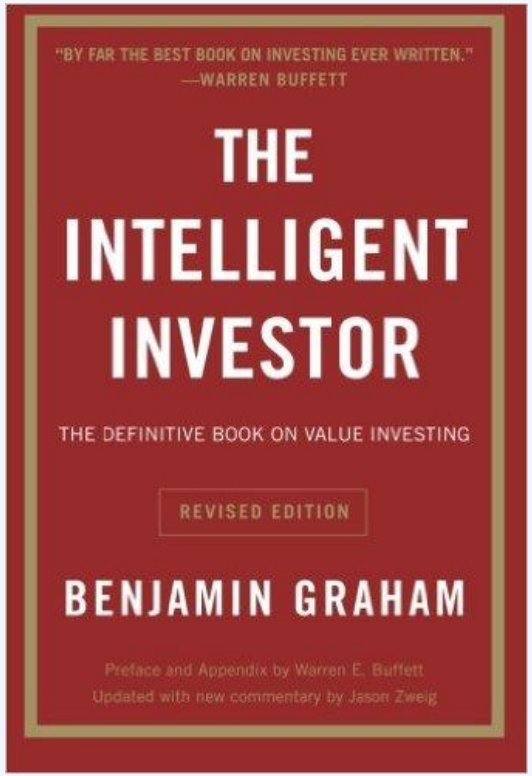
Session 3
Fundamentals of Public Funds Investing: Investment Terms and Concepts

January 18th, 2017

Jason Klinghoffer, CFA
Director, Debt Capital Markets
Mischler Financial Group

CDIAC

CALIFORNIA DEBT AND INVESTMENT ADVISORY COMMISSION



> "The art of investment has one characteristic that is not generally appreciated. A creditable, if unspectacular, result can be achieved by the lay investor with a minimum of effort and capability; but to improve this easily attainable standard requires much application and more than a trace of wisdom.

Graham, Ben: The Intelligent Investor.

WHAT IS A BOND?

- A fixed-income security (“bond”) is an instrument that allows governments, companies, and other types of issuers to borrow money from investors. Any borrowing of money is debt. The promised payments on fixed-income securities are, in general, contractual (legal) obligations of the issuer to the investor. For companies, fixed-income securities contrast to common shares in not having ownership rights. Payment of interest and repayment of principal (amount borrowed) are a prior claim on the company's earnings and assets compared with the claim of common shareholders.

  -Fixed Income Analysis (CFA Institute Investment Series)

Important Elements For Investors:

KEY FACTORS

- Bond features such as the **issuer**, **maturity**, **par value**, **coupon rate, payment frequency** and **bond structure** determine the bond's cash flows and are thus key determinants of expected return (and actual return).

- Embedded call options can affect scheduled cash flows and must be understood.

- Legal and regulatory considerations that apply to the contractual obligation between the bondholder and issuer and legal constraints that may exist between the bondholder and the constituents they represent (investment policy)

Important Elements For Investors:

ISSUERS

- Bond Issuers are classified by categories based on their characteristics
  - *Sovereign (national governments) - e.g. US Treasuries, UK Gilts, German Bunds*
  - *Non-Sovereign (muni's) – e.g. State of California G.O. bonds*
  - *Supra-National(multilaterals) –e.g. IBRD, IFC, IADB*
  - *Quasi-Government (GSE agencies)- e.g. FNMA, FHLMC, FHLB, FFCB, FAMCA, TVA*
  - *Corporate – e.g. GE, Toyota, Oracle,*

- Different categories expose investors to varying degrees of credit risk. This is the risk of an issuer defaulting on interest and/or principal payments in the future.
- Investment policies restrict public entities from investing in issuers that fall below certain rating levels as determined by the major rating agencies (S&P, Moody's, Fitch)

Important Elements For Investors:

MATURITY

- Date the issuer is obligated to repay the outstanding principal amount and any remaining interest.

- The term to maturity (tenor) indicates the period over which the investor can expect to receive interest payments and length of time until the principal is repaid in full.

- Bond maturities indicate the type of bonds you are buying:

  Less that one year → Money Market Securities (Bills)

  One year to Ten Years →Notes

  Greater than Ten Years → Bonds

Important Elements For Investors:

PAR VALUE

- The Par Value is the principal value the issuer agrees to repay the bondholders on the maturity date (also known as face value).
- Bond prices are quoted as a percentage of par value. Most bonds are priced off of a standard $1,000 par value per bond. Thus as a percentage price, bonds can trade at a discount, par, or at a premium.
    - A bond priced at 97.50 is considered a “discount” as it is trading at $975 per $1,000 bond being traded.
    - A bond priced at 100 is considered a “par” bond as it is trading at $1,000 per $1,000 bond being traded.
    - A bond priced at 101 is considered a “premium” bond as it is trading at $1,010 per $1,000 bond being traded.

Important Elements For Investors:

COUPON RATE

- The interest rate stated in annual terms that the issuer has agreed to pay each period until maturity (e.g. FHLMC 2.00% 11/30/21)
- A bond's coupon is calculated by multiplying the stated coupon rate by the par value of the bond. (e.g. coupon rate of 2.00% on a $1,000 bond = $20 of interest generated each year.)
- Bond's typically pay interest semi-annually (2x per year), but can also pay quarterly (Floaters) or even monthly (MBS). Using our above example, if the bond pays semi-annually, our bond would pay $20/2 or $10 per 6 month period.

Important Elements For Investors:

STRUCTURE

- Bonds can have many different characteristics and variables that can change both the timing and amount of cash flows. A bond's structure is an important element to consider as different structures are designed to benefit (or disadvantage) investors under different environments.

- Typical structure types (non-callable):
  - ***Fixed Rate*** (Vanilla or Conventional Bond): Bond pays a fixed rate of interest over a fixed schedule and does not change over the bond's life.
  - ***Zero-Coupon***: Issued at a discount to par and does not pay interest.
  - ***Step-Up/Down***: Bond pays interest at pre-determined interest rates over fixed schedule. (e.g. 3 year Step Up pays 1% for first year, 2% for second year, and 3% for third year).
  - ***Floating Rate Notes*** (FRN's): Bond pays varying levels of interest that change (typically quarterly) as the underlying reference rate changes (usually Libor). (e.g. 3 year FRN that pays 3Mo Libor +75bp and adjusts quarterly).

Important Elements For Investors:

CALL OPTIONS

- Bonds with embedded call options give the issuer the right to redeem all or part of the bond before the maturity date. Issuers benefit from issuing these bonds as a way to protect themselves against a decline in interest rates. Investors benefit by receiving a higher yield for taking on the risk the issuer will exercise that right.
- Typical Embedded Call Options:
    - ***One-Time Call (European Call):*** Issuer has right to call the bond only once on the specified call date.
    - ***Discrete Call (Bermuda Call)***: Issuer can call bond on specified dates throughout life of bond on or after the first call date. Most common Bermuda Call is quarterly callable (a ***Canary Call*** is a derivation of a Discrete Call in that it stops being callable at some point before maturity).
    - ***Continuous Call (American Call)***: Issuer has the right to call the bond at anytime on or after the first call date.

Important Elements For Investors:

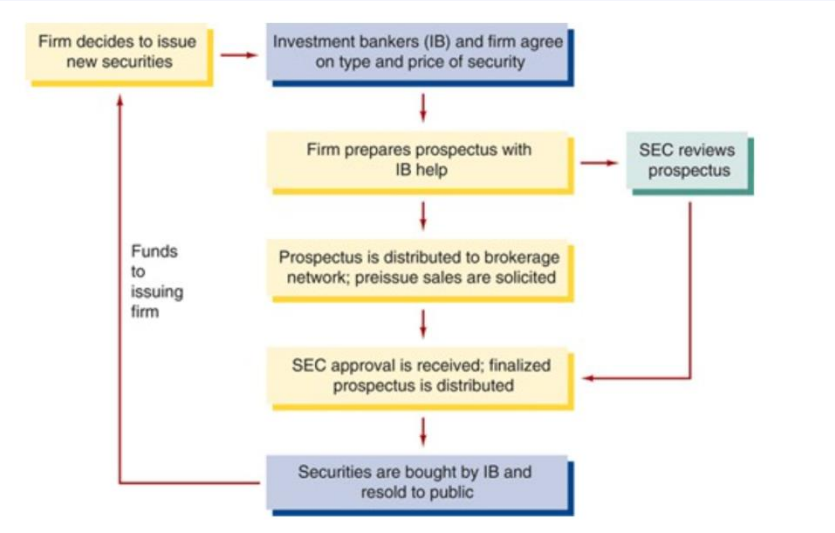
LEGAL & REGULATORY

- Most public entities have Investment Policies that ensure “legal” securities are being purchased by constraining the universe of bonds investors can purchase. Investment Policies are not strategy playbooks, but rather rulebooks that define the universe in which a manager can invest to minimize the risk of adverse events.

- Because these policies set general guidelines, it is still important to be aware of specific legal provisions that are unique to individual issues and issuers in the sectors to which you are investing:
    - Know the legal identity of the issuer and its legal form (parent, subsidiary, etc..)
    - The source of repayment proceeds (issuer, project cash flows, taxes, etc..)
    - Seniority (senior vs subordinated)
    - The asset or collateral backing (MBS, ABS, CMBS, etc..)
    - The credit enhancements (internal vs external enhancements)
    - The covenants (positive and negative covenants)

PRIMARY MARKET ISSUANCE – UNDERWRITING vs. MTN

- Much like equities, many bonds undergo an underwriting process:
  - Registration for sale of securities (Securities Act of 1933)
  - Securities are sold by directed underwriting or competitive/auction process



Understanding the Market:

PRIMARY MARKET ISSUANCE – UNDERWRITING vs. MTN

- Large corporate and GSE issuers utilize the Medium Term Note market for issuance. MTN's are offered by a Shelf Registration (SEC Rule 415) allowing issuers to sell new securities on a continuous basis without requiring a new SEC registration for each issue.

- MTN's have brought reduced costs and greater flexibility for issuers to raise capital. Investors receive broader access to different structures and credits to diversify risk and can even customize transactions utilizing a "reverse-inquiry".

Understanding the Market:

HOW BONDS TRADE

- Bonds are mostly traded over the counter (OTC) and not via exchanges.
  - Bond market is nearly twice the size of the equity market in the U.S. ($40.7t to $24.7t)
  - Bonds have many different characteristics and varying degrees of complexity making exchange trading difficult.

1. *There are under 4,000 actively traded stocks in the U.S. but there are tens of thousands of debt securities outstanding. (e.g. GE has 1 common stock in USD traded via exchanges, but over 450 USD debt securities outstanding with many different characteristics).*

1. *Bonds trade much less frequently than stocks. After the first few days of being issued, a bond might not trade again for months or even years making sustainable exchange trading difficult.*

2. *Average bond transaction size is around $1.2MM for most active 1,000 bonds and above $500,000 for less active bonds. Equities average trade size is roughly $10,000.*

Understanding the Market:

HOW BONDS TRADE

- Bonds rely on broker-dealers to serve as “market makers”.
  - Dealers quote prices to buy (bid) or sell (ask) securities. This provides liquidity to the market and gives investors the ability to move in and out of securities. Dealers attempt to profit by optimizing the bid-ask spread or earning concessions / commissions on bond transactions.
  - Unlike exchanges, quotes are not centralized and are not seen by all market participants. Your dealer coverage and resources available will dictate what you see in the market (thus dealer selection is important).
  - Dealers can quote different bid/ask levels to different customers. Latest trade transparency still has a delay (FINRA TRACE) and does not cover all securities.
  - Electronic trading has revolutionized equity trading but remains an uphill battle in the bond market. There are a variety of fee based and free (dealer-provided) platforms that are increasing transparency and creating more efficiencies, but the transition to these systems is gradual at best.

What Moves Bond Markets:

BRAVE NEW WORLD

- Bond markets can react on economic data (unemployment, GDP, CPI, etc…), fiscal policy decisions (government spending), monetary policy decisions (QE, Fed meetings), sector and idiosyncratic data, political commentary, market speculation and a new dependence on social media / mobile feeds.

Time Value of Money (TVM)

- Concept that money today is worth more than the same amount in the future.
- Rational investors prefer to receive money today rather than the same amount of money in the future because of money's potential to grow in value over a given period of time.
- Money today is considered the present discounted value under TVM.
- Fundamental formula of TVM accounts for the following variables:
  - FV = Future Value of Money
  - PV = Present Value of Money
  - N = Number of Compounding Periods Per Year
  - T = Number of Years
  - I = Interest Rate

Future Value

$$FV = PV * (1+(I/N))^{(N*T)}$$

Present Value

$$PV = FV /(1+(I/N))^{(N*T)}$$

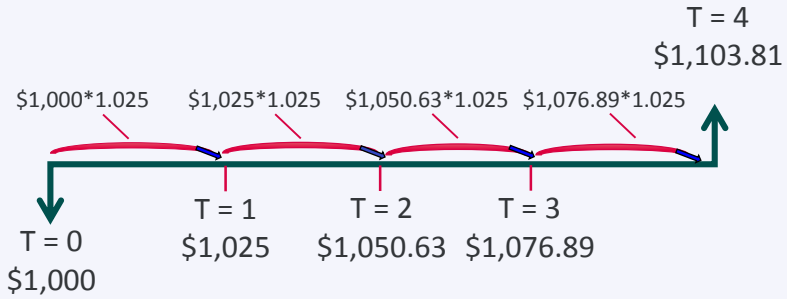
Time Value of Money (TVM)

Future Value

$$FV = PV * (1+(I/N))^{(N*T)}$$

Given a present value (PV), we can <u>compound</u> to return a future value (FV).

If we have $1,000 today and we will earn 5% per year, compounded semi-annually, how much will we have in 2 years?



$$FV = 1,000 * (1+(.05/2))^{(2*2)}$$

$$FV = 1,000 * (1.025)^{(4)} = \$1,103.81$$

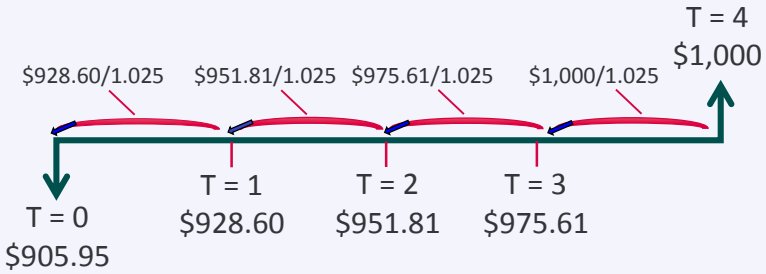
Time Value of Money (TVM)

Present Value

$$PV = FV /(1+(I/N))^{(N*T)}$$

Given a future value (FV), we can <u>discount</u> to return a present value (PV).

If we expect to receive $1,000 in 2 years and we will earn 5% per year, compounded semi-annually, what is the value today?



$$PV = 1{,}000 / (1+(.05/2))^{(2*2)}$$

$$PV = 1{,}000 / (1.025)^{(4)} = \$905.95$$

*See CDIAC Advanced PF Investing, Session One, Advanced Concepts for Public Investment Analytics: January 2016 for expanded review

YIELD (Internal Rate of Return)

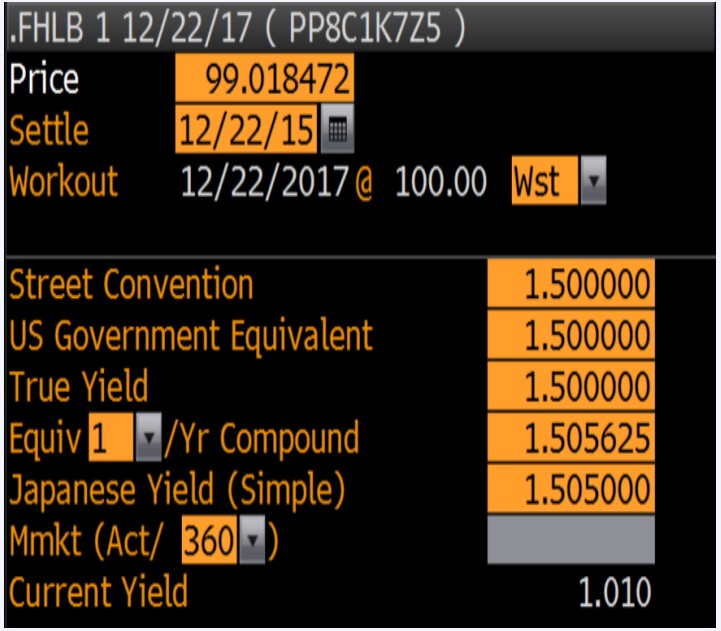
- Yield is the interest rate that will make the present value of the cash flows equal to the price of the bond.
- Yield accounts for both the income received and capital gain or loss that occurs until the point of redemption (YTC/YTM/YTW)
- Assumes that the coupon is reinvested at the stated yield (time value of money concept of compounding).
- Since yield uses a discounted cash flow calculation, the timing of the cash flows are also considered.

*2.00Yr Semi-Annual Pay using YA Function

Maturity (Yrs)	CPN	YTM	PAR
2	1.00%	1.50%	$1,000,000

Period	Cash Flow	PV Factor 1/(1+y)^n	PV Cash Flow (CF * PV Factor)
1	$5,000.00	0.992555831	$4,962.78
2	$5,000.00	0.985167078	$4,925.84
3	$5,000.00	0.977833328	$4,889.17
4	$1,005,000.00	0.970554172	$975,406.94

Bond Value (Sum PV Cash Flow)	Bond Price (Bond Value / Par Value)
$990,184.72	99.018



YIELD (Internal Rate of Return)

- Yield has an implicit reinvestment assumption that makes the yield achievable only if the coupons are reinvested at that yield.

Future Value of 2Yr Bond

FV Annuity Formula for calculating FV of Coupon Payments @ 1.50%/2

Par Value received at Maturity

Future Value of Compounded Cash Flows

Actual Cash Flows

Reinvestment Income at 1.50%

$$5{,}000\left[\frac{(1.00750)^4 - 1}{.00750}\right] = \$20{,}226.127 + \$1{,}000{,}000.00 = \$1{,}020{,}226.127 - \$1{,}020{,}000.00 = \$226.127$$

Present Value of 2Yr Bond

$5,113.346 + $5,075.281 + $5,037.50 + $1,005,000 = $1,020,226.127

1) Pay $4,962.78 to receive $5,000 in 6 Months. That $5,000 reinvested for 3 periods:
$5000(1.0075)^3 = **$5,113.346**

2) Pay $4,925.84 to receive $5,000 in 12 Months. That $5,000 reinvested for 2 periods:
$5000(1.0075)^2 = **$5,075.281**

3) Pay $4,889.17 to receive $5,000 in 18 Months. That $5,000 reinvested for 1 period:
$5000(1.0075) = **$5,037.50**

4) Pay $975,406.94 to receive **$1,005,000** in 24 Months (at maturity)

Maturity (Yrs)	CPN	YTM	PAR
2	1.00%	1.50%	$1,000,000

Period	Cash Flow	PV Factor 1/(1+y)^n	PV Cash Flow (CF * PV Factor)
1	$5,000.00	0.992555831	$4,962.78
2	$5,000.00	0.985167078	$4,925.84
3	$5,000.00	0.977833328	$4,889.17
4	$1,005,000.00	0.970554172	$975,406.94

Bond Value (Sum PV Cash Flow)	Bond Price (Bond Value / Par Value)
$990,184.72	99.018

YIELD (Internal Rate of Return)

Conventions:

-Yield to Maturity (YTM)

*Assumes cash flows exist through the maturity date.

-Yield to Call (YTC)

*Assumes cash flows exist through the next call date.

-Yield to Worst (YTW)

*Assumes cash flows exist to the point where the lowest obtainable yield is achieved.

Structure Type	Pricing to Par	Yield to Worst
Fixed Rate Clb	Par	YTM/YTC
Fixed Rate Clb	Discount	YTM
Fixed Rate Clb	Premium	YTC
Step Up/Down Clb	Par	YTC (Step Up), YTM (Step Down)
Step Up/Down Clb	Discount	Varies (Step Up), YTM (Step Down)
Step Up/Down Clb	Premium	YTC(Step Up), Varies (Step Down)

*2.00Yr 1.00% Fixed Callable @ Par

*2.00Yr 1.00% Fixed Callable @ Discount

*2.00Yr 1.00% Fixed Callable @ Premium

YIELD (Internal Rate of Return)

Bond Return Sources:

1) Periodic interest payments made via coupon payments (non-zero bonds)
2) Capital gain/loss at redemption (matured, called or sold)
3) Interest-on-interest from coupon reinvestment (at yield rate)

Yield drawbacks:

- Yield accounts for all three sources of return, however it assumes that coupons can be reinvested at quoted yield ("promised yield"). Higher coupon and longer maturity bonds derive more dollar return from Int-on-Int component.
- Yield does not depend on par amount, thus can be manipulated (e.g. using weighted average portfolio yield and separating cash from the equation).
- Yield encompasses all the risk inherent in the bond (interest rate, credit, liquidity, reinvestment risk).
- From a portfolio perspective, Yield is dependent on duration of assets and stability over budget cycle.

Premiums vs Discounts

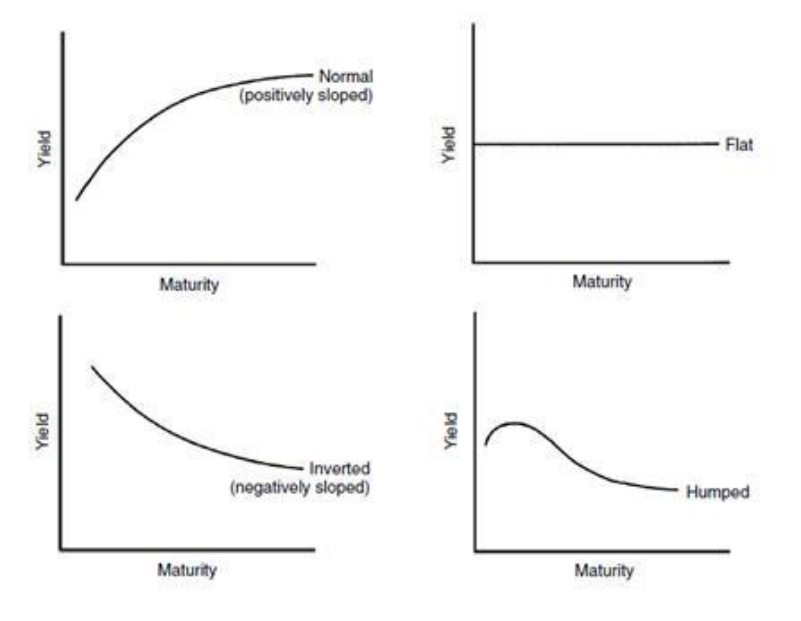
There are tradeoffs!

-Premiums increase coupon cash flow but create higher up front costs, amortization requirements, and possibly higher int-on-int which can lower actual total cash flow.
-Discounts decrease coupon cash flow but require less capital up front and still require accretion. Current income is lower!

**For income oriented investors, discounts can hurt! When current cash flow is key, par or slight premiums may make more sense.*

YIELD CURVE

- The Yield Curve is a line that plots interest rates to represent the relationship between maturity and yields. The Treasury curve is the most referenced yield curve and is used as the main benchmark for other debt.



Spread Measures: Yield Spread

- Yield Spread is simply the difference in basis points between the selected benchmark (e.g. maturity/duration matched Treasury) and non-benchmark security.
- It is the potential compensation for accepting the risks of a security relative to that of the selected benchmark.
- These risks can include:
  - Interest Rate Risk
  - Credit Risk
  - Liquidity Risk
  - Reinvestment Risk
- Example:
  - 3 Year US Treasury: Yield = 1.28%
  - 3 Year Agy Bullet: Yield = 1.35%
  - 3 Year Agy Callable: Yield = 1.50%
    - Bullet Yield Spread = 7 Basis Points
    - Callable Yield Spread = 22 Basis Points

Drawbacks:

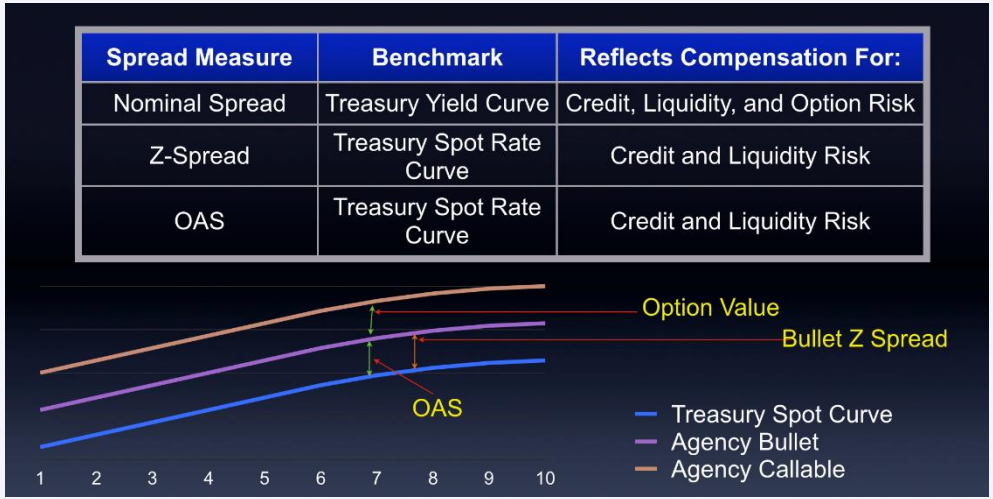
1) For both bonds, yield spread fails to consider yield curve or spot rate curve (only considers single point).

2) For callables, expected interest rate volatility may alter expected cash flows.

Spread Measures: Option Adjusted Spread (OAS)

- OAS is the constant spread over the designated curve that will cause the market price of a bond to equal the present value of its cash flows.
- By utilizing option models to evaluate characteristics of the embedded options, we create a spread measure that allows us to evaluate the option value (model specific), subtract it from the equation, and compare the spread to other callable and non-callable bonds (this is why it is also sometimes referred to as the “Option Removed Spread”).

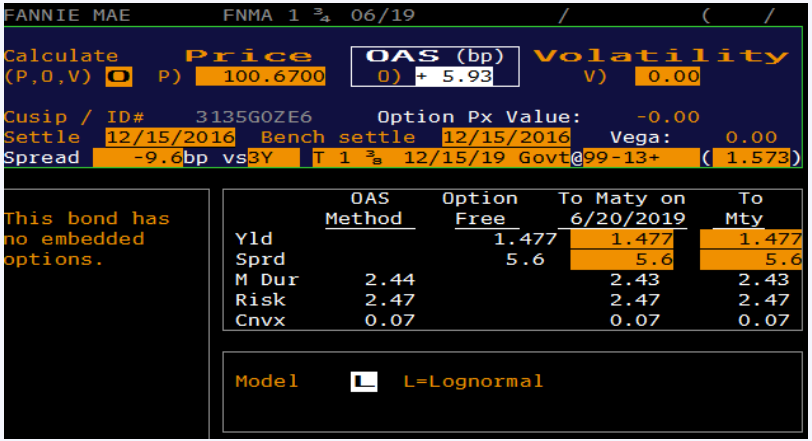
Spread Measure	Benchmark	Reflects Compensation For:
Nominal Spread	Treasury Yield Curve	Credit, Liquidity, and Option Risk
Z-Spread	Treasury Spot Rate Curve	Credit and Liquidity Risk
OAS	Treasury Spot Rate Curve	Credit and Liquidity Risk



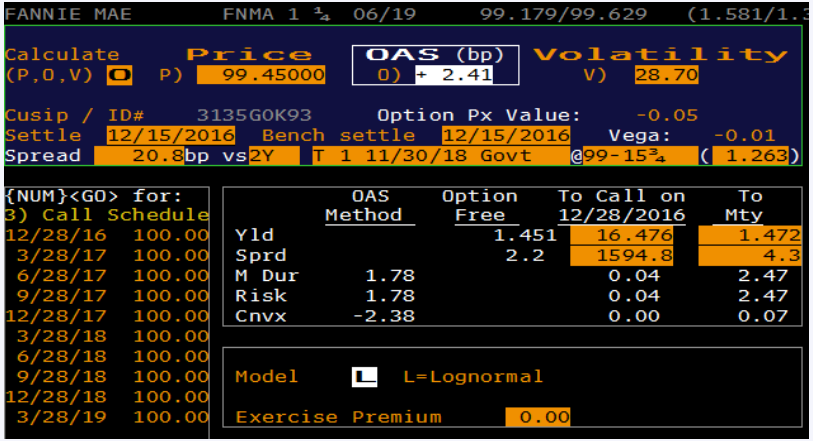
Spread Measures: Option Adjusted Spread (OAS)

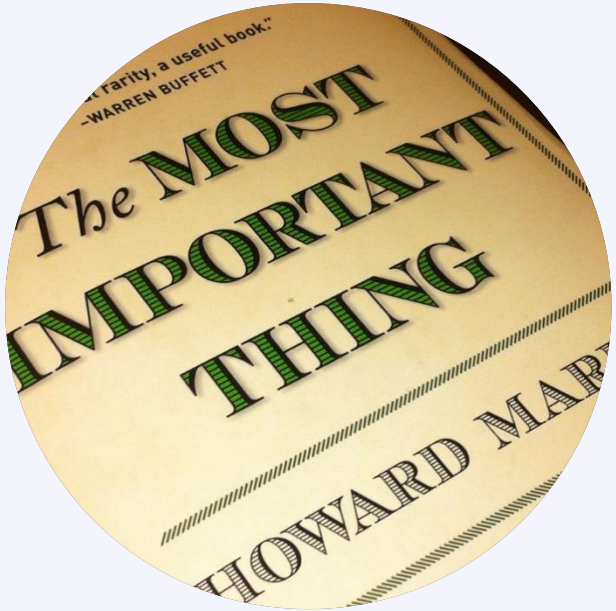
- OAS is often used as a measure of value relative to the benchmark. An OAS lower than that for a bond with similar characteristics and credit quality indicates that the bond could be overpriced. A larger OAS than that of a bond with similar characteristics and credit quality means that the bond could be underpriced. If the OAS is close to that of a bond with similar characteristics and credit quality, the bond looks fairly priced.

FNMA 1.75 06/20/19 Bullet



FNMA 1.25 06/28/19 Callable





> “Investing consists of exactly one thing: dealing with the future. And because none of us can know the future with certainty, risk is inescapable. Thus, dealing with risk is an essential—I think the essential—element in investing.”

Marks, Howard (2011-04-19). The Most Important Thing: Uncommon Sense for the Thoughtful Investor

RISK: Beyond the Measurements

- Risk means more things can happen then will happen. Much of the risk we take is not directly observable or measureable through statistical or mathematical means:

Underperforming Expectations

- Falling short of budgetary estimates of income
  1. Minimal haircut or aggressive projections of income estimates during budgeting process.
  2. Ineffective asset allocation to meet income goals.
  3. Failure to deploy and stay invested appropriately.

Career Risks

- Selling at a loss to meet operational liquidity needs
  1. Selling at a loss in the portfolio may cause accusations of liquidity mismanagement and violating the SLI mandate (Safety, Liquidity and Income).
  2. Mark-to-Market (GASB 31) can create impressions of undue risk taking and recognized losses becoming realized headaches. Effective communication is necessary to keep constituents informed and understanding of why losses are an important and necessary part of the investing process (remember…bonds mature!).

RISK: Beyond the Measurements

Career Risks (continued)

- Constituents access to information / confidence in your abilities.
    1. If you are afraid of your own abilities, chances are those around you see it too.
    2. Confidence is much easier to ascertain when the information flow is symmetric.
        - Have a plan, run consistent reports, understand your market, ask questions, leverage your resources!
    3. Arrogance and ignorance are the deadliest combination in investing.

Idiosyncratic / Event Risk

- Specific events can affect individual credits and sectors with little or no ability to measure impact beforehand.
- Example: EMC / DELL Acquisition
    - Solid fundamentals, A1/A Credit and IG 6 Banding.
    - Dell (BB Credit) announces acquisition attempt.
    - EMC volatility spikes, trades through BB credit in anticipation (4+% Yield).
    - Negative watch initiated, Dell on upgrade watch.
    - Fundamentals unchanged.
    - Diversification only tool to mitigate this risk.

RISK: Beyond the Measurements

Systematic Risks

- This risk inherent to the entire market. It is your non-diversifiable, market risk (volatility).
  - Interest rate changes, economic pressures, recessions and expansions, geo-political situations, globalization, integrated markets, etc..
  - Volatility measurements are possible, but are historical in nature.

Credit: Paresh Nath, UAE

RISK: Interest Rate Risk – P/Y Relationship

Understanding interest rate sensitivity is core to both single security analysis and managing your portfolio as a whole.

- At this point, you should understand the basic price/yield relationship.
  - As interest rates decrease, bond prices increase (holding all else constant).
  - As interest rates increase, bond prices decrease (holding all else constant).

*2 Yr Bullet, Price = **100.00 @ 1.00%***

CUSIP	PP8C1K7Z5	Price Calc:	
Settlement:	12/22/2015	Total Present Value	$1,000,000.00
Maturity:	12/22/2017	Accrued Interest	$0.00
YTW Date	12/22/2017	Total Dollar Value	$1,000,000.00
Par Amount:	1,000,000.00	Price in Convention	100.000
Yield to Worst	1.00%		

Time Period	Cash Flow Date	Cash Flow	PV Factor	Present Value	Weight
180 Days / 0.50 Years	6/22/2016	5,000.00	0.99502	4,975.12	0.498%
360 Days / 1.00 Years	12/22/2016	5,000.00	0.99007	4,950.37	0.495%
540 Days / 1.50 Years	6/22/2017	5,000.00	0.98515	4,925.74	0.493%
720 Days / 2.00 Years	12/22/2017	1,005,000.00	0.98025	985,148.76	98.515%
	Total	1,020,000.00		1,000,000.00	100.00%

Drop Interest Rates by 50Bp
YTW = 0.50%
*Price increases to **100.994***

CUSIP	PP8C1K7Z5	Price Calc:	
Settlement:	12/22/2015	Total Present Value	$1,009,937.81
Maturity:	12/22/2017	Accrued Interest	$0.00
YTW Date	12/22/2017	Total Dollar Value	$1,009,937.81
Par Amount:	1,000,000.00	Price in Convention	100.994
Yield to Worst	0.50%		

Time Period	Cash Flow Date	Cash Flow	PV Factor	Present Value	Weight
180 Days / 0.50 Years	6/22/2016	5,000.00	0.99751	4,987.53	0.494%
360 Days / 1.00 Years	12/22/2016	5,000.00	0.99502	4,975.09	0.493%
540 Days / 1.50 Years	6/22/2017	5,000.00	0.99254	4,962.69	0.491%
720 Days / 2.00 Years	12/22/2017	1,005,000.00	0.99006	995,012.50	98.522%
	Total	1,020,000.00		1,009,937.81	100.00%

Increase Interest Rates by 50Bp
YTW = 1.50%
*Price decreases to **99.018***

CUSIP	PP8C1K7Z5	Price Calc:	
Settlement:	12/22/2015	Total Present Value	$990,184.72
Maturity:	12/22/2017	Accrued Interest	$0.00
YTW Date	12/22/2017	Total Dollar Value	$990,184.72
Par Amount:	1,000,000.00	Price in Convention	99.018
Yield to Worst	1.50%		

Time Period	Cash Flow Date	Cash Flow	PV Factor	Present Value	Weight
180 Days / 0.50 Years	6/22/2016	5,000.00	0.99256	4,962.78	0.501%
360 Days / 1.00 Years	12/22/2016	5,000.00	0.98517	4,925.84	0.497%
540 Days / 1.50 Years	6/22/2017	5,000.00	0.97783	4,889.17	0.494%
720 Days / 2.00 Years	12/22/2017	1,005,000.00	0.97055	975,406.94	98.508%
	Total	1,020,000.00		990,184.72	100.00%

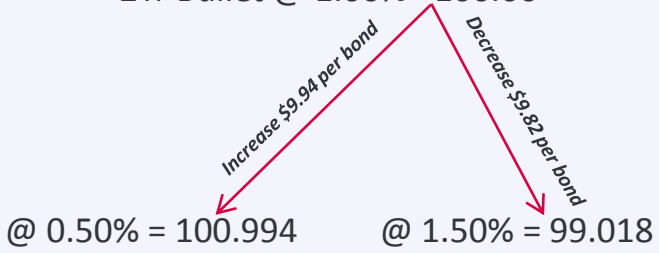
RISK: Interest Rate Risk – P/Y Relationship

Linkage between bond prices and yields is not linear

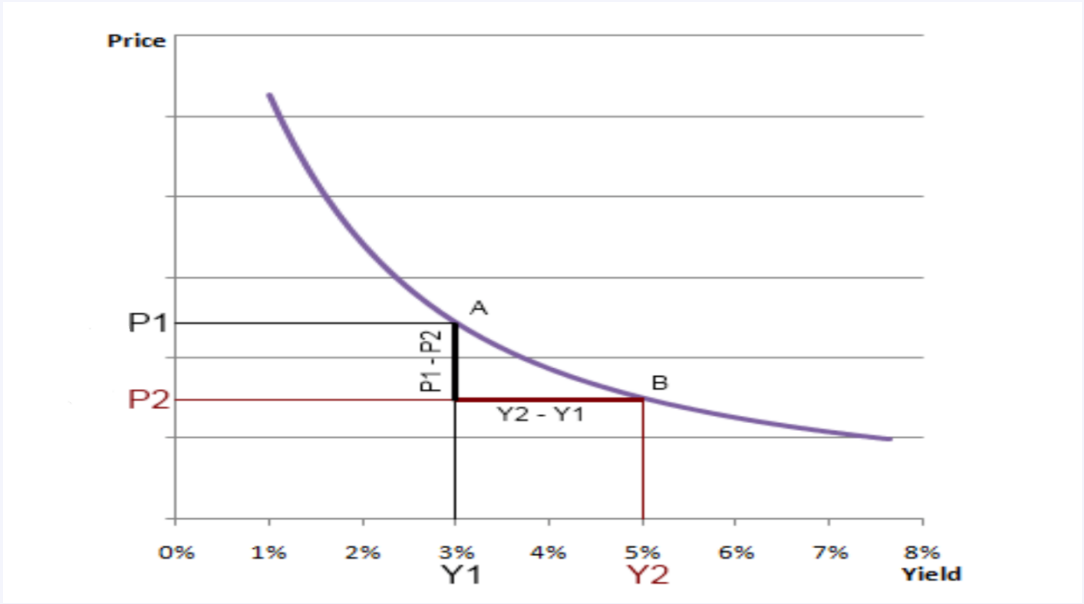
- Because a bond's price is derived from the present value of future cash flows (a percentage in the denominator), we get a curve that is convex in nature.

Using previous example:

2Yr Bullet @ 1.00% =100.00



Basic Price/Yield Relationship



RISK: Interest Rate Risk – Modified Duration

Modified Duration represents the approximate percentage change in a bond's price for a 100 basis points change in yield.

- Modified Duration converts Macaulay Duration into a percentage change measurement (Time →% Change).
- Modified Duration assumes that the bond's expected cash flow does not change when the yield changes.
- This metric works for option-free bonds such as Agency Bullets and Treasuries, but not with option-embedded bonds.

$$\left[\frac{1.985}{1+(.0100/2)}\right] = 1.975$$

$$\text{Modified Duration} = \frac{\text{Macaulay Duration}}{1 + \frac{\text{Yield to maturity}}{\text{Number of coupon periods per year}}}$$

Credit: CDIAC Issue Brief: #06-10

Or Approximate Using:

$$D_{modified} = \frac{P_{up} - P_{down}}{2 \times \triangle i \times P}$$

P_{up} = Bond's price when yield curve shifted up

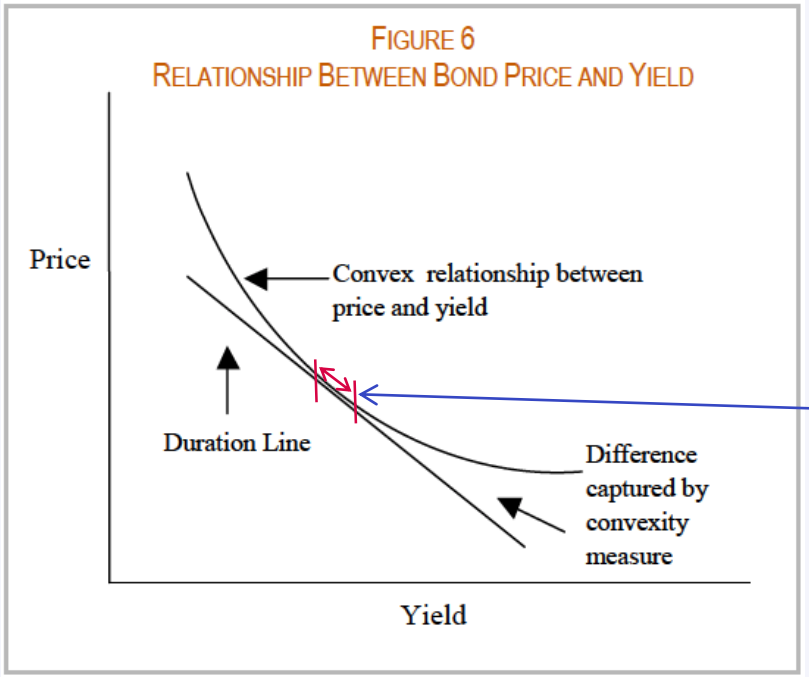
P_{down} = Bond's price when yield curve shifted up

i = Yield curve shift

P = Current price

RISK: Interest Rate Risk – Modified Duration

Example: *A Modified Duration of 2.00 means that for a 1.00% change in interest rates, we can expect our price to change* ***approximately*** *2.00% (increasing or decreasing).*



- Modified Duration is represented by the line tangent to the convex price/yield curve.
- Geometrically speaking, the tangent line is linear in nature.
- The slope of the tangent line is the first derivative to the graph of our function.
- This tangent line is the best linear approximation of the Modified Duration function near that input value.
- As you can see, linear approximations have limited usefulness beyond a certain point of our convex curve.
- This is why we say Duration is a good approximation for small price changes.
- For large changes, we have to take Convexity into account.

Credit: CDIAC Issue Brief: #06-10

RISK: Interest Rate Risk – Effective Duration

Effective Duration represents the approximate percentage change in a bond's price for a 100 basis points change in yield.

- Effective Duration takes into account that the bond's expected cash flow's can change when the yield changes.
- This metric works for option-free bonds such as Agency Bullets and Treasuries AND Callable Bonds.
- Effective Duration uses the same theory as Modified Duration, however the discounting of cash flows is estimated at different interest rates and the corresponding changes in those cash flows are taken into account.
- This requires a bond option valuation model to calculate and can not be done simply by hand (remember OAS?).

Modified Duration → Effective Duration

**3.00Yr 1.50% Fixed Callable, Callable Quarterly After 3 Month Lockout. Priced @ Par*

Effective Duration = 1.42

$$D_{effective} = \frac{P_{up} - P_{down}}{2 \times \triangle i \times P}$$

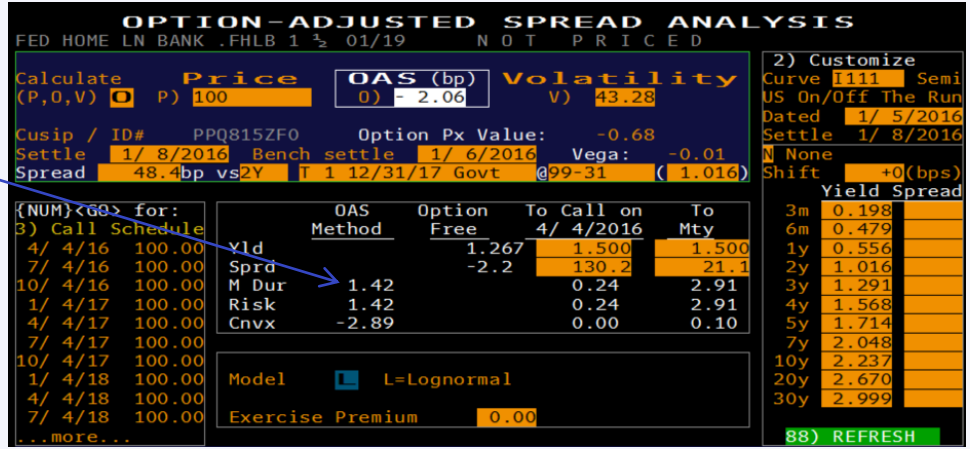
Found by bond option model

P_{up} = Bond's price when yield curve shifted up

P_{down} = Bond's price when yield curve shifted up

i = Yield curve shift

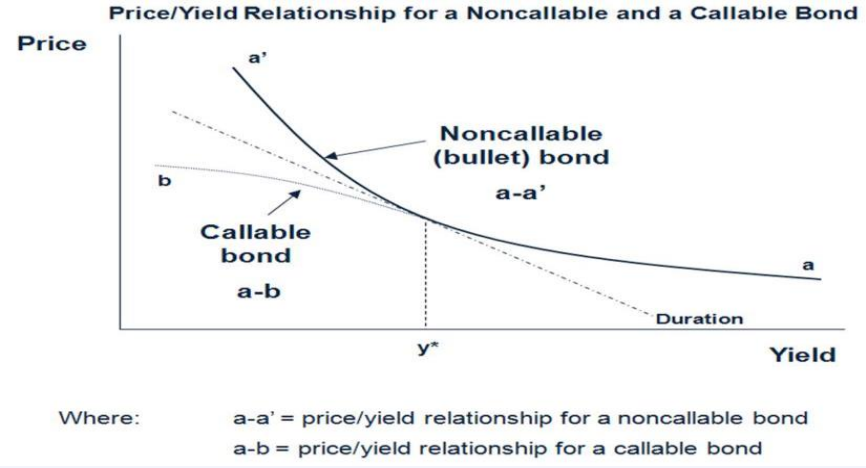
P = Current price



RISK: Interest Rate Risk – Convexity

Convexity measures the non-linear relationship between price and yield.

- Convexity is the measure of curvature of our price/yield function.
- Convexity, in a nutshell, corrects the error in the estimation of a bond's price if Duration alone is used to estimate.
- Because Convexity is the second derivative of our function, it essentially measures the rate of change of our first derivative (Modified or Effective Duration).
    - Positive Convexity: Duration rises as yields decline (prices increase at an increasing rate).
    - Negative Convexity: Duration lowers as yields decline (prices increase at an decreasing rate).
- To interpret convexity, think of it as being the approximate percent change in duration for a 1.00% change in yields.

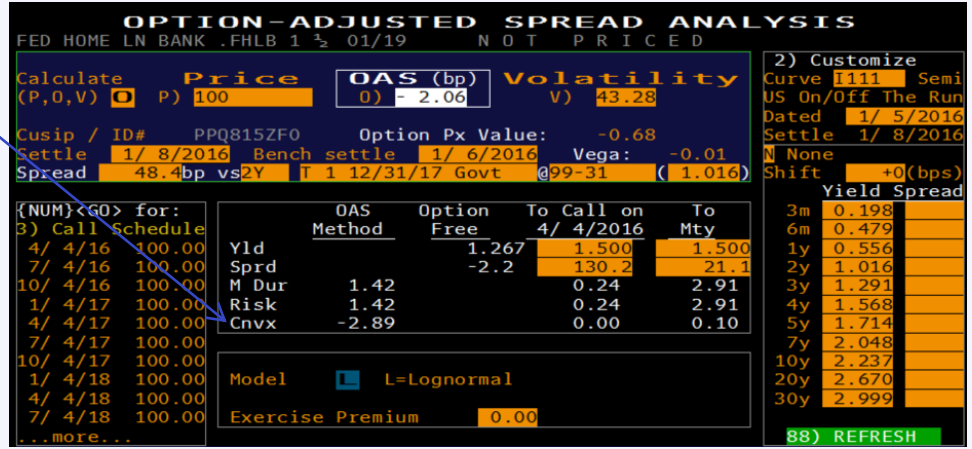


RISK: Interest Rate Risk – Convexity

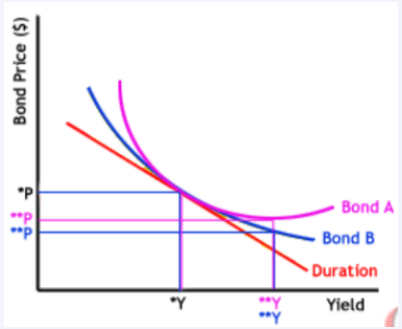
- Effective Convexity uses the same bond option valuation model approach like Effective Duration.
- A Convexity adjustment can be used to evaluate the actual price change of a bond.
- However, Convexity is of less importance for two reasons:
  1. We are usually concerned with smaller changes in interest rates (100bp and smaller) as they are more likely to be the concern investors have over the shorter lifespan of public fund portfolios (5 years and in).
  2. In portfolios with a mix of negatively and positively convex securities, a diversification effect occurs.

**3.00Yr 1.50% Fixed Callable, Callable Quarterly After 3 Month Lockout. Priced @ Par*

Effective Convexity = -2.89



- *We know the more positive the convexity, the less sensitive the bond is to interest rate changes.*
- *Thus, convexity can be used more on a relative value basis by comparing similar structures.*
- *For instance, if we have two like bonds with the same duration, but one has higher convexity (Bond A), we would prefer to own Bond A (assuming all else equal).*



RISK: Duration & Positive Convexity Combined

Maturity (Yrs)	CPN	YTM	PAR
5	2.25%	2.25%	$100,000,000
Bond Price		$1,000.00	
Macaulay Duration (Effective Maturity)			
Bond Semi Annual Macaulay Duration		9.514	
Bond Annualized Macaulay Duration		4.757	
Modified Duration = Macaulary Dur/(1+y)			
Semi Annual Modified Duration		9.408	
Annualized Modified Duration		4.704	
Convexity			
Semi Annual Convexity		100.621	
Annualized Convexity		25.16	

Price decreases at decreasing rate

$$\frac{\Delta P}{P} = -D_m \times \Delta y + \frac{(\Delta y)^2}{2} \times Convexity$$

New YTM	Change in Yield	Predicted Dur % Change	Predicted Dur Price	Actual % Change	Actual Price	Variance Per Bond	Convexity Effect on PAR	Convexity Adjustment
4.25%	2.00%	-9.41%	$905.92	-8.92%	$910.76	$4.84	$483,986.53	-8.91%
4.00%	1.75%	-8.23%	$917.68	-7.86%	$921.40	$3.72	$372,331.66	-7.85%
3.75%	1.50%	-7.06%	$929.44	-6.78%	$932.19	$2.75	$274,867.48	-6.77%
3.50%	1.25%	-5.88%	$941.20	-5.69%	$943.12	$1.92	$191,802.49	-5.68%
3.25%	1.00%	-4.70%	$952.96	-4.58%	$954.19	$1.23	$123,348.55	-4.58%
3.00%	0.75%	-3.53%	$964.72	-3.46%	$965.42	$0.70	$69,720.88	-3.46%
2.75%	0.50%	-2.35%	$976.48	-2.32%	$976.79	$0.31	$31,138.17	-2.32%
2.50%	0.25%	-1.18%	$988.24	-1.17%	$988.32	$0.08	$7,822.62	-1.17%
2.25%	0.00%	0.00%	$1,000.00	0.00%	$1,000.00	$0.00	$0.00	$0.00
2.0000%	-0.25%	1.18%	$1,011.76	1.18%	$1,011.84	$0.08	$7,899.70	1.18%
1.7500%	-0.50%	2.35%	$1,023.52	2.38%	$1,023.84	$0.32	$31,754.83	2.38%
1.5000%	-0.75%	3.53%	$1,035.28	3.60%	$1,036.00	$0.72	$71,802.25	3.60%
1.2500%	-1.00%	4.70%	$1,047.04	4.83%	$1,048.32	$1.28	$128,282.65	4.83%
1.0000%	-1.25%	5.88%	$1,058.80	6.08%	$1,060.82	$2.01	$201,440.60	6.08%
0.7500%	-1.50%	7.06%	$1,070.56	7.35%	$1,073.48	$2.92	$291,524.65	7.34%
0.5000%	-1.75%	8.23%	$1,082.32	8.63%	$1,086.31	$3.99	$398,787.38	8.62%
0.2500%	-2.00%	9.41%	$1,094.08	9.93%	$1,099.32	$5.23	$523,485.46	9.91%

Price increases at increasing rate

RISK: Weighted Average Maturity (WAM)

- WAM is usually applied as the weighted average amount of time until the mortgages in a mortgage-backed security (MBS) mature.
- It is also applied at the portfolio level to describe the weighted average time until the bonds in a debt portfolio mature.
- The higher the WAM, the longer it takes for all the bonds to mature.
- WAM is very easy to calculate and can be applied as a “perceived” risk measure. It is often used to compare and contrast portfolio managers along with their return and benchmark requirements.
- WAM does not measure interest rate risk and can be misleading when option-embedded bonds are present.

*WAM should be calculated using the market value percentage of portfolio for each security.

Sample WAM Calculation (Par Value)

1MM – 5 year GE bonds
2MM – 3 year FNMA Bonds
*WAM =.333*5 + .666*3 = 3.66 Years*

Sample WAM Calculation (Market Value)

1.1MM – 5 year GE bonds
1.8MM – 3 year FNMA Bonds
*WAM =.379*5 + .6206*3 = 3.76 Years*

RISK: Credit Risk – Ratings Matrix

Credit Ratings: An indicator of credit worthiness of specific debt securities or issuers.

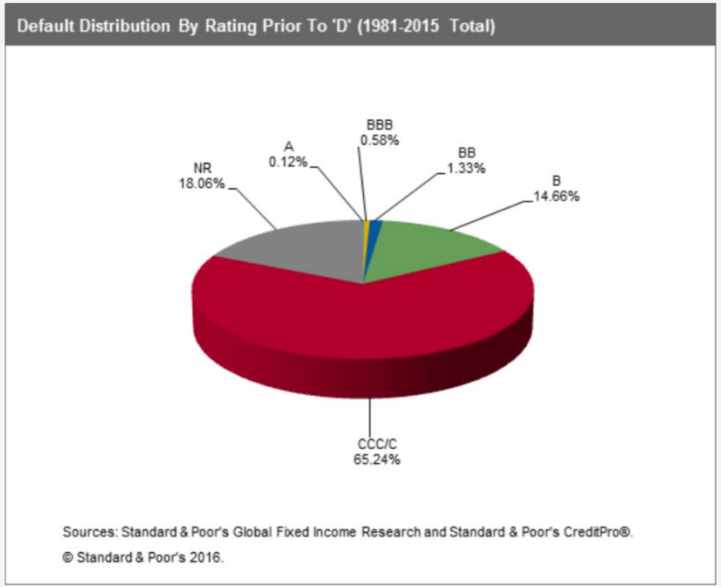
Credit ratings are typically assigned by one or more of three major credit rating agencies registered with the SEC (there are nine total as of Dec 2016).

The major agencies, known as Nationally Recognized Statistical Rating Organizations (NRSRO), are Moody's, Standard & Poor's and Fitch Ratings.

Moody's		S&P		Fitch		Rating description	
Long-term	Short-term	Long-term	Short-term	Long-term	Short-term		
Aaa	P-1	AAA	A-1+	AAA	F1+	Prime	Investment-grade
Aa1		AA+		AA+		High grade	
Aa2		AA		AA			
Aa3		AA–		AA–			
A1		A+	A-1	A+	F1	Upper medium grade	
A2		A		A			
A3	P-2	A–	A-2	A–	F2		
Baa1		BBB+		BBB+		Lower medium grade	
Baa2	P-3	BBB	A-3	BBB	F3		
Baa3		BBB–		BBB–			
Ba1	Not prime	BB+	B	BB+	B	Non-investment grade speculative	Non-investment grade aka high-yield bonds aka junk bonds
Ba2		BB		BB			
Ba3		BB–		BB–			
B1		B+		B+		Highly speculative	
B2		B		B			
B3		B–		B–			
Caa1		CCC+	C	CCC	C	Substantial risks	
Caa2		CCC				Extremely speculative	
Caa3		CCC–				Default imminent with little prospect for recovery	
Ca		CC					
		C					
C		D	/	DDD	/	In default	
/				DD			
				D			

RISK: Credit Risk – S&P Defaults Rates & Transitions

2015-S&P Global Corporate Annual Default Rates by Rating Category (%)							
	AAA	***AA***	***A***	***BBB***	***BB***	***B***	***CCC/C***
2008	0.00	0.38	0.39	0.49	0.81	4.08	27.27
2009	0.00	0.00	0.22	0.55	0.75	10.91	49.46
2010	0.00	0.00	0.00	0.00	0.58	0.85	22.73
2011	0.00	0.00	0.00	0.07	0.00	1.66	16.42
2012	0.00	0.00	0.00	0.00	0.30	1.56	27.33
2013	0.00	0.00	0.00	0.00	0.10	1.63	24.34
2014	0.00	0.00	0.00	0.00	0.00	0.77	17.03
2015	0.00	0.00	0.00	0.00	0.16	2.39	25.73



(1981-2015)-Avg One Year Corporate Transition Rates for U.S. (%)									
From/To	***AAA***	***AA***	***A***	***BBB***	***BB***	***B***	***CCC/C***	***D***	***NR***
AAA	87.31	8.67	0.58	0.04	0.12	0.04	0.04	0.00	3.19
AA	0.54	86.84	7.63	0.60	0.08	0.11	0.04	0.04	4.12
A	0.05	1.78	87.67	5.46	0.42	0.16	0.03	0.08	4.35
BBB	0.01	0.13	3.56	85.87	3.86	0.63	0.11	0.23	5.59
BB	0.02	0.05	0.18	5.00	76.65	7.81	0.61	0.81	8.86
B	0.00	0.04	0.12	0.22	4.77	75.27	4.49	3.93	11.17
CCC/C	0.00	0.00	0.20	0.29	0.73	12.01	44.27	28.21	14.30

RISK: Credit Risk – S&P Defaults Rates & Transitions

Summary Of Annual Corporate Rating Changes (%)* (cont.)

Year	Issuers as of Jan. 1	Upgrades	Downgrades§	Defaults	Withdrawn ratings	Changed ratings	Unchanged ratings	Downgrade/upgrade ratio
1995	2,868	9.07	9.87	1.05	4.60	24.58	75.42	1.09
1996	3,128	9.72	7.80	0.51	7.03	25.06	74.94	0.80
1997	3,490	9.20	7.94	0.63	7.56	25.33	74.67	0.86
1998	4,078	7.53	11.60	1.28	7.99	28.40	71.60	1.54
1999	4,529	5.92	12.06	2.14	9.05	29.17	70.83	2.04
2000	4,680	6.88	12.65	2.48	7.14	29.15	70.85	1.84
2001	4,756	5.99	16.61	3.78	7.57	33.96	66.04	2.77
2002	4,784	5.20	19.19	3.60	7.23	35.22	64.78	3.69
2003	4,782	6.46	14.60	1.92	7.34	30.32	69.68	2.26
2004	5,017	8.79	7.59	0.78	7.26	24.42	75.58	0.86
2005	5,307	12.85	9.21	0.60	8.52	31.19	68.81	0.72
2006	5,461	12.31	8.75	0.48	8.77	30.31	69.69	0.71
2007	5,646	13.51	9.30	0.37	10.63	33.81	66.19	0.69
2008	5,729	7.92	16.01	1.80	7.72	33.44	66.56	2.02
2009	5,616	4.81	19.12	4.18	8.89	37.00	63.00	3.98
2010	5,310	11.96	8.78	1.21	6.53	28.47	71.53	0.73
2011	5,629	12.24	11.97	0.80	7.85	32.87	67.13	0.98
2012	5,805	8.44	12.30	1.14	6.91	28.79	71.21	1.46
2013	6,041	11.41	9.39	1.06	6.74	28.59	71.41	0.82
2014	6,488	9.20	8.46	0.69	7.15	25.51	74.49	0.92
2015	6,906	7.43	11.79	1.36	8.36	28.93	71.07	1.59
Weighted		8.78	11.84	1.49	7.36	29.46	70.54	1.56

RISK: Credit Risk – S&P Defaults Rates & Transitions

Cumulative Defaulters By Time Horizon Among Global Corporates, From Original Rating (1981-2015)								
Number of issuers	**AAA**	**AA**	**A**	**BBB**	**BB**	**B**	**CCC/C**	**Total**
Defaulting within:								
One year				3	13	73	81	170
Three years		1	6	28	136	535	155	861
Five years		4	13	68	281	885	183	1,434
Seven years	2	7	27	99	373	1,069	192	1,769
Total	8	30	93	197	568	1,314	204	2,414
Percent of total defaults per time frame								
One year	0.0	0.0	0.0	1.8	7.6	42.9	47.6	
Three years	0.0	0.1	0.7	3.3	15.8	62.1	18.0	
Five years	0.0	0.3	0.9	4.7	19.6	61.7	12.8	
Seven years	0.1	0.4	1.5	5.6	21.1	60.4	10.9	
Total	0.3	1.2	3.9	8.2	23.5	54.4	8.5	

RISK: Credit Risk – Issuer Analysis

Single security analysis outside of the traditional Treasury/GSE framework can require additional time and effort to understand the risks associated with certain issuers and structures. There are a few areas that public fund managers can focus on to help assess risk in a timely and efficient manner (not comprehensive by any means).

- Solvency/Liquidity Ratios:
  - Current Ratio = Current Assets / Current Liabilities
  - Quick Ratio = (Cash + Short Term Marketable Securities + Receivables) / Current Liabilities
  - Cash Ratio = (Cash + Short Term Marketable Securities) / Current Liabilities
  - Interest Burden = EBT/EBIT
  - Interest Coverage Ratio = EBIT / Interest Payments

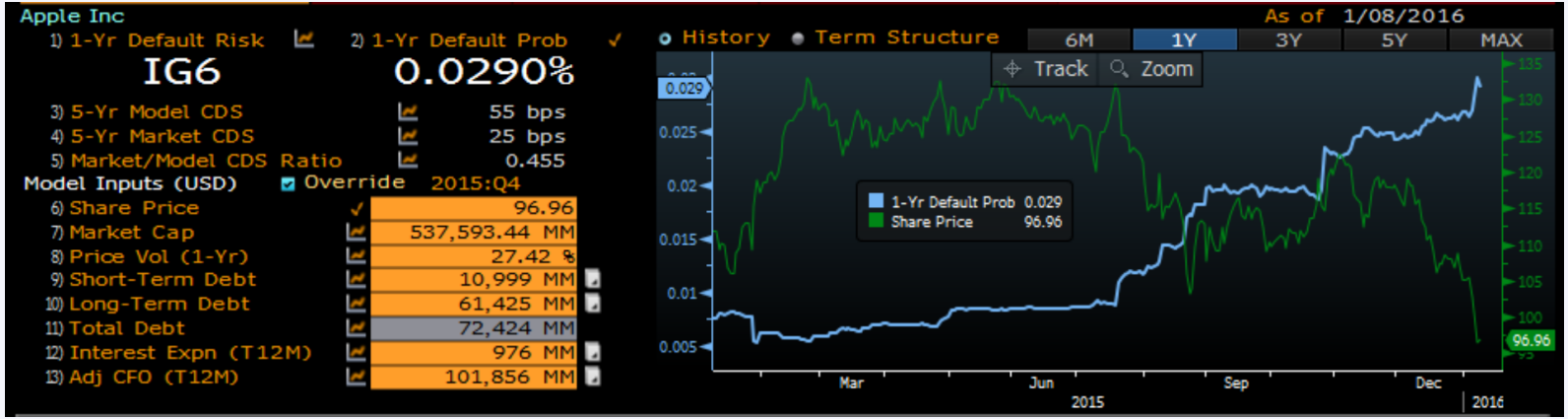
**Apple Ratios from Bloomberg on DES <go> Ratios tab*

Profitability		Structure	
EBITDA	82.5B	Curr Ratio	1.1
EBIT	71.2B	Quick Ratio	0.7
OPM	30.5%	Debt/Assets	22.2%
Prtx Mrgn	31.0%	Debt/Com Eq	54.0%
ROA	20.4%	A/R Trnovr	13.6
ROE	46.2%	Inv Turnover	62.8
ROC	32.6%	GM	40.1%
Ast TO	0.9	EBIT/Tot Int Exp	97.2

RISK: Credit Risk – Issuer Analysis

- Bloomberg DRSK / IG Banding
  - The DRSK Function is a fairly new tool from Bloomberg that provides a lot of the data scrubbing and adjustments that credit analysts would typically want to make for accounting differentials and advantageous accounting practices that create less transparency.
  - Based on the Merton Distance-to-Default methodology.
  - Financials adjusted for OPEB and Operating Leases to fairly evaluate across issuers (debt levels and interest expense understated otherwise).
  - Creates longer term implied CDS spreads and IG banding for estimation of default over 1 year.

* Bloomberg DRSK for Apple Inc.



RISK: Liquidity Risk - Issuer Analysis

- Bid / Ask Spreads
  - The amount by which the ask price exceeds the bid. This is essentially the difference in price between the highest price that a buyer is willing to pay for an asset and the lowest price for which a seller is willing to sell it.
  - Larger Bid/Ask spreads indicate additional cushion needed by dealers to maintain positions (axe) in a specific credit or issue. The larger the spread, the less liquidity is associated with it.

  - Bid / Ask Spreads can increase or decrease based on:
    - Issue Size - Benchmarks 250MM, GSE's generally relies on MTN market
    - Sector Rotation – Specific sectors can go out of favor (in favor) over time
    - Dealer Balance Sheets – Dealer's constrained capital minimizes desired axes and bids
    - Esoteric Structures: Uncommon structures or unique characteristics can make it hard to bid.
    - Thinly Traded Names: Smaller issuers with low visibility may be more difficult to bid.

RISK: Liquidity Risk - Issuer Analysis

- Benchmark Curves
  - Benchmark Curves are published for many credit rating ranges and sector types. These curves can give you a quick idea where the average benchmark issuers are yielding in the same space in which you are comparing. Since these benchmarks make up the biggest and most liquid securities, any yield differentials for a specific security may give insight into the liquidity and credit premium / discount.

* Bloomberg AA Corporate Credit Curve

RISK: Call Risk & Inflation Risk

- Call Risk (Reinvestment Risk)
  - Risk resulting from the possibility that a callable bond will be redeemed before maturity. When interest rates decline, issuers are incentivized to call the bonds away and re-issue at lower rates. This leaves investors reinvesting proceeds sooner than expected at lower interest rates.

- Inflation Risk
  - Risk that investors earn decreasing (or even negative) real interest rates over time. If inflation in the overall economy increases, the purchasing power of income generated by fixed rate bonds diminishes as the coupons stay the same. This risk can be mitigated through the use of structured bonds like floating rate securities or step-ups.

Introduction to Benchmarks

Benchmark:

A standard or point of reference against which things may be compared or assessed.

Benchmarks should encompass metrics that help communicate the risk and return profile the portfolio is attempting to achieve. The benchmark should encompass information that helps the manager ensure that they are achieving the following portfolio goals:

1) Ensuring adequate liquidity exists to pay current obligations

2) An appropriate amount of interest rate risk is being deployed

3) The portfolio is optimal among asset classes, maturities and structures

4) The portfolio is legal as defined by the investment policy to which the portfolio must abide

5) An optimal rate of return is achieved given the risks and constraints of the entity

Generally speaking, market benchmarks DO NOT qualify as adequate standards of measurement for public fund portfolios. For example, it is highly unlikely that the Merrill Corp/Gov 1-3yr benchmark encompasses the liquidity requirements, interest rate risk, asset allocation and optimal return desires of a specific public fund once the appropriate analysis has been done to establish those standards.

Questions?

Wisdom For the Day!

“You can't leave a footprint that lasts if you're always walking on tiptoes.”

– Marion Blakey, CEO, Rolls-Royce NA

Disclaimer

Mischler Financial Group does not warrant the correctness of any information herein or the appropriateness of any transaction. The contents of this electronic communication and any attachments are for informational purposes only and under no circumstances should they be construed as an offer to sell or a solicitation to buy any security. The information is intended solely for the personal and confidential use of the recipient of this electronic communication. If you are not the intended recipient, you are hereby notified that any use, dissemination, distribution or copying of this communication is strictly prohibited and you are requested to return this message to the sender immediately and delete all copies from your system. All electronic communication may be reviewed by authorized personnel and may be provided to regulatory authorities or others with a legal right to access such information. Opinions expressed herein are statements only of the date indicated and are not given or endorsed by Mischler Financial Group unless otherwise indicated by an authorized representative.