



IIT ROORKEE



NPTEL ONLINE
CERTIFICATION COURSE

QUANTITATIVE INVESTMENT MANAGEMENT

LECTURE 29

Fixed Income Portfolio Strategies -1

J P Singh

Department of Management Studies



WEIGHTED AVERAGE VS ACTUAL PORTFOLIO STATISTICS



PORTFOLIO STATISTICS

- Portfolio yield (meaning YTM), duration, dispersion of cash flows, and convexity are commonly computed as weighted averages based on market value weighting of each holding in the portfolio.
- These average computations are less accurate than portfolio statistics computed directly from the portfolio's aggregate cash flows.



- Portfolio statistics obtained directly from portfolio cash flow estimates should be used for ALM work rather than traditional weighted average calculations based on each bond.
- The difference in the two approaches is determined by the shape of the yield curve:
- With a flat yield curve, there is no difference.
- In an upward-sloping yield curve, portfolio duration and IRR (YTM) will be higher than weighted average duration and YTM of the bonds because portfolio statistics reflect all cash flows (and return) to be received and the longer maturity bonds will impact the portfolio for a longer time.

- To illustrate this issue:
- The ytm of a portfolio is not equal to the weighted average ytm of its constituents.
- A portfolio is made of equal proportions (by value) of two securities A and B. The current price of A is 100 and its respective cashflows over the next three years is 15, 15 and 115. The price of B is 100 and the cash flows are 6, 106 and 0. Calculate the YTM of A, B and the portfolio as well.



PORTFOLIO	YTM	0	1	2	3
A	0.15	-100	15	15	115
B	0.06	-100	6	106	0
PORTFOLIO	0.112891	-200	21	121	115



PORTFOLIO DURATION & CONVEXITY

- Consider a portfolio consisting of one ZCB of 1 year and one ZCB of 9 year maturities. Both bonds are redeemable at 1000.
- **The yield curve is upward sloping** with the relevant spot rates being: $S_{01} = 10\% \text{ p.a.}$ and $S_{09} = 30\% \text{ p.a.}$
- Calculate the actual and weighted average portfolio Macaulay durations & convexity.

WEIGHTED AVERAGE PORTFOLIO DURATION

$$P_A = \frac{1000}{(1 + S_{01})} = \frac{1000}{(1 + 0.10)} = 909.09$$

$$P_B = \frac{1000}{(1 + S_{09})^9} = \frac{1000}{(1 + 0.30)^9} = 94.30$$

Also $D_A = 1$, $D_B = 9$ so that

$$D_P = \frac{909.09 \times 1 + 94.30 \times 9}{909.09 + 94.30} = 1.75$$

ACTUAL PORTFOLIO DURATION

TIME	CASH FLOW C(T)	TC(T)	DISC TC(T)	
0	-1003.39	0	0	
1	1000	1000	825.46	
9	1000	9000	1601.4	
IRR	0.211448832		2426.8	
DURATION			2.4186	

WEIGHTED AVERAGE PORTFOLIO CONVEXITY

$$P_A = \frac{1000}{(1 + S_{01})} = \frac{1000}{(1 + 0.10)} = 909.09; P_B = \frac{1000}{(1 + S_{09})^9} = \frac{1000}{(1 + 0.30)^9} = 94.30$$

$$\text{Also } C_A = \frac{\frac{T(T+1)C_T}{(1 + S_{0T})^T}}{2P_A} = \frac{\frac{1 \times 2 \times 1000}{(1 + 0.10)^1}}{2 \times 909.09} = 1, C_B = \frac{\frac{9 \times 10 \times 1000}{(1 + 0.30)^9}}{2 \times 94.30} = 45 \text{ so that}$$

$$C_P = \frac{909.09 \times 1 + 94.30 \times 45}{909.09 + 94.30} = 5.14$$

ACTUAL PORTFOLIO CONVEXITY

TIME	CASH FLOW C(T)	$T(T+1)C(T)$	DISC $T(T+1)C(T)$
0	-1003.39	0	0
1	1000	2000	1650.915786
9	1000	90000	16013.88963
IRR	0.211448832		17664.80541
CONVEXITY			8.802562022

COMPUTATION OF PORTFOLIO STATISTICS

1. Project the time to receipt (starting with the nearest to most distant) of every portfolio cash flow.
2. Determine the aggregate portfolio cash flow in each period. Usually, six-month periods are assumed.
3. Determine the portfolio IRR that equates future cash flows with the current market value of the portfolio.
4. Use that IRR to determine the PV of each future cash flow from step 2. (The sum of those PVs will be the current portfolio market value.)



5. Calculate the PV weight (w) to apply to each payment as its PV (step 4) divided by the sum of the PVs.
6. For each cash flow, multiply its (w) by its time until receipt (t). The sum of the (w)(t)s is the portfolio's Macaulay duration.
7. Duration is normally expressed in years, so if the cash flow periods were in six-month increments, divide by 2 (two six-month periods in a year) for annual duration.

8. Portfolio dispersion is computed as the weighted average variance of when each cash flow is received around portfolio duration.
9. Remember, duration is just the weighted average of when all the cash flows are received).
10. Portfolio modified convexity can be computed by summing for each cash flow: $[(t)(t + 1)(w)]$ and then divide this sum by $(1 + \text{portfolio } IRR_{\text{periodic}})^2$.

YIELD CURVE STRATEGIES



ACTIVE PORTFOLIO MANAGEMENT

- Active management requires the manager to take a view on the future evolution of interest rates.
- If the manager acting on his view, is correct, and the view was not already reflected in security prices, the actions could add value to the portfolio's performance.

STRATEGIES FOR A STABLE CURVE



BUY & HOLD

- In an upward sloping curve, extend maturity (and therefore duration) to earn a higher yield and expected return.



EXAMPLE

- Consider two 10% annual coupon of maturity 3 years & 5 years respectively. Let the spot rates be: $S_{01} = 5\%$, $S_{02} = 6\%$, $S_{03} = 7\%$, $S_{04} = 8\%$, $S_{05} = 9\%$. We, then have:
- $$P_{0,3} = \frac{100}{1.05} + \frac{100}{1.06^2} + \frac{1100}{1.07^3} = 1082.17$$
- $$P_{0,5} = \frac{100}{1.05} + \frac{100}{1.06^2} + \frac{100}{1.07^3} + \frac{100}{1.08^4} + \frac{1100}{1.09^5} = 1054.29$$
- $$ytm_{0,3} = 6.88\%; \quad ytm_{0,5} = 8.62\%$$

- **An advantage of this strategy will be low turnover and transaction costs.**
- **This strategy is not necessarily passive if it involves selecting a duration or exposure to points on the yield curve (where rates are expected to be stable) that differ from the portfolio's benchmark.**

RIDE THE YIELD CURVE

- This strategy is based on the fact that as time passes, the bond's remaining maturity and duration decrease.
- In an upward sloping curve, that means its yield will decline as time passes.



EXAMPLE

- Consider a 10% annual coupon of maturity 5 years. Let the spot rates be: $S_{01} = 5\%$, $S_{02} = 6\%$, $S_{03} = 7\%$, $S_{04} = 8\%$, $S_{05} = 9\%$. Assume that at the end of the first year, the spot rate spectrum remains unchanged. We, then have:
- $$P_{0,5} = \frac{100}{1.05} + \frac{100}{1.06^2} + \frac{100}{1.07^3} + \frac{100}{1.08^4} + \frac{1100}{1.09^5} = 1054.29$$
- $$P_{1,4} = \frac{100}{1.05} + \frac{100}{1.06^2} + \frac{100}{1.07^3} + \frac{1100}{1.08^4} = 1074.40$$
- Thus, yield over the first year: $y_{0,1} = \frac{1074.40 + 100 - 1054.29}{1054.29} = 11.39\%$

TIMELINE	0	1	2	3	4	5
SPOT		0.05	0.06	0.07	0.08	0.09
CASH FLOW		100	100	100	100	1100
DCF	1054.3	95.24	89	81.63	73.5	714.9
TIMELINE	0	1	2	3	4	
SPOT		0.05	0.06	0.07	0.08	
CASH FLOW		100	100	100	1100	
DCF	1074.4	95.24	89	81.63	808.5	

- **This strategy differs from buy and hold in that the manager will look to find the bond with a combination of higher duration and positioned at the end of a relatively steep portion on the curve so that as time passes and its yield declines, the bond will offer the greatest increase in price.**

- Then, after the yield declines, the manager sells the bond and rolls out the curve to repeat the process by buying another bond at the end of a steep segment of the curve.
- Buying bonds at the end of a steep segment of the curve also means they have an initially higher yield, which also adds to the return earned.