CHARTA LEARNING · LESSON NOTES

The Investment Function in Financial-Services Management

FRM Part II

1 A story: the bank with spare cash

- Halden Bank holds a $400m securities portfolio
- Bills $80m, notes $200m, long bonds $120m, at market
- Two questions: which shelf, and for how long?
- Short paper: safe and liquid, but pays less
- Long paper: pays more, but its price can fall

IN THE LESSON

- Meet Halden Bank, a mid sized lender.
- After making all the loans it wants, it still has money left over, and it holds four hundred million dollars of securities, valued at today's market prices.
- Eighty million dollars is in Treasury bills, two hundred million in Treasury notes, and one hundred and twenty million in long dated bonds.
- The treasurer faces two questions every week.
- Which shelf should the money sit on, the short shelf or the long one?
- And for how long?
- Short paper is safe and easy to sell, but it pays less.
- Long paper pays more, but its price can fall sharply when interest rates rise.
- The whole lesson is about that choice.

2 Money market instruments

- Debt with an original maturity of 1 year or less
- Treasury bills and commercial paper
- Negotiable certificates of deposit (CDs)
- Repurchase agreements (repos)
- Bankers' acceptances

IN THE LESSON

- The short shelf is the money market.
- A money market instrument is a debt security with an original maturity of one year or less.
- Treasury bills are short government debt, sold at a discount and repaid at face value.
- Commercial paper is short, unsecured borrowing by large companies.
- A negotiable certificate of deposit, or C D, is a large deposit at a bank that the holder can sell to another investor before it matures.
- A repurchase agreement, or repo, is a sale of a security with a promise to buy it back later at a slightly higher price, so it works like a short loan secured by the security.
- A bank investing in one is the lender, buying the security and agreeing to sell it back.
- A bankers' acceptance is a promise to pay, often arising from trade, that a bank has guaranteed.

3 Capital market instruments

- Longer maturities: more than 1 year
- Treasury notes and bonds
- Agency bonds and municipal bonds
- Corporate bonds
- Mortgage-backed securities (MBS)

IN THE LESSON

- The long shelf is the capital market.
- Its instruments have maturities longer than one year.
- Treasury notes and bonds are the government's longer, coupon paying debt.
- Agency bonds are issued by government sponsored agencies, and municipal bonds by states and local governments.
- Municipal bond interest is often exempt from income tax, which matters later.
- Corporate bonds are issued by companies, so the bank takes on the company's credit risk.
- Last, mortgage backed securities, or M B S.
- Each one is a claim on a pool of home loans, and the borrowers' payments pass through to the holders.
- Because a homeowner can repay early, an M B S can be repaid sooner than planned, usually when rates have fallen.

4 The two shelves side by side

Strengths and weaknesses of each shelf

Feature	Money market	Capital market
Liquidity	High	Lower: thinner resale
Price swings	Small: duration < 1	Large: −D × Δy
Cash at maturity	Soon, predictable	Years away
Yield	Lower	Higher: term + credit
Main risk	Reinvestment	Price (rate) risk

IN THE LESSON

- Here are the strengths and weaknesses of each shelf, side by side, row by row.
- Liquidity first.
- Money market paper is highly liquid.
- Capital market paper is less so, because resale markets for many bonds are thinner.
- Price swings next.
- A money market instrument has a duration below one, so its price barely moves.
- For a capital market bond the price change is roughly minus duration times the change in yield, which can be large.
- Cash at maturity.
- Short paper returns predictable cash soon, while long paper returns it years away.
- Yield.
- The money market pays less, while the capital market pays more, through a term premium and a credit spread.
- And the main risk.
- For short paper it is reinvestment risk, the risk of rolling over at lower rates.
- For long paper it is price risk.

5 Quoting a bill: the discount basis

Discount yield = (F − P) ÷ F × 360 ÷ t
BEY = (F − P) ÷ P × 365 ÷ t

Face value F	Paid at maturity
Price P	Paid today
Days to maturity t	Days until the bill matures
Bond-equivalent yield	Use it to compare yields

IN THE LESSON

- Before comparing yields, we must put them on the same footing.
- Treasury bills and other discount instruments are quoted on a three hundred and sixty day discount basis.
- Write F for the face value paid at maturity, P for the price paid today, and t for the number of days to maturity.
- The discount yield is F minus P, divided by F, times three hundred and sixty over t.
- That understates the true return twice over.
- It divides the dollar gain by the face value instead of the price actually paid, and it uses a three hundred and sixty day year.
- The bond equivalent yield fixes both, for bills of up to six months.
- It is F minus P, divided by P, times three hundred and sixty five over t.
- Convert to it before comparing a bill with anything else.

6 Example 1: a bill against a rival

91-day bill: face $1,000,000, price $990,000. Rival yields 4.00% (BEY)

Discount	1,000,000 − 990,000	**$10,000**
Discount yield	10,000 ÷ 1m × 360 ÷ 91	**3.96%**
Bond-equivalent yield	10,000 ÷ 990,000 × 365 ÷ 91	**4.05%**
Rival security	quoted as a BEY	**4.00%**
Verdict	4.05% beats 4.00%	**Buy the bill**

IN THE LESSON

- Halden can buy a ninety one day bill with a face value of one million dollars for nine hundred and ninety thousand dollars.
- A rival security of the same length yields four per cent, quoted as a bond equivalent yield.
- The discount is one million minus nine hundred and ninety thousand, ten thousand dollars.
- The discount yield is ten thousand over one million, times three hundred and sixty over ninety one, which is three point nine six per cent.
- On that quote the bill looks worse than the rival.
- Now convert.
- Ten thousand over nine hundred and ninety thousand, times three hundred and sixty five over ninety one, is four point zero five per cent.
- The rival yields four point zero zero per cent.
- Four point zero five beats four, so Halden buys the bill.
- The quote had hidden the better deal.

7 Example 2: what the capital market pays

Yields today: 3-month bill 4.05%, 10-year Treasury 5.40%, 10-year corporate 6.60%

Pickup for term	5.40% − 4.05%	**1.35 pts**
Credit spread	6.60% − 5.40%	**1.20 pts**
$120m in bills, a year	120m × 4.05%	**$4.86m**
$120m in 10-year Treasuries	120m × 5.40%	**$6.48m**
Extra income a year	6.48 − 4.86	**$1.62m**

IN THE LESSON

- Today the three month bill yields four point zero five per cent, the ten year Treasury five point four zero, and a ten year corporate bond six point six zero.
- That is why a bank holds long paper at all: it pays more.
- The pickup for going longer is five point four zero minus four point zero five, one point three five percentage points.
- Much of it is the term premium, the extra return investors demand for tying money up longer and bearing price risk.
- The credit spread, the extra return for default risk, is six point six zero minus five point four zero, one point two zero points.
- On one hundred and twenty million dollars, bills pay four point eight six million a year, and ten year Treasuries six point four eight million.
- That is one point six two million dollars a year more.

8 Example 3: rates rise by one point

Yields rise 1 point. Bills: ModD 0.25. Long bonds: ModD 8. % change ≈ −ModD × Δy

Bills: % change	−0.25 × 1%	**−0.25%**
Bills: $ change	−0.25% × $80m	**−$0.2m**
Long bonds: % change	−8 × 1%	**−8%**
Long bonds: $ change	−8% × $120m	**−$9.6m**
Ratio of losses	9.6 ÷ 0.2	**48 times**

IN THE LESSON

- Suppose all yields rise by one percentage point.
- Halden's bills have a modified duration of a quarter, and its long bonds a modified duration of eight.
- Think of modified duration for now as a measure of price sensitivity, which we define properly later.
- As a rough rule, the percentage price change is minus modified duration times the change in yield.
- This is the cost of the extra income.
- The bills lose a quarter of one per cent, which on eighty million dollars is two hundred thousand dollars.
- The long bonds lose eight per cent, which on one hundred and twenty million is nine point six million dollars.
- The bonds lose forty eight times as much as the bills.
- And the bills will be repaid at face value within a few months anyway, so even that small loss disappears.

9 Example 4: reinvestment risk

Rates fall 1.5 points before Halden's $80m of bills mature and are rolled

Bill income now	80m × 4.05%	**$3.24m**
Rolled at the lower rate	4.05% − 1.5%	**2.55%**
Bill income after	80m × 2.55%	**$2.04m**
Income lost a year	3.24 − 2.04	**$1.20m**
Long bonds, locked at 5.40%	120m × 5.40%	**$6.48m**

Short paper protects the price; long paper protects the income

IN THE LESSON

- Suppose rates fall by one and a half percentage points before Halden's eighty million dollars of bills mature and must be rolled over.
- This is short paper's own weakness.
- Today the bills earn four point zero five per cent, so income is eighty million times four point zero five per cent, three point two four million dollars a year.
- They are rolled at the lower rate, four point zero five minus one point five, which is two point five five per cent.
- Income becomes eighty million times two point five five per cent, two point zero four million.
- Halden has lost one point two million dollars of income a year.
- Meanwhile the long bonds keep paying, because their yield is locked in.
- One hundred and twenty million at five point four zero per cent still gives six point four eight million.
- So short paper protects the price, and long paper protects the income.

10 The trade-off the exam tests

- Money market: liquidity, stable prices, cash soon
- But: lower yield and reinvestment risk
- Capital market: term premium and credit spread
- But: price risk and thinner resale markets
- Compare yields only on the same basis (BEY)

IN THE LESSON

- Put the pieces together and you have the trade-off the exam tests.
- The money market gives liquidity, stable prices and cash soon.
- In return it pays a lower yield and leaves the bank exposed to reinvestment risk when rates fall.
- The capital market pays more, through the term premium and the credit spread.
- In return the bank accepts price risk when rates rise, and resale markets that are thinner, so selling in a hurry can mean accepting a lower price.
- Neither shelf is better in general.
- The right mix depends on how much liquidity the bank needs and how much rate risk it can carry.
- And whenever you compare yields, first convert every quote to the same basis, the bond equivalent yield.

11 Why a bank holds securities

- Not simply the highest yield
- A secondary liquidity reserve, behind cash
- A source of income
- A diversifier of loan risk
- Collateral for pledging

IN THE LESSON

- Now to the second question: which securities should Halden actually pick?
- Start with why a bank holds them.
- A bank does not simply buy the highest yield, because the portfolio has jobs to do.
- First, it is a secondary liquidity reserve.
- Cash is the first line, and securities that can be sold quickly are the second.
- Second, it is a source of income, especially when loan demand is weak.
- Third, it diversifies the bank's risk.
- Loans are concentrated in the bank's own region and customers, and securities spread the risk elsewhere.
- Fourth, securities serve as collateral for pledging.
- Some deposits and borrowings must be secured by securities that the bank pledges.

12 What shapes the choice: risk and timing

- Credit quality: chance of default and the loss
- Marketability: sells fast, cheaply, near market value
- Maturity and interest rate risk
- Call or prepayment risk: repaid when rates fall

IN THE LESSON

- Those jobs shape the selection factors.
- The first is credit quality: how likely the issuer is to default, and how much would be lost.
- The second is marketability.
- That is how fast and how cheaply a security can be sold at a price near its market value.
- A Treasury bill sells in minutes at a fair price.
- A small local bond issue may take days and a price cut.
- The third is maturity and interest rate risk: the longer the security, the more its price moves when rates change.
- The fourth is call or prepayment risk.
- A callable bond can be repaid early by its issuer, and a mortgage backed security by home owners.
- Both tend to happen when rates fall, so the bank must reinvest at lower yields.

13 What shapes the choice: tax and rules

- Tax status: taxable or tax-exempt
- Pledging: a pledged security is not for sale
- Regulatory liquidity treatment
- Rank by risk-adjusted, after-tax yield
- Not by promised yield

IN THE LESSON

- The remaining factors come from tax and rules.
- Tax status matters because some interest, such as most municipal bond interest, is exempt from income tax, so a lower stated yield can be worth more after tax.
- Pledging requirements matter because a pledged security is tied up as collateral and is not available for sale.
- And regulators treat securities differently when they measure a bank's liquidity.
- Some count fully as liquid assets, and others count for less or nothing.
- So the question is never which security promises the most.
- The right ranking uses the risk adjusted, after tax yield, not the promised yield, which is the common error.

14 Putting yields on one basis

EL = PD × LGD
TEY = tax-exempt yield ÷ (1 − tax rate)

Probability of default	Chance of default in a year
Loss given default	Share lost if it defaults
Expected loss EL	Subtract from promised yield
Tax-equivalent yield	Compare with taxable yields

IN THE LESSON

- Two adjustments put yields on one basis.
- The first is for credit.
- Expected loss, E L, is the probability of default, P D, times the loss given default, L G D.
- P D is the chance the issuer defaults in a year, and L G D is the share of the investment lost if it does.
- Subtract the expected loss from the promised yield to get a risk adjusted yield.
- The second adjustment is for tax.
- The tax equivalent yield, T E Y, is the tax exempt yield divided by one minus the tax rate.
- It tells you what a taxable security would have to yield to leave the bank with the same income after tax, so you can compare it directly with taxable yields.

15 Example 5: ranking three bonds

Tax 25%. Corporate 6.60% (PD 3%, LGD 60%). Treasury 5.40%. Muni 4.40%, EL 0.10%

Corporate, net of EL	6.60% − 3% × 60%	**4.80%**
Treasury, no default risk	5.40% − 0	**5.40%**
Municipal, net of EL	4.40% − 0.10%	**4.30%**
Municipal, tax-equivalent	4.30% ÷ (1 − 0.25)	**5.73%**
Best, risk-adjusted after tax	5.73 > 5.40 > 4.80	**Municipal**

IN THE LESSON

- Halden pays tax at twenty five per cent and is choosing between three ten year bonds.
- The corporate bond promises six point six zero per cent, with a default probability of three per cent and a loss given default of sixty per cent.
- Its expected loss is three per cent times sixty per cent, one point eight points, so its risk adjusted yield is four point eight zero per cent.
- The Treasury has no default risk, so it stays at five point four zero.
- The municipal bond promises four point four zero per cent, tax free, with an expected loss of point one zero per cent, so four point three zero per cent net.
- Its tax equivalent yield is four point three zero divided by one minus point two five, which is five point seven three per cent.
- The order is five point seven three, then five point four zero, then four point eight zero.
- Promised yield put the municipal bond last.
- Risk adjusted, after tax, it comes first.

16 Example 6: how liquid is the portfolio?

Book value $420m; market value $400m; $160m at market value is pledged

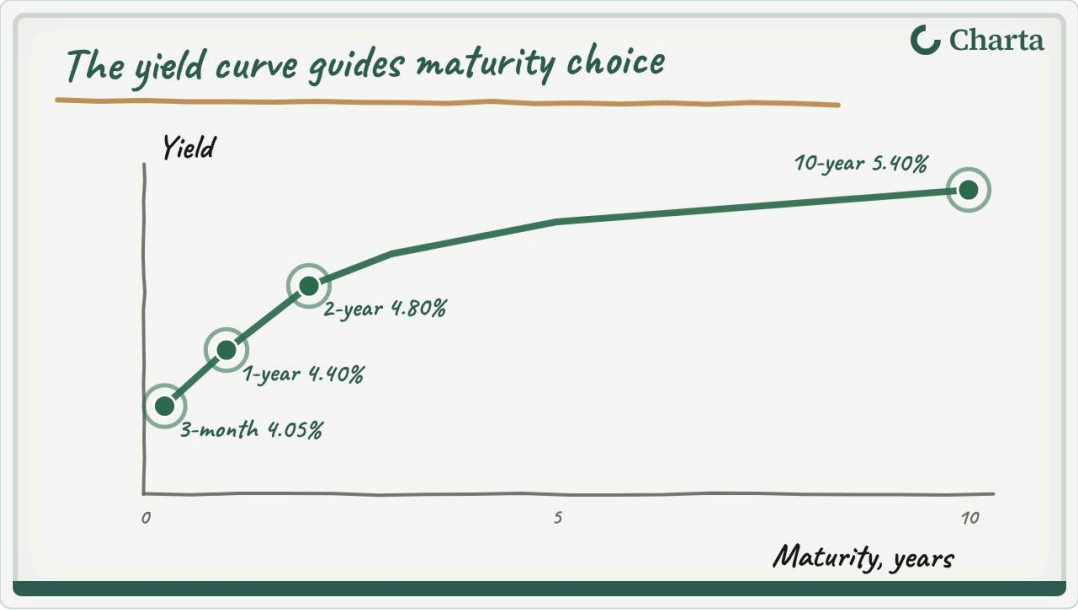
Book value	what Halden paid	**$420m**
Market value	after rates rose	**$400m**
Pledged, at market value	public deposits, borrowings	**$160m**
Unpledged, at market value	400 − 160	**$240m**
Overstatement, all at book value	20 (book) + 160 (pledged)	**$180m**

Measure liquidity on unpledged holdings at market value

IN THE LESSON

- Halden bought its securities for four hundred and twenty million dollars, which is their book value.
- Rates have since risen, and their market value has fallen to four hundred million, the figure we have used all along.
- Of that, one hundred and sixty million, at market value, is pledged as collateral for public deposits and borrowings.
- Pledged securities cannot be sold, so the unpledged holdings at market value are four hundred minus one hundred and sixty, two hundred and forty million dollars.
- That is Halden's real liquidity reserve.
- A manager who counted the whole portfolio at its book value of four hundred and twenty million would overstate it by twenty million from using book rather than market value, plus one hundred and sixty million from counting pledged securities, one hundred and eighty million dollars in all.
- That is the test of the liquidity reserve: measure liquidity on unpledged holdings, at market value.

17 The yield curve guides maturity choice



IN THE LESSON

- Now the third question: how long?
- The yield curve guides the answer.
- It plots the yield on Treasury securities against their maturity.
- Along the bottom is maturity in years, from zero to ten.
- Up the side is the yield.
- Halden's curve slopes upward.
- It starts at four point zero five per cent for the three month bill.
- It reaches four point four zero at one year and four point eight zero at two years, and climbs more slowly to five point four zero per cent at ten years.
- An upward slope rewards going longer, but each step out adds price risk.
- The curve tells the bank what it is paid for extending maturity.
- Duration, our next tool, tells it how much risk it takes on in return.

18 Duration: the ruler for price risk

D = Σ (t × PV of cash flow at t) ÷ price
ModD = D ÷ (1 + y), %ΔP ≈ −ModD × Δy

Duration D	Weighted average time to cash
Modified duration	% price change per 1 point
Yield change	Change in yield, in points
Portfolio duration	Market-value-weighted average

IN THE LESSON

- Duration measures the price risk of a maturity choice.
- Write D for duration.
- It is the weighted average time until the bond's cash flows arrive.
- Each time t is weighted by the present value of the cash flow paid then, as a share of the price.
- Modified duration is D divided by one plus the yield per period.
- It gives the percentage price change for a one point change in yield, so the price change is about minus modified duration times the yield change.
- For a portfolio, the duration is the market value weighted average of the durations of the holdings.
- That lets a bank measure the price risk of the whole portfolio with one number.

19 Example 7: duration of a three-year bond

3-year bond: 5% annual coupon, yield 5%, price 100

Year 1: PV × 1	5 ÷ 1.05 = 4.76; × 1	**4.76**
Year 2: PV × 2	5 ÷ 1.05^2 = 4.535; × 2	**9.07**
Year 3: PV × 3	105 ÷ 1.05^3 = 90.70; × 3	**272.11**
Duration	285.94 ÷ 100	**2.86 years**
Modified duration	2.86 ÷ 1.05	**2.72**

Coupons arrive early, so duration is below the 3-year maturity

IN THE LESSON

- Take a three year bond paying a five per cent coupon once a year, with a yield of five per cent, so its price is one hundred.
- Year one's coupon of five is worth five divided by one point zero five, four point seven six today.
- Times one year, that is four point seven six.
- Year two's coupon is worth five over one point zero five squared, about four point five three five.
- Times two years, nine point zero seven.
- In year three the bond pays one hundred and five, worth ninety point seven zero today.
- Times three years, two hundred and seventy two point one one.
- The sum is two hundred and eighty five point nine four.
- Divide by the price of one hundred, and duration is two point eight six years.
- Modified duration is two point eight six over one point zero five, two point seven two.
- Because the coupons arrive early, duration is below the three year maturity.

20 Example 8: Halden's portfolio duration

Mod. durations: bills $80m (0.25), notes $200m (4.1), long bonds $120m (8); $400m total

Bills: weight × ModD	80/400 × 0.25	**0.05**
Notes: weight × ModD	200/400 × 4.1	**2.05**
Long bonds: weight × ModD	120/400 × 8	**2.40**
Portfolio duration	0.05 + 2.05 + 2.40	**4.5**
Rates up 1 point	−4.5% × $400m	**– $18m**

IN THE LESSON

- These durations are modified durations.
- Bills are eighty of Halden's four hundred million dollars, with a duration of a quarter.
- Their weight times duration is eighty over four hundred times point two five, point zero five.
- Notes are two hundred million with a duration of four point one, giving two point zero five.
- Long bonds are one hundred and twenty million with a duration of eight, giving two point four zero.
- Add them: point zero five plus two point zero five plus two point four zero is four point five.
- So Halden's portfolio behaves like one bond with a duration of four and a half.
- If rates rise by one point, it loses about four point five per cent of four hundred million, eighteen million dollars.

21 Four maturity strategies

How to spread a portfolio across maturities

Strategy	What it is	Suits
Ladder	Equal amounts across maturities	Steady cash, no forecast
Barbell	Short and long, no middle	Liquidity plus yield
Bullet	All at one maturity	A known date
Rate expectations	Shorten or lengthen on a forecast	A confident view

IN THE LESSON

- How should a bank spread a portfolio across maturities?
- With the curve and duration in hand, it chooses one of four maturity strategies.
- A ladder spreads equal amounts across maturities.
- It suits a bank that wants steady cash coming due and makes no forecast.
- A barbell puts money at the short end and the long end, with nothing in the middle.
- The short end gives liquidity and the long end gives yield.
- A bullet puts everything at one maturity.
- It suits a known need on a known date.
- The rate expectations approach shortens or lengthens maturity according to a forecast of rates.
- It suits a bank with a confident view and the stomach to be wrong.

22 Example 9: ladder, barbell and bullet

Halden places $400m across maturities of 1 to 10 years

Ladder: ten rungs	400 ÷ 10	**$40m each**
Ladder: average maturity	(1 + 2 + … + 10) ÷ 10	**5.5 years**
Barbell: 1 and 10 years	200 at 1, 200 at 10	**5.5 years**
Cash due in year 1	ladder 40, barbell 200	**40 vs 200**
Bullet: all at 5 years	for a need in year 5	**$400m**

Same average maturity, very different liquidity

IN THE LESSON

- Suppose Halden places its four hundred million across maturities of one to ten years.
- A ladder has ten rungs, so four hundred divided by ten is forty million dollars at each maturity.
- Its average maturity is one plus two and so on up to ten, divided by ten, five and a half years.
- A barbell puts two hundred million at one year and two hundred million at ten years.
- Its average maturity is also five and a half years.
- But look at the cash due in year one: forty million from the ladder, two hundred million from the barbell.
- A bullet would put all four hundred million at five years, for a need in year five.
- Same average maturity, very different liquidity.

23 The rate-expectations approach

- Expect rates to rise: shorten maturities
- Then reinvest sooner at the higher rates
- Expect rates to fall: lengthen maturities
- Lock in yields and gain on prices
- Risk: the forecast is wrong

IN THE LESSON

- The rate expectations approach is the active strategy.
- If the bank expects rates to rise, it shortens maturities.
- Prices of long bonds would fall, and short paper protects it.
- Then, as the short paper matures, it reinvests sooner at the higher rates.
- If the bank expects rates to fall, it does the opposite and lengthens maturities.
- That locks in today's higher yields, and long bond prices rise as rates fall.
- The risk is plain: the forecast may be wrong.
- A bank that lengthened because it expected falling rates, and then saw rates rise, takes the largest price losses at exactly the wrong time.
- That is why many banks prefer the ladder, which needs no forecast at all.

24 Example 10: riding the yield curve

Curve: 1-year 4.40%, 2-year 4.80%. Halden holds a zero-coupon bond for 1 year

Buy 2-year zero at 4.80%	100 ÷ 1.048^2	**91.05**
Sell as 1-year at 4.40%	100 ÷ 1.044	**95.79**
Return for the year	95.79 ÷ 91.05 − 1	**5.20%**
A plain 1-year bond		**4.40%**
If the 1-year rate is 5.40%	100 ÷ 1.054 = 94.88	**4.20% < 4.40%**

It works only if the curve stays upward-sloping and steady

IN THE LESSON

- The one year yield is four point four zero per cent, the two year four point eight zero, and Halden holds a zero coupon bond for a year.
- To ride the yield curve, buy longer paper and sell it once it rolls down to a lower yield.
- Halden buys the two year zero for one hundred over one point zero four eight squared, ninety one point zero five.
- A year later, if the curve is unchanged, it sells at four point four zero for one hundred over one point zero four four, ninety five point seven nine.
- The return is ninety five point seven nine over ninety one point zero five, minus one, five point two zero per cent.
- A plain one year bond earns four point four zero.
- But if the one year rate rises to five point four zero, it sells at ninety four point eight eight and returns only four point two zero per cent, less than the plain bond.
- It works only if the curve stays upward sloping and steady.

25 Changing duration with futures

N = (Dt − Dp) × Vp ÷ (Df × Vf)
N < 0: sell contracts. N > 0: buy contracts

Target duration Dt	Duration you want
Portfolio duration Dp	Duration you have
Portfolio value Vp	Market value now
Futures duration Df	Duration of the future
Contract value Vf	Value of one contract

IN THE LESSON

- A bank need not sell bonds to change its duration.
- It can use tools such as interest rate futures and swaps.
- For futures, the number of contracts is set by a formula.
- Write D t for the target duration and D p for the portfolio's duration now.
- V p is the portfolio value.
- D f is the duration of the futures contract and V f the value of one contract.
- The number of contracts, N, is D t minus D p, times V p, divided by D f times V f.
- The sign tells you what to do.
- If N is negative, the bank wants less duration, so it sells contracts.
- If N is positive, it buys them.

26 Example 11: cutting duration with futures

Halden: $400m, ModD 4.5, target 3.0. Futures: ModD 6.0, contract value $100,000

Change in duration needed	3.0 − 4.5	**−1.5**
Contracts	−1.5 × 400m ÷ (6 × 100,000)	**−1,000**
Action	negative, so sell	**Sell 1,000**
Rates up 1 point: bonds	−4.5% × $400m	**−$18m**
Futures gain	1,000 × 6% × $100,000	**+$6m**

Net −$12m = 3.0% × $400m: the target duration

IN THE LESSON

- Halden's board thinks a modified duration of four and a half is too much and sets a target of three.
- The futures contract has a modified duration of six and a value of one hundred thousand dollars.
- The change in duration needed is three minus four and a half, minus one and a half.
- The number of contracts is minus one and a half times four hundred million, divided by six times one hundred thousand, which is minus one thousand.
- Negative, so Halden sells one thousand contracts.
- Check it.
- If rates rise one point, the bonds lose four and a half per cent of four hundred million, eighteen million dollars.
- The short futures gain one thousand times six per cent of one hundred thousand dollars, six million.
- The net loss is twelve million, which is three per cent of four hundred million: exactly the target duration.

27 Swaps, and matching duration

- Pay-fixed swap: shortens duration
- Receive-fixed swap: lengthens duration
- Match duration, not maturity
- 3-year coupon bond: duration 2.86, not 3
- A 3-year zero has a duration of exactly 3

IN THE LESSON

- Swaps do the same job.
- In an interest rate swap the bank exchanges fixed rate payments for floating rate payments.
- A pay fixed swap shortens duration, because the bank gives away a stream of fixed payments, which behaves like being short a bond.
- A receive fixed swap lengthens duration.
- One more rule: match duration, not maturity.
- Suppose Halden must pay out a fixed sum in exactly three years and wants its assets to keep pace whatever rates do.
- The three year coupon bond from our example has a duration of two point eight six, not three, because its coupons arrive early.
- A three year zero coupon bond has a duration of exactly three, so that is the match.

28 Mistakes to avoid

- Comparing a discount yield with a bond yield
- Ranking by promised, not risk-adjusted after-tax yield
- Counting pledged securities, or book value, as liquidity
- Matching maturity instead of duration
- Wrong futures sign: a negative N means sell

IN THE LESSON

- Here are the mistakes the exam looks for.
- First, comparing a bill's discount yield with a bond's yield.
- Convert to the bond equivalent yield first, or the bill looks worse than it is.
- Second, ranking securities by promised yield, rather than by yield net of expected loss and after tax.
- Third, counting pledged securities, or book values, as liquidity.
- Only unpledged holdings at market value can be sold to raise cash.
- Fourth, matching maturity when you should match duration.
- And fifth, getting the futures sign wrong.
- A negative number of contracts means sell, and a positive number means buy.
- If you avoid these five, most questions on this topic become arithmetic.

29 Try three quick questions

1. Muni yields 3.6% tax-exempt; tax rate 40%. Tax-equivalent yield?
   Answer: 3.6% ÷ (1 − 0.40) = 6.0%.
2. $20m of bonds, modified duration 5. Yields rise 0.5 point. Price change?
   Answer: −5 × 0.5% = −2.5%, about −$500,000.
3. $50m portfolio, ModD 2, target 4. Futures ModD 5, contract $100,000. Contracts?
   Answer: (4 − 2) × 50m ÷ (5 × 100,000) = +200: buy 200.

IN THE LESSON

- Now try three quick questions.
- Pause the video, think, then listen to the answers.
- Question one.
- A municipal bond yields three point six per cent, tax exempt, and the bank's tax rate is forty per cent.
- What is the tax equivalent yield?
- Three point six divided by one minus point four, which is six per cent.
- Question two.
- A bank holds twenty million dollars of bonds with a modified duration of five, and yields rise by half a percentage point.
- What is the price change?
- Minus five times half a per cent is minus two and a half per cent, a loss of about five hundred thousand dollars.
- Question three.
- A fifty million dollar portfolio has a modified duration of two, and the target is four.
- Futures have a modified duration of five and a contract value of one hundred thousand dollars.
- How many contracts?
- Four minus two, times fifty million, divided by five times one hundred thousand, is plus two hundred, so buy two hundred contracts.