Fixed Income Asset Pricing
Bus 35130 Spring 2024
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Homework 2
Due at the beginning of class 3

This homework is on the pricing and risk assessment of Leveraged Inverse Floaters. Please, write the solution to the homework as a clean report addressed to the principals of the fixed income group at JCH Fixed Income Group, LLP. The principals of JCH Fixed Income Group are very demanding, so make sure to describe exactly the source of your results. However, the report must be clean and concise. An appendix to the report may contain any additional material.

The data for this homework are collected in the data file *HW2_Data.xls* available on canvas.

Note 1: For each section below, there are questions that require pencil and paper (PP) answers, and questions that require actual computation using data and computer programs (CP). You are to do both.
Note 2: As with previous homework assignments there are "guides" for doing the homework in Excel, Matlab and Python. In each code provides partial solutions to the questions. To make the code run you are required to complete some formulas or to produce some of the results yourself. You are not required to use any of the guides, but use of one of them is recommended.

Leverage Inverse Floaters

Recommended Reading: Veronesi's Book. Chapter 2 (esp. 2.8); Chapter 3 (esp. 3.7)

In an environment of low interest rates, inverse floaters are popular investment vehicles that allow a fund manager to obtain a higher yield, by betting on the direction of the movement in interest rates. In particular, consider the following term sheet for a Leveraged Inverse Floater.

Leveraged Inverse Floater Term Sheet

Date	February 17, 2009
Maturity	February 17, 2014 (5 year)
Payments Frequency	Semi-annual
Interest Payment	Base Interest Rate minus 2 times Reference Interest Rate
Base Interest Rate	10%
Reference Interest Rate	6 month T-bill rate with standard 6 month lag

Do the following:

1. Bootstrap methodology

   (PP) Describe **bootstrap** methodology for extracting the term structure of interest rates.

   (PP) The *AllBondQuotes_20090217* tab of the data file provided contains Treasury Bills, Notes and Bonds on February 17, 2009. Use these data to manually compute the spot rates for maturity 0.5, 1, and 1.5. Show your work. *TIP: Maturity 0.4999 can be considered 0.5, and so on.*

   (CP) The *AllBondQuotes_20090217* tab of the data file provided contains Treasury Bills, Notes and Bonds on February 17, 2009.

   (i) Use these data to bootstrap the term structure of interest rates for as long a maturity as possible, and obtain the discount function. In particular, you will see that for several maturities, you will have a choice of which bonds to use in your bootstrap. Compute <u>two</u> discount curves, (a) one that uses the most recently issued bonds (as of 02/19/2009), and (b) one that uses the oldest bonds. Discuss the differences. Make sure to report what data you actually use for the bootstrap as well as any approximation you have to carry out. [Note: The bonds with highest coupon are the oldest ones].

   (ii) Plot the resulting term structure of interest rates (i.e. the spot rate function) for both cases (a) and (b). Discuss the difference and any other visible feature of the yield curve.

2. Leverage Inverse Floater pricing

(PP) Describe the cash flows of the Leverage Inverse Floater provided in Term Sheet. How can we decompose the Leverage Inverse Floater into simpler securities?

(PP) Discuss intuitively the benefits from investing in the Leverage Inverse Floaters as compared to an existing, traded, regular fixed rate note with the same maturity.

(CP) Use the results in Point 1 to compute the price of Leverage Inverse Floater described in the Term Sheet (which term structure do you use? Remember you have to come up with <u>one</u> price and not two. Explain your choice).

3. Duration and convexity

   (PP) Describe the **duration** of a fixed income security and how it is calculated in general. How is the duration of the Leverage Inverse Floater calculated? What are its components?

   (CP) Calculate the duration of the Leverage Inverse Floater. Plot the value of the Leverage Inverse Floater against a hypothetical parallel shift in the term structure of interest rates.

   (PP) Discuss your finding regarding the duration of the Leverage Inverse Floater and discuss the risk that an investor may face by investing in the Leverage Inverse Floater. In particular, compare the duration (and risk) of the Leverage Inverse Floater to that of a regular existing traded fixed-rate note with the same maturity.

   (PP) Describe the **convexity** of a fixed income security and how it is calculated in general. How is the convexity of the Leverage Inverse Floater calculated? What are its components?

   (CP) What is the value of the convexity of the Leverage Inverse Floater? Discuss.

4. **THIS IS AN OPTIONAL QUESTION FOR THOSE THAT ARE INTERESTED!** Value-at-Risk calculations

   (PP) Describe the Value-at-Risk concept and how it can be applied to fixed income securities, including Leverage Inverse Floaters.

(CP) Use the Duration and Convexity computed in Part 3 along with the data in *DBT6* tab of the data file provided to assess the risk of the Leverage Inverse Floater. In particular, compute the 1-day, 95% and 99% Value-at-Risk of the Leverage Inverse Floater, by using both the "historical approach," and the "normal distribution." Compare the result Value-at-Risk with the one of a regular 5-year bond. Comment.

Tip: See Veronesi's Book, Ch. 3.2.8 and 3.8. In particular, the 100-α% *Value-at-Risk is the value VaR such that* $Pr(L < VaR) = \alpha$ *where* L *is the portfolio dollar loss over one day.*