

**Lecture 5: Stock Positions and Portfolio Return**

- I. Reading.
- II. Return Calculation and Dividends.
- III. Stock Positions.
- IV. Portfolio Return Formula

**Lecture 5: Stock Positions and Portfolio Return**

- I. Reading.
  - A. BKM Chapter 3: Sections 3.6-3.7.
  - B. BKM, Chapter 5: read Section 5.2.
- II. Return Calculation and Dividends.
  - A. Return Calculation
    - 1. Return over a Period: Percentage change in the value of the investment over that period.
    - 2. Formula to calculate Return: For an arbitrary asset  $i$ :

$$R^i(t,t+1) = \frac{p^i(t+1) + c^i(t+1) - p^i(t)}{p^i(t)}$$
$$= \frac{p^i(t+1) + c^i(t+1)}{p^i(t)} - 1$$

where  $p^i(t+1)$  is the market price of asset  $i$  at time  $t+1$ ;  
 $c^i(t+1)$  is the cash flow from the asset at time  $t+1$ ;  
 $p^i(t)$  is the market price of asset  $i$  at time  $t$ ; and,  
 $R^i(t+1)$  is the return on asset  $i$  over the period from  $t$  to  $t+1$ .

3. Example: The following price data is available for IBM:

<HELP> for explanation.

N090 Equity COMP

**COMPARATIVE RETURN TABLE** Page 2 / 2  
 Range **11/ 4/04** - **11/ 5/04** Period  Daily 1 Day Period  
 (\* = No dividends or coupons)

Date	IBM			S&P 500 INDEX			S&P 500 INFO TECH IN		
	Price	Divs	Ret	Price	Divs	Ret	Price	Divs	Ret
F 11/ 5/2004	93.28		.97	1166.17	.021	.39	315.57		.95
T 11/ 4/2004	92.38		.00	1161.67		.00	312.61		.00

WSJ	YTD % CHG	52-WEEK HI	52-WEEK LO	STOCK (SYM)	YLD DIV %	PE	VOL 100s	NET CLOSE	NET CHG
11/4/04	-0.3	100.43	81.90	IBM IBM	.72	.8 20	68856	92.38	1.18
11/5/04	0.6	100.43	81.90	IBM IBM	.72	.8 20	66261	93.28	0.90

What is the 1-day return on IBM stock for 11/5/04? Answer:

Date	Dividend: IBM	Closing Price:IBM
11/4/04	0	92.38
11/5/04	0	93.28

So,

$$R^{IBM}(11/5/04) = \frac{p^{IBM}(11/5/04) - p^{IBM}(11/4/04)}{p^{IBM}(11/4/04)}$$

$$= \frac{93.28 - 92.38}{92.38} = 0.9742\%$$

- B. Return Calculation with Dividend.
1. Important Dates associated with a Dividend
    - a. Declared Date: when the board formally approves the dividend.
    - b. Ex-date: when the stock trades without its dividend.
  2. Example (cont): The following price information is available for IBM:

<HELP> for explanation.

N090 Equity COMP

**COMPARATIVE RETURN TABLE** Page 2 / 2  
 Range **11/ 5/04 - 11/ 8/04** Period  Daily 3 Day Period  
 (\* = No dividends or coupons)

Date	IBM			S&P 500 INDEX			S&P 500 INFO TECH IN		
	Price	Divs	Ret	Price	Divs	Ret	Price	Divs	Ret
M 11/ 8/2004	93.37	.180	.29	1164.89	.106	-.10	315.99	.054	.15
F 11/ 5/2004	93.28		.00	1166.17		.00	315.57		.00

WSJ

	YTD % CHG	52-WEEK HI	52-WEEK LO	STOCK (SYM)	YLD DIV	VOL % PE	NET 100s CLOSE	CHG
11/5/04	0.6	100.43	81.90	IBM IBM	.72	.8 20 66261	93.28	0.90
11/8/04	0.7	100.43	81.90	IBM IBM x	.72	.8 20 47348	93.37	0.27

What is the 1-day return on IBM stock for 11/8/04? Answer: Know 11/8/04 is the ex-date for IBM's dividend.

Date	Dividend: IBM	Closing Price: IBM
11/5/04	0	93.28
11/8/04	0.18	93.37

Thus,

$$R^{IBM}(11/8/04) = \frac{p^{IBM}(11/8/04) + Div^{IBM}(11/8/04) - p^{IBM}(11/5/04)}{p^{IBM}(11/5/04)}$$

$$= \frac{93.37 + 0.18 - 93.28}{93.28} = 0.2895\%$$

## III. Stock Positions.

## A. Example.

1. XYZ has the following price series

Date	Dividend: XYZ	Closing Price:XYZ
end 1/05	0	8
end 2/05	0	10
end 3/05	0	7

2. Suppose you have \$8000 cash at the end of 1/05. Your balance sheet at the end of 1/05 looks like:

Assets		Liabilities	
Cash	8000	Net Worth	8000
Total Asset	8000	Total Liab & Net W.	8000

3. Assume your broker requires interest of 1% per month on any funds borrowed from her. Any funds placed with your broker earns 1% also. This rate (EAR=12.68%) can be thought of as the riskless rate.

## B. Long the Stock.

1. Definition: Buying the stock with your own funds.
2. Example (cont):
  - a. At the end of 1/05, you invest \$6000 in XYZ shares at the closing price; so buy 750 shares and the remaining \$2000 you invest with your broker at 1% .

Assets		Liabilities	
750 XYZ sh @ \$8	6000		
Cash	2000	Net Worth	8000
Total Asset	8000	Total Liab & Net W.	8000

- b. By the end of 2/05, XYZ's price has gone up.

Assets		Liabilities	
750 XYZ sh @ \$10	7500		
Cash (2000 @ 1%)	2020	Net Worth	9520
Total Asset	9520	Total Liab & Net W.	9520

- c. By the end of 3/05, XYZ's price has plunged.

Assets		Liabilities	
750 XYZ sh @ \$7	5250		
Cash (2020 @ 1%)	2040.20	Net Worth	7290.20
Total Asset	7290.20	Total Liab & Net W.	7290.20

## C. Buying Stock on Margin.

1. Definition: Buying stock using funds borrowed from a broker; the client is charged the call money rate on the borrowed funds (plus a fee).
2. Percentage margin: refers to net worth (value of the stock less amount borrowed) as a percentage of the value of the stock:

$$\text{Margin} = \frac{\text{Net Worth}}{\text{Value of Stock}}$$

- a. In the U.S., the Board of Governors of the Federal Reserve System has set the minimum initial margin at 50%; so the borrowed amount must be less than 50% of the value of the stock purchased.
- b. As the value of the stock decreases so does the percentage margin.
- c. If the percentage margin falls below the maintenance margin set by the broker, the customer has to put up enough collateral satisfy the maintenance margin.

## 3. Example (cont):

- a. At the end of 1/05, you want to buy 1400 shares in XYZ; and so need to borrow  $1400 \times \$8 - \$8000 = \$3200$  from your broker.

Percent Margin =  $8000/11200 = 71.43\% > 50\%$ .

Assets		Liabilities	
1400 XYZ sh @ \$8	11200	Loan	3200
		Net Worth	8000
Total Asset	11200	Total Liab & Net W.	11200

- b. By the end of 2/05, XYZ's price has gone up.

Percent Margin =  $10768/14000 = 76.91\%$ .

Assets		Liabilities	
1400 XYZ sh @ \$10	14000	Loan (\$3200@1%)	3232
		Net Worth	10768
Total Asset	14000	Total Liab & Net W.	14000

- c. By the end of 3/05, XYZ's price has plunged.

Percent Margin =  $6536/9800 = 66.69\%$ .

Assets		Liabilities	
1400 XYZ sh @ \$7	9800	Loan (\$3232@1%)	3264
		Net Worth	6536
Total Asset	9800	Total Liab & Net W.	9800

D. Short Selling Stock

1. Definition: Borrowing the stock and selling it.
2. Proceeds from the sale must remain with the broker.
3. Percentage margin: refers to net worth as a percentage of the value of the stock borrowed:

$$\text{Margin} = \frac{\text{Net Worth}}{\text{Value of Stock}}$$

- a. As the value of the stock increases, the percentage margin decreases.
  - b. If the percentage margin falls below the maintenance margin set by the broker, the customer has to put up enough collateral to satisfy the maintenance margin.
4. Example (cont):
- a. At the end of 1/05, you have \$8000 in cash with your broker.
    - (1) You borrow 1400 shares of XYZ. The loan is denominated in shares of XYZ not in dollars.

Assets		Liabilities	
1400 XYZ sh @ \$8	11200	Loan (1400 sh @ \$8)	11200
Cash	8000	Net Worth	8000
Total Asset	19200	Total Liab & Net W.	19200

- (2) You sell the borrowed shares at the closing price at the end of 1/05.

$$\text{Margin} = 8000 / 11200 = 71.43\%$$

Assets		Liabilities	
Cash	19200	Loan (1400 sh @ \$8)	11200
		Net Worth	8000
Total Asset	19200	Total Liab & Net W.	19200

b. By the end of 2/05, XYZ's price has gone up.

$$\text{Margin} = 5392 / 14000 = 38.51\%$$

Assets		Liabilities	
Cash (\$19200@1%)	19392	Loan (1400 sh@\$10)	14000
		Net Worth	5392
Total Asset	19392	Total Liab & Net W.	19392

c. By the end of 3/05, XYZ's price has plummeted.

$$\text{Margin} = 9786 / 9800 = 99.86\%$$

Assets		Liabilities	
Cash (\$19392@1%)	19586	Loan (1400 sh@\$7)	9800
		Net Worth	9786
Total Asset	19586	Total Liab & Net W.	19586

d. To close out the position at the end of 3/05, take the following steps:

(1) purchase 1400 shares of stock.

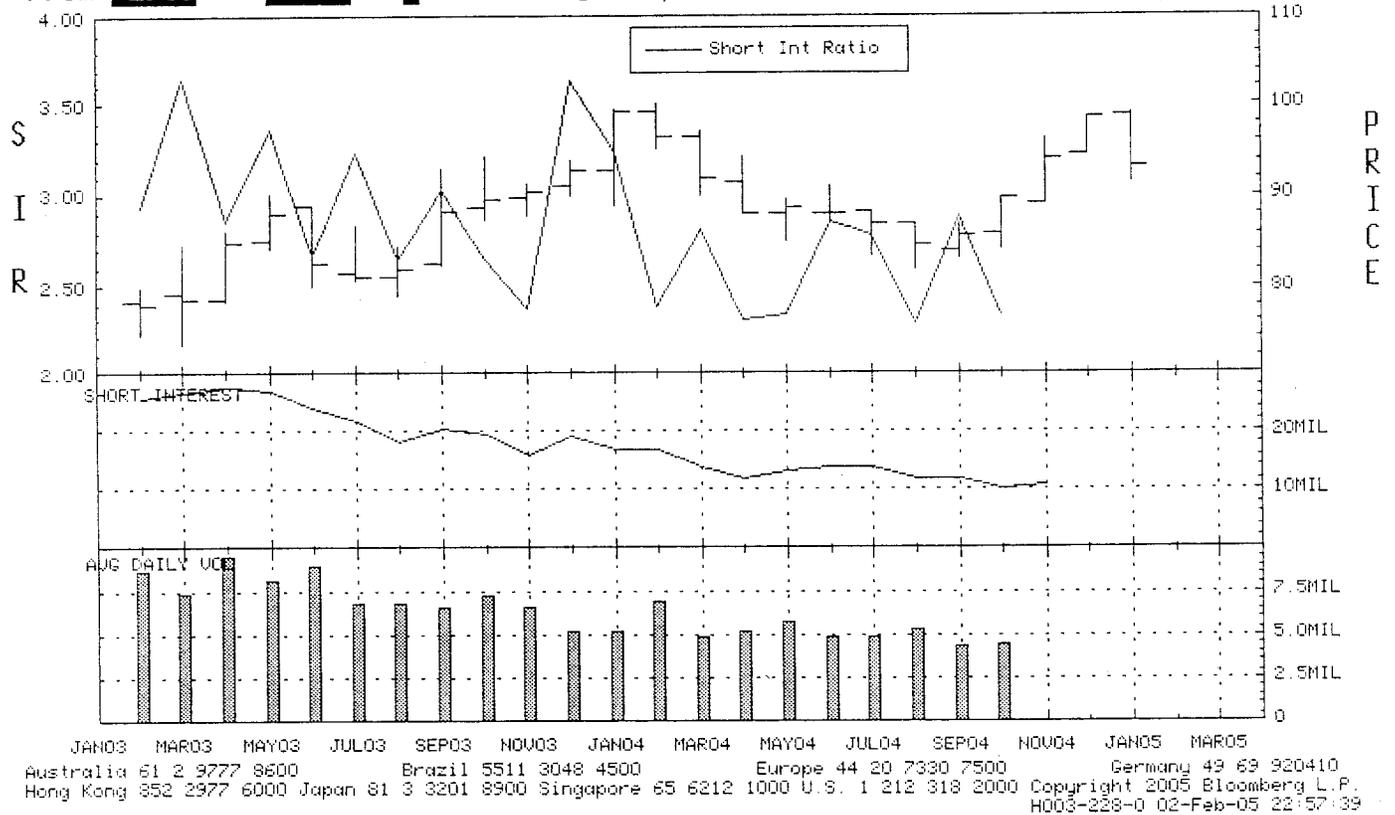
Assets		Liabilities	
Cash	9786	Loan (1400 sh@\$7)	9800
1400 sh XYZ @\$7	9800	Net Worth	9786
Total Asset	19586	Total Liab & Net W.	19586

(2) repay the stock loan.

Assets		Liabilities	
Cash	9786	Net Worth	9786
Total Asset	9786	Total Liab & Net W.	9786

5. Short Interest
  - a. At the end of each month, all brokers report their customer's short positions in all stocks.
  - b. Short Interest Ratio
    - (1) Short Interest/Av Daily Trading Volume.
    - (2) measures the number of days to close out the outstanding short position given the average daily trading volume for the stock.

<HELP> for explanation, <MENU> for similar functions. N090 Equity SI  
 Enter all values and hit <GO> or # <PAGE> for table.  
**SHORT INTEREST FOR IBM US \$ IBM**  
 From 2/03 to 2/05 A V-Monthly Vol, A-Avg Daily vol or N-None Y Price(Y/N)



**Table 9**

**Four Factor Model Parameters for EW and VW Portfolios  
of Firms with High Short Interest, by Subperiod**

Intercepts and their t-statistics from monthly time series regressions of  $r_{pt} - r_{ft}$ , the percentage excess return over the risk-free rate on a portfolio in time period t, regressed on  $r_{mt} - r_{ft}$  is the realization of the market risk premium in period t,  $SMB_t$  is the return on a portfolio of Small stocks Minus the return on a portfolio of Big stocks in period t,  $HML_t$  is the return on a portfolio of High book-to-market (value) Minus Low book-to-market (growth) stocks in period t, and  $MOM_t$  is the return on a portfolio of prior winners minus the return on a portfolio of prior losers, are reported. For July 1988-December 1994, 78 monthly returns are used in the regressions. For January 1995 to December 2002, 96 monthly returns are used. The 2.5% portfolio in month t is the portfolio composed of all Nasdaq stocks in with a short interest ratio of greater than 2.5% (short interest/shares outstanding) in month t-1. The portfolio is updated monthly. The 99<sup>th</sup> percentile portfolio in month t is composed of all stocks that are in the top one percent of short interest ratios in month t-1.

$$r_{pt} - r_{ft} = a + b(r_{mt} - r_{ft}) + sSMB_t + hHML_t + mMOM_t + e_{pt}$$

Sample	Four-factor model intercepts			
	Equally Weighted		Value Weighted	
	2.5-4.9%	99 <sup>th</sup> %ile	2.5-4.9%	99 <sup>th</sup> %ile
Panel A: All Markets (NYSE-Amex only prior to July 1988)				
July 1988-1994	-0.62 <sup>***</sup> (-2.46)	-1.36 <sup>***</sup> (-3.54)	0.42 <sup>*</sup> (1.90)	-1.00 <sup>***</sup> (-2.45)
1995-2002	-0.05 (-0.21)	-1.18 <sup>***</sup> (-2.92)	0.25 (0.91)	0.13 (0.24)
July 1988-2002	-0.28 (-1.58)	-1.25 <sup>***</sup> (-4.42)	0.31 <sup>*</sup> (1.69)	-0.38 (-1.09)
1976-2002	-0.28 <sup>**</sup> (-2.08)	-0.53 <sup>***</sup> (-2.44)	0.27 <sup>*</sup> (1.76)	-0.05 (-0.17)
Panel B: NYSE-Amex				
1976-June 1988	-0.28 (-1.47)	0.29 (0.94)	0.17 (0.67)	0.44 (0.94)
July 1988-1994	-0.45 (-1.53)	-1.62 <sup>***</sup> (-2.75)	0.55 <sup>***</sup> (2.41)	-1.45 <sup>**</sup> (-2.32)
1995-2002	-0.34 <sup>*</sup> (-1.72)	-1.36 <sup>***</sup> (-2.67)	0.23 (0.99)	-0.64 (-0.90)
July 1988-2002	-0.41 <sup>**</sup> (-2.12)	-1.46 <sup>***</sup> (-3.71)	0.34 <sup>**</sup> (2.06)	-0.95 <sup>*</sup> (-1.85)
1976-2002	-0.45 <sup>***</sup> (-2.88)	-0.72 <sup>***</sup> (-2.68)	0.21 (1.35)	-0.42 (-1.18)
Panel C: Nasdaq				
July 1988-1994	-0.89 <sup>***</sup> (-2.56)	-1.36 <sup>***</sup> (-3.03)	-0.26 (-0.61)	-1.59 <sup>***</sup> (-3.20)
1995-2002	0.20 (0.63)	-1.24 <sup>**</sup> (-2.28)	0.51 (1.16)	-0.06 (-0.09)
July 1988-2002	-0.24 (-0.95)	-1.27 <sup>***</sup> (-3.49)	0.17 (0.54)	-0.73 <sup>*</sup> (-1.66)

## E. Comparison

1. What is the monthly return each month for the three investments?

a. Recall that in the absence of any dividend payment:

$$\text{Return} = [\text{Price (end)} / \text{Price (start)}] - 1.$$

b. So

$$\text{Portfolio Return} = [\text{Portfolio Value(end)} / \text{Portfolio Value(start)}] - 1$$

c. Note that Portfolio Value is given by Net Worth.

	Long 6000 XYZ sh		Buy 1400 XYZ sh on Margin		Short Sell 1400 XYZ sh	
Date	Net Worth	Return	Net Worth	Return	Net Worth	Return
1/05	8000		8000		8000	
2/05	9520	19%	10768	34.6%	5392	-32.6 %
3/05	7290.20	-23.4%	6536	-39.3%	9786	81.5%

2. Buying on Margin vs Going Long

a. Instead of using starting net worth to buy a firm's stock, the investor uses it to buy a larger number of the firm's shares on margin.

(1) A given price decline causes a larger reduction in net worth.

(2) A given price increase causes a larger increase in net worth.

(3) So the investor's net worth is more sensitive to changes in the stock price.

3. Short-selling vs Buying the Stock

a. Short-selling causes net worth to have a negative sensitivity to changes in the stock price.

(1) A price decline causes an increase in net worth.

(2) A price increase causes a decrease in net worth.

## IV. Portfolio Return Formula

- A. The following formula can be used to calculate the return on a portfolio given the returns on the assets that comprise the portfolio:

$$R_p(t) = \omega_{1,p} R_1(t) + \omega_{2,p} R_2(t) + \dots + \omega_{N,p} R_N(t)$$

where

$N$  is the number of assets in the portfolio;  
 $R_i(t)$  is the return on asset  $i$  in period  $t$ ;  
 $\omega_{i,p}$  is the weight of asset  $i$  in portfolio  $p$ ;  
 $R_p(t)$  is the return on portfolio  $p$  in period  $t$ .

- B. Portfolio weights must sum to 1.

## C. Example (cont):

1. Suppose I have \$8000 to invest at the end of January 2005.
2. I decide to invest \$6000 in XYZ and \$2000 in the Riskless Asset.
3. I have invested:
  - a.  $\$6000/\$8000=0.75$  or 75% of my money in XYZ.
  - b.  $\$2000/\$8000=0.25$  or 25% in the riskless asset.
4. Your portfolio's return in February 2005 can be calculated using this formula:

$$\begin{aligned} R_p(2/05) &= \omega_{XYZ,p} R_{XYZ}(2/05) + \omega_{f,p} R_f(2/05) \\ &= 0.75 \times 25\% + 0.25 \times 1\% \\ &= 19\%. \end{aligned}$$

which matches the return calculated earlier.

D. Interpretation of the Portfolio Weighting  $\omega$ 1. Buying a Stock on Margin:  $\omega_{\text{Stock}} > 1$  and  $\omega_{\text{Riskfree}} < 0$ 

a. Example (cont): When 1400 shares of XYZ were bought on margin at the end of January 2005, the weight on XYZ in the portfolio was  $> 1$ .

(1) The value of the portfolio at the end of January 2005 was \$8000, of which  $1400 \times \$8 = \$11200$  was invested in XYZ and  $-\$3200$  was invested in the riskless asset.

(2) So,

$$\omega_{\text{XYZ},p} = \$11200 / \$8000 = 1.4$$

$$\omega_{f,p} = -\$3200 / \$8000 = -0.4$$

(3) Note the weights sum to 1.

(4) Then can calculate the portfolio return for February 2005:

$$\begin{aligned} R_p(2/05) &= \omega_{\text{XYZ},p} R_{\text{XYZ}}(2/05) + \omega_f R_f(2/05) \\ &= 1.4 \times 25\% + -0.4 \times 1\% \\ &= 34.6\% \end{aligned}$$

which agrees with the return calculated earlier.

2. Short selling:  $\omega_{\text{Stock}} < 0$ 

a. Example (cont): When 1400 shares of XYZ were short sold at the end of January 2005, the weight on XYZ in the portfolio was  $< 0$ .

(1) The value of the portfolio at the end of January 2005 was \$8000, of which  $-1400 \times \$8 = -\$11200$  was invested in XYZ and  $\$8000 + \$11200 = \$19200$  was invested in the riskless asset.

(2) So,

$$\omega_{\text{XYZ},p} = -\$11200 / \$8000 = -1.4$$

$$\omega_{f,p} = \$19200 / \$8000 = 2.4$$

(3) Note the weights sum to 1.

(4) Then can calculate the portfolio return for February 2005:

$$\begin{aligned} R_p(2/05) &= \omega_{\text{XYZ},p} R_{\text{XYZ}}(2/05) + \omega_f R_f(2/05) \\ &= -1.4 \times 25\% + 2.4 \times 1\% \\ &= -32.6\% \end{aligned}$$

which agrees with the return calculated earlier.