Duration and Risk

Presenters:

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Overview

Investment Analysis:

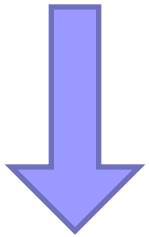
Duration Calculation

- Duration and concepts of convexity
- Different types of duration calculations
- Portfolio duration, risk and strategies
- Application of Bloomberg analysis

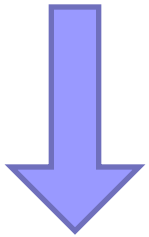
Measuring and Evaluating Risk

- **Interest Rate Risk**
  - Macaulay Duration
  - Modified Duration
  - Effective/OAS Duration
  - Risk vs. Duration
- **Convexity and Performance**
- **Credit Risk**
  - Spread Duration/Risk
  - Probability of Default

Macaulay Duration



Modified Duration



Effective/OAS Duration

Interest Rate Risk and Duration

Inverse relationship between price and yield. The price of some bonds however are more affected by changes in yield.

Interest Rate Risk:

The risk that interest rates will rise causing the yields of bonds to rise and consequently making prices fall.

Duration:

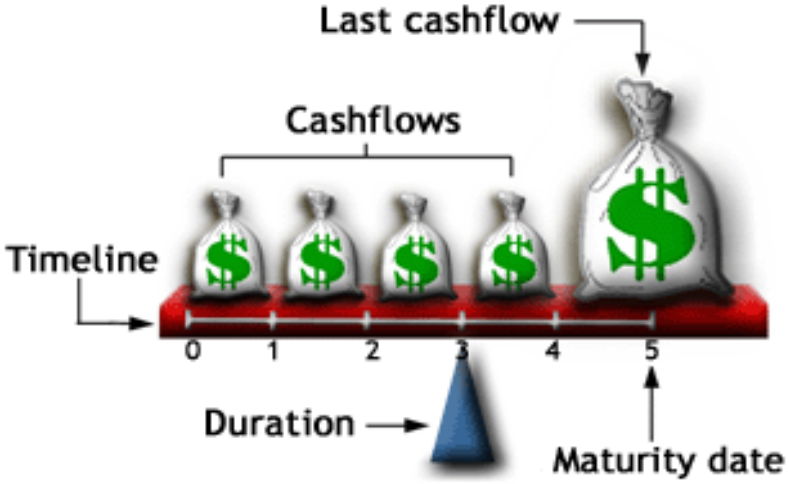
Investors can quantify how much the price of a bond will change as the yield changes through duration, The Duration is a measure of the % change in a bonds value changes in yield.

Risk/DV01:

Measures an absolute dollar movement of the bond.

Macaulay's Duration

Time in years until ½ of the future cash flows are received. Consider a bond that pays coupons annually and matures in five years. Its cash flows consist of five annual coupon payments and the last payment includes the face value of the bond.



The moneybags represent the cash flows you receive over the five-year period. To balance the red lever at the point where total cash flows equal the amount paid for the bond, the fulcrum must be farther to the left, at a point before maturity. (Duration/100 - change in yield 0.01%)

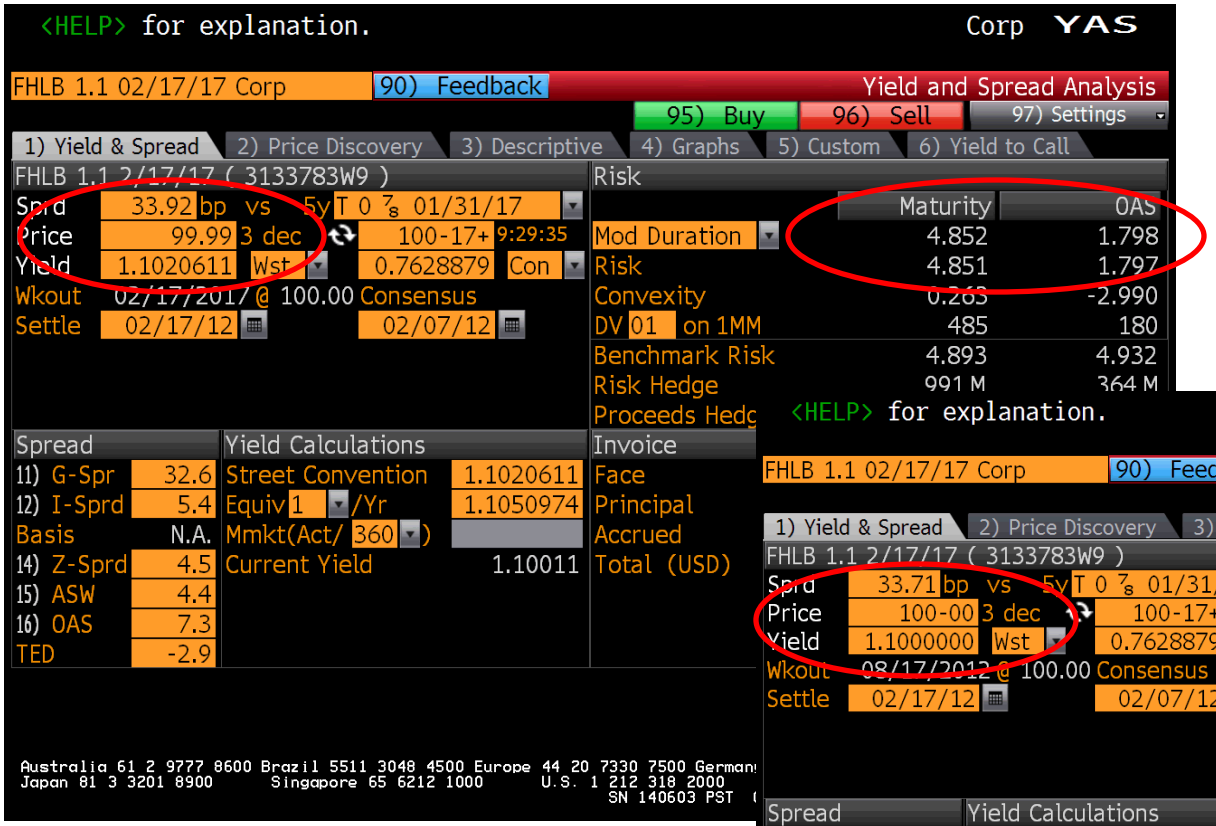
Why should we use a Bonds Duration rather than it's maturity?
T 1 3/8 11/30/15 vs T 9 1/4 2/15/16

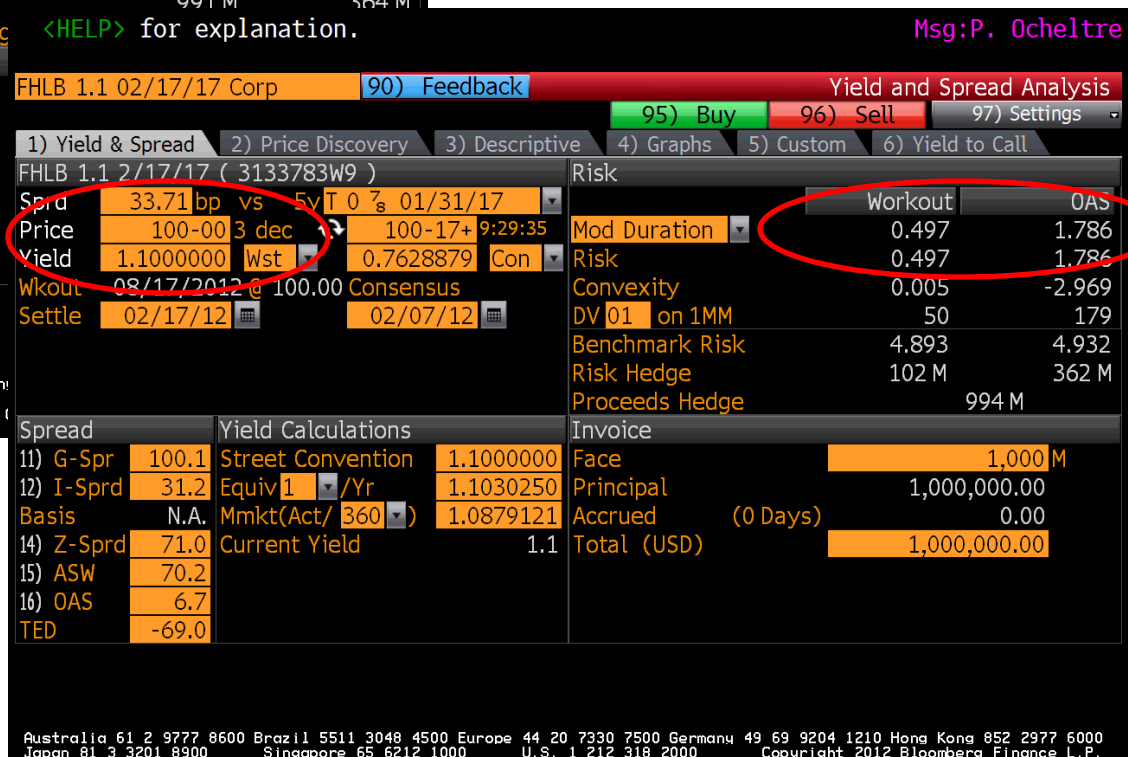
Modified Duration

Macaulay duration is close but not accurate. By modifying Macaulay's duration we have a more accurate measure of the price change.

$$\text{Modified Duration} = \frac{\text{Macaulay's Duration}}{(1 + \text{Yield/Compounding Frequency})}$$

Modified Duration and Non-Bullet Securities
Small changes in price can cause large swings in duration measures





Effective Duration

Effective or OAS duration allows for better evaluation of bonds with embedded optionality such as callable bonds. Effective duration better represents the trading sensitivity of callable bonds and is not subject to the immediate wide swings observed with the modified duration of callable securities.

Effective Duration = **Change in Price of Bond resulting from a parallel shift in yield curve.**

Effective Duration provides a better measure of price sensitivity for non-bullet securities

Risk

Modified Duration is still not the most accurate way to quantify the price change of a bond.

Risk is a more accurate measure. Multiply the full price of the bond by the modified duration

$$\text{Risk} = \frac{\text{Modified Duration X Full Price}}{100}$$

Duration is a measure of %. Risk is a measure of $.

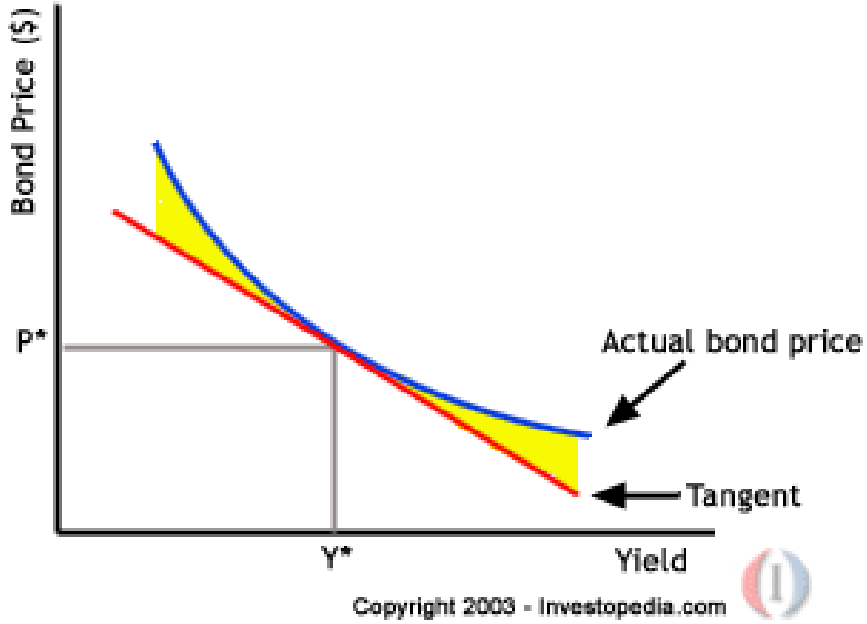
At Par: Duration = Risk

At a Discount: Duration > Risk

At a Premium: Duration < Risk

Convexity

Modified duration does not account for large changes in yield. If we were to use duration to estimate the price resulting from a significant change in yield, the estimate would be inaccurate. The convexity calculation, therefore, accounts for the inaccuracies of the linear duration line. Essentially, convexity shows how much a bond's price changes in response to a change in yield.

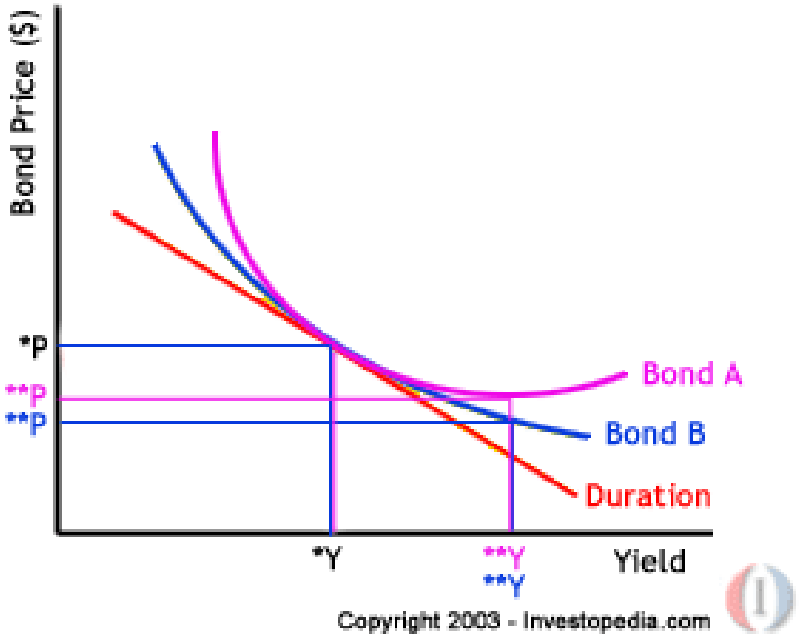


Convexity

Convexity is Good

A bond with greater convexity is less affected by a change in interest rates.

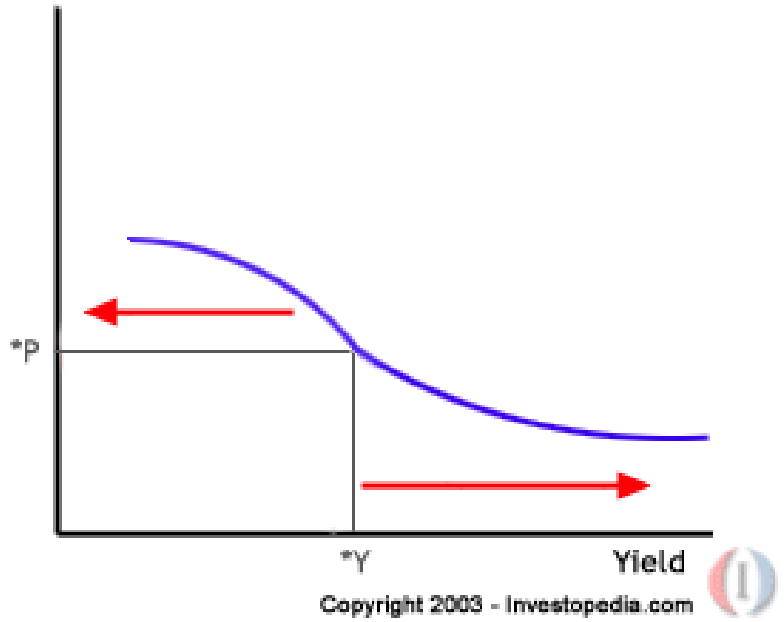
Bonds with greater convexity will have a higher price than bonds with a lower convexity, regardless of whether interest rates rise or fall.



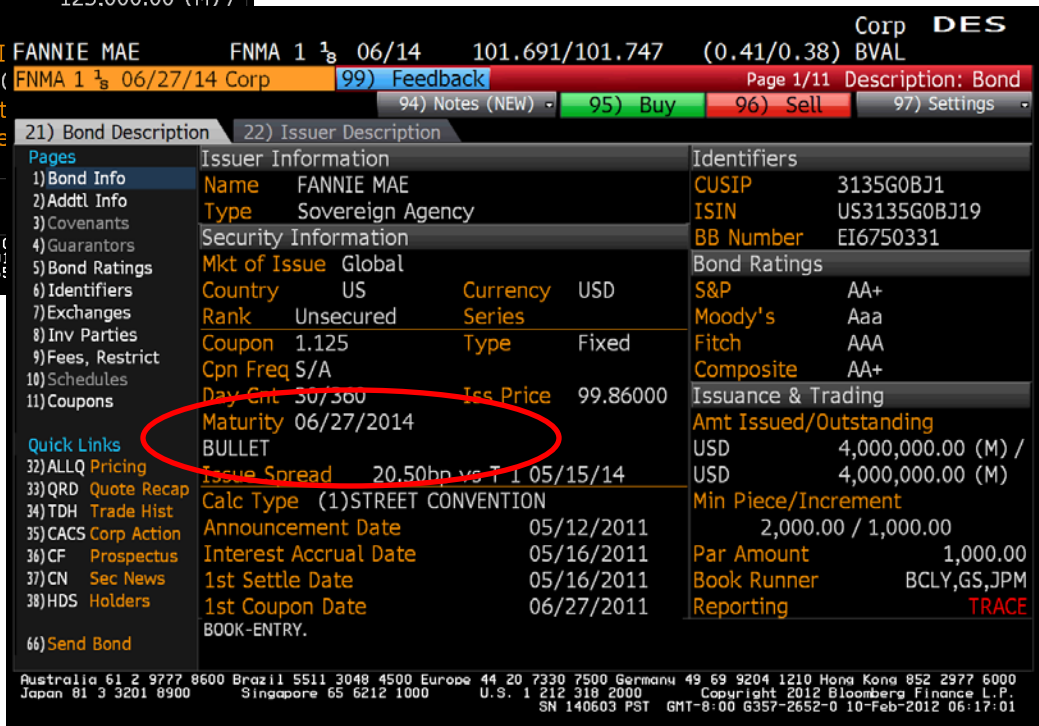
Convexity

Callable bonds will exhibit negative convexity at certain price-yield combinations.

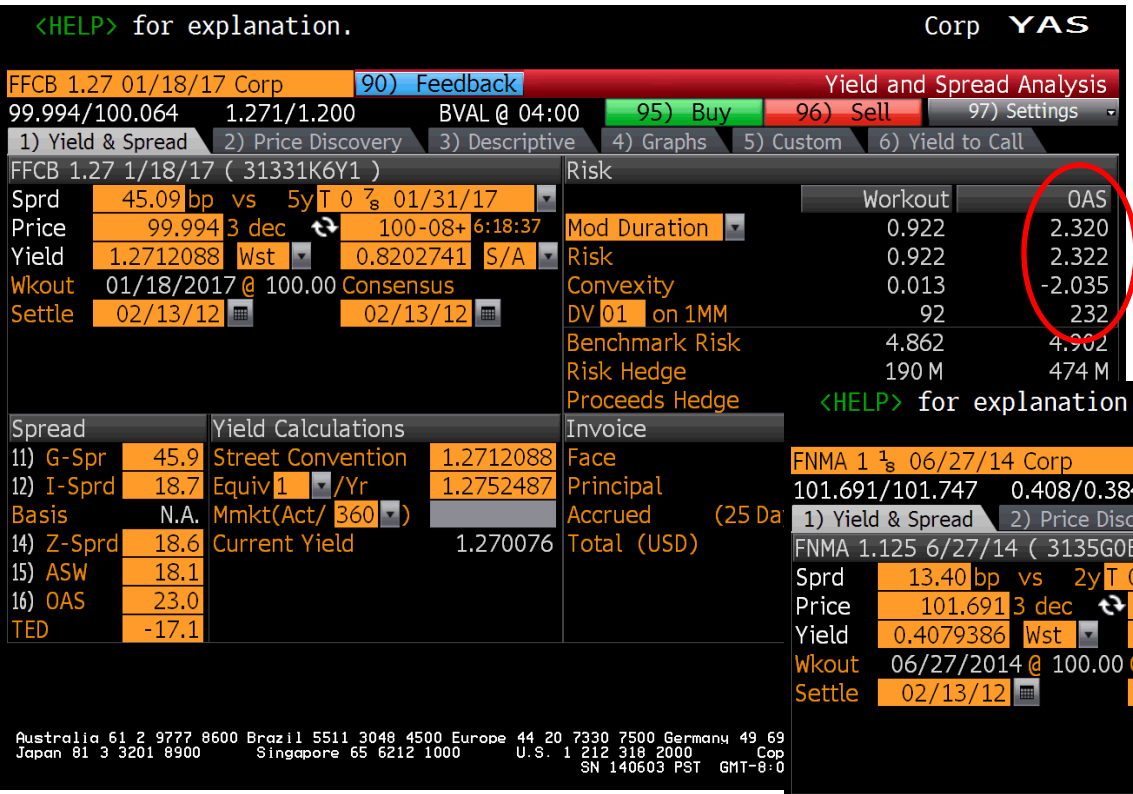
Negative convexity means that as yield decrease, duration will also decrease.

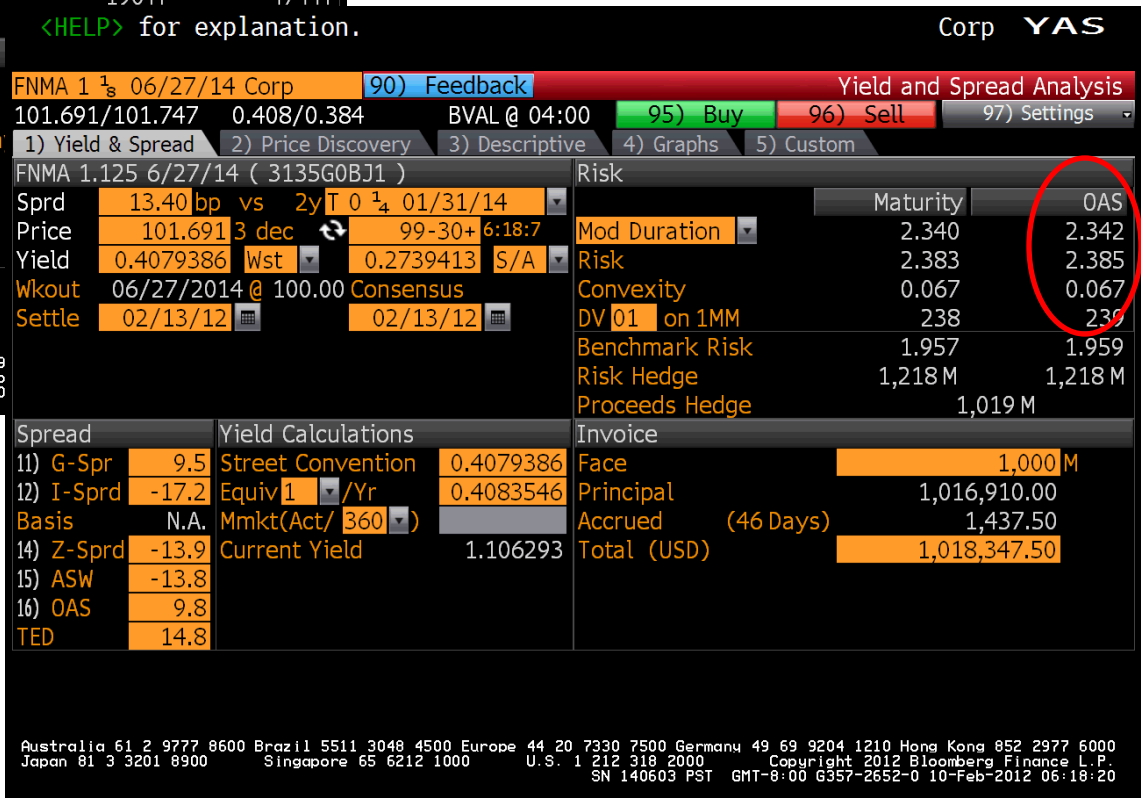


How does convexity effect the return of a bond?
FNMA 1.125 6/27/14 vs FFCB 1.27 1/18/17

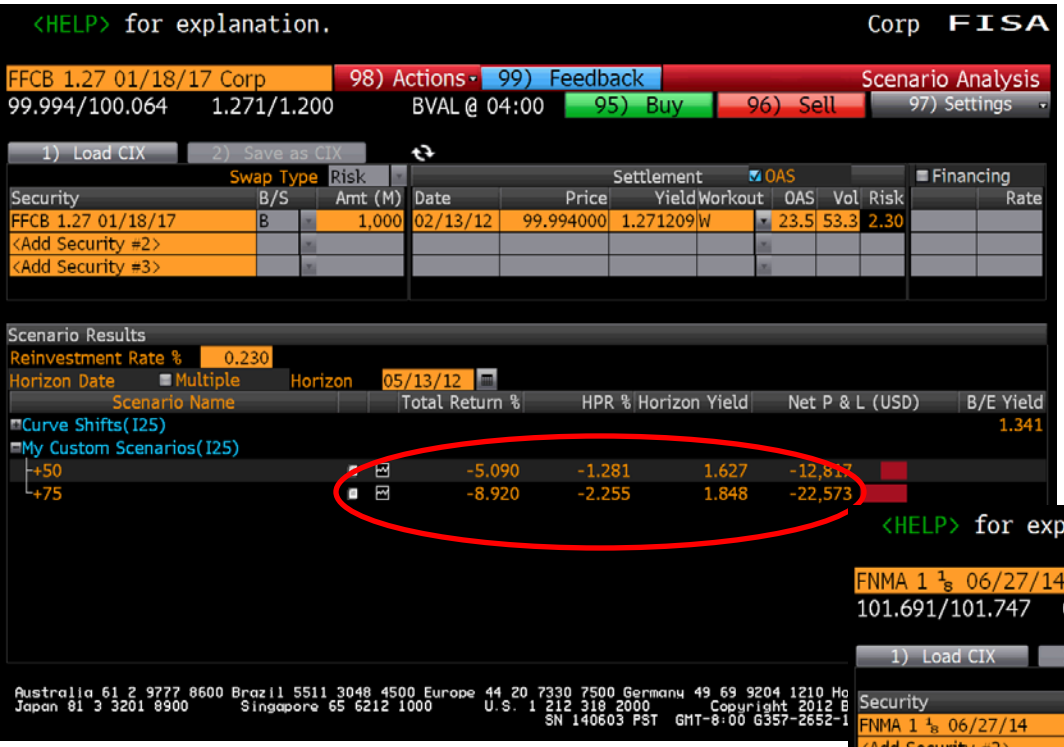


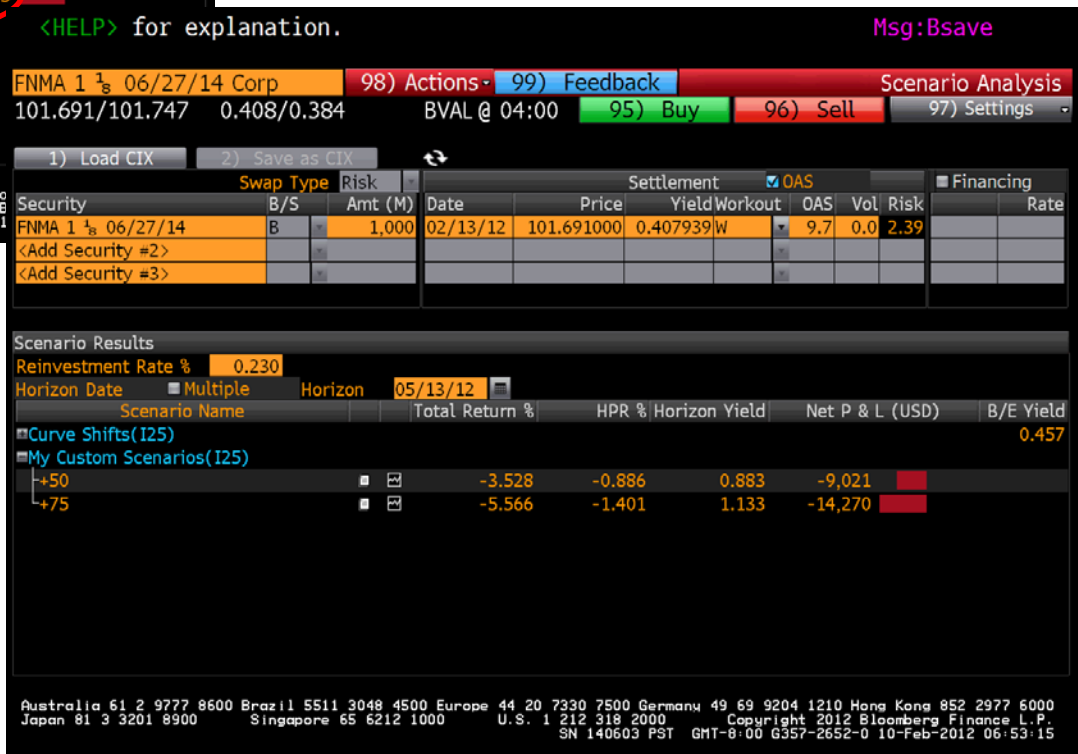
The Durations of the Securities are Virtually Identical
Convexities are much different



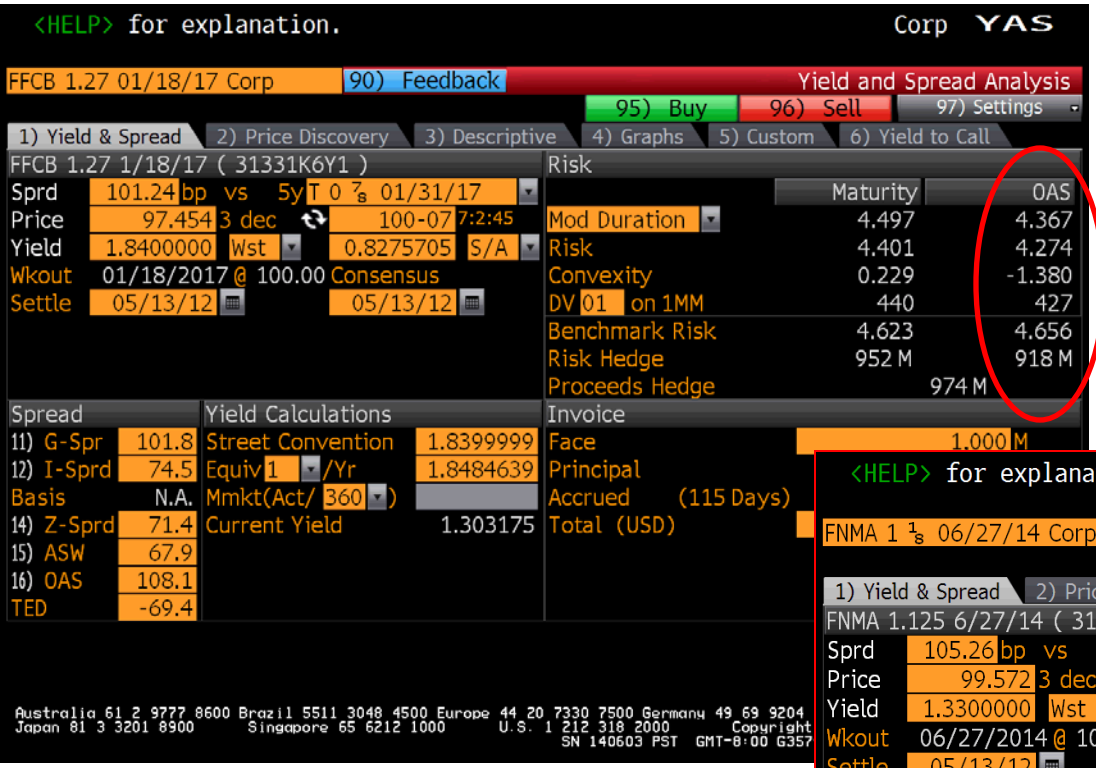


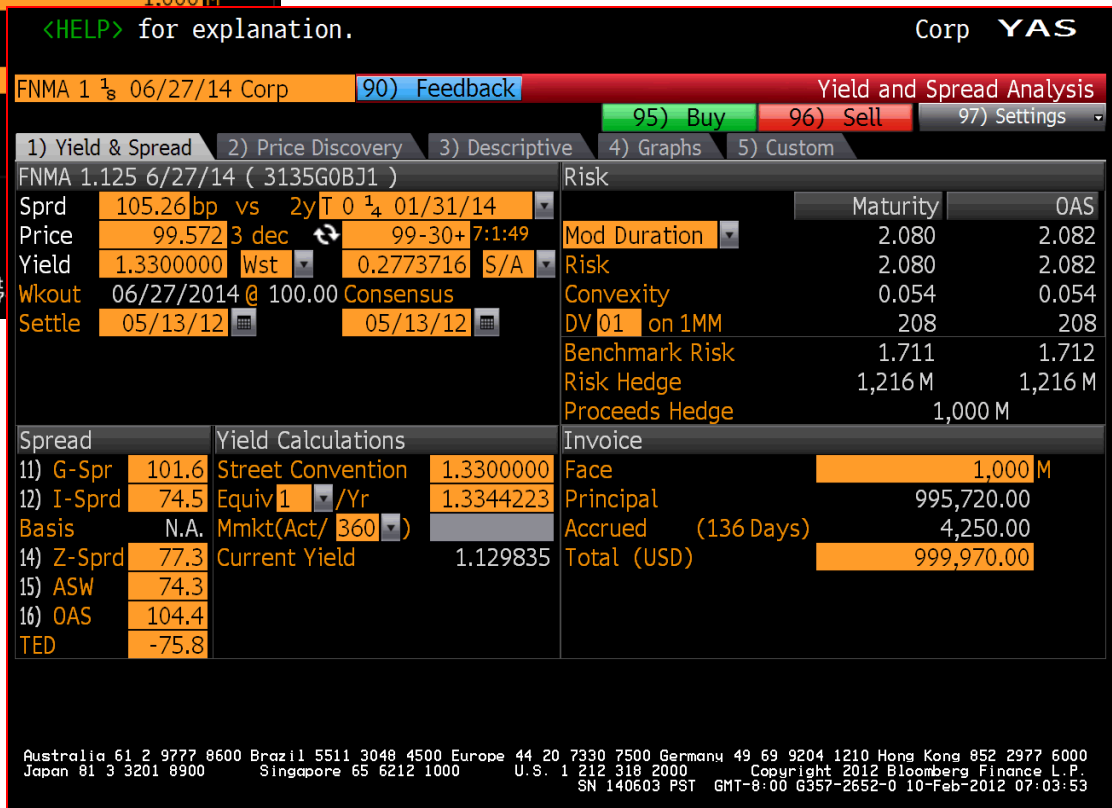
3 month returns with modest interest rate increases





Convexity Effects Duration and Risk as Rates Change

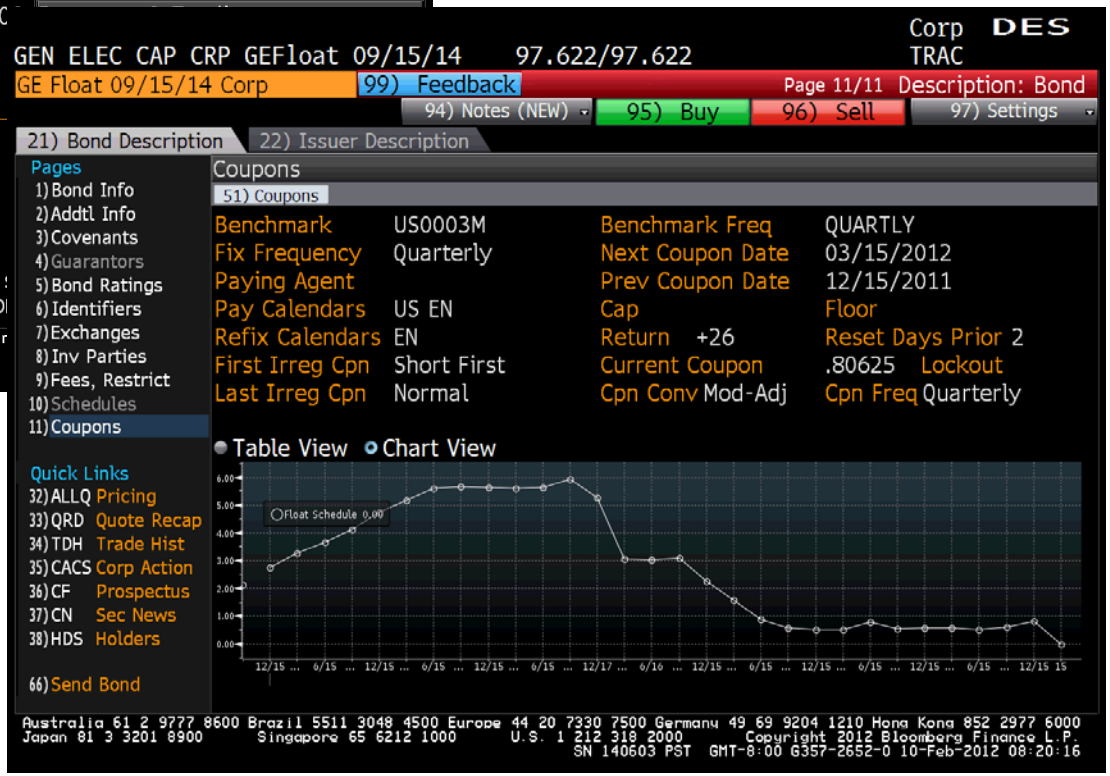




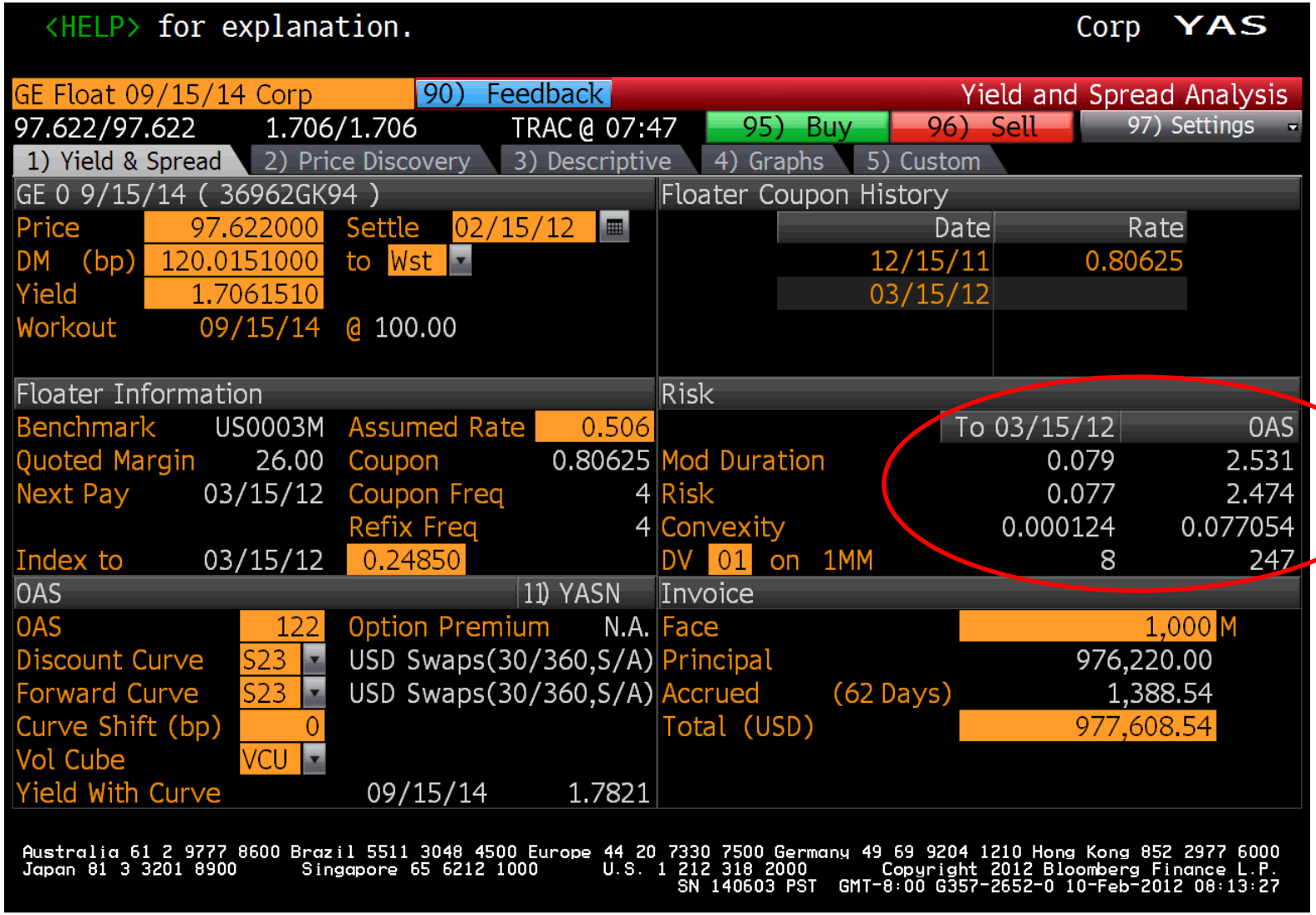
Credit Risk

- **Credit Spread Risk vs. Duration**
  - Credit/OAS duration measures
  - Bullet Securities: Credit Duration = Interest Rate Duration
  - Callable Securities: Credit Duration ~ Interest Rate Effective Duration
  - Floating Rate Securities: Credit Duration is substantial different than Interest Rate Duration

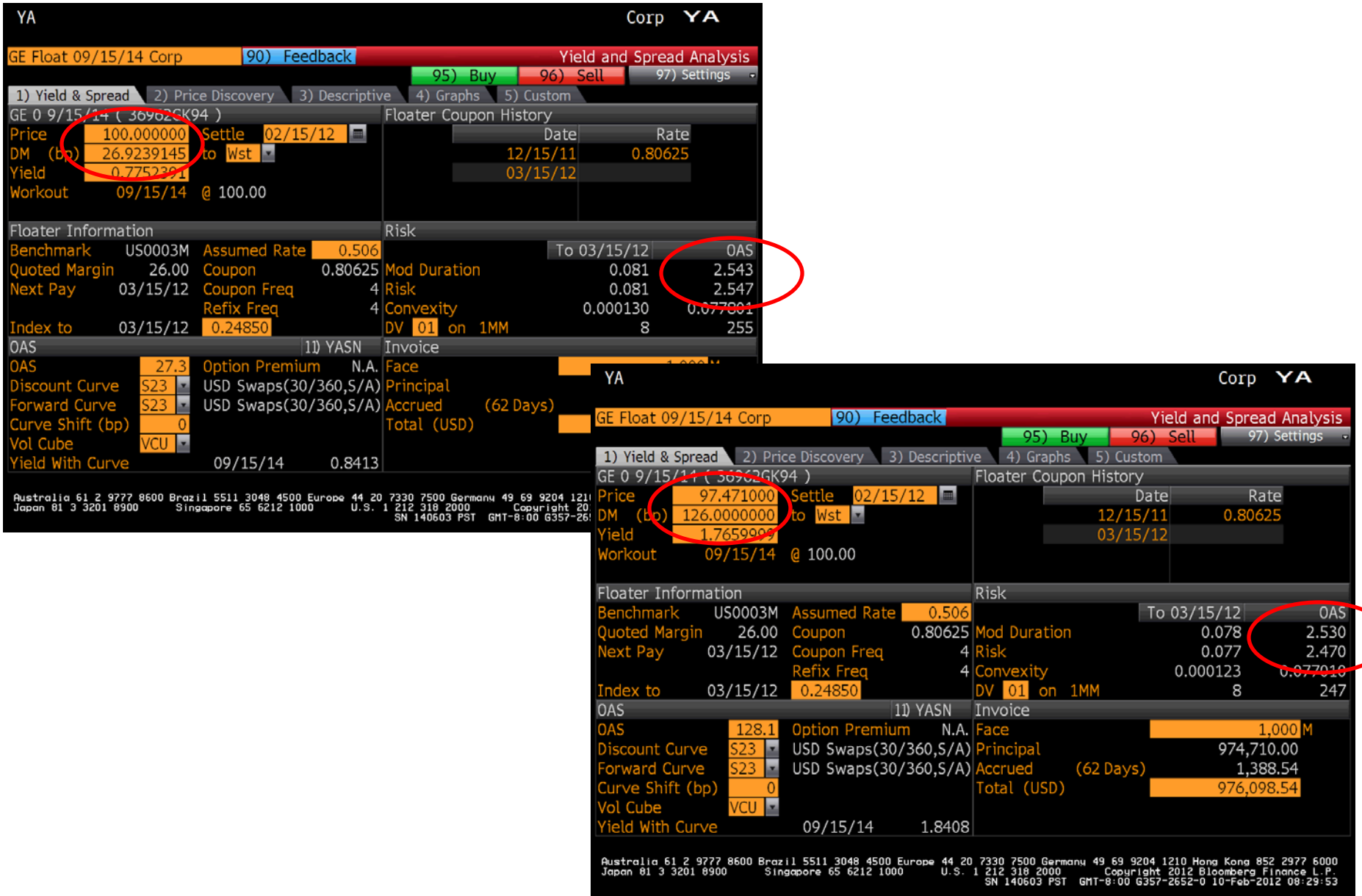
Floating Rate Example: GE Float 9/15/14



Measuring Credit Risks of a Floating Rate Bond



Example Quantifying Risk of Widening Credit Spreads



Summary: It's a Risky World!

- Investing is Inherently Risky
- Effective Investment Management can be defined as Effective Risk Management
- Identifying and Quantifying risk is critical for long term effective portfolio management
- Duration and the Risk of Portfolio will change with Interest Rate Shifts
- Credit Risk involves more than simple default risk

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