Arbitrage in the Government Bond Market?[1]

On January 7, 1991, Samantha Thompson, who analyzed and traded government bonds for the firm of Mercer and Associates, noticed what she thought were major discrepancies in the prices of a number of long-maturity U.S. Treasury bonds. These apparent discrepancies might permit Mercer and its clients to substitute superior bonds for existing holdings, and pocket a positive pricing difference as well. Her firm could also capture arbitrage profits by taking offsetting positions to the extent that they were able to establish short positions in the overpriced securities.

What made this alleged arbitrage opportunity so unusual was that it existed in the U.S. government bond market, the largest, most liquid, and closely watched fixed-income market. As of December 1990, the U.S. Treasury had almost $2.2 trillion of Treasury bills, notes, and bonds outstanding.[2] To put this market's magnitude in perspective, Treasury obligations outstanding at the end of 1990 were 1.8 times as large as total U.S. corporate bonds outstanding, 3.2 times as large as total bank loans outstanding, and 3.0 times as large as total municipal bonds outstanding.[3] Throughout the 1980s and early 1990s, raising Treasury debt through the capital markets served as the mechanism for funding the large budget deficits incurred by the federal government.

The Treasury market was significant not only for its size, but also for its liquidity. On an average day, approximately 5% of all government securities changed hands.[4] In comparison, turnover in the New York Stock Exchange in 1990 was 46% for the year, or approximately .2% per day.[5] The closely-watched Treasury market was an unlikely place to find arbitrage opportunities.

---

[1]This case study describes the situation analyzed in the working paper, "Negative Put and Call Prices Implicit in Callable Treasury Bonds," by Michael E. Edleson, David Fehr and Scott P. Mason. This topic is also treated by Francis A. Longstaff in "Are Negative Option Prices Possible? The Callable U.S. Treasury Bond Puzzle" *Journal of Business* 65 (October 1992), pp. 571-592.

[2]A Treasury bill has an original maturity (maturity at issue) of less than or equal to 1 year, Treasury notes have maturities of 2-10 years, and Treasury bonds have maturities of greater than 10 years. As of December 1990 there were $527 billion, $1,265 billion, and $388 billion of bills, notes, and bonds outstanding, respectively (*Economic Report of the President*, February 1992, p. 394).

[3]*Federal Reserve Bulletin*, September 1991, p. A-43. Only the $3.85 trillion outstanding balance of mortgages (all classes) account for more funds than Treasury securities.

[4]Joint Report on the Government Securities Markets, January 1992, p. B-28.

[5]New York Stock Exchange Fact Book, 1991, p. 77.

Professors Michael E. Edleson and Peter Tufano wrote this case from public sources as the basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation. The case, while set in a hypothetical organization, uses actual trade data and is patterned after a real situation.

Copyright © 1993 by the President and Fellows of Harvard College. To order copies or request permission to reproduce materials, call 1-800-545-7685 or write Harvard Business School Publishing, Boston, MA 02163. No part of this publication may be reproduced, stored in a retrieval system, used in a spreadsheet, or transmitted in any form or by any means—electronic, mechanical, photocopying, recording, or otherwise—without the permission of Harvard Business School.

DO NOT COPY

New Treasury securities were brought to market regularly, a wide group of dealers actively traded them, and prices were widely disseminated.

Of the $388 billion of Treasury bonds outstanding at the beginning of 1991, 26 issues with aggregate face value of $98 billion were callable. Callable Treasury bonds, issued during the 1973-1984 period, typically had original maturities of 30 years and coupon rates ranging from 7% to 14%.[6] What differentiated callable Treasuries from noncallable Treasury bonds was the call feature that the government retained. The Treasury retained the right, but not the obligation, to redeem the callable Treasuries at par (100) on any semiannual interest payment date within five years of maturity, provided that it gave investors four months' notice. For example, the government could redeem the 7% callable Treasury bond maturing on May 15, 1998, at face value on any of the ten semiannual interest payment dates beginning in May 15, 1993.[7] If the Treasury chose to redeem the bonds on May 15, 1993 (the first possible call date), it would need to give notice to investors no later than January 15, 1993. **Exhibit 1** shows the Treasury's call policy over the past half century.

On January 7, 1991, Samantha Thompson's attention was caught by the pricing of the 8¼ May 00-05, or the 8.25% coupon Treasury bond[8] maturing May 15, 2005, first callable on May 15, 2000, whose price appeared out of line relative to other bonds in the market. By combining noncallable bonds maturing in 2005 with zero coupon Treasuries (or STRIPS)[9] maturing in 2005, Ms. Thompson could create a synthetic bond with semiannual interest payments of $4.125 per $100 face value and whose final payment of $100 at maturity exactly matched those of the callable bond—if the callable bond *was not called*. Because this synthetic bond did not surrender a redemption right to the government, it should be worth more to investors (i.e., have a higher price or a lower yield) than the callable bond of the same maturity.

Alternatively, Ms. Thompson could construct another synthetic noncallable Treasury bond by combining noncallable bonds maturing in 2000 with STRIPS maturing in 2000; this synthetic should also be worth more than the callable 00-05. This synthetic matched the callable bond—if it *was called* at the first possible date. It too should be worth more than the callable bond. Based on the prices on January 7, 1991, these simple pricing relations seemed to be violated. Current prices for that day are given in **Exhibit 2**; a time series of price data for the callable bond is shown in **Exhibit 3**.

If Ms. Thompson's analysis was correct, it suggested a way for clients who owned the callable 00-05s to profit. Clients who paid taxes had to concern themselves with the tax ramifications of these trades (see **Exhibit 4**), but clients who did not pay taxes, such as pension funds, could immediately capitalize on the price discrepancy.

Investors who did not own the callable 00-05s could also profit, to the extent that they could establish short positions in the relatively overpriced security and long positions in the relatively underpriced security. "Selling short" entails borrowing a security from another party, selling it today, and promising to redeliver the security to the lender at some future time. **Exhibit 5** gives additional details on short selling in the bond market and the practice of reverse repurchase agreements.

The apparent relative mispricing of the bonds had been rather persistent over the past few weeks. Ms. Thompson wondered how she could best take advantage of this pricing situation for the benefit of her various investment clients. Also, she knew that Mercer was active in the repo markets

---

[6]Longstaff, p. 573.

[7]In the price listing, this callable Treasury would show up as 7 May 93-98. The first year is the call year, and the second is the final maturity if the bond is not called.

[8]There is $4.2 billion (in face value) worth of this particular Treasury bond issue outstanding.

[9]STRIPS (Separate Trading of Registered Interest and Principal of Securities) are effectively zero coupon bonds that are direct obligations of the federal government.

NON-COPY

and occasionally participated in bond arbitrage on its own account. As she analyzed the numbers, she weighed the risks and rewards presented by this opportunity.

DO NOT COPY

Exhibit 1 Summary of Postwar U.S. Treasury Call Policy, 1946-1991

	Summary of Postwar U.S. Treasury Call Policy		
Callable Bond	**Optimal Call Date**	**Called**	**Price**
3.000 June 1946-48	June 1946	Yes	101.000
3.125 June 1946-49	June 1946	Yes	101.031
2.000 Mar. 1948-50	Mar. 1948	Yes	100.343
2.000 Dec. 1948-50	Dec. 1948	Yes	100.434
2.750 Mar. 1948-51	Mar. 1948	Yes	100.688
2.000 June 1949-51	June 1949	Yes	100.313
2.000 Sep. 1949-51	Sep. 1949	Yes	100.297
2.000 Dec. 1949-51	Dec. 1949	Yes	100.434
2.000 Mar. 1950-52	Mar. 1950	Yes	100.359
2.000 Sep. 1950-52	Sep. 1950	Yes	100.359
2.500 Sep. 1950-52	Sep. 1950	Yes	100.625
4.250 Oct. 1947-52	Oct. 1947	Yes	100.281
3.125 Dec. 1949-52	Dec. 1949	Yes	100.922
2.000 Sep. 1951-53	Sep. 1951	No	100.016
2.000 Sep. 1951-53	Mar. 1952	No	100.094
2.000 Sep. 1951-53	Sep. 1952	No	100.188
2.000 Sep. 1951-53	Mar. 1953	No	100.031
2.500 Dec. 1949-53	Dec. 1949	Yes	100.688
2.250 Dec. 1951-53	Dec. 1951	Yes	100.719
2.750 June 1951-54	June 1951	Yes	100.594
2.000 Dec. 1952-54	June 1954	No	100.281
2.250 June 1952-55	June 1952	No	100.156
2.250 June 1952-53	Dec. 1952	No	100.188
2.250 June 1952-53	June 1954	Yes	100.531
3.000 Sep. 1951-55	Sep. 1951	Yes	100.063
2.000 June 1953-55	June 1953	Yes	100.188
2.000 Dec. 1951-55	Dec. 1951	No	100.031
2.000 Dec. 1951-55	June 1954	No	100.188
2.000 Dec. 1951-55	Dec. 1954	Yes	100.656
3.750 Mar. 1946-56	Mar. 1946	Yes	101.125
2.250 June 1954-56	June 1954	Yes	100.594
2.375 Mar. 1957-59	Sep. 1958	Yes	100.406
2.250 Sep. 1956-59	Sep. 1958	Yes	100.375
2.750 Sep. 1956-59	Sep. 1956	Yes	100.406
2.875 Mar. 1955-60	Mar. 1955	Yes	100.844
2.750 June 1958-63	June 1958	Yes	100.375
2.750 Dec. 1960-65	Dec. 1960	No	100.156
2.750 Dec. 1960-65	June 1961	No	100.438
2.750 Dec. 1960-65	Dec. 1961	No	100.531
2.750 Dec. 1960-65	June 1962	No	100.625
2.750 Dec. 1960-65	Dec. 1962	Yes	100.313
7.500 Aug. 1988-93	Apr. 1991	No	100.625

Source: Francis A. Longstaff, "Are Negative Option Prices Possible? The Callable U.S. Treasury-Bond Puzzle," *Journal of Business* 65 (October 1992), p. 583.

Note: This exhibit lists each of the Treasury bonds that should have been called during the 1946-91 period. The first part of "Callable Bond" (e.g., 3.000) indicates the coupon rate (e.g., 3%). The first year is the call year, and the second is the final maturity if the bond is not called. "Optimal Call Date" indicates the month in which the Treasury had the opportunity to make a call for a bond that was trading at or above par at the beginning of the call notice month (four months prior to the actual date on which the bond could be called). "Called" indicates whether the Treasury made the call. "Price" is the bid price of the security as reported in the U.S. Treasury *Bulletin* at the beginning of the call notice month.

DO NOT COPY

Exhibit 2 Capital Markets Data at January 7, 1991

	Ask	Bid
Treasury Bonds		
8¼ May 00-05	101:08	101:04
12 May 05	129:29	129:23
8⅞ May 00	104:16	104:12
Treasury STRIPS		
May 00	46:21	46:08
May 05	30:10	29:29

Note: By the conventions of the bond market, colons in bid and ask quotes represent 32nds; 101:08 means 101-8/32 or 101.25. For both the bonds and STRIPS, these prices reflect a purchase of $100 principal or par value of these securities.

DO NOT COPY

Exhibit 3 Price of the 83 May 00-05 Treasury Bond

CT COPY

Exhibit 4 Tax Considerations in Buying and Selling U.S. Treasury Bonds and Notes

The taxation of Treasury bonds and notes reflects the fact that holders of these securities earn taxable income (and possibly losses) through three mechanisms: explicit payments of interest, implicit payments of interest, and capital gains and losses. Bond investors subject to federal taxation need to consider all of these tax ramifications. The following general principles characterize the tax treatment of Treasury bonds and notes:

- Explicit interest payments are treated as ordinary income in the year in which they are made. Interest on Treasury securities is exempt from state and local taxes.

- If you pay a premium (a price over par) to buy a bond, this premium can be deducted (amortized) over time to offset a portion of taxable interest. In effect, investors are able to accelerate their recognition of these particular taxable losses and offset them against interest income.

- Changes in the price of the bond from purchase to sale are generally treated as capital gains or losses, and recognized when the bond is sold, with the exception of the following point.

- Changes in the price of a security because of implicit payments of interest (which primarily affect zero-coupon bonds or STRIPS) are taxable income each year, even though no cash interest is paid and even if the investor does not sell the bond.

The specific rules on the tax treatment of Treasury securities can be quite complex and change over time. The following examples illustrate typical applications of current tax codes:

1. Investor A buys a 7% coupon bond for $90. The semi-annual interest payments of $3.50 are taxable interest in the year received. Later, the bond is worth $95. If A sells the bond at that time, she realizes a $5 capital gain,[a] taxable in the year of sale. If A holds the bond to maturity, in that tax year she will recognize a $10 taxable capital gain ($100 par value received less $90 paid).

2. Investor B pays $46.32 for a 10-year STRIP (zero-coupon bond) when it is first offered. Over the coming 10 years, B receives no interest payments, and he holds the STRIP to maturity to receive $100, a gain of $53.68 over the price paid. The increase in value from $46.32 to $100 is not treated as a capital gain at maturity. Rather, this bond, selling at an original issue discount (OID), is treated as having made taxable implicit interest payments each year. Because $46.32 grows to $100 in 10 years at an 8% effective annual rate (constant yield), the bond is treated as if it pays 8% interest per year. In investor B's case, he will report OID interest in the first year of $3.71, or $46.32 × 8%. If instead of holding the STRIP to maturity, B sells it after one year for $51.32 (a $5 profit), $3.71 would be reported as interest, and the remainder, $1.29, would be taxable as a capital gain.

DO NOT COPY

Exhibit 4 Tax Considerations in Buying and Selling U.S. Treasury Bonds and Notes (Continued)

3. Investor C pays $116 for a seasoned 12% coupon bond which delivers eight semiannual payments of $6 and a final principal payment of $100. The $16 purchase price premium over par can be amortized over the 4 years to reduce net interest that is taxable. If the bond was issued before September 27, 1985, C would take a straight-line $4/year deduction, effectively reporting only 8% interest.b By taking this deduction, C would reduce the tax basis of the bond from $116 to $100 over the four years; thus there would be no capital gain or loss at maturity.

a. Complex rules affect the capital status on such "market discount" bonds if they were issued after July 18, 1984; in such cases, some of the gain will be reported as interest income instead of capital gain.

b. For bonds issued on or after that date, the constant yield method (IRS Publication 1212) is used.

DO NOT COPY

Exhibit 5 Establishing a Short Position through Short Selling and Reverse Repurchase Agreements in the Bond Market

An investor with a "long position" in a security *owns* the security, and this position can be set up by *purchasing* the security. Investors with long positions profit if the security's price rises. An investor with a "short position" in a security *owes* the security, and this position can be set up by *selling* the security. Investors with short positions profit if the security's price falls. It is quite common for investors to sell bonds they do not own, either through short sales or reverse repurchase agreements, thus creating a net short position.

SHORT SALES

Suppose the 8¼ of May 00-05 are "trading rich" (overpriced). A trader desires to sell the bond, but does not own it. To set up a short position, the trader locates an owner of the bond who is willing to lend it out. The trader borrows the bond and then sells it (a short sale). The borrowed bond will be collateralized by either cash or securities; also, a fee is paid to the lender for the borrowing privilege. The borrower must pay the lender any interest payments made while the security was borrowed. Finally, the borrower must return the borrowed bond to the lender at some time in the future, or upon the demand of the lender. At that time, having already sold that bond, the borrower must either enter into another borrowing arrangement or purchase the bond in the open market to replace the borrowed bond.

REVERSE REPURCHASE AGREEMENTS

In the Treasuries market, bond borrowing is less common than entering into reverse repurchase agreements ("reverse repo") for establishing a short position. If you own a security, you could enter into a sale-and-repurchase-agreement ("repo") by simultaneously selling the security and agreeing to repurchase it at a later date, effectively obtaining a collateralized short-term loan. Viewed from the other side of the transaction, this contract, known as a reverse repurchase agreement, commits you to buy a security now and agree to resell it at a pre-set price in the future. The reverse repo is similar to borrowing a security and providing cash collateral for a fixed term. You receive interest on the cash collateral and pay an interest fee for the privilege of borrowing the security; the resulting net interest rate is called the "repo rate." Typical time frames for repos are one day (*overnight* repos), *term* repos of a few days to a few months, or *open* repos that roll over daily automatically unless terminated by either party. For example, investor D enters into a one-week, $10 million, 5.27% reverse repo with a dealer for the 8¼ bond of May 00-05. He has made a $10 million short-term loan[10] to the dealer; and in turn he gets possession of the bond as collateral. In a week, investor D will get his money back (with $10,247 interest) but must return the bond.

Combining a reverse repo with a sale of the security effectively results in a short sale. In the example above, suppose investor D enters into the reverse repo described and receives the 8¼ May 00-05 bond as collateral. At the same time, D sells the bond in the market (receiving $10 million). In substance, D has established a short position in the bond, in that D profits if the price of the bond falls. To see this, recognize that at the outset, D paid $10 million, but simultaneously received the same amount for selling the bond. However, D is obligated to resell the bond to its counterparty in a week for $10,010,247 (the repo amount plus interest). If the bond price decreases, D purchases the bond in the market for less than $10,010,247, and delivers it at maturity of the reverse repo for a profit.[a]

[a]Perhaps you could have received 5.87% ("market repo rate") on your money; why take 60 basis points less? If the 83 May 00-05s are in generally high demand (e.g., to deliver against short sales), traders will pay a fee, or accept below-market rates, to gain possession of the "special" security. In rare cases, repo rates can drop to almost 0% for particular special securities.

DO NOT COPY