How to Value and Hedge Inverse Floaters

While some investors may be reluctant to enter the inverse floater market because of the perceived complexity of inverses, the relative lack of sponsorship from the traditional investor base has left many relative value opportunities for the willing investor. Further, the inverse is identical to a transaction that many investors are already familiar with: repo financing. In this article we examine the valuation and hedging of inverse floaters, paying particular attention to the similarity between inverse floaters and collateralized repo transactions.

A Quick Introduction to Inverses

Inverses are CMOs with a coupon rate that moves inversely with an index, most often chosen to be a short-term rate such as LIBOR. Typically, inverses are the residual side-effect of the creation of a floating rate tranche from an underlying fixed rate bond, most often itself a tranche in a larger CMO structure. Floaters are a popular investment product for investors seeking short-durations assets that closely match their liability structure. Typically, banks and thrifts are the natural buyers of floaters, since their liabilities are closely correlated with short-term rates such as LIBOR and COFI.

Inverses are created in the following way:

- A fixed rate tranche of a CMO is broken up into two pieces, an inverse and a floater.
- The floater is backed by a significant fraction of the principal of the fixed rate, with a coupon typically given by an index plus some fixed spread. A cap on the floater coupon is chosen to meet the investor's economic needs.
- The inverse is the residual of the fixed rate after splitting off of the floater. It is usually backed by a *smaller* fraction of the original principal of the fixed rate than that backed by the floater.

The fact that the inverse typically has a smaller principal balance than the floater is crucial in understanding inverses. As the floater price is generally insensitive to changes in rates, many of the properties of the underlying fixed rate, such as duration and yield, become concentrated in the inverse. This gives the investor the opportunity to profit from many of the attributes of the underlying in a more focused fashion. Generally, this is referred to as leverage. The fact that inverses are inherently levered has made them popular investments in their own right.

Leverage and Repo Transactions

In both fixed income and equity markets, the concept of leverage plays a central role. Leverage is generally defined as the ratio of borrowed funds to equity or capital. In a repo transaction, an investor purchases an asset using funds borrowed from the repo market using the asset as collateral. Typically, the lender will require a haircut, which means that the investor must provide a down payment for the loan, then borrow the remaining balance at a given rate, which is generally known as the repo rate. The amount of leverage provided by this transaction is the ratio of the borrowed funds to the down payment.

There are several aspects to a repo transaction that can have a considerable impact on the economics and viability of a leveraged position:

- The whole principal amount of the transaction (borrowed amount plus equity) appears on the investor's balance sheet.
- The investor is faced with margin call risk in the event of a general market downturn. In such a scenario, availability of on-going financing could become an issue as well.
- As the financing is not capped, there is the possibility that the net interest on the position could be negative.

Inverses as Leveraged Transactions

Inverses are very similar to repo transactions, in the sense that the inverse plays the part of the equity and the sale of the corresponding floater plays the part of the borrowed funds. In the boxes at the bottom of the next page, we work through the mechanics of both an inverse floater and a repo transaction.

The degree of leverage provided by the sale of the floater is given by the ratio of the dollar value of the sale of the floater to the dollar value of the inverse. In the example in the boxes, the nominal repo rate of the inverse is given by LIBOR + 40, which is the coupon being paid out on the balance that is "borrowed" in the form of the floater. This nominal rate is not representative of the true rate of funding in an inverse, as the coupon payment to the floater is capped. If we include the value of the cap, the effec-

tive funding rate of the inverse will be lower than the nominal rate of the floater coupon.

Leverage, Duration and Yield of Inverse

It is useful to generalize the example below to quantify the notion of leverage in an inverse. When we create a floater, there are three basic characteristics that are specified: the underlying coupon of the collateral and the index, and the cap on the floater. The floater/inverse combination is structured such that when the coupon on the floater hits its cap, then all of the interest from the underlying bond goes to the floater and none goes to the inverse. This fact uniquely determines the face amounts of the inverse and the floater and the coupon on the inverse. Referring to the example below, we can generalize the inverse cash flows as:

1. Inverse = (M + 1) × Fixed Rate – M × Floater

where **M** is the ratio of the floater principal to the inverse principal. In order to determine the leverage of the inverse, we need to take the ratio of the dollar value of the floater (the amount synthetically borrowed) to the dollar value of the inverse (the equity), so the leverage can be written as an effective multiplier:

2. EM = M × (Price of Floater / Price of Inverse) = Leverage of Inverse

Note that when the floater and the inverse are both priced near par, this formula will reduce to the multiplier **M**. Using this definition, we can express the duration of the inverse in terms of the duration of the fixed rate and floater:

3. Inverse Duration = Dur of Fixed + EM × (Dur of Fixed – Dur of Floater)

What we can see from this formula is that if there is a large degree of leverage in the inverse (EM is large), then the inverse will have a duration that is many times that of the underlying fixed rate. Typically, floaters have short durations in comparison with the fixed rate, meaning that most of the duration of the fixed rate bond must be absorbed by the inverse.

As the demand for floater/inverse creation often comes from the floater side, it is useful to note that the degree of leverage of an inverse depends on the coupon of the underlying fixed rate and the cap on the floater. The overall cap on the interest paid to the floater is given by:

Repo Transaction:
An investor purchases $100MM of FNMA 7.5s priced at par. The purchase is financed by $20MM of equity and $80MM of borrowed funds at the repo rate (RP) using pass-throughs as collateral.

The coupon income of the $20MM in equity is:

Income = $100MM × 7.5% – $80MM × RP

In terms of the original investment, this is a coupon of:

Coupon Income = ($100MM / $20MM) × 7.5% – ($80MM / $20MM) × RP

= 5 *x* 7.5% – 4 × RP = 37.5% – 4 × RP

The leverage of this position is 4:

Leverage = 4 = $80MM borrowed / $20MM equity

Inverse Floater:
An investor buys $20 MM of an inverse floater priced at par. This inverse is structured from $100MM FN 7.5s also priced at par, leaving $80MM of a LIBOR + 40 bp floater with a 9 3/8% coupon cap priced at par.

The coupon of the inverse is:

Income = $100MM × 7.5% – $80MM × Floater

In terms of the face value of the inverse, this is:

Coupon Income = ($100MM / $20MM) × 7.5% – ($80MM / $20MM) × Floater

= 5 × 7.5% – 4 × Floater = 37.5% – 4 × Floater

The leverage of the inverse is 4:

Leverage = 4 = $80MM of Floater / $20MM of Inverse

4. Cap = Fixed Rate + Fixed Rate / M

This implies that for a given fixed rate, the higher the cap on the floater, the lower the leverage of the inverse.

In an approximate sense, we can use the same form of equation (3) for the yield and OAS of an inverse (though particularly for OAS, this should be used as a rough guide and not as an equality). The basic conclusion that we can reach from these equations is that the leverage inherent in an inverse will tend to increase the duration, yield, and OAS of an inverse over and above that of the fixed rate, in proportion to the leverage of the bond.

Hedging an Inverse With Swaps

Typically, the coupon of an inverse is determined by the short end of the yield curve, whereas the fixed rate bond from which it is created is often a function of the longer end of the yield curve. Hedging with an instrument that is sensitive only to longer-term rates is often inadequate in hedging out the real interest rate risk of an inverse. Perhaps the easiest way to hedge an inverse is to use another instrument that is very similar to a financed bond position: a swap.

As an example, we can consider FN 99-32 SD, a PAC-II inverse backed by FNMA 6s with a coupon of $2.4 \times (8.05 - \text{LIBOR})$. One approach to hedging this bond would be to use swaps in the following way (the table at the bottom of the page diagrams the transaction):

- As the holder of the inverse must pay out 2.4 times LIBOR for each inverse, the investor would enter into 2.4 payer swaps (paying fixed and receiving one-month LIBOR on a monthly basis) for each par amount of inverse, in order to effectively hedge out the coupon exposure.
- The maturity of the fixed notional swap could be chosen to be the average life of the inverse at some prescribed speed, or the notional could be chosen to amortize to match the cash flows of the inverse more closely.
- Embedded in the inverse are caps on LIBOR at the strike of the inverse (8.05% in the above example). The investor could sell 2.4 of these caps for every par amount of inverse (either as amortizing caps or with a maturity of the average life of the bond) and keep the premium.
- Any residual duration could then be managed actively through Treasuries.

In addition to the duration hedging, an investor could also hedge out prepayment and/or convexity risk by purchasing Bermudan receiver swaptions (giving the right to receive fixed and pay floating at several specified dates), or equivalently, using cancelable swaps rather than plain-vanilla swaps. As we discussed in a previous article ("CMOs Are Cheap, but How to Unlock the Value?" *Mortgage Market Comment*, November 9, 1999), using cancelable swaps is an effective way of managing duration and prepayment risk, especially in a situation where the extension risk of a bond is limited.

By using Bermudan receiver swaptions or a cancelable swap, an investor can protect against a scenario where the face amount of the inverse decreases because of fast prepayments, leaving the investor with more notional on the payer swap than is necessary. In such a case, the investor would simply lower the notional on the swap either by canceling a portion of the swap or by exercising the Bermudan receiver swaption, which would also lower the effective notional on the payer swap.

The choice of how many swaptions to purchase — or equivalently, what proportion of the swap should be cancelable — is a function of the callability of the underlying fixed rate. In the case of FN 99-32 SD, the underlying collateral is FN 6s, which is to a large

Mechanics of Hedging FN 99-32 SD With Swaps and Swaptions

Hedging an inverse with swaps and swaptions. LIBOR refers to one-month LIBOR. Maturity for swap, swaptions, and cap is approximately 2.7 years (average life of FN 99-32 SD at projected speed). The swap rate would be set by setting the maturity of the swap to be 2.7 years.

Transaction	Face	Receive	Pay
Buy FN 99-32 SD	1.0	2.4 x 8.05%	2.4 x LIBOR (capped at 8.05%)
Buy payer swap	2.4	LIBOR	Swap rate
Buy Bermudan receiver swaption	2.4	Right to receive swap rate	Right to pay LIBOR
Sell three-year cap on LIBOR struck at 8.05%	2.4	premium	Max(LIBOR - 8.05%, 0)

extent out of the money from a prepayment perspective. In this case, we would need only a reasonably small fraction of the swaps to be cancelable, as the probability of a significant proportion of the balance paying down is relatively unlikely. We could structure the cancellation schedule, as was done in the earlier article, so that various balances are cancelable after certain lockouts. This allows the investor the flexibility of purchasing back only the amount of optionality that is deemed necessary, and leaving the maximum spread over and above the hedge.

Relative Value of Inverses

Formulating the analysis of inverses as a modified financing transaction allows the investor to value inverses by comparing the financing implicit in the inverse with what can be achieved directly with mortgage repo. While not all investors can or do use repo transactions to fund themselves, valuing inverses in this way is a powerful tool to extract the value of the inverse.

In determining the relative value of the inverse, there are three components for an investor to consider:

- The value of the underlying cash flows. This is the most important determinant of relative value for the investor.
- The degree of leverage offered by the floater/ inverse structure.
- The level of inherent funding offered by the sale of the floater, paying particular attention to the value of the cap.

As an example, we will examine all three components in the case of FN 99-32 SD. The inverse is offered at a volatility-adjusted LIBOR OAS of 75 bp (90-05 as of November 18, 1999). Floaters such as FN 99-32 FD (the floater corresponding to FN 99-32 SD) trade at approximately 60 DM at the consensus speed of 130 PSA, which would give a volatility-adjusted LIBOR OAS of 0 bp (99-20 as of November 18).

As the multiplier (and approximate leverage) provided by the sale of the floater is 2.4 (i.e., for every $3.40 par amount of original fixed rate, $1.00 is allocated to the inverse and $2.40 is allocated to the floater), we can determine the implied price of the combination to be:

$$\mathbf{1.0/3.4 \times (90\text{-}05) + 2.4/3.4 \times (99\text{-}20\ ) = 96\text{-}27}$$

The volatility-adjusted LIBOR OAS for this fixed rate bond would be 17 bp. With other short-duration discount assets trading 5–10 bp tighter than this, the fixed rate is on the fair to cheap side relative to other short-average-life alternatives.

In purchasing the inverse, the investor is synthetically funding the purchase of a short discount PAC-II bond with an average life of two-and-a-half to three years at projected speeds and a volatility-adjusted LIBOR OAS of 17 bp. The funding implicit in the sale of the floater (including the value of the cap) is at LIBOR, with the sale of the floater providing approximately 78% of the funds for the purchase.

Going back to our original discussion of leverage, there are several differences between repo transactions and inverses that often make inverses more attractive to investors:

- By purchasing the inverse, the investor is locking in the implied financing and leverage for the life of the bond.
- Inverse investors do not face the possibility of margin calls on the implied floater financing.
- The interest paid on the implied financing is capped at the strike of the inverse, so that the net interest on the position cannot go negative.
- In contrast to a repo, only the principal of the inverse appears on the balance sheet, not the entire asset position.

Opportunities in Inverse Floaters

With the traditional investor base for inverses less active at the current time, inverse floaters can provide investors with the opportunity to profit by leveraging cheap cash flows. The value of inverses is a function of the underlying fixed rate cash flows as well as the leverage and implicit financing provided by the sale of a floater. However, when comparing the implicit financing in the inverse with a mortgage repo transaction, it is important for investors to keep in mind that the implicit funding of an inverse is capped, secure for the life of the bond, and not subject to margin calls. For these reasons, inverses are often a better way to leverage a mortgage security than using the repo markets.