

# FNCE 529Q: Fixed Income Securities

Spring 2018 Term 1

## Assignment 2 due 2/19/2018

The Excel file "Assignment 2 Data.xls" contains the following data:

Col A: Date

Cols B-F: Key rates for maturities 0.5–10 years

Cols H-AA: Interpolated spot discount rates for maturities 0.5–10 years

Cols AG-: Data for five constant maturity coupon bonds. The maturities and coupons are 2 years 6%, 3 years 12%, 5 years 5%, 7 years 10% and 10 years 8%. For each bond, I provide the bond price for \$100 face value, yield-to-maturity quoted as APR, and Macauley duration

Assume you just bought \$10,000,000 face value of the 7-year coupon bond. You are now thinking about hedging this bond with any/all of the other 4 coupon bonds with the purpose of eliminating interest rate risk. Your boss (ehem, that's me) suggests that you back-test your hedging strategy by looking at how it would have performed week-do-week since 1990.

### Question 1:

For each date in the historical sample, construct a standard DV01-based hedge of the 7-year coupon bond using each of the other 4 coupon bonds (4 different hedge strategies). Evaluate the hedging error by comparing the total value of your portfolio on that date and one week later. Compute the mean, standard deviation, and skewness (why do I care about skewness?) of the hedging errors.

Based on this analysis, which bond would you decide to hedge with? Justify your answer by specifically referring to the statistics you computed above.

Evaluate the transaction costs associated with the different hedges. One idea is to look at the dollar transactions it takes week-to-week to remain duration neutral. How does this analysis of turn-over (or other proxies of transaction costs you might think of) affect your choice of the best hedge.

Your boss mentions that competing firms have started to adjust their hedge ratios for the fact that changes in yield to maturities are (a) not equally volatile and (b) not perfectly correlated across bonds. He asks you to look into this.

### Question 2:

To understand what your boss is talking about, compute first the standard deviation of week-to-week changes in the five key rates (points on the spot discount rate curve) as well in the yields to maturity of the five coupon bonds. Are yield changes equally volatile across maturities and/or coupons?

Next, compute the correlations between the week-to-week changes in key rates as well as in the yields to maturity of the five coupon bonds. Are yield changes perfectly correlated across maturities and/or coupons?

Given this evidence, report back to your boss on whether or not unequal standard deviations and/or imperfect correlations are something to worry about.

Regardless of your answer to question 2 (unfortunately for you), your boss has read up on regression-based adjustments to the standard DV01-based hedge. He has decided that he would like you to backtest also this idea.

### Question 3:

Repeat your analysis of Question 1 adjusting this time the hedge ratios for the different standard deviations and imperfect correlations between yields to maturity. Perform your corrections in a rolling fashion as you would in real time – that is, in order to construct the adjustment factor for date  $t$  you can only use historical data through date  $t$ . You'll need to make some decision about the historical sample length over which you compute the adjustment factor (do you compute the regression beta over 1 month, 1 year, use all the available data, etc?). Justify your decision.

Based on this analysis, which bond would you decide to hedge with if your boss decided to go with the adjustment? Justify your answer by specifically referring to the statistics you computed above. If your choice is different from Question 1, explain why. If the answer is the same, try to understand why.

Evaluate again the transaction costs associated with the different hedges. Beyond looking at week-to-week turnover, you could now also examine how the adjustment factor fluctuates week-to-week. How does this affect your choice of the best hedge.

### Question 4:

Combining the results of questions 1-3, what is your advice to your boss about whether or not the regression-based adjustment is sensible and/or worthwhile?

Impressed with your analysis, your boss wants to dig in just a little deeper. Having recently read about key-rate hedging in Tuckman and Sararat's textbook, he wants you to backtest that idea as well. For this, you of course have to first make sure you understand how key-rate hedging works.

Question 5:

Derive the historical key-rate DV01s and modified key-rate durations of all five coupon bonds with respect to each of the five key rates.

Question 6:

Pick a recent date. Construct for the date you picked a key-rate neutral portfolio (meaning all key rate DV01s of the portfolio are zero) consisting of the \$10,000,000 face value of the 7-year coupon bond and the following six bonds: a 6-month Treasury bill, a 1-year Treasury bill, the 2-year coupon bond, the 3-year coupon bond, the 5 year coupon bond, and the 10 year coupon bond. The Treasury bills can be priced using the spot rates.

What is the value of the key-rate neutral portfolio? What do you expect the value to be and why?