



IIT ROORKEE



NPTEL ONLINE
CERTIFICATION COURSE

QUANTITATIVE INVESTMENT MANAGEMENT

LECTURE 31

Fixed Income Portfolio Strategies - 3

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SELECTION OF CURVE STRATEGY



EXAMPLE

- Consider a portfolio with a benchmark that is laddered and has a duration of 10. The manager is considering three possible strategies:
- Bullet: 100% in securities with a duration of 10. The yield and convexity are 4.51% and 16.4 respectively.
- Barbell: 50% in securities with a duration of 2 and 50% in securities with a duration of 18, for portfolio duration of 10. The yield and convexity are 4.30% and 24.7 respectively.
- Ladder: Match the benchmark which has an equal distribution of 1 to 19 duration bonds for portfolio duration of 10. The yield and convexity are 4.39% and 20.1 respectively.

A. OPTIMAL STRATEGY FOR A SMALL AND VERY NEAR TERM PARALLEL UPWARD SHIFT IN THE YIELD CURVE.

- There is no distinct advantage for any strategy. They all have the same duration and expected change in value for a parallel shift.**
- The bullet has a yield advantage, but over a short time period that will not matter much.**
- The barbell has more convexity but for a small change in rates that will not matter much.**
- The ladder more closely matches the portfolio benchmark's duration distribution but has no material expected return advantage in this scenario.**



OPTIMAL STRATEGY FOR A LARGE PARALLEL AND VERY NEAR TERM UPWARD SHIFT IN THE YIELD CURVE.

- **The barbell.**
- With a large increase in interest rates, the higher convexity of the barbell will produce the greatest cushioning of price decline.

OPTIMAL STRATEGY FOR A LARGE PARALLEL DOWNWARD SHIFT IN THE YIELD CURVE OVER THE NEXT 12 MONTHS.

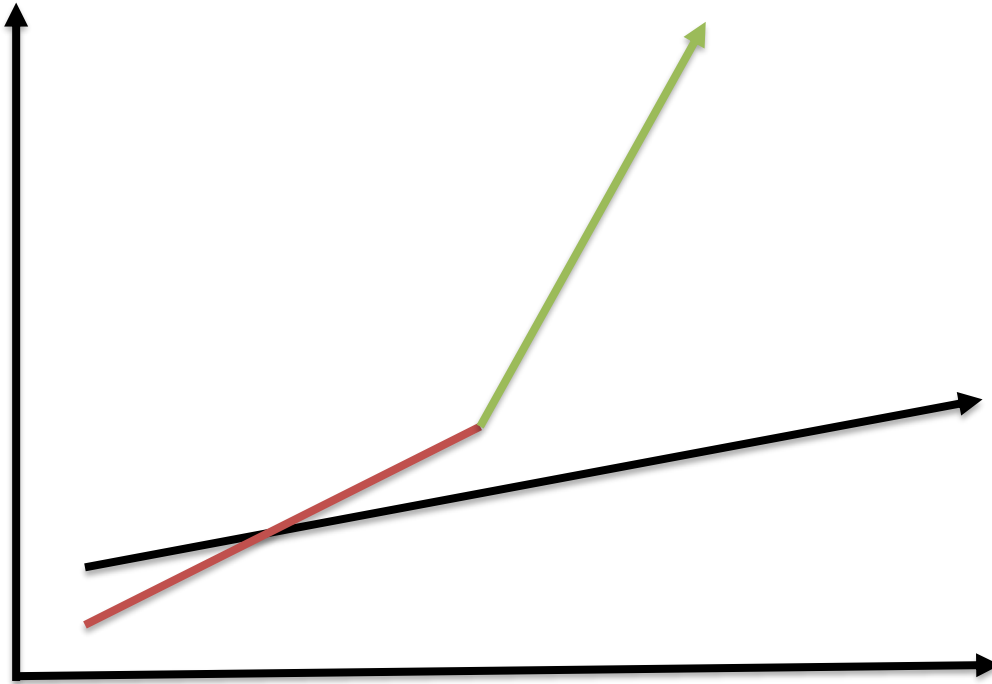
- There is no distinct advantage for any strategy. There are conflicting issues. They all have the same duration.**
- The bullet has a yield advantage over the next 12 months.**
- The barbell has more convexity which will increase its value gain for a large decrease in rates.**
- The ladder more closely matches the portfolio benchmark's duration distribution but has no material expected return advantage in this scenario.**

D. OPTIMAL STRATEGY FOR AN IMMEDIATE STEEPENING OF THE CURVE WITH SHORT RATES (DURATION OF 1) DECREASING 50 BP, NO CHANGE IN INTERMEDIATE RATES (DURATION OF 10), AND LONG RATES (DURATION OF 19) INCREASING 50 BP.

- **The bullet is best.** With no change in intermediate rates, it will not decline in value. The others will decline in price.
- The manager has described a pivot in the curve. With long rates up 50 bp and high duration there will be a large decline in value. The 50 bp decrease in shorter rates with less duration will not produce as large a value gain.
- Thus the barbell will decline the most and the ladder will decline some.

E. STATE THE OPTIMAL STRATEGY IF THE MANAGER EXPECTS AN IMMEDIATE STEEPENING OF THE CURVE WITH SHORT RATES (DURATION OF 1) DECREASING 10 BP, INTERMEDIATE RATES (DURATION OF 10) INCREASING 40 BP, AND LONG RATES (DURATION OF 19) INCREASING 90 BP.

- **The bullet is best for the same reasons as in previous case.**
- **There is a steepening and that favors the bullet.**
- **There are also elements of a parallel upward shift, but all strategies have the same duration and respond the same to a parallel shift, ignoring the small convexity effect.**



F. OPTIMAL STRATEGY FOR IMMEDIATE FLATTENING OF THE CURVE WITH SHORT RATES INCREASING 50 BP, NO CHANGE IN INTERMEDIATE RATES, AND LONG RATES DECREASING 50 BP.

- The barbell because it has the most exposure to long duration assets where rates will decrease. This will give it the largest value gain.**

CONVEXITY ISSUES



IMPACT OF CONVEXITY

- All else being the same, it is beneficial to have greater convexity when large changes in rates are expected.
- The convexity will magnify value gain when rates decrease and cushion price loss when rates increase.
- However, there is likely to be a cost in the form of lower yield (and income from the portfolio).

INCREASING CONVEXITY



METHOD 1: BARBELL VS BULLET

- To increase convexity, the more distributed future cash flows of a barbell will have higher convexity, but lower yield.
- To decrease convexity, the more concentrated future cash flows of a bullet will have lower convexity, but higher yield.
- Generally, shifting between barbell and bullet structures has only a modest impact on convexity, holding total duration the same.
- Options have a much more dramatic impact on convexity.

METHOD 2: OPTIONS ON BONDS

- Please note that we are NOT talking about embedded issuer call options that exist in callable bonds. We are considering portfolios of bonds together with calls written on them.
- Long call options on bonds (or on bond futures contracts) increase in value as the underlying increases.
- Thus they provide increased upside for portfolio value as bond prices increase and rates decline.
- More upside means more positive convexity.

- **Long put options on bonds (or on bond futures contracts) increase in value as the underlying decreases. Thus they reduce the downside as bond prices decline and rates increase. Less downside means more positive convexity.**

- **Buy call and/or put options to increase convexity. The premiums paid to buy the options effectively reduce the yield earned on the portfolio.**
- **Sell call and/or put options to decrease convexity. The premiums received from selling the options effectively increases the yield earned on the portfolio.**
- **Many portfolios have constraints that restrict the use of options.**

METHOD 3: BONDS WITH EMBEDDED OPTIONS

CALLABLE BONDS

- Callable bonds can be decomposed as an option-free bond and a short call position on the underlying bond.
- If rates decline the issuer's right to call the bond increases in value and the price upside of the bond is limited.
- Thus the callable bond has diminished in value and hence has negative convexity (at lower rates) compared to an otherwise equivalent option-free bond.
- Callable bonds have a higher yield than an equivalent option-free bond.

PUTTABLE BONDS

- Puttable bonds can be decomposed as an option-free bond and a long put position on the underlying bond.
- If rates increase, the owner of the bond can put the bond to the issuer.
- The owner's right to put the bond increases in value and reduces the price downside of the bond as rates increase.
- Thus the puttable bond has increased positive convexity (at higher rates) compared to an otherwise equivalent option-free bond.
- Puttable bonds have lower yield than an equivalent option-free bond.

SUMMARY:

INCREASING CONVEXITY WITH OPTION BONDS

- **Decrease holdings of callable bonds and/or increase holdings of puttable bonds to increase convexity (and decrease yield).**
- **Increase holdings of callable bonds and/or decrease holdings of puttable bonds to decrease convexity (and increase yield).**

CONSTRUCT A DURATION-NEUTRAL GOVERNMENT BOND PORTFOLIO TO PROFIT FROM A CHANGE IN YIELD CURVE CURVATURE.

- **Consider three portfolios with the same duration of 7 constructed from three government bonds with durations of 3, 7, and 11.**
- **An equal weighted ladder of 3, 7, and 11 duration bonds.**
- **A bullet with only the 7 duration bond.**
- **An equal weighted barbell of the 3 and 11 duration bond.**

STEEPENING CURVE

- **Steepening Curve:** The bullet is the best with no exposure to the relative, large increase in rates for the higher duration bond.
- The barbell is the worst with the greatest relative exposure to the large increase in rates for the higher duration bond.

FLATTENING CURVE

- **Flattening Curve: The barbell is the best with the greatest exposure to the relative, large decrease in rates for the higher duration bond.**
- **The bullet is the worst with no exposure to the relative, large decrease in rates for the higher duration bond.**

CURVATURE CHANGE

- Now consider a situation with the intermediate rate increasing relative to the longer and shorter rate.
- The barbell is the best with no exposure to the relative increase in intermediate rates.
- The bullet is the worst with 100% exposure to the relative increase in intermediate rates.
- In the converse situation, the bullet is the best with 100% exposure to the relative decrease in intermediate rates.
- The barbell is the worst with no exposure to the relative decrease in intermediate rates.



BUTTERFLY TRADES: LONG BODY BUTTERFLY

- Butterfly trades are a leveraged way to capture value when curvature changes.
- They involve taking:
- a long position in the bullet and
- offsetting short position in the offsetting barbell.
- Thus, a butterfly portfolio shorts the barbell portfolio i.e. borrows at a combination of shorter and longer rates and invests the proceeds in intermediate-term bonds.
- This can be called short the wings and long the body.

- The short position funds the long position so no investor capital is required.
- The long and short duration cancel each other for a 0 net duration.
- But it has net negative convexity because the barbell with the higher convexity is short.
- Butterfly trades profit primarily from change in curvature.

- It profits from decreasing curvature i.e. increasing short & long end rates with decreasing intermediate rates.
- In this case, the long bullet will profit from price increase due to declining intermediate rates and the short barbell will also profit from price decline due to increasing short & long end rates.

- It also has net negative convexity and profits from having higher yield.
- Recall that in a rational market the compensation for giving up convexity is higher yield, all else the same.



SHORT BODY BUTTERFLY

- A butterfly portfolio shorting intermediate-term bonds (borrowing at intermediate rates) and investing the proceeds in the barbell portfolio is a short butterfly.
- This can be called short the body (intermediate) and long the wings (barbell).

- Since the barbell with more dispersed cash flow has greater convexity than the concentrated cash flow of short bullet position, the short butterfly has net positive convexity and profits from high volatility.



- The butterfly short the body (intermediate) and long the wings (barbell) profits from increasing curvature.
- Increased curvature could manifest itself as, for example, a rise in the intermediate rates with the short and long term rates being unchanged/decreasing.
- This would mean that the value of the short body (intermediate) would fall while the long wings (barbell) would remain unchanged/rise. Thus, the value of the butterfly will increase.

- **Greater the net convexity of the butterfly i.e. lesser the convexity of the short body, greater would be this increase in value. The increase would be profits from increasing curvature.**