



MANAGING BOND PORTFOLIOS

FIN 366: INVESTMENTS
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BOND PORTFOLIOS

Constructing bond portfolios requires an investor to consider bonds' default risk, interest rate risk, time to maturity, callability, putability, and other bond characteristics such as *duration* and *convexity*.



[S&P NetAdvantage](#) provides information on corporate bond issues, including their yields, coupons, collateral, and credit ratings, and duration and convexity measures we will discuss.¹

DURATION

Duration is a measure of the *effective maturity* of a bond, defined as the weighted average of the times until each of the bond's payments. This measure considers both the timing and amount of coupon payments to be received. It provides a measure of the overall interest rate sensitivity of bonds. The higher the duration, the greater sensitivity to interest rate changes.

A bond's duration is determined in two steps. First, compute the "weights" of each of the bond's cash flows:

$$w_t = \frac{CF_t / (1 + y)^t}{\text{Bond Price}}$$

Then, compute the duration by summing the product of each of the weights and its respective time period:

$$D = \sum_{t=1}^T t \times w_t$$



PRACTICE: What is the duration of a 7% coupon bond maturing in 2 years with a par value of \$10,000? The bond's YTM is 6%. Assume annual coupon payments.

SOLUTION: By the formula

$$w_t = \frac{CF_t / (1 + y)^t}{\text{Bond Price}}$$

The time 1 weight:

$$w_1 = \frac{700 / (1 + 0.06)^1}{10183.34} = 6.4849\%$$

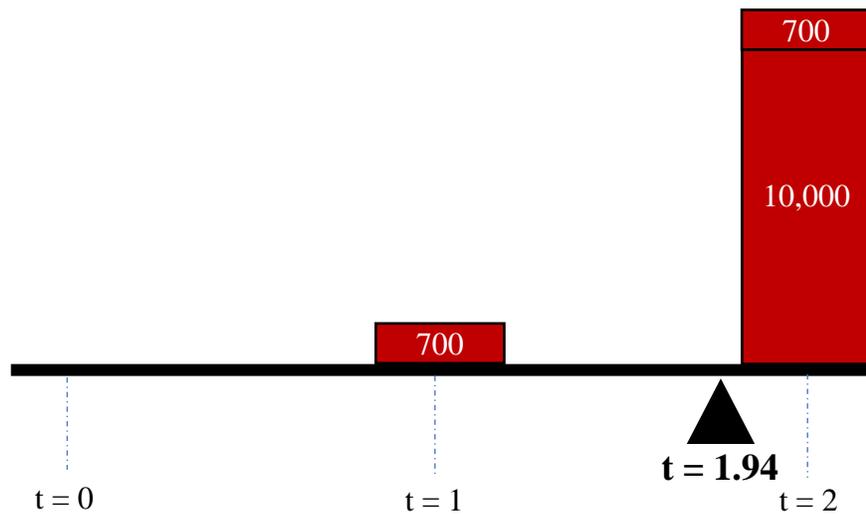
because we compute the price by $N = 2$, $I/Y = 6$, $PMT = 7\% \times 10,000 = 700$. The Time 2 weight is

$$w_2 = \frac{10700 / (1 + 0.06)^2}{10183.34} = 93.5151\%$$

which includes both the coupon and the face value in the CF . We determine the duration by

$$D = \sum_{t=1}^T t \times w_t = (1 \times 6.4849\%) + (2 \times 93.5151\%) = 1.94$$

INTERPRETATION: Think of the duration measure as the “balance point” on a lever of cash inflows:



The Excel file [Duration](http://josephfarizo.com/fin366.html) available at josephfarizo.com/fin366.html provides additional practice problems.



What is the duration of a zero coupon bond?

Immunizing bond portfolios from interest rate risk entails matching durations of assets and liabilities to protect from over exposure to interest rate changes.

Example: In the insurance industry, the insurer may match the duration of its assets (premiums invested) with expected claims.

Example: Pension funds may match their bond portfolio’s cash inflows with benefits due to retiring employees.

DEFAULT RISK AND BOND RATINGS

Bonds promise but cannot guarantee a fixed flow of income: they are not free of default risk. **Bond rating agencies** evaluate the creditworthiness of a bond and the bond's issuer, assigning grades contingent on the bond's ability to pay its coupons and principal to the bondholder.

The three major bond ratings agencies are [Fitch](#), [Moody's](#), and [S&P Global](#). Ratings agencies differ in methodology and grading scale, using financial ratios, forecasts, industry analysis, and analysis of a firm's competitive landscape.²

Figure 1: Bond Ratings Summary

Bond Ratings Summary			
Moody's	S&P/Fitch	Description	Quality
Aaa	AAA	<i>Extremely strong</i> capacity to pay interest and principal.	Very High Quality
Aa	AA	<i>Very strong</i> capacity to pay interest and principal.	
A	A	<i>Strong</i> capacity to pay interest and principal.	High Quality
Baa	BBB	<i>Adequate</i> capacity to pay interest and principal.	
Ba B Caa Ca	B CCC CC	<i>Speculative</i> with respect to capacity to pay interest and repay principal in accordance with bond terms.	Speculative/Poor
C	C	Income bonds where no interest is being paid.	Very Poor
D	D	Bonds in default.	

While bond ratings are important, they are not excellent predictors of default. From the [Financial Crisis Inquiry Report](#) following the 2008 financial crisis: “We conclude the failures of credit rating agencies were essential cogs in the wheel of financial destruction.”³

The broadest categories used across rating agencies and investors are **investment grade bonds** and **speculative grade (junk) bonds**. Investment grade bonds have “high” or “very high” quality and probability of paying all coupons and principal while speculative grade bonds are “poor” or “very poor”.



All else equal, which bonds (investment grade or speculative) should offer investors higher yields?

Different bonds issued by the same firm can have different ratings.

- **Collateral:** specific asset pledged against possible default on the bond (a **secured** bond is backed by collateral)
- **Debenture:** an **unsecured** bond not backed by collateral
- **Subordination:** senior debtholders paid first in the event of bankruptcy

As one might expect, bonds collateralized by a specific asset are safer than debentures that are only backed by the creditworthiness and reputation of the issuer. *Subordinated debt* is riskier than *senior debt*, but each are due to collect their claims prior to the residual claimants (equity holders).

INTEREST RATE RISK

Interest rate risk is important when constructing bond portfolios. It is the risk that bond values change in changing interest rate environments. Indeed, there is an inverse relationship between bond prices and yields, but the relationship is *nonlinear*. We consider 4 properties regarding the

relationship between bond prices and interest rates, and we illustrate each case using a \$1,000 bond with a 10% *annual* coupon.

PROPERTY 1: YTM INCREASES AND DECREASES

An increase in a bond’s YTM results in a smaller price change than a decrease in yield of equal magnitude. This is due to **convexity**, or curvature in the price-yield relationship, a desirable trait for bond investors.

	YTM = 5%	YTM = 7%	YTM = 3%
N	30 years	30 years	30 years
PMT	100	100	100
FV	1000	1000	1000
I/Y	5%	7%	3%
PV	\$1768	\$1372	\$2372

- YTM ↓2% (5% to 3%), the price change is 34.2% (from \$1,768 to \$2,372)
- YTM ↑2% (5% to 7%), the price change is -22.4% (from \$1,768 to \$1,372)

PROPERTY 2: TIME TO MATURITY

Prices of long-term bonds tend to be more sensitive to interest rate changes than prices of short-term bonds.

	YTM = 5%	YTM = 7%		YTM = 5%	YTM = 7%
N	30 years	30 years	N	15 years	15 years
PMT	100	100	PMT	100	100
FV	1000	1000	FV	1000	1000
I/Y	5%	7%	I/Y	5%	7%
PV	\$1768	\$1372	PV	\$1518	\$1273

- YTM ↑2% (5% to 7%) for **30-year bond**, price change = **-22.4%** (from \$1,768 to \$1,372)
- YTM ↑2% (5% to 7%) for **15-year bond**, price change = **-16.1%** (from \$1,518 to \$1,273)

PROPERTY 3: SENSITIVITY TO MATURITY

While the sensitivity of prices to yields increases with times to maturity, it *increases at a decreasing rate* as time to maturity increases.

	YTM = 5%	YTM = 7%	YTM = 5%	YTM = 7%	YTM = 5%	YTM = 7%
N	15 years	15 years	30 years	30 years	45 years	45 years
PMT	100	100	100	100	100	100
FV	1000	1000	1000	1000	1000	1000
I/Y	5%	7%	5%	7%	5%	7%
PV	\$1518	\$1273	\$1768	\$1372	\$1888	\$1408

- YTM ↑ 2% for the **15-year bond**, price change = **-16.1%** (from \$1,518 to \$1,273)
- YTM ↑ 2% for the **30-year bond**, price change = **-22.4%** (from \$1,768 to \$1,372)
- YTM ↑ 2% for the **45-year bond**, price change = **-25.4%** (from \$1,888 to \$1,408)

PROPERTY 4: COUPONS

Interest rate risk is inversely related to the coupon rate: prices of low-coupon bonds are more sensitive to changes in interest rates than price of high coupon bonds.

	YTM = 5%	YTM = 7%		YTM = 5%	YTM = 7%
N	30 years	30 years	N	30 years	30 years
PMT	100	100	PMT	200	200
FV	1000	1000	FV	1000	1000
I/Y	5%	7%	I/Y	5%	7%
PV	\$1768	\$1372	PV	\$3306	\$2613

- YTM ↑ 2% for **10% coupon bond**, price change = **-22.4%** (from \$1,768 to \$1,372).
- YTM ↑ 2% for **20% coupon bond**, price change = **-20.9%** (from \$3,306 to \$2,613).

Consider a small sample of the Franklin Templeton [Western Asset Core Plus Bond Fund](#)⁴ holdings (of over 2,700) below:

Figure 2: A Sample Bond Portfolio

 FRANKLIN TEMPLETON				
SECURITY	RATE	MATURITY DATE	FACE AMOUNT [†]	VALUE
CORPORATE BONDS & NOTES - 36.4%				
COMMUNICATION SERVICES - 3.3%				
Diversified Telecommunication Services - 1.2%				
Altice France SA, Senior Secured Notes	7.375%	5/1/26	34,775,000	\$36,477,236 ^(a)
AT&T Inc., Senior Notes	3.800%	2/15/27	1,250,000	1,412,243
AT&T Inc., Senior Notes	2.300%	6/1/27	25,680,000	26,951,378
AT&T Inc., Senior Notes	1.650%	2/1/28	37,680,000	37,840,302
AT&T Inc., Senior Notes	2.250%	2/1/32	14,430,000	14,483,246
Entertainment - 0.0%^{††}				
Netflix Inc., Senior Notes	5.375%	2/1/21	2,675,000	2,708,438
ViacomCBS Inc., Senior Notes	3.875%	4/1/24	1,720,000	1,875,376
Walt Disney Co., Senior Notes	4.500%	2/15/21	8,000	8,126
Walt Disney Co., Senior Notes	6.200%	12/15/34	260,000	385,039
CONSUMER DISCRETIONARY - 2.3%				
Automobiles - 0.5%				
BMW US Capital LLC, Senior Notes	1.850%	9/15/21	1,590,000	1,609,666 ^(a)
Ford Motor Co., Senior Notes	8.500%	4/21/23	4,890,000	5,337,899
Ford Motor Co., Senior Notes	9.000%	4/22/25	3,850,000	4,419,011
Ford Motor Co., Senior Notes	4.750%	1/15/43	2,720,000	2,467,856
Ford Motor Credit Co. LLC, Senior Notes	5.750%	2/1/21	2,940,000	2,965,725
Ford Motor Credit Co. LLC, Senior Notes	3.336%	3/18/21	900,000	901,350
Ford Motor Credit Co. LLC, Senior Notes	5.875%	8/2/21	21,080,000	21,514,775

Notice the portfolio has a number of bonds *within* a firm and *across* many firms. The bonds have varying coupon rates, time to maturity, call features, put features, and credit ratings. Some may be secured while others may be debentures. When constructing bond portfolios, fund managers should consider all of these characteristics to understand the overall risk, interest rate sensitivity, duration, and convexity of the bond portfolio.

END NOTES

¹ S&P NetAdvantage: <http://newman.richmond.edu:2048/login?url=http://na.capitaliq.com/ip/RICHU>

² Fitch: <https://www.fitchratings.com/> Moody's: <https://www.moodys.com/> S&P: <https://www.spglobal.com/ratings/en/>

³ The *Financial Crisis Inquiry Report* also noted that “credit rating agencies assigned overly optimistic ratings”. For example, “From 2000 to 2007, Moody’s rated nearly 45,000 mortgage-related securities as triple-A. This compares with six private-sector companies in the United States that carried this coveted rating in early 2010. In 2006 alone, Moody’s put its triple-A stamp of approval on 30 mortgage-related securities every working day. The results were disastrous: 83% of the mortgage securities rated triple-A that year ultimately were downgraded.” The report is available at: <https://www.govinfo.gov/content/pkg/GPO-FCIC/pdf/GPO-FCIC.pdf>

⁴ Franklin Templeton Western Asset Core Plus Bond Fund: <https://www.franklintempleton.com/investments/options/mutual-funds/products/90150/I/western-asset-core-plus-bond-fund/WACPX>