , duration, and convexity (in both their general and yield-based forms); two-factor metrics like key-rate '01s, partial  $PV01$ s, and forward bucket '01s; and empirical methods like regression and principal component analysis.

Part Three turns to the arbitrage pricing of contingent claims, i.e., of securities with cash flows that depend on interest rates, like options. The science of arbitrage pricing in this context is followed by a framework in which

to think about the shape of the term structure of interest rates in terms of expectations, risk premium, and convexity. One-factor term structure models are then described, to be used both in their own right, when appropriate, and as building blocks toward more sophisticated models. Chapter 11, the last chapter in Part Three, has two parts. First, it presents a multi-factor model for use in relative value applications, along with suggestions for estimating its parameters empirically. Second, it introduces the *LIBOR* Market Model, an extremely popular model for pricing exotic derivatives, in a particularly accessible manner.

Finally, Part Four applies the knowledge gained in the previous three parts to present and analyze a broad and extensive range of fixed income topics and products including repo, bond and note futures, rate futures, swaps, options, corporate bonds and credit default swaps (CDS), and mortgage-backed securities.

This edition substantially revises and expands the second. The only parts of the book that have remained essentially unchanged are Chapters 7 through 10 on pricing contingent claims with one-factor term structure models. The rest of the material that was in the second edition has been updated and, with the exception of a couple of particularly interesting case studies, the numerical illustrations, examples, and applications are all new. In addition, several chapters in this third edition are completely new and others significantly expanded. New chapters include the Overview, Chapter 17 on how the realities of financing have changed the practice of discounting cash flows, and Chapter 19 on corporate bond and CDS markets. Significantly expanded chapters include Chapter 6 on empirical hedging, which now includes principal component analysis; Chapter 11, which was discussed above; Chapter 18 on volatility and fixed income options, which now covers a very broad range of products, Black-Scholes pricing, and a mathematically simple introduction to martingale pricing; and Chapter 20, on mortgages and mortgage-backed securities, which takes a much more market-oriented approach and adds material on pool characteristics, TBAs, and dollar rolls.



## Acknowledgments

**T**he authors would like to thank the following people for helpful comments and suggestions: Amitabh Arora, Larry Bernstein, John Feraca, Lawrence Goodman, Jean-Baptiste Homé, Dick Kazarian, Peyron Law, Marco Naldi, Chris Striesow, and Doug Whang. We would like to thank Helen Edersheim for carefully reviewing the manuscript and sparing readers from phrases like “options wroth about \$2” and the like. Finally, we would like to thank Bill Falloon, Meg Freeborn, and Natasha Andrews-Noel at Wiley for their patience and support throughout the process of putting this book together.

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# An Overview of Global Fixed Income Markets

This overview begins with a snapshot of fixed income markets across the globe and continues with concise reviews of fixed income markets in the United States, Europe, and Japan. These reviews have three goals: one, to describe how households and institutions achieve their borrowing and investing objectives through fixed income markets; two, to highlight the magnitude of the amounts of securities outstanding and of the balance sheets of market participants; and three, to emphasize the themes that are particularly relevant and significant for understanding today's markets.

## **A SNAPSHOT OF GLOBAL FIXED INCOME MARKETS**

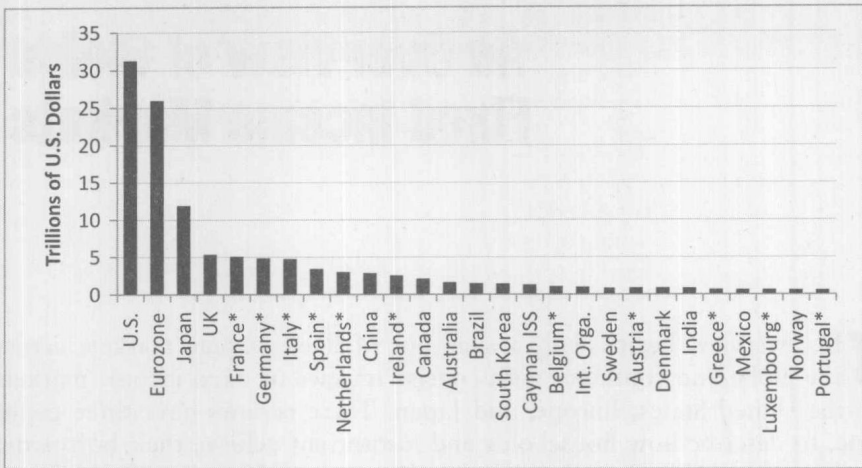
While fixed income markets are truly global, the vast majority of securities originate in the United States, Europe, and Japan. Figure O.1 shows the notional amounts outstanding of debt securities by residence of issuer, arranged in order of decreasing size. The largest markets by far are in the United States, the *Eurozone*, Japan, and the United Kingdom. (The Eurozone includes countries that are part of the European Union and also use the Euro as their currency.) The amounts outstanding for many Eurozone countries are shown individually in the graph, and indicated with asterisks, because several of these markets rank among the largest in the world on their own.

Derivative securities do not have an issuer in the same sense as do debt securities, but the distribution of the notional amounts of over-the-counter (OTC) interest rate derivatives across currencies tells a story similar to that of Figure O.1. According to Figure O.2, which shows amounts outstanding of single-currency, OTC interest rate derivatives, markets are dominated by contracts denominated in EUR (Euro), USD (United States dollar), JPY (Japanese Yen), and GBP (British Pound).<sup>1</sup> And with respect

---

<sup>1</sup>The other currencies appearing in the graph are CHF (Swiss Franc), SEK (Swedish krone), CAD (Canadian dollar), AUD (Australian dollar), NOK (Norwegian krone), HKD (Hong Kong dollar), DKK (Danish krone), and NZD (New Zealand dollar).

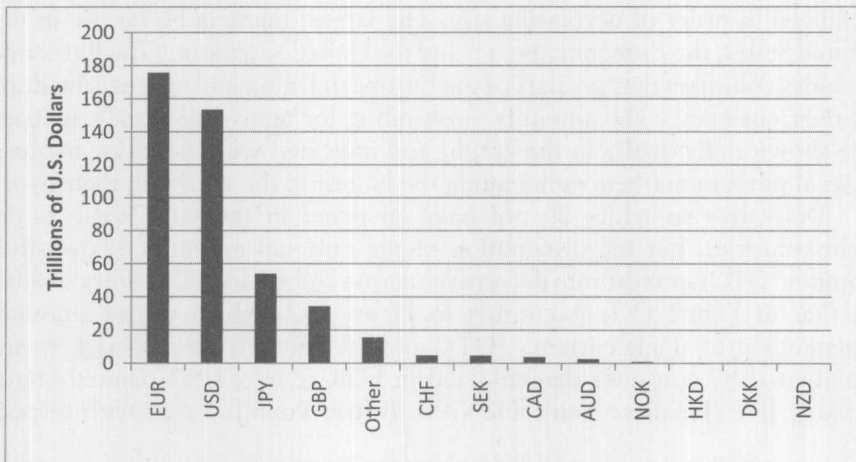




**FIGURE O.1** Debt Securities by Residence of Issuer as of March 2010  
*Source:* Bank for International Settlements.

to exchange-traded derivatives, Table O.1 shows that Europe and North America comprise almost all of the outstanding notional amount.

It is worthwhile noting that Figures O.1, O.2, and Table O.1 report the place of origination of fixed income securities rather than the place of residence of the ultimate owners or counterparties. So, to take one of the more significant examples, China's ownership of nearly \$850 billion of U.S.



**FIGURE O.2** Amounts Outstanding of OTC Single-Currency Interest Rate Derivatives as of December 2009  
*Source:* Bank for International Settlements.

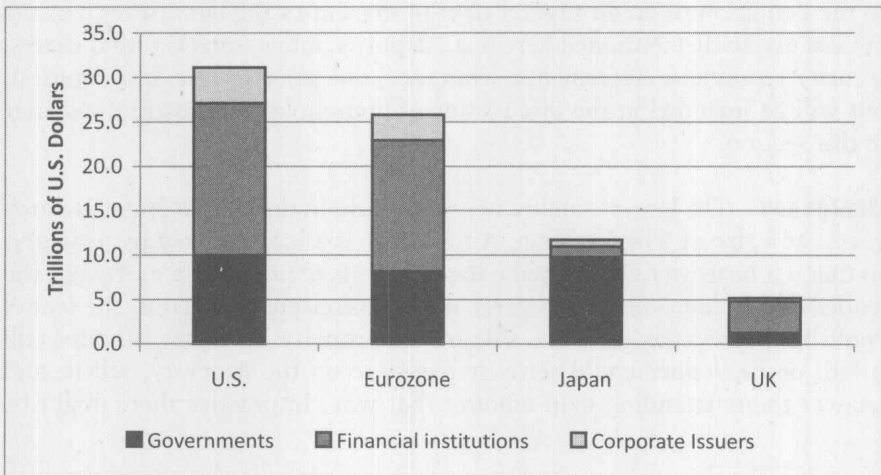
**TABLE 0.1** Exchange-Traded Interest Rate Derivatives as of March 2010, in Billions of U.S. Dollars

Region	Notional
Europe	27,807
North America	22,604
Asia and Pacific	10
Other	934

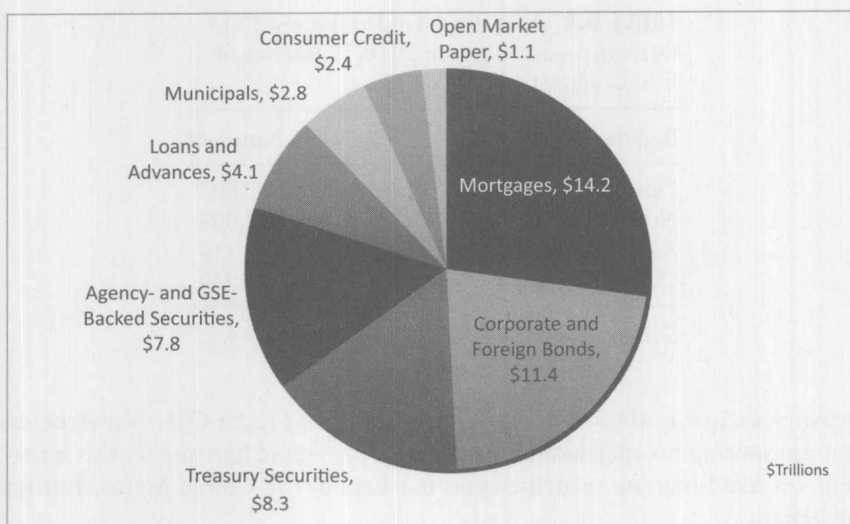
Source: Bank for International Settlements.

Treasury securities does not appear anywhere in Figure O.1. Nevertheless, even accounting for such instances, the data presented here justify this book’s focus on fixed income securities and markets in the United States, Europe, and Japan.

As a final note before turning to the three overviews, Figure O.3 gives a coarse breakdown of the composition of debt securities in the United States, the Eurozone, Japan, and the United Kingdom. (The totals are the same as those reported in Figure O.1.) While the proportions of debt issued by governments, financial institutions, and corporations are similar in the United States and the Eurozone, debt markets in Japan are dominated by governments while those in the United Kingdom are dominated by the issues of financial institutions.



**FIGURE 0.3** Debt Securities by Residence of Issuer and Sector as of March 2010  
Source: Bank for International Settlements.



**FIGURE O.4** Credit Market Debt in the United States as of March 2010  
 Source: Flow of Funds Accounts of the United States.

## FIXED INCOME MARKETS IN THE UNITED STATES

### Securities and Other Assets

Figure O.4 shows the major categories of credit market debt in the United States, along with the size of the market for each, as of March 31, 2010.<sup>2</sup> Due to the definition of credit market debt in this cut of the data, several assets are not explicitly mentioned here (e.g., deposits, money-market fund shares, security repurchase agreements, insurance and pension reserves, equities), but will be included in the discussions of households and institutions later in this section.

**Mortgages** The largest single category of debt in the United States is *mortgages*, at a size of \$14.2 trillion. A mortgage is a loan *secured* by property, so that if a borrower fails to make the payments required by a mortgage, the lender has a claim on the property itself. Exercising this claim, the lender could keep proceeds from the sale of the property up to the amount still owed; or the lender could *foreclose* on the property, sell it, and recover the outstanding loan amount that way. In practice there might be

<sup>2</sup>The data for this figure and for much of this section come from the Board of Governors of the Federal Reserve System, “Flow of Funds Accounts of the United States,” June 10, 2010. See also the accompanying “Guide to the Flow of Funds Accounts.”

restrictions on the immediate or full exercise of this claim, like bankruptcy and other borrower protections or any tax liens on the same property. Finally, depending on the laws of the relevant state, the lender might or might not have *recourse* to the borrower's other assets to collect any remaining amount owed after the sale of the property.

Of the \$14.2 trillion outstanding, \$11.6 trillion is home or other residential mortgages, \$2.5 trillion is commercial mortgages, and \$138 billion is farm mortgages. To put the size of this market into context, two comparative statistics are useful. First, the annual gross domestic product (GDP) of the United States as of the first quarter of 2010 was \$14.6 trillion.<sup>3</sup> Hence, it would take almost the entire output of the economy for one year to pay off all mortgage debt. Second, as of March 31, 2010, the public debt of the United States, at a historical high of \$12.8 trillion, was \$1.4 trillion less than the amount of mortgage debt outstanding.

Mortgages and mortgage-backed securities are the subject of Chapter 20.

**Corporate and Foreign Bonds** The second largest category of debt in Figure O.4 consists of corporate and foreign bonds. Corporate bonds are sold by businesses to finance investment, like the building of a new plant, the purchase of other businesses, or the purchase of investment securities. Bonds are also sold to *refinance* outstanding debt issues, that is, to retire existing debt not with corporate cash, which might have better uses, but with the proceeds raised by selling new debt. Motivations for retiring existing debt include redeeming maturing debt, repurchasing an issue to be rid of bond covenants that have become overly onerous, or exercising an embedded option to repurchase bonds at some prespecified and currently attractive call price.

As of the end of March 2010, \$11.4 trillion of corporate and foreign bonds were outstanding, \$5.6 trillion of which were sold by corporations in the financial sector. Proceeds raised by the financial sector, as will be discussed shortly, are used for the most part to purchase other securities.

Corporate bonds and derivatives on corporate bonds, namely, *credit default swaps*, or CDS, are the subject of Chapter 19.

**Treasury Securities** The next category is *Treasury securities*, obligations of the U.S. government incurred to finance its spending. U.S. Treasuries are among the most liquid securities in the world, meaning that investors can almost always buy and sell large amounts of Treasuries at prices close to relatively transparent market levels. In addition, while the finances of the U.S. government have deteriorated by historical standards, its debt is still

<sup>3</sup>Source: Bureau of Economic Analysis, U.S. Department of Commerce.