Bond Theory Notes

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1 Yield Curve and Term Structure

The **yield curve** is a graphical representation of interest rates (yields) of bonds with equal credit quality but differing maturity dates.

- A **normal yield curve** slopes upward, indicating longer-term bonds have higher yields.
- An **inverted yield curve** suggests economic recession, where short-term rates exceed long-term rates.
- A **flat yield curve** implies uncertainty or transition in market expectations.

Term structure of interest rates describes how yields change with respect to different maturities, assuming zero credit risk. It is essential in bond pricing and interest rate modeling.

Key Theories Explaining Term Structure:

1. **Expectations Theory:** Long-term rates are a geometric average of current and expected future short-term rates.
2. **Liquidity Preference Theory:** Investors demand a premium for holding longer-term securities.
3. **Market Segmentation Theory:** Different investors prefer different maturities based on liabilities and investment goals.

2 Credit Spread

The **credit spread** is the difference in yield between a corporate bond and a government bond of similar maturity. It compensates investors for credit risk.

$$\text{Credit Spread} = \text{Yield}_{\text{Corporate}} - \text{Yield}_{\text{Treasury}}$$

Factors Affecting Credit Spread:

- Credit rating and default risk
- Economic conditions
- Liquidity of the bond
- Market sentiment

3 Pricing of Callable Bonds

A **callable bond** gives the issuer the right to redeem the bond before its maturity at a specified call price.

Valuation Approach:

The value of a callable bond can be expressed as:

$$\text{Price}_{\text{Callable}} = \text{Price}_{\text{Straight Bond}} - \text{Value of Call Option}$$

Challenges:

- The presence of the embedded call option introduces negative convexity.
- Requires interest rate modeling for scenario-based cash flows.
- Callable bonds are often priced using lattice models (e.g., binomial trees) or Monte Carlo simulations.

Investor Perspective:

Investors require higher yields for callable bonds to compensate for reinvestment risk and call risk.

4 Risks Associated with Bonds (Even if Risk-Free)

Even for bonds considered risk-free (e.g., government securities), several risks remain:

1. **Interest Rate Risk:** Value of a bond decreases as interest rates rise.
2. **Reinvestment Risk:** Cash flows (coupons) may have to be reinvested at lower rates.
3. **Inflation Risk:** Purchasing power of fixed coupon payments may decline.
4. **Liquidity Risk:** Difficulty in selling the bond without significant price impact.
5. **Market Risk:** General market volatility can impact bond pricing.

Even "risk-free" bonds are not entirely free from market forces that affect return.
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a4paper, margin=1in Quantitative Finance Notes Bond Theory 2
Bond Theory and CQF Practice Questions Shreya Biswas

5 Yield Curve and Term Structure

The **yield curve** is a plot of interest rates for bonds of equal credit quality but varying maturities. The term structure of interest rates underlies this concept.

Theories Explaining the Term Structure

- **Expectations Theory**
- **Liquidity Premium Theory**
- **Market Segmentation Theory**

CQF Question 1

Q: According to the Pure Expectations Theory, what does an upward-sloping yield curve imply?

A: It implies that the market expects future short-term interest rates to rise. Long-term rates reflect the average of expected future short-term rates.

CQF Question 2

Q: Why might the yield curve be flat, even if short-term rates are expected to rise?

A: A flat curve may reflect counterbalancing effects of rising expectations and lower liquidity premiums, or market uncertainty.

6 Credit Spread

The **credit spread** is the difference in yield between a corporate bond and a risk-free bond of the same maturity. It compensates investors for default risk and illiquidity.

$$\text{Credit Spread} = Y_{\text{Corporate}} - Y_{\text{Treasury}}$$

CQF Question 3

Q: If a 5-year corporate bond yields 4.8% and the 5-year Treasury yields 3.2%, what is the credit spread?

A:

$$\text{Credit Spread} = 4.8\% - 3.2\% = 1.6\%$$

CQF Question 4

Q: Name three factors that typically cause credit spreads to widen.

A:

- Deterioration in the issuer's creditworthiness.
- Market-wide risk aversion increase.
- Decrease in bond liquidity.

7 Pricing of Callable Bonds

Callable bonds contain an embedded option that allows the issuer to redeem the bond before maturity.

$$\text{Callable Bond Price} = \text{Straight Bond Price} - \text{Call Option Value}$$

CQF Question 5

Q: Why do callable bonds generally offer a higher yield than comparable non-callable bonds?

A: Investors demand compensation for the reinvestment and call risk associated with the issuer redeeming the bond early when interest rates decline.

CQF Question 6

Q: Which valuation method is most commonly used for pricing callable bonds?

A: Lattice models (e.g., binomial interest rate trees) or Monte Carlo simulations are commonly used to model interest rate paths and determine the optimal call strategy.

8 Risks Associated with Bonds (Including Risk-Free)

Even government securities are subject to various risks:

- **Interest Rate Risk**
- **Reinvestment Risk**
- **Inflation Risk**
- **Liquidity Risk**

CQF Question 7

Q: What risk does a bondholder face if interest rates fall after purchasing a bond?

A: Reinvestment risk – the bondholder may have to reinvest coupon payments at lower interest rates, reducing overall yield.

CQF Question 8

Q: A 10-year zero-coupon Treasury bond is purchased. Is the bond truly "risk-free"?

A: No. While it has no credit risk, it is still subject to interest rate risk and inflation risk, which can reduce real returns.