Hedging a Fixed-Income Portfolio with Swap Futures

The addition of 5-year and 10-year interest rate swap futures to the CBOT interest rate futures complex provides holders of fixed-income securities with instruments for effectively managing interest rate and credit spread risk.

One especially interesting possibility for institutional money managers involves the use of combinations of Treasury note futures and swap futures to structure hedges to protect a typical portfolio of corporate and Treasury securities against losses caused by rising interest rates. For the purpose of illustration, this discussion will focus on the 10-year sector of a hypothetical portfolio and show how a combination of CBOT 10-year Treasury note futures and CBOT 10-year swap futures can provide an effective hedge.

This paper will summarize the important features of the CBOT swap futures contract, review the structuring of hedge positions with futures, and show how a variety of hedge alternatives might perform given probable changes to both the risk-free and risky yields.

The CBOT 10-Year Interest Rate Swap Contract

The CBOT 10-year swap futures contracts will cash settle to the International Swaps and Derivatives Association (ISDA) Benchmark Rate* for a 10-year U.S. dollar interest rate swap.

Other than the cash settlement feature, the CBOT swap futures resemble the familiar CBOT Treasury and agency contracts in a number of ways that will make the structuring of hedge positions relatively straightforward. The $100,000 par trading unit of these contracts represents the fixed-rate side of a 10-year interest rate swap that exchanges semiannual fixed payments at a 6% annual rate for floating rate payments based on 3-month LIBOR. It will trade in price terms quoted in points ($1,000) and 32nds of the $100,000 notional par value. The trading cycle will be March, June, September, and December, as with the other fixed-income contracts.

To determine the price, given a swap rate, simply solve this formula:

$$\$100{,}000 * [6/r + (1 - 6/r) * (1 + 0.01 * r/2)^{-20}]$$

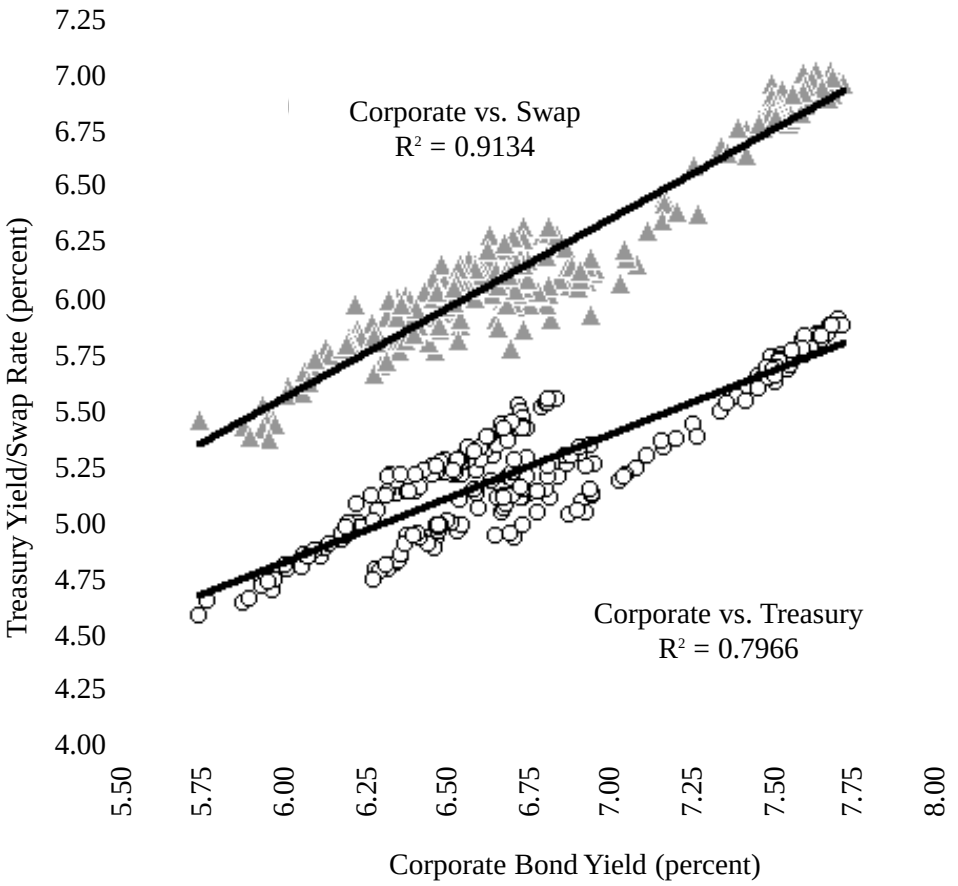
Note that r represents the ISDA Benchmark Rate for a 10-year U.S. dollar interest rate swap, expressed in percent terms. (For example, if the ISDA Benchmark Rate were five and a quarter percent, then r would be 5.25.)

*ISDA Benchmark mid-market par swap rates collected at 11:00 a.m. by Reuters Limited and Garban Intercapital plc and published on Reuters page ISDAFIX1.
Source: Reuters Limited.

An important fact about the CBOT swap futures contract for hedgers is its close correlation with such fixed-income securities as corporate bonds. The scatterplots of Exhibit 1 relate the daily yield changes of a bond issued by Transamerica Corporation, the 9.375% of March 08, to those of a 10-year constant maturity swap and to those of a 10-year constant maturity Treasury note for the period from October 2000 to September 2001.

Exhibit 1. Swaps Correlate More Closely with Corporates than Treasuries Do

Transamerica Corp. 9.375% of March 2008 vs. 10-Year Constant Maturity Treasury and 10-Year Constant Maturity Swap (Daily, October 2000 to September 2001)



The 0.9134 R^2 of the corporate-swap regression suggests that the variability of the swap rate accounts for 91.34% of the variability in the corporate yield. In contrast, the 0.7966 R^2 of the corporate-Treasury regression suggests that the variability of the Treasury yield accounts for slightly less than 80% of the variability in the yield of the corporate bond.

This exhibit illustrates the more general point that CBOT swap futures will provide effective hedges for portfolios of corporate bonds. Indeed, these contracts will significantly reduce the challenge of achieving prudent risk management and staying in compliance with the accounting requirements of FAS 133.

Exhibit 2. A Sample Portfolio

Issuer	Coupon	Maturity	YTM	Modified Duration (years)	DV01 ($)	Par Amount ($ millions)	Full Price ($ 000s)	S&P Credit Rating
Treasury	6.5	2/15/10	4.55	6.56	0.0748	67	76,387	
Treasury	5.625	5/15/08	4.64	5.48	0.0588	92	98,762	
Treasury	5	8/15/11	4.57	7.77	0.0807	84	87,192	
Treasury Sector				6.56			262,341	
Time Warner Enterprises	8.18	8/15/07	5.47	4.72	0.0540	82	93,710	BBB+
Texas Utilities	6.375	1/1/08	6.19	5.06	0.0517	30	30,678	BBB
Rockwell International	6.15	1/15/08	6.04	5.13	0.0521	52	52,837	A
Transamerica Corporation	9.375	3/1/08	6.34	4.93	0.0573	15	17,445	AA-
Coastal Corporation	6.5	6/1/08	6.76	5.25	0.0528	30	30,153	BBB
United Airlines	6.831	9/1/08	5.99	5.51	0.0579	38	39,949	A-
Burlington Northern Santa Fe	7.34	9/24/08	5.67	5.36	0.0606	3	3,390	A+
News America Holdings	7.375	10/17/08	6.56	5.34	0.0575	30	32,292	BBB-
Litton Industries	8	10/15/09	6.70	5.81	0.0647	60	66,834	BBB-
American Standard Inc.	7.625	2/15/10	7.59	6.10	0.0615	41	41,332	BB+
Caterpillar Inc.	9.375	8/15/11	6.01	6.79	0.0853	22	27,628	A+
Corporate Sector				5.39			436,248	
Portfolio				5.83			698,589	

Source: Bloomberg Financial

A Sample Portfolio

Suppose you manage a fixed-income portfolio with a 10-year sector that resembles the one shown in Exhibit 2.

Granted, an actual portfolio will contain many more issues than this sample. However, this collection provides exposure to a number of business sectors and to a range of credit quality, and should serve for purposes of illustration.

Of the Treasury securities in this portfolio, the 5% of August 11 was the current on-the-run 10-year, while the 6.5% of February 10 had just become cheapest to deliver (CTD) into the CBOT 10-year Treasury note futures when these data were recorded. The 5.625% of May 08 had recently been CTD.

You can see that the coupons of the 11 corporate bonds in Exhibit 2 range from a high of 9.375% to a low of 6.15% and have maturities from August 07 to August 11. With the exception of American Standard, all of these issuers are investment grade credits, but the credit ratings range from the S&P AA- of the Transamerica issue to the BBB- of the News America Holdings and Litton Industries issues. American Standard is a BB+ credit.

Further, Exhibit 2 shows weighted average durations for the two sectors and for the portfolio as a whole. The row labeled Treasury Sector shows that this $262.341 million holding has a duration of 6.56 years. The $436.248 million corporate sector holding has a duration of 5.39 years. And the $698.589 million portfolio has a duration of 5.83 years.

Initial Market Concerns

As you survey economic conditions, your chief near-term concern may well be that a combination of building inflationary pressure and world events might precipitate a credit event that could sharply erode the value of your holdings and make it difficult to liquidate them at acceptable prices.

Given these concerns, you may decide that prudence requires that you hedge this holding until the danger passes. Should a credit event occur, the hedge would buy you time and make it possible to liquidate more nearly on your terms than on the market's. Having resolved to hedge, you are faced with the questions of how and with which hedge instruments. Among your alternatives are:

- to hedge the entire portfolio with 10-year T-note futures
- to hedge the entire portfolio with 10-year swap futures
- to hedge the Treasury sector with Treasury futures and the corporate sector with swap futures

Structuring the Hedges

Fixed-income securities with different coupons and maturities respond differently to yield change. This price sensitivity to yield change can be captured in terms of the dollar value of a basis point (DV01) for a given security. To find the DV01 for an individual security, given a modified duration and a full price, you can solve the formula:

$$\frac{(\text{Duration} / 100) * \text{Full Price}}{100} = \text{DV01}$$

For example, using this formula with the price and duration data of Exhibit 2, you can see that a $98,762,000 position in the Treasury 5.625% of May 08, with its 5.48 duration, has a DV01 of $54,122 while an $87,192,000 position in the Treasury 5% of August 11, with its 7.77 duration, has a $67,748 DV01. These DV01s predict that a 1 bp rise in yield would drive the value of the 5.625% of May 08 down $54,122 while the same yield change would drive the value of the smaller holding in the 5% of August 11 down $67,748. Obviously, the 5% of August 11 is more sensitive to yield change than the 5.625% of May 08 is.

The structuring of hedge positions, then, requires that the futures position be ratioed to the position in the security being hedged in order that the two positions will respond equally to a given yield change. Given that the DV01 of the 10-year Treasury note futures contract was $72.50 on the day these data were recorded, you can solve the hedge ratio formula to see that it would take 747 contracts to hedge the 5.625% of May 08 and 934 contracts to hedge the 5% of August 11.

$$\frac{\text{5.625\% of May 08 DV01}}{\text{futures DV01}} = \frac{54{,}122}{72.50} = 747 \text{ contracts}$$

$$\frac{\text{5\% of August 11 DV01}}{\text{futures DV01}} = \frac{67{,}748}{72.50} = 934 \text{ contracts}$$

In structuring a portfolio hedge, you can use a weighted average duration for the Treasury segment, the corporate segment, or the entire holding and use the total full prices of the relevant segments to find DV01s. Exhibit 3 shows that, based on the data in Exhibit 2, the Treasury segment had a $172,096 DV01, the corporate segment had a $235,138 DV01, and the entire portfolio had a $407,277 DV01 (note that the portfolio DV01 does not equal the sum of the two sector DV01s due to rounding error). At the same time, along with the the 10-year Treasury note futures $72.50 DV01, the 10-year swap futures had a $77.00 DV01.

Exhibit 3. DV01s and Hedge Ratios

		DV01 ($)
Treasury sector		172,096
Corporate sector		235,138
Portfolio		407,277
10-year Treasury futures		72.50
10-year swap futures		77.00
Hedge Ratios		
	To hedge	*Hedge Ratio*
1	Full portfolio with 10-yr. T-note futures	5,618
2	Full portfolio with swap futures	5,289
3	Treasury sector with 10-yr. T-note futures	2,374
4	Corporate sector with swap futures	3,054

Exhibit 3 also shows the hedge ratios that result from substituting these DV01s in the hedge ratio formula. Hedging the entire portfolio with Treasury futures (as in the first alternative mentioned) requires a position short 5,618 futures contracts. Similarly, hedging the entire portfolio with swap futures (the second alternative) requires a position short 5,289 futures contracts. The third alternative, in which you hedge Treasuries with Treasury futures and corporates with swap futures, requires a position short 2,374 10-year Treasury futures contracts and a position short 3,054 10-year swap futures contracts.

Predictions of Portfolio and Hedge Performance

During the summer of 2001, for example, the 10-year Treasury-swap rate credit spread widened 40 bps. Corporate yields generally followed the direction of the swap rate. Should that happen again, and the swap rate and corporate yields rise 60 bps while Treasury yields rise only 20 bps, the underlying portfolio will suffer an approximate $17.55 million loss. Exhibit 4 shows that the sector DV01s predict that $3,441,920 of the loss will come from the Treasury sector and $14,108,280 of it will come from the corporate sector.

The Treasury futures hedge (according to the prediction of its $72.50 DV01) will respond to the 20 bp change in the Treasury yields and generate an $8,146,100 gain (see Exhibit 4, Scenario 1). From this, you can see that the Treasury futures hedge can be expected to offset less than half the portfolio loss, leaving you with a $9,404,100 loss.

Exhibit 4. Predicting Portfolio Changes and Hedge Results

Underlying Portfolio Result

Sector	DV01 ($)	Yield Change (bps)	Number of Contracts	Gain/Loss ($)
Treasury	172,096	20		-3,441,920
Corporate	235,138	60		-14,108,280
Portfolio				**-17,550,200**

Scenario 1 - Hedge Entire Portfolio with Treasury Futures

Sector	DV01 ($)	Yield Change (bps)	Number of Contracts	Gain/Loss ($)
10-year T-note	72.50	20	5,618	8,146,100
Portfolio				-17,550,200
Hedge Mismatch				**-9,404,100**

Scenario 2 - Hedge Entire Portfolio with Swap Futures

Sector	DV01 ($)	Yield Change (bps)	Number of Contracts	Gain/Loss ($)
10-year swap	77.00	60	5,289	24,435,180
Portfolio				-17,550,200
Hedge Mismatch				**6,884,980**

Scenario 3 - Hedge Treasury Sector with Treasury Futures, Hedge Corporate Sector with Swap Futures

Sector	DV01 ($)	Yield Change (bps)	Number of Contracts	Gain/Loss ($)
10-year T-note	72.50	20	2,374	3,442,300
10-year swap	77.00	60	3,054	14,109,480
Total Hedge Result				**17,551,780**
Portfolio				**-17,550,200**
Portfolio Mismatch				**1,580**
Treasury to 10-year T-note Mismatch				**380**
Corporate to Swap Mismatch				**1,200**

Alternatively, you could hedge the entire portfolio with swap futures. This strategy has the advantage of responding to the larger change in the swap rate and corporate yields. Yet, as Exhibit 4, Scenario 2 shows, the relevant DV01s predict that this hedge will generate a futures gain far larger than the loss the underlying portfolio will suffer. In a FAS 133 world, this is hardly a satisfactory result.

The third alternative looks far more promising than either of the first two and underscores the idea that, when it comes to hedges, you should choose horses for courses. That is, you can hedge the Treasury sector with 10-year Treasury note futures and the corporate sector with 10-year swap futures.

As the details of Exhibit 4, Scenario 3 show, the relevant DV01s predict that these two hedge positions will generate a total futures gain of $17,551,780. For all practical purposes, this represents a good offset. The $1,580 variation represents less than a basis point and is far less than normal bid-ask spreads.

Words of Caution

Hedges like these should not be put on and forgotten. For one thing, changes in Treasury and corporate yields and the swap rate cause shifts in the relevant DV01s. Also, changes in CTD status in the Treasury market can greatly affect the Treasury futures DV01. As a result of these variable factors in the hedge structures, these hedges should be monitored constantly and rebalanced when shifting interest rates alter the DV01s sufficiently to indicate the need to do so.

Conclusion

Even this simple example shows that CBOT interest rate swap futures can enhance the precision of your hedging efforts. Because swap futures show close correlation with corporate bonds, they allow you to choose the hedging tool appropriate to the task, whether swap or Treasury futures, and to hedge portfolios of bonds with credit risk more accurately than has previously been possible with futures.

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