



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

January 23<sup>rd</sup>, 2019

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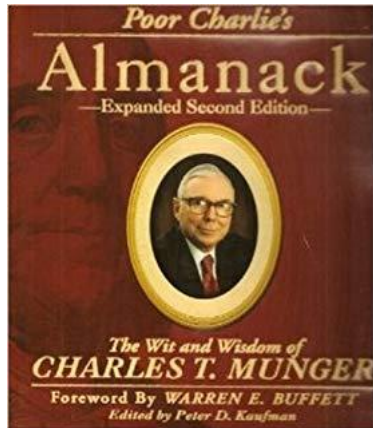
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**CALIFORNIA  
DEBT AND  
INVESTMENT  
ADVISORY  
COMMISSION**



“Spend each day trying to be a little wiser than you were when you woke up. Day by day, and at the end of the day—if you live long enough—like most people, you will get out of life what you deserve.”

*Munger, Charles T: Poor Charlie's Almanack.*

## 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*
  - *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 than 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.)
- Bonds 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 Quarterly 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:

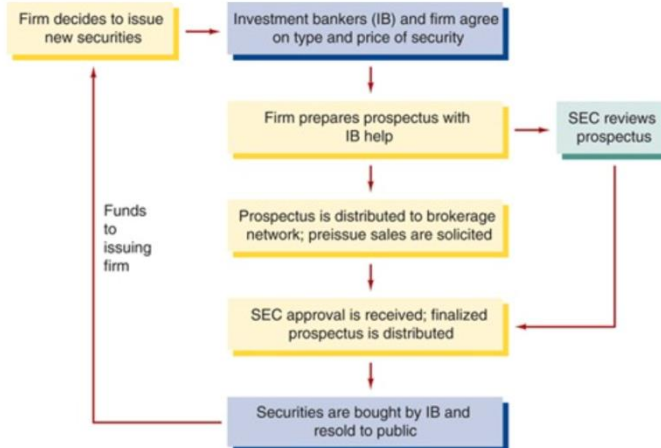
### LEGAL & REGULATORY

- 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)

# Understanding the Market:

## 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 approximately 35% larger than the equity market in the U.S. (\$40.7t to \$30.0t)
  - 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 trading over an exchange. There are tens of thousands of debt securities outstanding. (e.g. GE has 1 common stock in USD traded via exchanges, but over 370 USD debt securities outstanding with many different characteristics).
    2. 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.
    3. 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

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

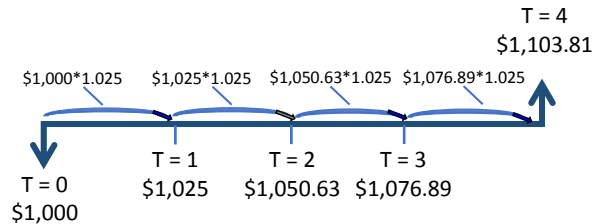
# Time Value of Money (TVM)

## Future Value

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

Given a present value (PV), we can compound 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?



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

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

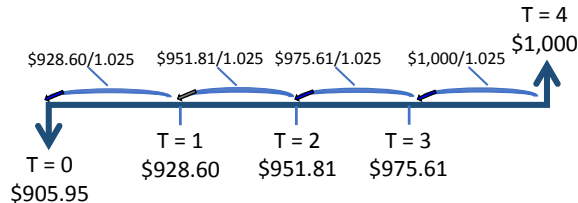
# Time Value of Money (TVM)

## Present Value

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

Given a future value (FV), we can discount 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?



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

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

# YIELD (Internal Rate of Return)

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

- 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)
- Since yield uses a discounted cash flow calculation, the timing of the cash flows are also considered.
- The price of the bond can be decomposed into a set of present values, each of which is the present value of a particular future cash flow.

Maturity (Yrs)	Coupon (SA)	YTM	PAR
2	1.00%	1.50%	1,000,000
Period	Cash Flow	$\frac{CF}{(1+YTM/2)^N}$	Present Value
1 = 6 Months	\$5,000	$\frac{\$5,000}{(1+.015/2)^1}$	\$4,962.78
2 = 1 Year	\$5,000	$\frac{\$5,000}{(1+.015/2)^2}$	\$4,925.84
3 = 1.5 Years	\$5,000	$\frac{\$5,000}{(1+.015/2)^3}$	\$4,889.17
4 = 2 Years	\$5,000	$\frac{\$5,000}{(1+.015/2)^4}$	\$4,852.77
4 = 2 Years	\$1,000,000	$\frac{\$1,000,000}{(1+.015/2)^4}$	\$970,554.17
<b>Total Present Value</b>			<b>\$990,184.72</b>
<b>Converted Bond Price</b>			$\frac{990,184.72}{10,000} = 99.018$

\*2.00Yr Semi-Annual Pay using YA Function

.FHLB 1 12/22/17 ( PP8C1K7Z5 )	
Price	99.018472
Settle	12/22/15
Workout	12/22/2017 @ 100.00 Wst
Street Convention	1.500000
US Government Equivalent	1.500000
True Yield	1.500000
Equiv 1 /Yr Compound	1.505625
Japanese Yield (Simple)	1.505000
Mmkt (Act/ 360)	
Current Yield	1.010

# 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*

Settlement Date	12/22/15	Price	100	Blend	Fu
YTC (PP8C1K7Z5)	Date	Price	Yield		
Yield to Maturity	12/22/2017	100.00	1.000000		
Yield to Custom	12/22/2017	100.00	1.000000		
Yield to Next Call	03/22/2016	100.00	1.000000		
Yield to Worst Call	03/22/2016	100.00	1.000000		
Callable					

*\*2.00Yr 1.00% Fixed Callable @ Discount*

Settlement Date	12/22/15	Price	99.9	Blend	Fu
YTC (PP8C1K7Z5)	Date	Price	Yield		
Yield to Maturity	12/22/2017	100.00	1.050658		
Yield to Custom	12/22/2017	100.00	1.050658		
Yield to Next Call	03/22/2016	100.00	1.401401		
Yield to Worst Call	12/22/2017	100.00	1.050658		
Callable					

*\*2.00Yr 1.00% Fixed Callable @ Premium*

Settlement Date	12/22/15	Price	100.1	Blend	Fu
YTC (PP8C1K7Z5)	Date	Price	Yield		
Yield to Maturity	12/22/2017	100.00	0.949405		
Yield to Custom	12/22/2017	100.00	0.949405		
Yield to Next Call	03/22/2016	100.00	0.599401		
Yield to Worst Call	03/22/2016	100.00	0.599401		
Callable					

# 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)

## **Yield drawbacks:**

- 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!**

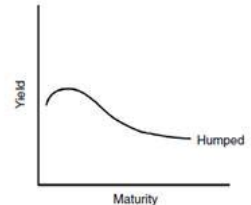
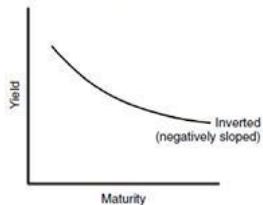
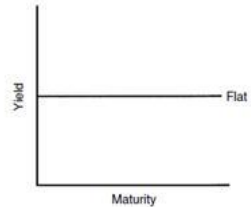
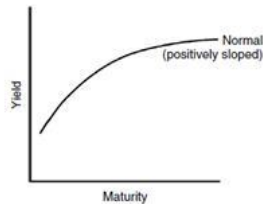
*-Premiums increase coupon cash flow but create higher up front costs, amortization requirements*

*-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

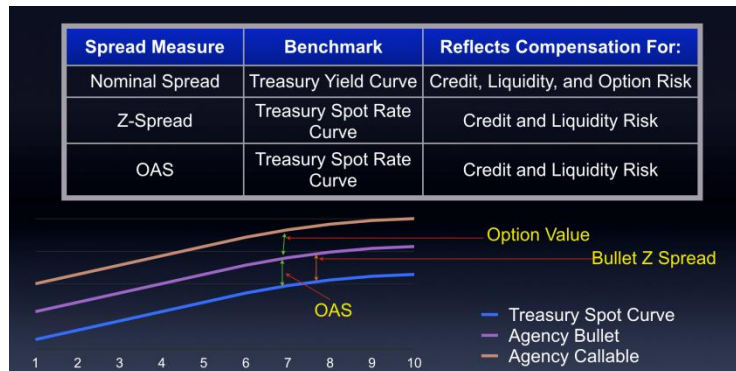
### **Drawbacks:**

- 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 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

FANNIE MAE FNMA 1.75 06/19		Calculate		Price	OAS (bp)	Volatility
(P,0,V)	(P)	100.6700	0	5.93	0.00	
Cusip / ID#	3135G0Z6	Option Px Value:	-0.00			
Settle	12/15/2016	Bench settle	12/15/2016	Vega:	0.00	
Spread	-9.6bp vsBY	T 1 1/2	12/15/19 Govt	@99-13+	(1.573)	

	OAS Method	Option Free	To Maty on 6/20/2019	To Mtly
Yld Sprd		1.477	1.477	1.477
M Dur	2.44		2.43	2.43
Risk	2.47		2.47	2.47
Cnvx	0.07		0.07	0.07

Model	<input type="checkbox"/> L=Lognormal
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### FNMA 1.25 06/28/19 Callable

FANNIE MAE FNMA 1.25 06/19		Calculate		Price	OAS (bp)	Volatility
(P,0,V)	(P)	99.45000	0	2.41	28.70	
Cusip / ID#	3135G0K93	Option Px Value:	-0.05			
Settle	12/15/2016	Bench settle	12/15/2016	Vega:	-0.01	
Spread	20.8bp vs2Y	T 1 11/30/18	Govt	@99-15%	(1.263)	

	OAS Method	Option Free	To Call on 12/28/2016	To Mtly
Yld Sprd		1.451	16.476	1.472
M Dur	1.78		0.04	2.47
Risk	1.78		0.04	2.47
Cnvx	-2.38		0.00	0.07

Model	<input type="checkbox"/> L=Lognormal
Exercise Premium	0.00



“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 than will happen. Much of the risk we take is not directly observable or measurable 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, geopolitical 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%	
<b>Total</b>		<b>1,020,000.00</b>		<b>1,000,000.00</b>	<b>100.00%</b>	

*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%	
<b>Total</b>		<b>1,020,000.00</b>		<b>1,009,937.81</b>	<b>100.00%</b>	

*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%	
<b>Total</b>		<b>1,020,000.00</b>		<b>990,184.72</b>	<b>100.00%</b>	

# 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

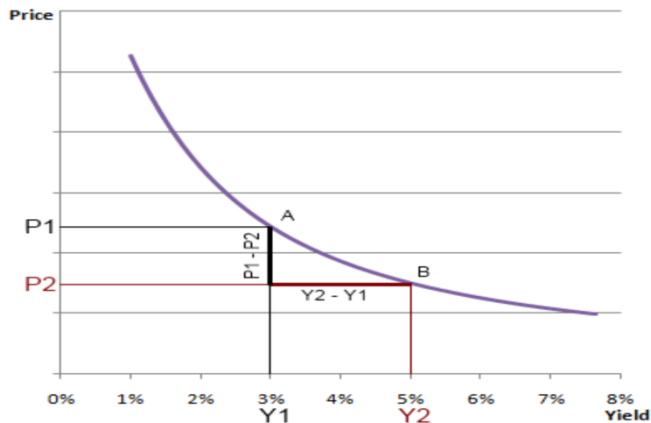
Increase \$9.94 per bond

Decrease \$9.82 per bond

@ 0.50% = 100.994

@ 1.50% = 99.018

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.

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



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

Or Approximate Using:

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

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

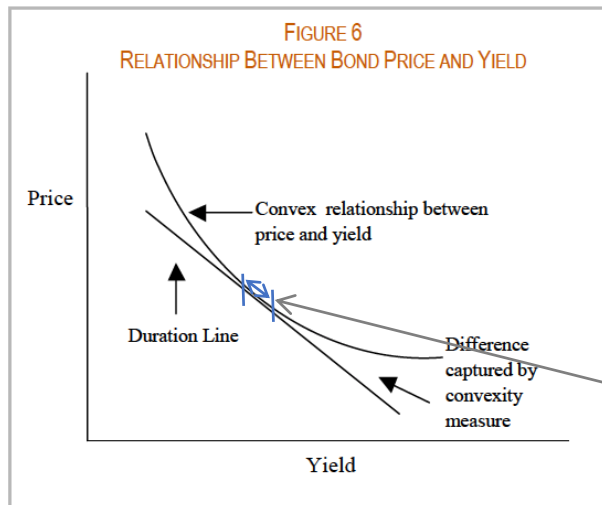
$P_{\text{down}}$  = Bond's price when yield curve shifted up

$i$  = 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).



Credit: CDIAC Issue Brief: #06-10

- 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.

# 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

$$D_{\text{Effective}} = - \frac{P_{\text{up}} - P_{\text{down}}}{2 \times \Delta i \times P}$$

← Found by bond option model

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

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

$\Delta i$  = Yield curve shift

$P$  = Current price

Effective Duration = 1.42

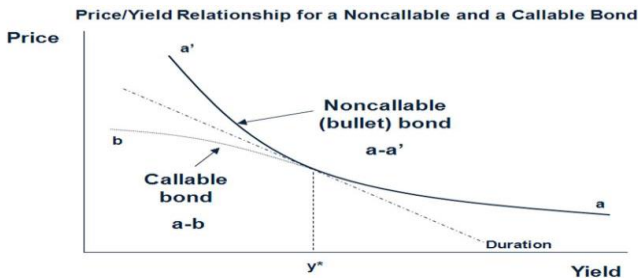
\*3.00Yr 1.50% Fixed Callable, Callable Quarterly After 3 Month Lockout. Priced @ Par

OPTION-ADJUSTED SPREAD ANALYSIS									
FED HOME LN BANK .FHLB 1 5 01/19 NOT PRICED									
Calculate	Price	OAS (bp)	Volatility						
(P,0,V)	P	100	0	-2.06	V	43.28			
Cusip / ID# PPO815ZF0 Option Px Value: -0.68									
Settle	1/ 8/2016	Bench	settle	1/ 6/2016	Vega:	-0.01			
Spread	48.4bp	vs2Y	1	12/31/17	Govt	699-31	(1.016)		
{NUM}<GO> for:	OAS	Option	To	Call on	To				
3) Call Schedule	Method	Free	4/	4/2016	Mty				
4/ 4/16	100.00	Yld	1.267	1.500	1.500				
7/ 4/16	100.00	Sprd	-2.2	130.2	21.1				
10/ 4/16	100.00	M Dur	1.42	0.24	2.91				
1/ 4/17	100.00	Risk	1.42	0.24	2.91				
4/ 4/17	100.00	Cnvx	-2.89	0.00	0.10				
7/ 4/17	100.00								
10/ 4/17	100.00								
1/ 4/18	100.00								
4/ 4/18	100.00								
7/ 4/18	100.00								
Model	L=Lognormal								
Exercise Premium	0.00								
2) Customize									
Curve	1111	Semi							
US On/Off	The	Run							
Dated	1/ 5/2016								
Settle	1/ 8/2016								
N	None	30	(bps)						
Shift									
Yield Spread									
3m	0.198								
6m	0.479								
1y	0.556								
2y	1.016								
3y	1.291								
4y	1.568								
5y	1.714								
7y	2.048								
10y	2.237								
20y	2.670								
30y	2.999								
88) REFRESH									

## 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 a decreasing rate).
- To interpret convexity, think of it as being the approximate percent change in duration for a 1.00% change in yields.



Where:  $a-a'$  = price/yield relationship for a noncallable bond  
 $a-b$  = price/yield relationship for a callable bond

## 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.

### Sample WAM Calculation (Par Value)

1MM – 5 year GE bonds

2MM – 3 year FNMA Bonds

$$WAM = .333*5 + .666*3 = 3.66 \text{ Years}$$

### Sample WAM Calculation (Book Value)

1.1MM – 5 year GE bonds

1.8MM – 3 year FNMA Bonds

$$WAM = .379*5 + .6206*3 = 3.76 \text{ Years}$$

# 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 ten 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.

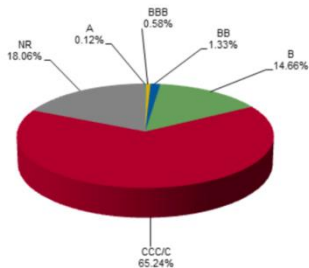
Moody's		S&P		Fitch		Rating description		
Long-term	Short-term	Long-term	Short-term	Long-term	Short-term			
Aaa	P-1	AAA	A-1+	AAA	F1+	Prime	Investment-grade	
Aa1		AA+		AA+		High grade		
Aa2		AA		AA				
Aa3		AA-		AA-				
A1		A+	A-1	F1	Upper medium grade			
A2	P-2	A	A-2	A	F2	Lower medium grade	Non-investment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

# RISK: Credit Risk – S&P Default 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

Default Distribution By Rating Prior To 'D' (1981-2015 Total)



Sources: Standard & Poor's Global Fixed Income Research and Standard & Poor's CreditPro®.  
© Standard & Poor's 2016.

(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 Default 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
<b>Defaulting within:</b>								
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

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.

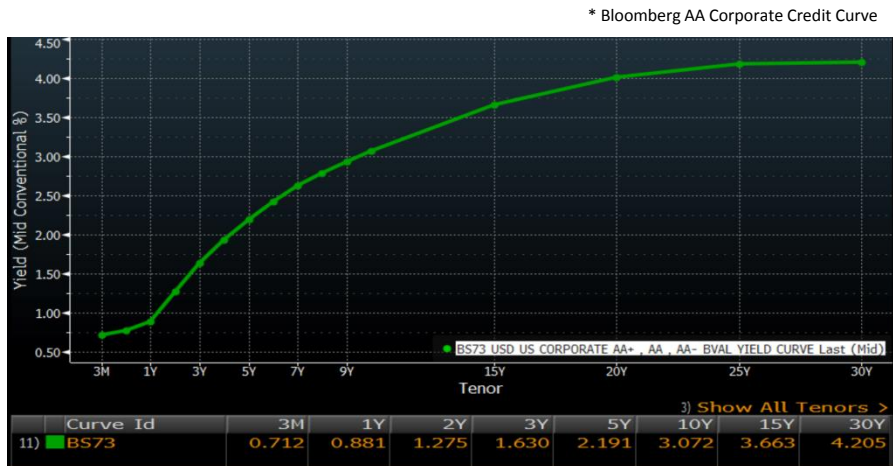


## RISK: Liquidity Risk – Issuer Analysis

- 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.



## 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.

# RISK: 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 1-5yr 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!

**“An investor without objectives is like a traveler without a destination.”**

**– Ralph Seger, Founder, Provident Investment Mgmt.**

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