Preliminaries

Fixed income

Fixed income basics

- Fixed income, as a field, studies securities that stipulate specific financial obligations…
- … in the form of promises to pay interest and to return principal…
- … and the derivatives written on those securities
- Holders of fixed income securities have fully specified cash-flow rights but no control rights
- So they are debt claims, the mirror image of equity claims

Universal principles of debt math

- A debt contract stipulates:
  1. An initial balance/original face value b_0
  2. A frequency of payments and total number T of payments (term to maturity)
  3. An interest rate r_t for each period $t = 1,2, \dots T$
  4. Payments m_t for each period $t = 1,2, \dots T$
- Debt algebra:
  1. At a given date, interest due is $b_{t-1}\, r_t$
  2. Balance at date t is $b_t = b_{t-1} + b_{t-1} r_t - m_t$
  3. If $b_T > 0$, balance is due in one *balloon payment*

Continuous compounding digression

- In derivations it is sometimes useful to use continuous compounding rather than simple interest
- Simple interest is what people use in practice in most cases so we will do most if not all of our work that way
- But to follow some of our readings we need to do a quick interest algebra digression

Simple interest vs. continuous compounding

- In standard contracts, interests are stated per annum and paid at a stated frequency
- Example: If the annualized interest rate is *r* and the number of payments per year (the *frequency)* is 2, then interest paid in a given period is $\frac{r}{2}$ per unit of balance
- Correspondingly, the effective interest rate per year (*EAR*) is:
$$\left(1+\frac{r}{2}\right)^2-1$$
- Generalizing to a frequency of *k* payments per year the effective interest rate is:
$$\left(1+\frac{r}{k}\right)^k-1$$
- As *k* grows large this converges to e^r-1, which is continuous compounding
- Generalizing, if *r* compounds continuously over *t* years, the effective return is $e^{rt}-1$

Simple to continuous

A simple interest rate r^s at frequency k is equivalent to a continuously compounded interest rate r^c if:

$$e^{r^c} = \left(1 + \frac{r^s}{k}\right)^k$$

i.e.

$$r^c = k \ln\left(1 + \frac{r^s}{k}\right)$$

Continuous to simple

A continuous interest rate r^c is equivalent to a simple interest rate r^s at frequency *k* if:

$$r^s = k\left(e^{\frac{r^c}{k}} - 1\right)$$

Example

- Consider a zero-coupon bond due in one quarter with a face value of *100* and currently selling for *98*

- What is the simple, quarterly compounded rate of interest per annum on this investment?
- What is the continuously compounded rate of interest on this investment?
- What is the EAR on this investment?

Back to work: warm-up example

- An untaxed corporation has the option to prepay (*call*) a bond with 5 years to maturity, $\$100M$ in remaining principal, a 10% yearly rate, fixed and monthly payments
- It can replace it with a 5 year bond with the same payment structure but a 9% yearly rate
- It believes rates will fall no further
- Prepayment penalties are 2% of outstanding principal
- Assume not other costs (floatation, overlap…)
- Should it exercise the option?

The algebra

- Current payment is $2,124,704.47
- New payment would be $2,075,835.52, for a monthly saving of $48,869.95
- Appropriate discount rate for the corresponding string of cash flows is 9% (Why?)
- Gross value of refi: $2,354,182.11
- This exceeds prepay costs, *the call option is in the money*, so yes, exercise…
- … as long as you are confident in your belief that rates will fall no further

Deeper option considerations

- Exercising the option kills the option
- If rates fall to, say, 8.5% in two months, the gap between 9% and 8.5% will not suffice to cover prepay costs, so you'll be stuck at 9%
- Had you waited to exercise, you would be able to lower your rate to 8.5%
- What is the value of waiting to exercise an option that is already in the money?
- We will also learn how to answer tough questions like that

Some language

- Debt contracts whose balance is zero after T periods ($b_T = 0$) are called *fully amortizing*
- Interest rates can be fixed, vary on a fixed schedule, or according to some other market rate
- Amortization can be negative -- balance can grow -- from one period to the next (if $m_t < b_{t-1}r_t$)

Ex: Bullets (fixed-rate IO bonds)

- For all t:
  1. $r_t = r$
  2. $m_t = b_o r$
- Zero amortization: $b_T = b_0$

Ex: zero-coupon bond

- For all t:
  1. $r_t = 0$
  2. $m_t = 0$

- Zero amortization: $b_T = b_0$

Floating rate coupon bonds (floaters)

- For all t:
  1. Initial rate: r_0
  2. At reset, $r_t^* = index_t + QM$
  3. *QM* is the typically fixed quoted margin
  4. r_t adjust towards r_t^* subject to caps and floors, both absolute and on adjustment steps
  5. $m_t = b_o r_t$

- Zero amortization: $b_T = b_0$

- Libor was the most typical index until last year but we have now moved towards alternative reference rates like CMT or SOFR

Inverse floaters

- For all t:
  1. $r_t = \bar{r} - index_t$ where $\bar{r}$ is some fixed reference
  2. caps and floors

- Those, together with duration/maturity mismatch, killed Orange County finances in 1994

Ex: Fixed rate, fixed payment debt

- For all t:
  1. $r_t = r$
  2. $m_t = m$
- Fully amortizing: $b_T = 0$
- What must m be? (Fixed annuity formulae)
- $m = b_0 r / (1 - (1 + r)^{-T})$

The fundamental equation of debt design

- Full amortization means:

$$b_T = 0, \quad \text{or, equivalently,} \qquad b_0 = \sum_{t=1}^{T} \frac{m_t}{(1+r)^t}$$

- More generally:

$$b_0 = \sum_{t=1}^{T} \frac{m_t}{(1+r)^t} + \frac{b_T}{(1+r)^T}$$

- Absent side payments, r is the loan's IRR <u>if all payments are made</u>, i.e. the YTM on the debt contract

Market value vs book value

- The book value of a bond is its face value b (we'll often write *FV* too)

- Market value is what the bond would sell for in the market:

$$MV = \sum_{t=1}^{T} \frac{m_t}{(1+y)^t} + \frac{b_T}{(1+y)^T}$$

where y is the *yield-to-maturity* investors are currently requiring from the bond

Market value drivers

- Tautologically:

$$y = r^F + RP$$

- Ergo, two things move market values:
  1. The general level of interest rates (*market conditions*)
  2. Spread changes caused by category-wide or issuer specific reasons

- Trivially, $MV < FV$ if and only if $y > r$, and vice versa

Illustration: floaters

- Floaters adjust to movements in r^F so, at least around resets, floaters subject to no credit risk should trade close to par
- But floaters do not adjust to movements in *RP*
- If spreads over benchmarks narrow or broaden, the market value of outstanding floaters will deviate from par

Discount margins (DM)

- A standard measure of par deviations for floaters, computed at resets, is the discount margin

- Letting MV be the invoice price of a semi-annual floater with n payments left at reset:

$$MV = \sum_{i=1}^{n} \frac{FV \times \frac{index_i + QM}{2}}{\left(1 + \frac{index_i + DM}{2}\right)^i} + \frac{FV}{\left(1 + \frac{index_i + DM}{2}\right)^n}$$

- Note that *MV*<*FV* if and only if *DM*>*QM*

Fixed payment example

- $100K$, monthly payments, 10 years, $r = 7\%/12$

1. With full amortization: $m = \$1{,}161.08$
2. With 30K balloon: $m = \$\,987.76$

Graduated payment example

- A corporation wants to finance 50% of a $\$1M$ investment with some debt
- Cash-flows are expected to increase by 0.5% a month over ten years, so the corporation would like debt payments to match that profile
- A lender is willing to do it with a 7% annual interest rate and a fully amortizing contract
- What is the payment schedule?
- Answer: fundamental equation of debt design

Issuers

- Governments
- Government sponsored enterprises
- Corporations
- Municipalities
- Commercial and investment banks

Seniority

- Senior securities get paid first (within their type) in the event of default, disposition, or reorganization
- Subordinated securities get paid after senior securities have been paid
- *Pari Passu*: All creditors at the same level of capital structure are treated as one class

Security

- Secured instruments (mortgages, e.g.) are collateralized by specific tangible assets (real estate, plants, warehouses, machines, airplanes…)
- In theory, secured claims have *absolute priority* over other financial claims, including senior unsecured claims

Callable/Redeemable securities

- A fixed income security is callable if the issuer may redeem it before maturity
- This is an option which the issuer has the right but not the obligation to exercise
- Terms are specified by the indenture document (aka prospectus):
  1. Lockout period
  2. Call price
  3. Make-whole provisions

Sinking fund provisions

- A commitment by the issuer to make regular deposits into a trustee-managed fund to be used, eventually, to pay back the issue

Convertible securities

- A fixed income security is convertible if the buyer has the right but not the obligation to exchanges its claims for a fixed number of equity claims
- A traditional bond with a call option

Covenants

- Legal commitments by the issuer
- *Positive, negative, and financial*
- Typical financial covenants:
  1. Maximum leverage (Debt/EBITDA, say)
  2. Minimum DSCR (EBITDA/Interest)
  3. Minimum rating
- *Incurrence* covenants (as opposed to *maintenance* covenants) are triggered by specific events

Privately traded vs publicly traded securities

- *Private claims:* traded in private markets (restricted and opaque)
- *Public claims:* traded in public markets (much less restricted and much more transparent)

What is a public corporation? (take 1)

- A *public corporation* or *publicly traded corporation* is a corporation whose common equity trades in public markets
- Public corporations can and do issue private claims
- Private corporations can and do issue public claims
- Public does **not** mean *listed* on a public exchange

What is a public corporation? (take 2)

"In general, we use the term to refer to a company that has public reporting obligations. Companies are subject to public reporting requirements if they:

1. *Sell securities in a public offering (such as an initial public offering, or IPO);*
2. *Allow their investor base to reach a certain size, which triggers public reporting obligations; OR*
3. *Voluntarily register with us."*

From Investors.gov, i.e. the SEC

YTM, YTC, YTW

- *Yield-to-maturity:* Investor's IRR assuming all payments are made to maturity
- *Yield-to-call:* Investor's IRR assuming a bond is redeemed at the first call date (after figuring call price and/or make-while provisions)
- *Yield-to-worst=min(YTC,YTM)*

Spot-yield curve (the z's)

- A curve that shows the annualized ytm's of zero-coupon treasury bonds at the maturities for which they can be calculated…
- … and some interpolation where they can't
- We will learn how it is built via bootstrapping
- The fundamental building block of all fixed-income thinking…
- … because all fixed income securities, in the end, are packages of zeros, and must be priced accordingly

Par yield

- Given zero-coupon yields, the coupon rate that makes market value of a risk-free bond equal to par
- Example: Zero-coupon spot rates are 1, 2, and 3 percent at respectively, 6m, 1y, 1.5y. What is the 1.5y par yield?
- Letting c denote the par yield, it solves:

$$\frac{100\frac{c}{2}}{1+0.5\%}+\frac{100\frac{c}{2}}{(1+1\%)^2}+\frac{100+100\frac{c}{2}}{(1+1.5\%)^3}=100$$

- So:

$$c=2\times\frac{100-P_{1.5}}{P_{0.5}+P_1+P_{1.5}}$$

where P_n is the price of a maturity n zero of face value 100

- Par yields are de facto swap rates

Plain-vanilla interest rate swaps

Fixed leg buyer **Floating leg buyer**

$$Notional(A) \times floating\ rate\ (\tilde{r}_t) \longrightarrow$$

$$\longleftarrow Notional(A) \times Swap\ rate\ (r)$$

Swap rates are par yields

- At origination r is set so that PV(fixed leg)=PV(floating leg)
- But, at least roughly, PV(floating leg) = A – PV(A at maturity)…
- … while PV(fixed leg) = PV(Ar to maturity)
- Ergo PV(Ar to maturity) + PV(A at maturity)= A
- Par yields!
- Better yet, risk free par yields!
- Because swap markets are more active and complete than treasury markets (= require less interpolation), they are used in lieu of spot yields in most fixed income calculations

Why is PV(floating leg) = A – PV(A at maturity)?

- The floating leg is *investable:*
  1. *Invest A at floating rate to maturity*
  2. *Recover A in the end*

- That simple strategy costs A today and pays $\{A\tilde{r}_t\}_{t=1}^{T}$ plus *A* at maturity

- So *A=PV(floating leg) +PV(A at maturity)*

- Not just true at origination, true at every reset

- Argument only limited by:
  1. Investability assumption (transaction costs)
  2. Counterparty risk

- So it doesn't apply well to corporate floaters or Real Estate swaps, among others, but applies very well, if not perfectly, for LIBOR swaps…

- … hence for Eurodollar futures since those have payoffs identical to LIBOR swaps

But then we can use swap rates to get spot rates!

- Assume S/A swap rates hence par yields are 1%, 2%, and 3% over the next 18 months, what are spot yields?

- First one is easy: 1%

- Second one, we know:

$$100 = \frac{1}{1 + \frac{1\%}{2}} + \frac{100}{\left(1 + \frac{z(1)\%}{2}\right)^2}$$

- And so on for deeper maturities
- Bootstrapping!

Practical difficulties

- Swaps compound quarterly where T-bonds compound annually
- With different day-count conventions too in some conversion cases
- That's why we use Bloomberg to handle those details
- <SWPM>

Day-count convention

- Between coupon dates interest accrues as time passes

- Day-count conventions are used to measure the fraction of time elapsed between coupon dates

- Two main conventions in the US:
  1. 30/360 US
  2. Actual/Actual ICMA (Treasuries)

- All captured by Excel's yearfrac

30/360 US

- Take two dates (M_1, D_1, Y_1) and (M_2, D_2, Y_2), how many "years" are they apart?

- Day count factor (DCF) =

$$\frac{360 \times (Y_2 - Y_1) + 30 \times (M_2 - M_1) + D_2 - D_1}{360}$$

- With a few annoying adjustments we need to make:
  1. If $D_2 = 31$ and $D_1 = 30\ or\ 31$, then $D_2 = 30$
  2. If $D_1 = 31$, then $D_1 = 30$
  3. February adjustment

Actual/Actual ICMA

- Day count factor =

$$\frac{Days(Date1, Date2)}{Days\ in\ coupon\ period \times Frequency}$$

Accrued interest

$$Accrued\ interest = Day\ count\ factor^{**} \times Principal \times Coupon\ rate^{*}$$

where, note:

** DCF is measured since last interest payment

* Use annualized coupon rate

Clean and dirty prices

- *Dirty/invoice price* is the price actually paid for the bond on the *settlement date*
- But what is quoted on Bloomberg (and all similar platforms) is the *clean price* which equals:

dirty price – accrued interest

Clean and dirty prices

$$Clean\ price =$$

$$\left[\frac{redemption}{\left(1+\frac{YTM}{k}\right)^{N-k*DCF}}\right]$$

$$+\left[\sum_{t=1}^{N}\frac{100\times\frac{rate}{k}}{\left(1+\frac{YTM}{k}\right)^{t-k*DCF}}\right]$$

$$-100\times rate\times DCF$$

- *Notes: Here, k is the frequency, N is the total number of payments, and t indexes periods. DCF is the day count factor since the most recent coupon.*

Put another way…

$$Clean\ price + accrued\ interest =$$

$$Dirty\ price =$$

$$\left[\frac{redemption}{\left(1+\frac{YTM}{k}\right)^{N-k*DCF}}\right]$$

$$+\left[\sum_{t=1}^{N}\frac{100\times\frac{rate}{k}}{\left(1+\frac{YTM}{k}\right)^{t-k*DCF}}\right]$$

Tick size and quotation

- Treasury notes are quoted relative to par, in 32nd of a dollar (*tick size*):

ISSUE	BID	ASK	CHANGE	YIELD
6 1/2 8/15/05-N	105.08	12	+3	5.57

- This note (N) was issued with a coupon rate of 6.5% and a maturity of 8/15/05
- Bid price is \$(105+8/32), ask price is \$(105+12/32)
- Yield is YTM at ask price
- Third "decimal" added as needed: + for ½, 2 for ¼, 6 for ¾ of a 32nd

Tick size and quotation

- Treasury bills are quoted as discount to par on an annual Actual/360 day basis):

ISSUE	BID	ASK	CHANGE	YIELD
12/3/98	5.08	5.06	-.03	5.26

- 12/3/98 is the maturity date
- Assume we are 169 days to maturity in example above, the bid price of the bill, per $10k of par is:

$$\$10{,}000 - \frac{(508 \times 169)}{360} = \$9{,}761.52$$

Main risks of investing in fixed income

1. Interest rate risk + Re-investment risk
2. Inflation risk
3. Default/credit risk
4. Call/prepayment risk
5. Liquidity risk
6. Exchange rate risk
7. “Volatility risk”

Duration and convexity

- Taylor expansion for any smooth function:

$$df = f(x + dx) - f(x) \approx f'(x)dx + \frac{1}{2}f''(x)(dx)^2$$

- Let $V(y)$ be a bond value given bond yield y,

$$d\log(V(y)) = \frac{dV(y)}{V(y)} \approx -D\,dy + \frac{1}{2}C(dy)^2$$

where D is *modified duration* and C is *convexity*

Macaulay duration and modified duration

- Given k coupons per year and a total of n payments:

$$V = \sum_{i=1}^{n} \frac{CF_i}{\left(1 + \frac{y}{k}\right)^i} = \sum_{i=1}^{n} PV_i$$

- Macaulay duration:

$$McD = \sum_{i=1}^{n} \frac{PV_i \times \frac{i}{k}}{V}$$

- Modified duration:

$$D = \frac{McD}{1 + \frac{y}{k}}$$

Duration facts

- Duration increases with maturity, falls with yield, and falls with the coupon rate
- Duration of a zero of maturity T *is* T
- Floaters (should roughly) return to par at each reset so they are like very-short term zeros
- Their duration is the time to the next reset, i.e., super short
- Swapping fixed (long-duration) for floating (short-duration) is the easiest way to manage one's duration

Dollar duration measure

- "Bloomberg risk":

$$\frac{D}{100} \times V$$

- Dollar duration (*DV01*) is the risk per basis point change in rates:

$$\frac{D \times V}{10{,}000}$$

Convexity (semi-annual bonds, n payments)

$$C = \frac{1}{\left(1+\frac{y}{2}\right)^2} \sum_{i=1}^{n} \frac{CF_t \times \left(\left(\frac{i}{2}\right)^2 + \frac{i}{4}\right)}{V\left(1+\frac{y}{2}\right)^i}$$

$$= \frac{1}{\left(1+\frac{y}{2}\right)^2} \sum_{t=\frac{1}{2},1,\frac{3}{2},\ldots\frac{n}{2}} \frac{PV_t \times \left(t^2 + \frac{t}{2}\right)}{V}$$

Convexity facts

- Convexity increases (in a convex fashion) with maturity, falls with yield, and generally falls with the coupon rate
- Convexity of a zero of maturity T is T^2
- Some bonds (callable bonds, e.g.) can feature negative convexity
- Convexity is good so more convex bonds, all else equal, should in general be more expensive
- This is why we generally expect the term structure to be concave

Duration times spread

- Hard to compare bonds that feature very different spreads (over risk-free benchmarks)

- So common practice is to measure (first-order) rate sensitivity as:

$$DTS = Duration \times Spread$$

- Premise is that spread ratios ought to be stable, that relative spread changes are more reasonable to expect than absolute rate changes

Spread (effective) duration

- Change in the price of bond caused by a 100 basis point (1%) change in spread
- For fixed-rate instruments, usually similar to modified duration
- For floaters, very different

Floating rate coupon bonds (floaters)

- For all t:
  1. Initial rate: r_0
  2. At reset, $r_t^* = index_t + premium_t$
  3. r_t adjust towards r_t^* subject to caps and floors, both absolute and on adjustment steps
  4. $m_t = b_o r_t$

- Zero amortization: $b_T = b_0$

- Libor was the most typical index until last year but we have now moved towards alternative reference rates like CMT or SOFR

Credit-default swaps, a preview

Protection/CDS buyer **Protection/CDS seller**

$$Premium = Notional(A) \times Swap\ rate\ (\kappa)$$

If "credit event"

$$\begin{aligned} Payment &= Face\,Value\ of\ oustanding\ debt - Market\,Value \\ &= Loss\ given\ default\ (LGD) \end{aligned}$$

CDS rates are risk-premia

- Intuitively (we will prove it under premise of perfect markets), CDS rates should match the spread between the yield on the underlying and the risk-free counterpart

- Indeed, both are compensation for probability of default times loss given default

- Two big, practical applications of this fundamental fact:
  1. Synthetic CDOs *(Who needs to issue securities any more? Just fake it with purely nominal CDS contracts)*
  2. CDS basis convergence trades

Convertible bond arbitrage

- A *convertible bond* gives the holder the right to convert her bond investment into equity at an agreed-upon *conversion price* and/or *conversion ratio*

- Example: Consider a 6-month convertible bond with face-value $1,000, S/A coupon rate of 10%, and a conversion price of $25

- The conversion ratio is $\frac{1000}{25} = 40$ shares per bond

Convertible bond valuation

- Assume the share price 6 months from now is either \$20 or \$30, each with equal ***risk-neutral probability*** and that the 6-month risk-free (z) rate is 5% (annualized as always)
- What is the value of the bond?
- If the holder does not convert in 6 month, they get \$1,100
- If they do convert they get $40 \times$ share price
- Obviously the option is exercised when and only when the share price is \$30

Fundamental theorem in Finance

No arbitrage

$$\Longleftrightarrow$$

$$q = \frac{E^*(X)}{1 + r^F}$$

where the expectation* is with respect to a synthetic probability distribution called the risk-neutral probability and r^F is the risk free rate

Most of modern finance prices assets by estimating the RNP first and then pricing assets as if agents were risk neutral

This is especially true in fixed income

Convertible bond valuation (2)

- The value of the bond is

$$\frac{\frac{1}{2}\times 1100+\frac{1}{2}\times 40\times 30}{1+\frac{5\%}{2}}\approx 1{,}121.95$$

- Another way to write this is:

$$\frac{1100}{1+\frac{5\%}{2}}+\frac{\frac{1}{2}\max(40\times 20-1100{,}0)+\frac{1}{2}\max(40\times 30-1100{,}0)}{1+\frac{5\%}{2}}$$

Convertible bond valuation (2)

- The value of the bond is

$$\frac{\frac{1}{2}\times 1100+\frac{1}{2}\times 40\times 30}{1+\frac{5\%}{2}}\approx 1{,}121.95$$

- Another way to write this is:

$$\underbrace{\frac{1100}{1+\frac{5\%}{2}}}_{\text{Value of the bond without the conversion feature (\textit{investment value})}}+\frac{\frac{1}{2}\max(40\times 20-1100{,}0)+\frac{1}{2}\max(40\times 30-1100{,}0)}{1+\frac{5\%}{2}}$$

Convertible bond valuation (2)

- The value of the bond is

$$\frac{\frac{1}{2}\times 1100+\frac{1}{2}\times 40\times 30}{1+\frac{5\%}{2}} \approx 1{,}121.95$$

- Another way to write this is:

Value of the call option to convert

$$\frac{1100}{1+\frac{5\%}{2}}+\frac{\frac{1}{2}\max(40\times 20-1100,0)+\frac{1}{2}\max(40\times 30-1100,0)}{1+\frac{5\%}{2}}$$

Value of the bond without the conversion feature (*investment value*)

Pure convertible bond arbitrage

- Assume that immediately prior to the final coupon payment, the share having already moved up to $30, the bond trades at $1,150
- Then buy the convertible, convert and sell the resulting shares gives you a pure arbitrage
- But that is not what hedge funds mean by convertible arbitrage, a practice made popular by Ed Thorp, the spiritual father of all quants
- *Convertible arbitrage* in the way quants use the expression is not an arbitrage, it is a *convergence trade*

Ed Thorp's version

- If value of the convertible bond is less than value of the non-convertible equivalent plus the value of the call option (the value of the *warrants*):
  1. *Buy the convertible bond*
  2. *Short the stock*

- The number of shares (the *hedge ratio*) is set to immunize the impact of movements in the share price on the bond, this is called *delta hedging*

- Hedge ratio is continuously/dynamically adjusted by buying or selling more stock

No arbitrage

- Tons of risks remain:
  1. *Interest rate risk (can be hedged in standard ways)*
  2. *Default risk (negative gamma/convexity in the large)*
  3. *Risk that mispricing will worsen rather than increase, like it does during financial crises*

Positive gamma?

- When price goes up, bond's delta goes up **<u>locally</u>**, and vice versa
- The rate of change in delta as prices change is called gamma
- When the price goes up the bond's value goes up both because the probability of conversion goes up and the conversion price goes up
- In principle, this makes Ed Thorpe's position **<u>locally</u>** convex

Bond value vs stock price

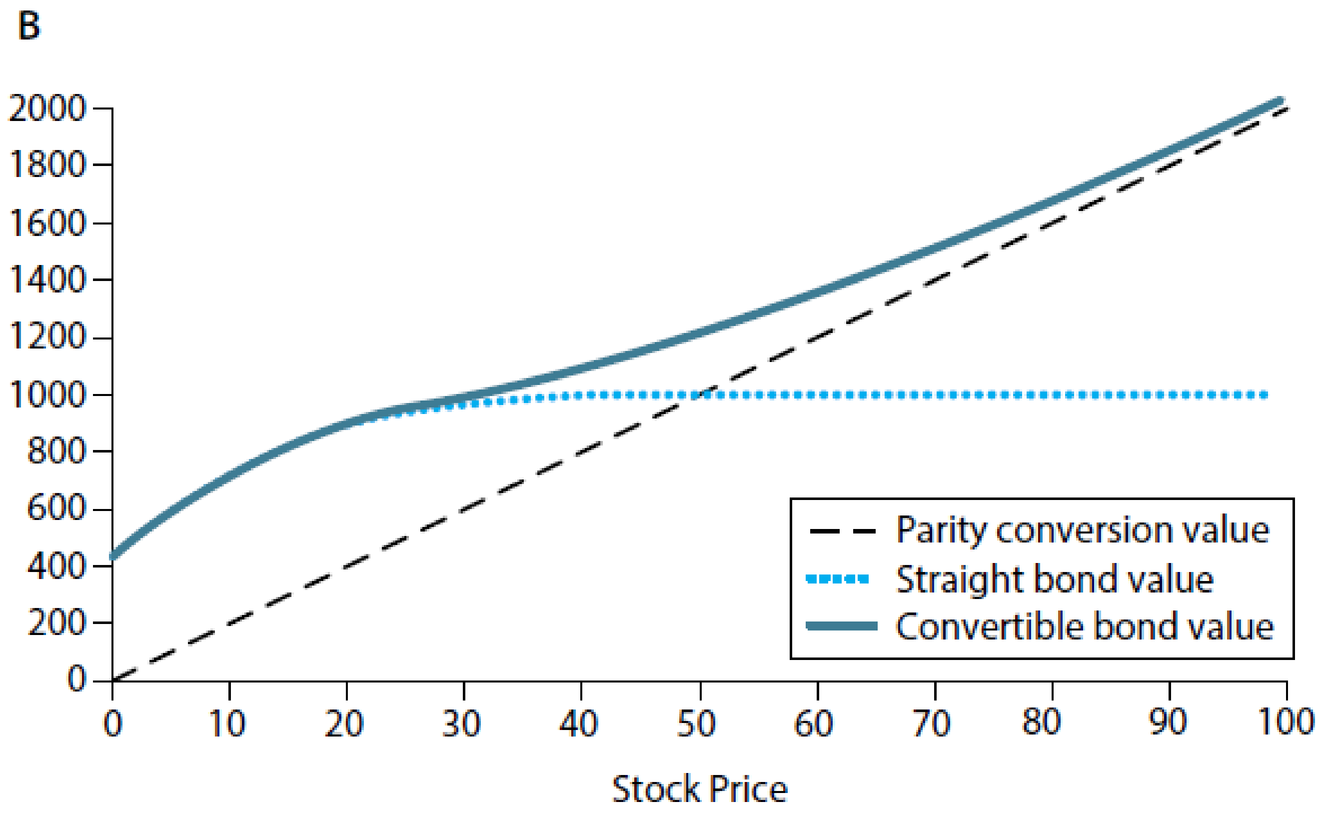


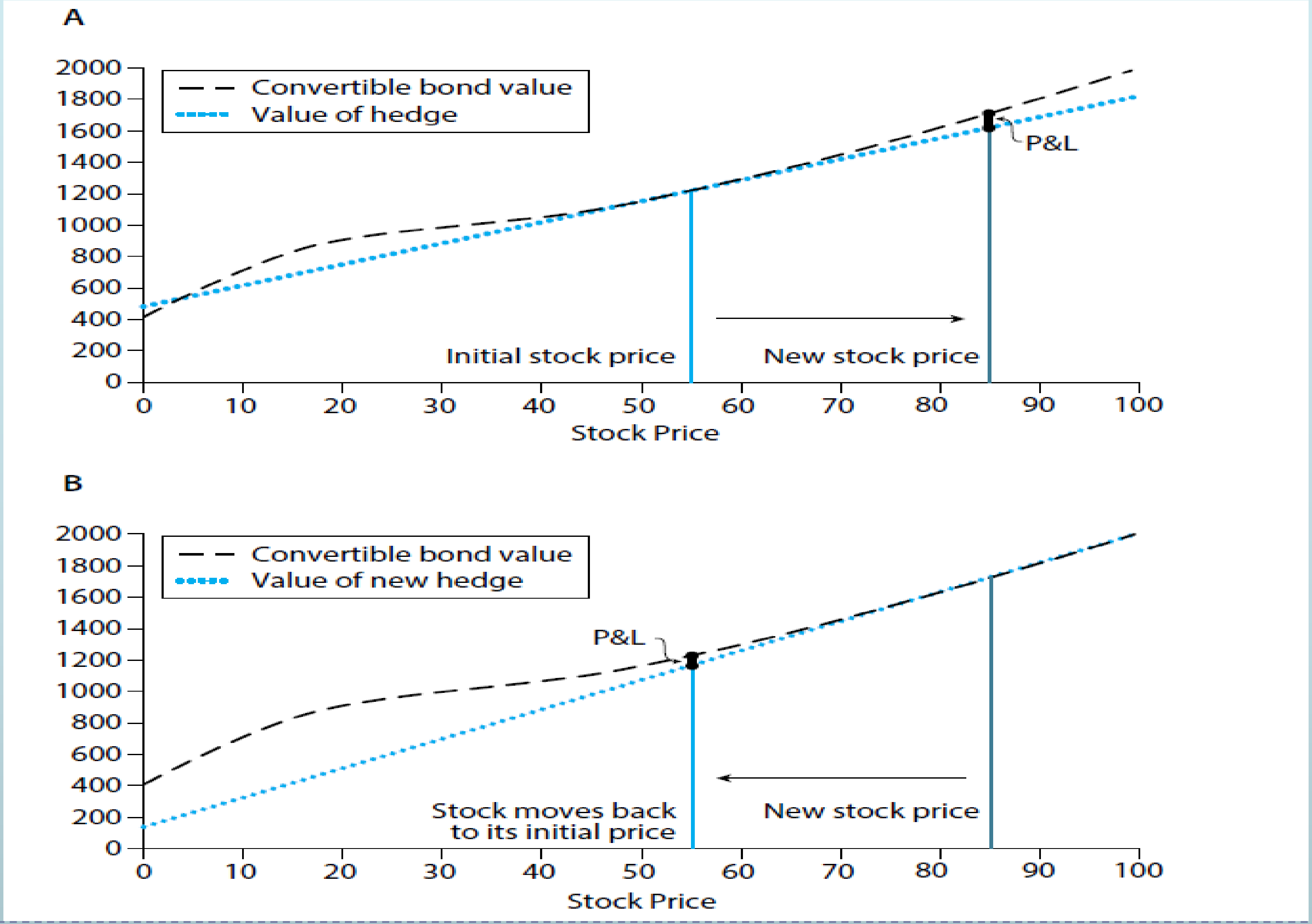
Figure 15.3. How the value of a convertible bond depends on the firm value and stock price.

Panel A. Convertible bond value vs. firm value.

Panel B. Convertible bond value vs. stock price.

- Source: Pedersen's "Inefficiently efficient," a great book

Dynamic hedging



- Source: Pedersen's "Inefficiently efficient," a great book

Stat arb

- Mine for and exploit statistical relationships, usually centers around some reversion to the mean argument
- Example: we expect yields on similar instruments for KO and PEP to be *co-integrated*
- If an exogenous event (large trade, say) nudges the relationship, enter a *pair trade* until shock is dissipated


Buy KO CB USD SR
Sell PEP CB USD SR
96) Actions
97) Edit
Spread Analysis
BMRK Mid YTM
BMRK Mid YTM 03/18/2021 - 03/18/2022
Regression Corr 120
Mult 1.0 Const 0.0
Mult 1.0 Const 0.0 Normalize by Factor 100.0 Calc % Local CCY
1D 3D 1M 6M YTD 1Y 5Y Max Daily Table
Add Studies or Events
Edit Chart
Mid Yield To Maturity
BH178254 Corp 2.648
AP448686 Corp 2.664
Hi: 2.752
Hi: 2.806
67.66%
74.90%
Low: 1.146
Low: 1.051
Spread Summary
Last -1.6643
Mean -2.7637
Off Avg 1.0995
Median -2.7729
StDev 5.204
StDev from Mean 0.2113
Percentile 57.9365
High 03/10/22 11.4274
Low 04/12/21 -14.3659
BH178254 Corp - AP448686 Corp -1.6643
Hi: 11.4274
Low: -14.3659
Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar
2021 2022
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Speed of convergence

- Consider the following model of the spread:

$$S_{t+1} = \gamma S^* + (1-\gamma)S_t + \epsilon_{t+1}$$

where ϵ is noise and γ is the speed of adjustment

- If the spread has a tendency to return to some mean then γ should estimate to a number between 0 and 1
- The closer to 1 the faster the speed of adjustment
- A common stationarity test (Dickey-Fuller) involves testing the hypothesis that $\gamma = 0$

Fixed income strategies

- Macro:
  1. Economic activity
  2. The level of interest rates
  3. The shape of interest rates

- Industry/sector *allocation*

- Fundamental credit analysis (*selection*)

- Arbitrage/convergence trades: market neutral in principle, but watch out for the steamroller