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Agency CMOs- An Inverse Floater Primer

- **We discuss the reasons for creation of inverse floater structures in the market.**
- **We provide a detailed description of the various equations that govern the price, notional and duration relationships of an inverse floater, strip floater and collateral.**
- **Inverses can be thought of as leveraged positions in collateral and a short position in a floater.**
- **We discuss the various approaches in the valuation of inverse floaters and their strengths and weaknesses.**
- **Inverses not only extend when rates rise but also lose coupon as the coupon is pegged to the rising index.**
- **When rates fall, though the coupon of the inverse rises, price appreciation is constrained because the bond gets more callable.**
- **We illustrate how the risk parameters of an inverse (durations, convexities, vega, partial durations) change with changing shapes and levels of the yield curve.**

In this article we discuss inverse floaters, the reasons for creation, risks in holding them and the behavior of an inverse floaters risk parameters across various interest rate shocks.

Inverse floaters were first created as an effort to raise the cap embedded in CMO floaters to make the floaters more attractive to investors. Fixed rate collateral is usually split into a floater and an inverse floater to facilitate floater creation. The coupon rate on an inverse floater changes in the opposite direction of the reference rate used to set the coupon for the floater.

The cap on the floater determines its maximum achievable coupon, which in turn can never exceed the total interest cash flow of the underlying fixed rate. It follows that in the event the indexed rate rises and hits the floater cap, the inverse coupon drops towards its minimum coupon or floor – usually zero. Alternatively, if the indexed rate falls to zero, the inverse coupon hits its cap while the floater coupon drops to its fixed spread or the margin. These embedded options (caps and floors) ensure the appropriate distribution of interest cash flows within the floater/inverse structure.

A simple example

We illustrate a simple example where we create a floater and an inverse floater from new 30-year 6s. We walk through the basic expressions for the structural parameters governing the inverse/floater pair.

$$Price_{Inverse} = (M+1)Price_{Fixed} - M\,Price_{Floater}$$

$$Coupon_{Inverse} = (M+1)Coupon_{Fixed} - MCoupon_{Floater}$$

Dirty prices are used in the formula above adjusting for the delay for the various bonds in the equation.

$$M \equiv \frac{Principal_{Floater}}{Principal_{Inverse}},$$

M is commonly referred to as the multiplier. Note that when M=1, the floater and inverse prices and coupons add up to twice the collateral price and coupon respectively.

By definition,

$$L \equiv M\frac{Price_{Floater}}{Price_{Inverse}}$$

is the leverage of the inverse.

The floater/inverse pair is structured such that when the coupon on the floater hits the cap, the coupon on the inverse goes to its minimum value. Thus the cap on the floater works out to be

$$cap_{Floater} = \frac{(M+1)coupon_{Fixed} - Min(coupon_{inverse})}{M}$$

In fact in most cases, when the floater hits its cap, the minimum attainable coupon on the inverse is zero. This

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corresponds to the maximum achievable cap on the floater. Therefore, setting the

$$Min(coupon_{inverse}) = 0,$$

we obtain

$$cap_{Floater} = coupon_{Fixed} + \frac{coupon_{Fixed}}{M}$$

Rearranging the equations above, we get

$$cap_{Floater} = coupon_{Fixed} + \frac{coupon_{Fixed}}{L\dfrac{Price_{Inverse}}{Price_{Floater}}}$$

We can draw some interesting conclusions from the equations above. First, the higher the cap on the floater the lower the leverage on the inverse. If the leverage is equal to the multiplier and is 1, the maximum allowable cap is twice the collateral coupon.

The relationship between the caps of the floater and the inverse can be shown as

$$\frac{cap_{inverse}}{cap_{Floater}} = M - \frac{M^2 spread}{(M+1)Coupon_{Fixed}}$$

Finally, the floor on the floater is the spread. The inverse hits its floor when the floater reaches its cap.

$$floor_{Floater} = spread$$

$$floor_{Inverse} = (M+1)coupon_{Fixed} - Mcap_{Floater}$$

In the event that the cap on the floater is its maximum, we get

$$floor_{Inverse} = 0$$

In our example of creating a simple floater deal off of 3 WALA 30-year 6s, we choose to create a strip floater with a 7% cap and an initial margin of 45bps to 1-month Libor (approximately where the market is today). Using the equations listed above we arrive at the following structural parameters for the deal (Table 1).

Table 1: Floater/Inverse floater deal characteristics

The deal is created off 30-year 3WALA 6s, 6.49 WAC

	Principal	Coupon	Cap	Floor
Floater	85.71	1M Libor + 45	7.0%	0.45%
Inverse Floater	14.29	-5.99*1M Lib+39.29	39.3%	0%
Pass-through	100	6.0%		

Source: JPMorgan

We can also draw some interesting conclusions on the risk metrics of floaters and inverse floaters from the price equation listed above (the first equation listed in the piece). Given that duration is the first order change of price relative to rates and convexity the second order change, we differentiate the equation to get the following relationships.

$$duration_{Inverse} = duration_{Fixed} + M(duration_{Fixed} - duration_{Floater})$$

This leads to the conclusion that higher levered inverses have longer durations. In the limiting case:

$$duration_{Floater} \rightarrow 0$$

$$duration_{Inverse} = (M+1)duration_{Fixed}$$

The equation above is a handy way of estimating inverse durations if the floater on the other side has minimal duration (no principal lockout in the floater).

Similar results are obtained for the convexity relationship between collateral, inverse floaters and floaters.

$$convexity_{Inverse} = convexity_{Fixed} + M(convexity_{Fixed} - convexity_{Floater})$$

The durations and convexities represented in these equations are understood to be dollar durations and convexities.

Inverses are leveraged transactions

An interesting observation from looking at the relationships between inverses, floaters and collateral is the concept of leverage. Buying a strip inverse is equivalent to a leveraged position in collateral funded by

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the strip floater. Consequently, the degree of leverage is equal to the ratio of the dollar value of the sale of the floater to the dollar value of the inverse. Not surprisingly, an inverse IO provides the maximum leverage since it represents 100% financing of a fixed-rate MBS.

This leads us to our conclusion that it is important to think of the value of the floater and collateral while analyzing the value of inverse floaters. The difficulty in valuing inverses as levered positions in collateral is that it is difficult to value the underlying bond if the inverse is anything other than a strip.

There are a few approaches to valuing inverse floaters. We discuss the different methods briefly and their strengths and weaknesses. Broadly speaking the different methods could be

1) Creation value
2) OAS methodology
3) Swap/cap methodology (cost of hedging)
4) Valuing the inverse relative to liquid Trust IOs and POs

Creation value and OAS methodology

Valuing the underlying structure from which the inverse and floater is often times the toughest task. In transparent cases like in our example identifying creation value and analyzing the bond is most useful.

For example, using the equations listed in the piece we arrive at creation value for the inverse/floater mix shown in the example. Assuming the standard fees in Agency deals and adding a minimal 2 ticks in arb to compensate for the distinct possibility of not being able to sell all of the inverse floater, we arrive at the prices and risk characteristics shown in Table 2.

This approach only comments on whether the bonds are being offered at reasonable prices relative to creation. Notice how though the floater is priced where the market is today the OAS of the floater and the inverse are negative. This is a reflection of the excess demand for front end cash flows (floaters) given the flatness of the yield curve.

Market traded prices on inverses and floaters could vary significantly from creation value depending on demand supply dynamics in the market. In times when the Fed is expected to ease monetary policy unexpectedly or in periods where the Fed is expected to stop tightening monetary policy, inverse cash flows typically richen on an OAS basis and trade away from creation.

It would thus also be useful to consider the value of structure by its current OAS relative to historical OAS trends.

Swap/Cap methodology

We know that a long position in an inverse floater is equal to a long position in collateral and a short position in a capped floater. Shorting a floater is equivalent to borrowing funds at the reference rate of the floater plus the spread.

This means that the owner of an inverse floater is receiving fixed (collateral) and paying floating (floater). This is the same as a position in swaps. Obviously one would have to value an amortizing swap since mortgage cash flows amortize down. Also as the floater is capped, the value of the swap needs to be increased by the value of the cap. Though this methodology sounds logical it is difficult to replicate the uncertainty of mortgage cash flows (prepayments change with rates) without depending on a prepayment model. Once we depend on a prepayment model this form of replication becomes equivalent to valuing the bond on an OAS basis.

Table 2: Base characteristics of deal

Description	Coupon	WAC	WAM	WALA	AL	Sprd/ UST	Price	Yield	OAS	OAD	OAC	Spd Dur	Vol Dur	Formula	Cap
Strip Floater	5.62	6.49	357	3	7.4	69	100-00	5.65	-12.7	1.3	-1.3	4.2	-0.27	LIB1M + 0.45	7
Inverse	8.28	6.49	357	3	7.4	394	98-22	8.91	-28.4	17.1	-5.8	4.0	-0.29	39.3 -6 x LIB1M	39.3
Collateral	6.00	6.49	357	3	7.4	117	99-09	6.14	-11.6	3.5	-1.9	4.2	-0.27		0

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Valuing Inverses versus Trust IOs & POs

Another widely used method of valuation in the market is to value the inverse floater relative to the valuations of liquid Trusts and collateral. This methodology accounts for moneyness (coupon and cap) embedded in inverses versus liquid securities. This is usually done by comparing the inverse versus collateral and Trust OAS. While this method is useful in comparing the current valuation of a levered mortgage structure relative to IO/PO, it suffers from the disadvantage of not providing color on the absolute richness or cheapness of the bond.

We suggest using a combination of these methods listed above while valuing inverse floaters instead of relying on just one methodology.

What are the risks in holding inverse floaters?

Rising and falling short term rates have a marked effect on the valuation of inverses as short term rates directly affect the coupon. In addition to the coupon variability the shape of the yield curve also plays a big role in the risks embedded in inverse floaters.

Typically as rates rise prepayment speeds slowdown as the homeowners option goes out of the money. Thus the inverse extends due to slower speeds and loses coupon due to rising rates. Price appreciation in a rally is also constrained because, although the coupon is rising on the inverse floater, faster speeds are shortening the average life of the bond thus constraining its price appreciation. Table 3 shows the partial duration profile of the strip inverse, convexity, spread duration and vol duration over various instantaneous yield curve shocks at constant OAS. Close examination of these changing metrics sheds more light on the effect of a security whose coupon changes with rate movements in correlation with speed changes. Notice how the partial durations increase in the 5 and 10-year bucket when rates rise and decrease when rates fall. The partials also increase in steepeners and decrease in flatteners. Understanding this dynamic is valuable as an understanding of changing risk profiles helps in the effective risk management.

It is also important to note that the prices shown in the Table below are at constant OAS shocks. In reality, the increased callability of the inverse in a rally would restrict the price appreciation in the market much lower than the prices shown in the lower rate scenarios.

Table 3: Examining the sensitivity of inverse floaters to changes in interest rates

All shocks are instantaneous at constant OAS

	-100	-50	unch	50	100	flat1	steep1	flat2	steep2
Price	111-00+	106-06+	98-22	89-21	80-09	79-18+	74-27+	109-21	113-11
OAD	6.0	11.8	17.1	20.9	22.3	17.6	24.8	4.0	4.0
OAC	-10.7	-10.5	-5.8	-1.8	6.7	6.3	9.6	-4.6	-10.0
Vega	-0.4	-0.5	-0.3	0.1	0.5	0.3	0.8	-0.3	-0.4
KRDur 3M	1.5	1.0	0.5	0.4	-0.2	0.5	0.5	1.7	1.9
KRDur 2Y	4.6	6.3	7.1	6.4	4.5	1.3	4.4	4.2	3.1
KRDur 5Y	0.7	3.3	5.7	7.5	8.1	7.8	8.7	0.0	-0.4
KRDur 10Y	-1.3	0.4	2.2	4.1	6.1	5.7	6.4	-2.2	-1.4
KRDur 20Y	0.2	0.6	1.2	2.0	3.0	2.3	4.2	0.0	0.3
KRDur 30Y	0.1	0.2	0.4	0.5	0.7	0.6	0.9	0.1	0.1

flat1: 1M: 100, 2Y: 150, 10Y:75
steep1:1M:75, 2Y: 100, 10Y:150
flat2: 1M: -75, 2Y:-100, 10Y:-150
steep2: 1M: -100, 2Y: -150, 10Y:-75

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