University of Pennsylvania
The Wharton School

Fall 2011 | FNCE 601 Corporate Finance | Franklin Allen

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QUARTER 2

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COURSE SCHEDULE AND DUE DATES
QUARTER 2

Week 1	
Th: 10/27	Review session during regular class
Week 2:	
Mon: 10/31	**MIDTERM EXAM** 6:15-7:45pm
Tu: 11/1	**NO PROBLEM SET DUE** Section 10: Market Efficiency Read Ch. 14 BMA
Th: 11/3	Section 10: Market Efficiency (cont.) Section 11: Issuing Securities Read Chs. 15 and 16 BMA
Week 3:	
Tu: 11/8	**PROBLEM SET 5 DUE** Section 11: Issuing Securities (cont.)
Th: 11/10	Section 12: Payout Policy Read Ch. 17 BMA
Week 4:	
Tu: 11/15	**PROBLEM SET 6 DUE** Section 12: Payout Policy (cont.) Section 13: Capital Structure Read Chs. 18 and 19 BMA
Th: 11/17	Section 13: Capital Structure (cont.)
Week 5:	
Tu: 11/22	**PROBLEM SET 7 DUE** Section 13: Capital Structure (cont.) Section 14: Investment and Financing Decisions Read Ch. 20 BMA
Th: 11/24	No class: Thanksgiving Holiday
Week 6:	
Tu: 11/29	**PROBLEM SET 8 DUE** Section 14: Investment and Financing Decisions (cont.) Section 15: Valuation Read Ch. 20 BMA

Th: 12/1	Section 15: Valuation (cont.) Section 16: Risk Management and Pricing Derivatives Read Chs. 21 and 22 BMA
Week 7:	
Tu: 12/6	**VALUATION CASE DUE BY 9am – UPLOAD TO WEBCAFE** Section 16: Risk Management and Pricing Derivatives (cont.)
Th: 12/8	Case presentations
Fri: 12/16	**FINAL EXAM**: 9:00-11:00am

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Corporate Finance
Fall 2011

Problem Set 5
(Due November 8, 2011)

Section 9

1. Which of the following statements is/are correct?

   A. The beta of a portfolio of all the firm's securities is a weighted average of the betas of the individual securities
   B. Companies with cyclical revenues that are positively correlated tend to have higher asset betas
   C. For a firm with no debt, its equity beta and its asset beta are equal.
   D. Using the same risk-adjusted discount rate to discount all cash flows ignores the fact that the more distant cash flows are more risky
   E. Each project should be evaluated at its own opportunity cost of capital; the true cost of capital depends on the use to which the capital is put
   F. None of the above

2. Wishwash Inc. is a pure play firm. Its assets have a beta of 0.75. The expected risk premium on the market, $r_M - r_F$, is 8% and the risk free rate, r_F, is 4%. What is the company's discount rate for projects like its existing assets?

3. Project cash flows are supposed to do which of the following?

   A. Reflect the most likely outcomes
   B. Incorporate conservative assumptions about revenues, operating costs, and so forth with the degree of conservatism increasing as the beta increases
   C. Represent cash flows that will be received if the firm meets its budgeted targets for revenues, operating costs and so forth with the risks of not meeting targets being offset with a higher hurdle rate
   D. Represent a probability-weighted average of future cash flows
   E. None of the above

4. What does the use of a constant risk-adjusted discount rate imply about the certainty equivalents of project cash flows? Assume expected project cash flows are constant over time and the CAPM holds.

A. CEQs are also constant over time
B. CEQs decline linearly, e.g., $CEQ_1 = 0.95$, $CEQ_2 = 0.90$, $CEQ_3 = 0.85$, etc.
C. CEQs decline geometrically, e.g., $CEQ_1 = 0.90$, $CEQ_2 = 0.81$, $CEQ_3 = 0.729$, etc.
D. None of the above

Examination Question-Section 9

5. The Goodtread Rubber Company has the following two divisions.
(i) Tire Division -- which manufactures tires for new autos
(ii) Recap Division -- which manufactures recapping materials that are sold to independent recapping shops.

Since auto manufacturing moves up and down with the general economy, the Tire Division's earnings contribution to Goodtread's stock price is highly correlated with the returns on most other stocks. If the Tire Division was operated as a separate company the beta of its assets would be 1.60. The sales and earnings of the Recap Division, on the other hand, are not as cyclical since recap sales are high when people cannot afford to buy new tires. The beta of Recap's assets is 0.40. Approximately 75% of Goodtread's corporate assets are in the Tire Division and 25% in the Recap Division. Goodtread has no debt. Currently, the risk free rate is 5% and the expected return on the market portfolio is 12%. There are no taxes and the assumptions of the CAPM are satisfied.

(a) What is the required rate of return on Goodtread's stock?
(b) What discount rate should Goodtread use to evaluate capital budgeting projects? Explain your answer.

Section 10

6. Which of the following statements is/are correct?

A. The weak form of the efficient market theory implies that security prices reflect all the information contained in past security prices
B. There is considerable evidence that successive share price changes are highly correlated
C. The weak form of the efficient market theory implies that technical analysis is valueless
D. If the strong form of the efficient market theory is correct the weak form of the theory must also be correct but the reverse is not true
E. The evidence suggests that many professionally managed US funds do consistently outperform the market
F. None of the above

7. Texas oil is all equity financed and has 100 shares, each worth $100. There are no corporate or personal taxes and there is no discounting. For each of the events described, give the numerical impact on share price. Assume that markets are semi-strong efficient.

(a) At t = 0, oil is struck off the coast of New Jersey. This strike is not anticipated by investors. The oil well is expected to be worth $100 in total. This information is not made public at this time.
(b) At t = 1, a press release is made informing the public of the find.
(c) At t = 2 it is announced that dividends of $1 per share will be paid in 3 weeks. (The dividend for the past six years has been $1 per share.)
(d) At t = 3, $1 per share is paid out in dividends.
(e) It is known by investors that Texas Oil is drilling in Nova Scotia. The expected value of the field is $200 in total. At t = 4, it is announced the field is dry and has no expected value.

8. Consider the following situation.

	t = 0 investment		t = 1 payoffs
Safe asset:	For each 1 invested	---------->	1.25
Risky asset: (real estate)	Fixed supply 1	---------->	1 with prob. 0.75 3 " " " 0.25
	Price P		Expected payoff = 1.5

All investors are risk neutral so there is no risk premium.

(a) What is the price of the risky asset in the case where markets are efficient and everybody invests their own wealth?

(b) People put their money in banks and this is then lent to investors at a rate of 10 percent. Investors in the safe asset and risky can borrow 1 and must pay back 1.1 if they are able to. What is the price of the risky asset in this intermediated case?

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FNCE 601
Corporate Finance
Fall 2011

Problem Set 6
(Due November 15, 2011)

Section 11A

1. Which of the following statements is/are correct?

   A. The maximum number of shares that can be issued is known as the authorized share capital
   B. Majority voting makes it easier for a particular group of stockholders to elect a director that will represent that group's interests
   C. Debt due in less than one year is known as unfunded debt
   D. In the U.S. a subordinated lender holds a junior claim and in theory is paid only after all senior creditors are satisfied
   E. All Eurobonds are issued by European companies
   F. If a company goes out of business, the preferred stock is junior to both debt and common stock
   G. A warrant gives the company the option to sell a set number of common shares at a set price on or before a set date
   H. When the owners of a convertible bond wish to exercise their option to buy shares, they do not pay cash - they give up the bond
   I. None of the above

2. The book value of Placebo Drug Company's common equity is as follows:

Common Shares ($0.50 par value)	$1,000,000
Additional Paid-in Capital	$4,000,000
Retained Earnings	$5,500,000
Treasury Shares at cost	($ 200,000)
Net Common Equity	$10,300,000

   Suppose that the company now sells 500,000 additional shares, at a price of $1.75 cash. What is the new value for additional paid in capital?

Note: There is no examination question for Section 11A

Section 11B

3. Which of the following statements is/are correct?

   A. Large companies can file a shelf registration covering financing plans up to two years in the future
   B. The preliminary prospectus is known as a "tombstone"
   C. It is generally less expensive to issue stock than to issue the same amount of debt
   D. Shelf registration allows the firm to file a registration statement with the SEC to cover a series of subsequent stock or debt issues
   E. The issue price is largely irrelevant in a rights offering as long as the rights are exercised
   F. Rights issues are generally cheaper than cash offers, and yet many corporations avoid rights issues
   G. Venture capital money is typically advanced in stages with some startups going through several stages before their IPO
   H. None of the above

4. The Upas Drug Company is making a rights issue at $15 of one new share for every four shares currently held. If the stock price before the issue was $20, what is the likely ex-rights price?

Examination Question - Section 11B

5. Western Airline has decided to raise $5M in new equity by means of a rights offering. They have decided to issue 50,000 new shares. The stock currently sells for a rights-on price of $150 per share. If the ex-rights price is expected to be $133.33 per share, answer the following questions assuming all the rights are exercised unless otherwise stated.

   (a) What is the issue price?
   (b) How many shares are currently outstanding (before the rights issue)?
   (c) What percentage of the rights were actually exercised if the ex-rights price turns out to be $135.71?
   (d) Suppose the firm anticipates that 30% of the rights will not be exercised. What should the issue price be if the other issue terms stay the same and the firm wants to raise the same amount of money?

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Wharton School

FNCE 601
Corporate Finance
Fall 2011

Problem Set 7
(Due November 22, 2011)

Section 12

1. Which of the following statements is/are correct?
   A. If a dividend is unlikely to be repeated in the future, it is usually called a "special" dividend
   B. Dividends are sent to all stockholders who are registered on the record date
   C. If a firm fixes its investment and borrowing policy additional cash dividends can only come from the sale of shares
   D. Other things equal, a high tax rate on dividends means that investors expect a lower rate of return on stocks
   E. None of the above

2. Which of the assumptions below are not necessary for MM's "dividend irrelevance" argument?
   A. That future stock prices are certain
   B. That there are no taxes on dividends
   C. That there are no issue costs
   D. None of the above

3. A firm has $1 per share in cash, which it will use either to repurchase shares, or to pay a cash dividend. Share price is $20. Other things equal, what will the share price after a repurchase at $20 be if MM holds?

4. You own 500 shares of Tar Heel Shoe, paying an annual dividend of $2 per share and currently selling at $35 per share (before the dividend). You depend on the dividend to pay the rent. Suppose the firm eliminates the dividend and repurchases shares at $35 instead. What will you be able to do to replace next year's dividend check? Assume you pay no taxes and the middle-of-the-roader's theory holds.

Examination Questions - Section 12

5. On January 1, X8 Timothy bought 200 shares of Cannon and 200 shares of Dorkus. Both cost $20 per share at that time. He sold 50 of each on December 31, X8 and received $22 per share for Cannon and $21.75 per share for Dorkus. He sold the remaining shares of both corporations on December 31, X9 and received $24 per share for Cannon and $23 per share for Dorkus. Cannon paid no dividends at all during the time he held it. Dorkus paid an annual dividend of $0.75 per share on December 31 every year he held them and he received the full dividend before he sold them. Timothy was in the 28 percent tax bracket in both years and paid the same tax rate on dividends and realized capital gains.

(i) What were the total cash receipts after taxes from each stock on December 31, X8 and December 31, X9?
(ii) Suppose Timothy's after tax opportunity cost of capital is 15 percent. Did he do better on his Cannon stock or his Dorkus stock?
(iii) What can we conclude about the optimality of the dividend policies followed by Cannon and Dorkus for other shareholders?

6. Consider an economy with three types of investor. There are individuals who are taxed at high rates on dividend income and low effective rates on capital gains, corporations who pay a high effective tax rate on capital gains and a low rate on dividends and institutions that pay no taxes on dividends or capital gains. There are three types of stock in this economy, low payout, medium payout and high payout. The before and after tax total payoffs (i.e. including dividends and capital gains) on these three types of stock for the three groups are as follows.

Stock	Low Payout	Medium Payout	High Payout
Before-tax Payoffs	$25	$25	$25
After-tax Payoffs for			
Individuals	$18	$16	$12
Corporations	$17	$19	$21
Institutions	$25	$25	$25

The total amount of low, medium and high payout stock in the economy is $750 million, $900 million and $1,400 million respectively. Individuals' and corporations total holdings of stock are $600 million and $400 million respectively. All three groups are risk neutral and choose the stocks they invest in to maximize their after-tax income.

(a) Give a table showing the equilibrium holdings of individuals, corporations and institutions of low, medium and high payout stocks respectively.

(b) If the price of the medium payout stock is $48 per share, what are the prices of the low and high payout stocks respectively? Explain briefly why they must take on these values.

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FNCE 601
Corporate Finance
Fall 2011

Problem Set 8
(Due November 29, 2011)

Section 13

1. Which of the following statements is/are correct?

   A. Financial leverage increases the expected return and risk of the shareholder
   B. In perfect capital markets with no taxes, the company's capital structure does not affect either its operating income or its total market value, but it does affect the expected return on the firm's assets
   C. Modigliani and Miller's Proposition II says that the rate of return shareholders require increases as the firm's debt/equity ratio increases
   D. None of the above

2. Under what conditions would a policy of maximizing the value of the firm not be the same as a policy of maximizing shareholder wealth?

   A. If an issue of debt affects the value of existing debt
   B. If the firm issues debt for the first time
   C. If the beta of the equity is positive
   D. None of the above

3. Doyce & Clennam is financed entirely by common stock which is priced to offer a 15% expected return. If the company repurchases 10% of the common stock and substitutes an equal value of risk-free debt yielding 6%, what is the expected return on the common stock after the refinancing? (Assume MM Propositions hold.)

4. Which of the following is/are correct?

   A. The present value of the interest tax shield is the same regardless of whether a firm plans to borrow permanently or temporarily
   B. Usually we discount the interest tax shield at the rate of interest on the firm's debt
   C. Because creditors foresee the costs of bankruptcy, they charge a higher rate of interest to compensate for the present value of these costs
   D. When a firm is in financial distress, an increase in business risk reduces share value
   E. It is always in the interests of shareholders to provide money for positive NPV projects
   F. If the trade-off theory of optimal capital structure is correct, the stock price should always decrease when the company retires debt because of the loss of tax shields
   G. None of the above

5. If a firm borrows permanently $25 Million at an interest rate of 7%, what is the present value of the interest tax shield? (Assume the corporate tax rate $T_c = 0.35$)

6. If a firm borrows $25 Million for one year at an interest rate of 8%, what is the present value of the interest tax shield? (Assume $T_c = 0.35$)

Examination Questions - Section 13

7. The Timpkin Corporation is considering a change in its debt/equity ratio. It currently has an all-equity capital structure. The total value of this equity is $30 million. The rate of return on equity when the firm has no debt is 10 percent. The firm is considering making a debt issue of $15M to repurchase $15M in equity. The debt is risk free and the interest rate on it will be 7 percent. There are no taxes and capital markets are perfect.

   (a) What is the total value of the firm after the change in capital structure?

   (b) What is the return on the equity of the firm after it changes its capital structure?

   (c) Consider a shareholder who initially has an optimal portfolio with $5,000 of equity in the firm and a total of $10,000 of risk free bonds. What will be the optimal value of her equity in the firm and her total amount of risk free bonds after the firm changes its capital structure?

   (d) Suppose the firm announces a project costing $2M with an NPV of $1M. The project was not anticipated by investors. The firm issues $1M of equity and $1M of debt to finance the project. What is the total value of the firm after the financing of the project?

CONTINUED

8. Bill Stout is the CEO of the OOPS Corporation. OOPS is currently in financial distress and it is uncertain whether it will be able to make future payments on outstanding debt. The firm has debt that will come due one year from now. The payment that must be made then is $17.5 million. The shareholders would receive nothing if the firm went bankrupt at the current time. The firm has $14 million on hand to make an investment in one of the two projects listed below which both cost $14 million. It could also just leave the funds in the bank where they are earning 10%. The risk free rate is 10%. The projects are both expected to last one year and have betas equal to 0. Each project has the following after-tax cash flow one year from now.

Probability	Project A	Project B
0.5.	$15M	$5M
0.5.	$17.5M	$25M

(a) What is the expected cash inflow from each project at the end of the year?

(b) Which project has the higher NPV?

(c) Bill chooses to do project B and defends his choice by saying that he is doing what the shareholders want. Explain his argument by calculating the present value of the total expected payoff to the shareholders one year from now if it does Project A compared to Project B.

(d) Do you think Bill has pleased the company's bondholders? Explain by calculating the present value of the total expected payoff to the bondholders one year from now if it does Project A compared to Project B.

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FNCE 601
Corporate Finance
Fall 2011

Problem Set 9
(Not to be handed in)

Section 14

1. A firm is proposing to undertake a scale expansion. It would cost $40 million and produce an expected cash flow of $5 million a year in perpetuity before it is taxed at the corporate rate of 35%. The firm is financed 40% by debt. The expected return on the firm's equity is 20% and the interest rate on its debt is 12%. What is the NPV of the project using the weighted average cost of capital?

2. A project costs $15 million and is expected to produce after-tax cash flows of $3 million a year for 10 years. The opportunity cost of capital is 14%. If the firm has to issue stock to undertake the project and issue costs are $300,000, what is the project's APV?

3. A project costs $10 million and is expected to produce after-tax cash flows of $5 million for each of the next 2 years. The opportunity cost of capital is 10%. The firm has a policy of setting debt to 50% of the project's base case present value at the start of each year. If debt carries an interest rate of 6% and MM'S Proposition I corrected for taxes holds, what is the projects APV? Assume $T_c = 0.35$.

Examination Question - Section 14

4. The Sharp company is considering whether to expand or not by building another plant. The plant would require an outlay of $10M on 12/31/X0. On 12/31/X1 the firm will move equipment from its other plants into the new plant. If the new plant were not built this equipment could be sold for an after-tax amount of $15M. The plant will be completed and ready to produce on 01/01/X2. In 20X2, its first year of production, it will produce 15,000 machines. These are each expected to sell for for $1,000 and cost $200 in raw materials and labor. In 20X3, its second year of production, the plant will produce 20,000 machines. These are each expected to sell for $1200 and cost $250 in raw materials and labor. The plant then ceases production. The plant and equipment it contains have no salvage value. The firm can depreciate the plant over the two years it is in production, using straight line depreciation. It cannot depreciate the equipment it moves from its other plants into the new plant. It has a corporate tax rate of 35 percent. The opportunity cost of capital for the project if it is all equity financed is 10 percent. Assume all cash flows occur at the end of the year and that the firm has other profitable ongoing operations.

   (a) Calculate the base-case NPV of the plant at 12/31/X0 assuming it is all equity financed.

   (b) Calculate the APV of the plant at 12/31/X0 assuming that in each of the three years 20X1-20X3 the optimal debt capacity of the firm is increased by 40 percent of the project's base-case PV. There are no other financial side effects. The interest rate on the debt is 8 percent.

(Note: There are no questions other than the case on Section 15)

Section 16

5. Which of the following statements is/are correct?

   A. A call option gives its owner the right to buy stock at a fixed exercise price
   B. If you write a put option, you acquire the right to sell stock at a fixed exercise price
   C. When a call option expires and the stock price is above the exercise price, the option is worth the stock price plus the exercise price
   D. An investor who has an option to buy stock and enough money in the bank to exercise the option is in the same position as an investor who owns the stock plus an option to sell it
   E. The value of a call option decreases as the rate of interest and time to maturity increase
   F. A call option provides the investor with leverage - the investor has to pay the call's purchase price today but does not need to pay the exercise price until later
   G. A warrant is a long-term call option issued by the company
   H. None of the above

6. Suppose an investor buys one share of stock and a call option on the stock. What will be the value of her investment on the final exercise date if the stock price is equal to the exercise price?

   A. The exercise price
   B. The value of two shares of stock
   C. The value of one share of stock plus the exercise price
   D. None of the above

7. Which of the following investors would be happy to see the stock price fall sharply?

   A. Investor who has sold a call option
   B. Investor who owns a put option
   C. Investor who has sold a put option
   D. Investor who owns a call option
   E. Investor who owns the stock and has sold a call option
   F. Investor who owns the stock and a put option
   G. None of the above

8. Which of the following features decrease the value of a call option, other things equal?

   A. A high expected return on the underlying stock
   B. A high interest rate
   C. A highly variable stock price
   D. A long time to maturity
   F. A high exercise price
   G. None of the above

9. A call option has an exercise price of $150. At the final exercise date, the stock price could be either $100 or $200. Which two of the following investments would combine to give the same payoff as the stock?

   A. Lend PV $200
   B. Buy 4 calls
   C. Buy 2 calls
   D. Borrow $100
   E. Lend PV $100
   F. Sell 4 calls
   G. None of the above

10. Wombat's stock price has fallen to $110. In the next six months, its price will either fall to $86 or rise to $165. What is the value of a six-month call option with an exercise price of $140? The interest rate is 10.25 percent per year, or 5 percent over six months.

    A. $20
    B. $18.46
    C. $8.88
    D. None of the above

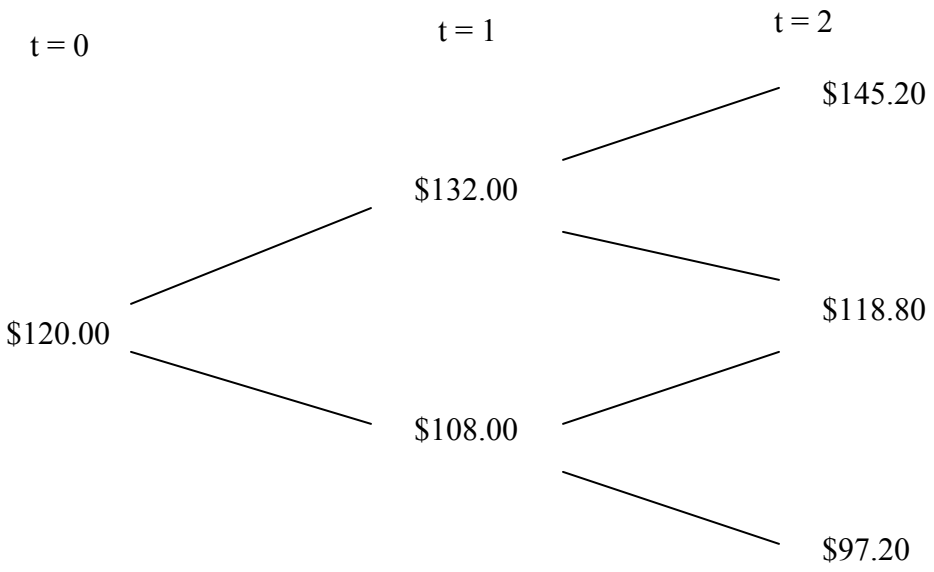
11. Which of the following inputs is/are not needed to use the Black-Scholes formula?

A. Risk-free interest rate
B. Exercise price
C. Time to maturity
D. Beta of the stock
E. Standard deviation of the stock
F. Expected rate of return on the stock
G. None of the above

Examination Questions - Section 16

12. Using the Black-Scholes formula, find the value of the call and the put on Bethlehem Steel stock if the current stock price is $123, the exercise price is $115, the time to maturity is 48 days, the variance of the continuously compounded annual returns of the stock is 0.25 and the continuously compounded risk free rate is 0.04 per annum.

13. The following diagram shows the movements in the stock price of the Smith Corporation. The firm does not pay dividends.



The risk free rate of interest is 5% per period. What is the price of a European call option on the stock of the Smith Corporation with exercise price $110?

SOLUTIONS TO PROBLEM SET 9

Solutions – Section 14

1. $$r_{WACC} = \frac{D}{D+E}(1-T_c)r_D^* + \frac{E}{D+E}r_E$$

Substituting,

$$r_{WACC} = 0.40 \times 0.65 \times 0.12 \; + \; 0.6 \times 0.20 = 0.1512$$

After-tax cash flow is 0.65 × \$5 M = \$3.25 M.

NPV = -\$40 M + (\$3.25M/0.1512) = -\$18.51 M

2. NPV = -\$15 M + \$3 M × AF(10 years, 14%) = \$648,000.

Subtract the financial affect of issue costs of \$300,000 and the

APV = 648,000 – 300,000 = \$348,000.

3. $$\text{Base case NPV} = -10\text{M} + \frac{5\text{M}}{1.1} + \frac{5\text{M}}{1.1^2}$$

$$= \text{-\$1.322 M}$$

At date 0 (i.e. the start of year 1)

$$\text{Base case present value of two years of operations} = \frac{5\text{M}}{1.1} + \frac{5\text{M}}{1.1^2}$$

$$= \$8.6777\text{M}.$$

At date 1 (i.e. the start of year 2)

$$\text{Base case present value of year two operations} = \frac{5\text{M}}{1.1}$$

$$= \$4.545\text{M}.$$

$$\text{PV tax savings} = 0.35 \times 0.06 \times 0.5 \times \left[\frac{8.6777\text{M}}{1.06} + \frac{4.545\text{M}}{1.06^2}\right] = 0.128\text{M}$$

$$\text{APV} = \text{-\$1.322M} + \$0.128\text{M}$$

$$= \text{-\$1.194M}$$

4. (a)

($M's)	12/31/X0	12/31/X1	12/31/X2	12/31/X3
Plant	-10			
Equipmen		-15		
Deprec. Tax Shield			1.75	1.75
(Rev.-Costs)(1-T)			7.80	12.35
Net After-tax Cash	-10	-15	9.55	14.10

Depreciation tax shield = ($10 M/2) × 0.35 = $1.75 M

After-tax operating profits = $Q_t (P_t - C_t)(1 - T)$ t=X2,X3

Q_t = Quantity, P_t = Price, C_t = Costs, and T = tax rate

$$NPV = \sum_{t=X0}^{X3} \frac{CASH\ FLOW_t}{(1.1)^{t-X0}} = -\$5.15\ M$$

(b)

t	Base-case PV	0.4×base-case PV
X0	4.849735	1.9398
X1	20.3347	8.1339
X2	12.8182	5.1272

Note that the base-case PV is found by discounting all the remaining cash flows i.e.

$$\frac{-15}{1.1} + \frac{9.55}{1.1^2} + \frac{14.1}{1.1^3} = 4.849375$$

$$\frac{9.55}{1.1} + \frac{14.1}{1.1^2} = 20.3347$$

$$\frac{14.1}{1.1} = 12.8182$$

$$PV\ OF\ TAX\ SHIELD = 0.08 * 0.35\left[\frac{1.9398}{1.08} + \frac{8.1339}{(1.08)^2} + \frac{5.1272}{(1.08)^3}\right]$$

$$= \$0.3595\ M$$

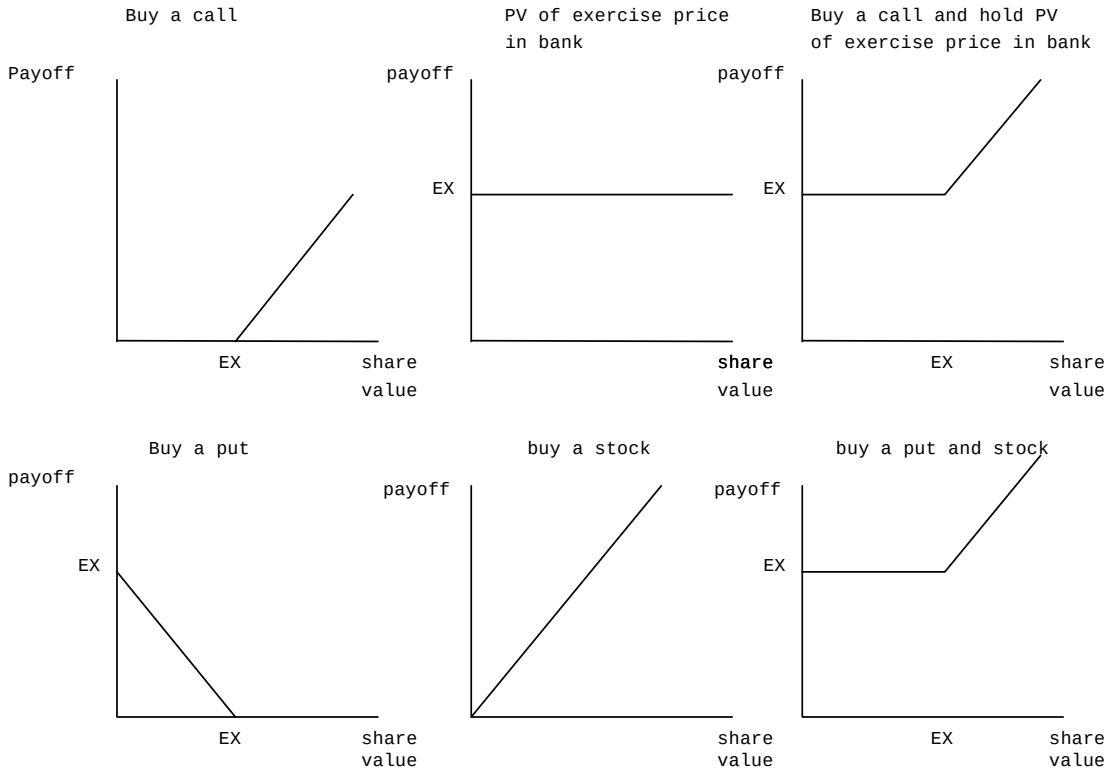
$$APV = -\$5.15\ M + \$0.3595\ M = -\$4.79\ M$$

5. A. It follows from the definition of a call that this statement is correct.

B. A buyer of a put option acquires the right to sell stock at a fixed exercise price. If you write a put option you are selling it so the statement is false.

C. When a call option expires and the stock price is above the exercise price, the option is worth the difference between the stock price and the exercise price. The statement is false.

D. It can be seen from the diagram below that the statement is correct.



E. From the simple two-state formula for valuing a call it can be seen that the value of a call increases as the risk free rate increases. The statement is false.

F. From the definition of a call this is correct.

G. From the definition of a warrant this is correct.

==> Answers A, D, F, and G

6. The call option would be worthless so she would be left with the value of one share of stock, which is equal to the exercise price. ==> Answer A

7. If the stock price fell sharply, that would imply that there is less chance that a call would arrive at the last possible exercise date in-the-money (above the exercise price) meaning a call's value would fall (and correspondingly a put's value would rise). For an investor who owns the stock and has sold a call, a sharp fall in price would not make much difference if the call were deep in-the-money (well above the exercise price), but a sharp fall would cost that investor dearly if the call were out-of-the-money (below the exercise price; prove this to yourself). An investor who owns the stock and a put option also would not be happy to see the stock price fall sharply (why?) ==> Answers A and B

8. The value of a call option does not depend on the expected return on the underlying stock and increases with the interest rate, the variability of the stock price, and the time to maturity; the value decreases as the exercise price increases. ==> Answer F

9. A call would have a value of $0 in the low state and $50 in the high state. The combination of lending the present value of $100 and owning two calls would lead to a total payoff of $100 in the low state and $200 in the high state. ==> Answers E and C

10. The hedge ratio, m, is $(U - D)/(C_U - C_D)$ which equals
($165 - $86)/($25 - 0) = 3.16

$$C = \frac{1}{m}\left(P - \frac{(D - m C_D)}{1 + r_f} \right) = \frac{1}{3.16}\left(\$110 - \frac{\$86 - 3.16 \times 0}{1.05} \right) = \$8.88$$

==> Answer C

11. See formula for Black and Scholes. ==> Answers D and F

Solution - Examination Question – Section 16

12. Use Black and Scholes formula

t = 48/365 = 0.1315
P = 123
EX = 115
$\sigma^2 = 0.25$
$r_F = 0.04$

The question asks for the value of the call initially.

The value of a call is

$$C = P \times N(d_1) - EX \times e^{-rt} \times N(d_2)$$

where

$$d_1 = \frac{\log_e\left(\frac{P}{EX}\right) + rt + \frac{\sigma^2 t}{2}}{\sigma\sqrt{t}}$$

$$d_2 = d_1 - \sigma\sqrt{t}$$

First find d_1 and d_2

$$d_1 = \frac{\log_e\left(\frac{123}{115}\right) + 0.04 \times 0.1315 + 0.25 \times 0.1315/2}{\sqrt{0.25 \times 0.1315}} = 0.49058$$

$$d_2 = 0.49058 - \sqrt{0.25 \times 0.1315} = 0.30926$$

Looking in Appendix Table 6 of Brealey and Myers gives

N(0.49)=0.6879; N(0.31)=0.6217

Substituting in the formula

$$C = 123 \times 0.6879 - 115 \times e^{-0.04 \times 0.1315} \times 0.6217 = 13.49$$

Using the Put-Call Parity formula

$$Put = C - \left(P - EXe^{-r_F t}\right) = 13.49 - (123 - 115 \times \exp^{-0.04 \times 0.1315}) = 4.89$$

13. We solve this problem by solving backwards. In other words we start by solving for the call price at the nodes at t=1 and then solve at the mode at t=0. In the upper node at t=1, the hedge ratio is (35.2-8.8)/(145.2-118.8)=1 (The hedge ratio is equal to 1/m, where m is defined as in your notes). Thus, the value of the call at this node is given by

C = 1× (132-(118.8-1×8.8)/1.05) = $27.2381

Similarly, in the lower node, we have the hedge ratio as (8.8-0)/(118.8-97.2) = 0.4074 meaning m = 1/0.4074 = 2.4545. Then,

C = 0.4074×(108-(97.2-2.4545× 0)/1.05) = $6.2857

At t=0, we simply re-apply the above formula using the values we found as C_u and C_d in the new calculation. Here, we have m = (132-108)/(27.2381-6.2857) = 1.1455 so that 1/m = 0.873. Substituting these values in the formula gives

$$C = 0.873\times(120-(108-1.1455\times6.2857)/1.05) = \$20.9524$$

An alternative way to solve for the price of the call option would be using the risk neutral probability measure. At t=0, an upward movement in the stock price means each \$1 invested would become 132/120 = \$1.1. On the other hand, a downward movement means each \$1 invested would become 108/120 = \$0.9. Given that the risk free rate of interest is 5%, a risk neutral investor would attach probability p = (1.05-0.9)/(1.1-0.9) = 0.75 to the event of an upward price movement and the complementary probability 1-p = 0.25 to the event of a downward price movement. Thus, the value of the payout to the call if the stock price initially goes up is

$$C_u = (1/1.05)(0.75\times(145.2-110)+0.25\times(118.8-110)) = \$27.2381$$

And, the value of the payout to the call if the stock price initially goes down is

$$C_d = (1/1.05)(0.75\times(118.8-110)+0.25\times(0)) = \$6.2857$$

Then, at t=0, the value of the payout to the call (i.e. its price) is

$$C = (1/1.05)(0.75\times27.2381+0.25\times6.2857) = \$20.9524$$

FNCE 601

Fall 2011 Franklin Allen

Geely-Volvo Case

This case is concerned with Geely's Acquisition of Volvo from Ford. It counts for 11% of the course grade. The administrative details are as follows.

Groups: The case should be done in groups of three people or less. If you want to keep working with the group you have used for the last case that is no problem. If you wish to enlarge the group because the case is more involved then that is also no problem. You are **strongly** advised **not** to do this case on your own. If you would like to form a group but do not know anybody please send me an e-mail or see me.

Case: The case is attached. We will have covered the material you need to do the case in class by Tuesday, November 29.

Deadline: The deadline for submitting the case is 9am, Tuesday, December 6. Please submit the case electronically similarly to the first case to Turn-in-Folders-Case II.

E-mail with the bid: In addition to submitting the case, please send Chenying Zhang, the head TA, an e-mail with your bid. Structure the e-mail as follows. The title line should contain the folder name, your valuation on a per share basis and the section your team is able to present in (if called upon).

<TO:>	chezhang@wharton.upenn.edu
<TITLE:>	Buffet_Murdoch_Gates 85 Section 1
<BODY:>	[empty]
<ATTACHMENT:>	[none]

There will be about 200 e-mails so please follow these instructions carefully. Note that Chenying will be grading the cases.

Present-ations: A few groups will be asked to make presentations in class on Thursday, December 8. Please make sure that you give the telephone number of a contact person with voicemail so that if necessary I can call you by the evening of Tuesday, December 6 and request that your group make a presentation.

Problems: If anything about these administrative details is unclear, please do not hesitate to contact me.

Geely - Volvo

As is well known, Spring Festival is the most important festival for Chinese people when everyone takes a break from work to spend quality time in family reunion. However, on the eve of the 2010 Spring Festival, Li Shufu, president of the Geely Group, was still working diligently. He was checking with his financial advisor via telephone on each and every detail of a long-awaited acquisition agreement. In the past several months, they had made some 150,000 amendments to the contract. In less than a month, Li is planning to fly to Gothenburg in Sweden to close the acquisition deal after 800 days' of unremitting efforts. This ambitious takeover would mark the first step for the Chinese auto industry to become global, and as a result would require the utmost dedication.

It was no surprise that when Li Shufu set forth the goal of building Geely into a famous worldwide automaker a decade before, his close colleagues still doubted that "it was merely a beautiful yet farfetched dream". Even at the 2008 Detroit Auto Show when Li Shufu formally proposed his conception of acquiring Volvo to Ford, the management of the then US auto giant with a market capitalization of over USD 30 billion would have found it difficult to believe that a Chinese automaker whose market value was only a small percentage of Ford's would one day accomplish such an unlikely mission.

In 2009, auto sales in China surged by 46.15% year-on-year to 13.64 million, surpassing the US whose 2009 sales had declined by 21.16% to 10.43 million, to become the world's largest auto market. Meanwhile, Volvo had its main sales force deployed in North America and Europe, with only 220,000 vehicles ever sold to China, which accounted for less than 7% of its global sales. Volvo had lost USD 730 million in the first three quarters of 2009, explaining 56.2% of Ford's total loss. However, Li Shufu believed that the alliance between Volvo and Geely would inject new vigor and vitality to the 87-year old

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This case was written by Marina Monteiro Vannucci WG'11, Andre Luiz Soresini WG'11, Roberto Medri WG'11, Lei Zhang EG'11, Ziwei Ling WG'12, Zhengyi Li WG'12 under the supervision of Wharton Professors Franklin Allen and John Percival. It is presented as the basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation. All data are from public sources.

European veteran and facilitate its penetration into the booming Chinese market. He set an ambitious target of increasing the sales of Volvo in China to 200,000 annual units by 2015, taking up 20% of the luxury car market in China. This aggressive forecast implied that the global sales of Volvo would have to double within five years.

Geely

In 1997, Li Shufu, who started in the household appliance industry, brought his enterprise into the auto industry. Since the government had stopped issuing licenses for auto manufacturing at that time, Li Shufu had to obtain permission to manufacture passenger cars by acquiring a small state-owned auto manufacturer in Sichuan, which was on the verge of bankruptcy. One year later in August, the first Geely SRV (Small Recreation Vehicle) rolled off the assembly line in the city Lin Hai of Zhejiang. The engines were purchased from China FAW (First Automobile Works), which was a joint venture with Toyota. However, due to fierce competition, China FAW raised the price of the engines and cancelled after-sales support. Geely had no choice but to pursue independent R&D. Through genuine innovation and sound R&D, Geely established an independent production line of engines, gearboxes and in-car electronic systems.

After 13 years' unremitting efforts, Zhejiang Geely Holding (Group) Ltd. (Geely Group), headquartered in Hangzhou, had over 7 manufacturing facilities in China and research centers and production lines of DSI automatic gearboxes in Australia as of 2011. By 2011, Geely had an annual capacity of 600,000 finished vehicles, and the same number of engines and gearboxes. Geely Group features over 30 categories of finished vehicles in three major brands, namely, Di Hao, Quan Qiu Ying and Ying Lun, with engine displacement of 1.0L to 1.8L and manual or automatic gearboxes.

Geely Group has established a complete marketing network in China with approximately 1,000 brand 4S shops and 1,000 service branches. It also has about 200 overseas sales and service branches. Besides, Geely has invested millions of dollars to set up a first rate call center in China which renders service to users on a 24/7 basis. It is among the first to adopt an SAP-based ERP sales management

system and after-sale service system to guarantee prompt response to users' demands and rapid processing of market information. In addition, Geely has also taken the lead in B2B and B2C e-business marketing to pioneer online marketing of cars. As of the beginning of 2010, the accumulated number of Geely vehicles running on the road was over 1.8 million and Geely was recognized as a "well-renowned brand" in China.

Among the 170,000 employees of Geely, 2,000 are engineers. There are three academicians of the National Academy of Sciences, dozens of foreign experts, dozens of Ph.D.'s, hundreds of masters and hundreds of senior engineers or research level senior engineers, all of whom have a made great contribution to the enterprise. Li Shufu not only stressed on "introducing talents" but also on "nurturing talents". From 1998 to 2005, Geely established Zhejiang Geely Automotive School, Zhejiang Geely Technician College, Beijing Geely University, Sanya College of Hainan University in Lin Hai, Beijing and Hainan respectively. In 2007, Geely launched Zhejiang Geely Automotive Engineering School, the first school of its kind in China, which provides graduate education on automotive engineering. Meanwhile, Geely has set up the "Future Talent Foundation," which has provided scholarships for about 1,000 students who come from impoverished families but are diligent top performers and are willing to contribute to Geely's future growth.

With the growth of the company and the expansion of China's auto industry, Geely Group injected its principal business and assets into Geely Automobile Holdings Limited (Geely Automobile) and listed as a whole on SEHK (Hong Kong Stock Exchange) via reverse takeover of Guorun Holdings (HK-00175).

In Oct 2006, at the Royal Garden Hotel in London, Li Shufu signed a collaboration agreement with Manganese Bronze Holdings Ltd on behalf of Geely Automobile. The agreement provided that Geely Automobile would start a joint venture with Manganese Bronze Holdings to produce the time honored TX4 brand of London taxi in Shanghai. At the same time, Manganese Bronze would offer a placement of 30% of new common stocks to Geely Automobile at £2.5 per share for 48% of the equity

of the joint venture. After the completion of the transaction, with 23% of the total share capital of Manganese Bronze, Geely would become its largest shareholder.

In September 2009, Geely announced it would raise USD 379 million from Goldman Sachs through the issuance of convertible bonds to finance Geely's future projects and the acquisition of quality assets from its parent company. Some analysts believed that it was also a symbolic signal that the listed Geely Automobile was raising capital for the Geely Group to acquire Volvo.

Ford

Founded by Henry Ford in 1903, Ford Motor Company was the first company in the world to incorporate conveyer-belt assembly lines and mass production – which later became known as Fordism.[1] The company quickly began expanding its operations throughout the world, gaining market share. Prices were competitive owing to highly efficient engineering techniques. By 1906, Ford was the top selling brand in the US and continued being among the top leaders in the market until the present day.

The post-9/11 recession in 2001 further impacted the already sluggish automobile industry. The fall in stock markets required companies to make significant contributions to their pension funds, severely hurting their financial health. The industry was also affected by increasing oil prices from 2005 to 2008. Amongst the Big Three (Ford, GM, Chrysler), Ford had a better financial condition than its peers as it had raised $23 billion in cash in 2006. GM and Chrysler were forced by the Government to file for bankruptcy in 2009. Nonetheless, Ford's situation was still delicate and Ford needed to carefully plan its strategy going forward.

Business Units[2]

North America. The continent is the main source of revenue for the Company. Sales reached $50.5 billion in 2009, accounting for approximately 50% of total sales. Ford, Lincoln, and Mercury brand vehicles comprised the bulk of the sales in the region.

[1] Wikipedia.com: History of Ford, Automotive Industry in the US, Automotive Industry Crisis 2008-2009
[2] Ford's 2009 Annual Report

Europe. Ford-brand vehicles constitute the core of the Company's business in the region. Market share increased 0.5% between 2008 and 2009, to 9.1% - the highest level since 1998. Nonetheless, total sales were $29.5 billion in 2009, decreasing 24% year-over-year.

South America. The region's contribution to Ford's business is still relatively low – only 7.5% of sales made in 2009 came from South America, primarily from Ford-brand vehicles. However, Ford is planning to increase its activities by heavily investing in its operations in Brazil to deliver more fuel efficient and better quality vehicles.

Asia Pacific and Africa. Sales amounted to $5.5 billion in 2009, also mainly from Ford-branded vehicles. Ford's business strategy in the region is to introduce updated core products in key markets, including China.

Non-core assets. This unit is comprised of sales throughout the world of Volvo-brand vehicles. Volvo's revenues were $12.4 billion in 2009. In previous years, Ford Motors decided to focus its business on the global Ford brand. As a result, it began to divest non-core assets – it sold its interest in Jaguar, Land Rover and in Mazda in 2008 – and announced plans to sell Volvo in 2009.

Volvo

A car built from Swedish steel – the best in the world in the 1920s – would be of higher quality, enabling it to compete successfully with the leading firms on the market. This was the rationale of the decision to found Volvo (Latin for "I roll") made by accountant Assar Gabrielsson and engineer Gustaf Larsson in 1927. Since its inception, Volvo has established itself as the world's safest, most environmentally conscious carmaker. From the invention of the first three-point seat belt to the creation of the world's first rear-facing child seat, Volvo's brand has always been associated with the highest standards of quality and safety, which has won the company dozens of international prizes.

Volvo's international success story starts only five years after its foundation, when it already exported cars to several countries around the world, including Denmark, Finland, Norway, the

Netherlands, Cuba, Egypt, Morocco, Palestine, and Syria.[3] The entry into the US market took place many years later, in 1955, and in 1963 Volvo became the first European automaker to produce cars in North America. It took Volvo ten years to see the return on this investment – in 1973 the USA became Volvo's biggest car market.

From its foundation until the early 1990s, Volvo managed to operate at a profit every single year.[4] With high investments in its international subsidiaries, Volvo operated at a loss for three consecutive years in 1990 – 1992, but managed to recover its profitability in the following years[5]. This continuous success led several major car manufacturers to consider acquiring Volvo. But it wasn't until 1999 that this became a reality. It was with tangible dismay, that shareholders approved the sale of the Swedish "Crown Jewel" to Ford Motors.

Ford, which in 1999 was the world's most profitable carmaker, acquired Volvo for $6.45 billion, a figure slightly less than Ford's profits from previous year operations of $6.57 billion.

In December 2008, after several years of financial losses, Ford decided to sell Volvo at a disclosed list price of US$6 billion[6]. Although many candidates were believed to be interested in purchasing Volvo from Ford, Zhejiang Geely Holding Group was chosen as one of the preferred buyers. Volvo's financial statement is presented in Exhibit 1.

Competition

Historically described as an oligopolistic industry, the auto industry had the big three American players (GM, Ford, and Chrysler) as the world's dominant forces in terms of innovation, sales, and market share. Although deemed unlikely, the threat of new entrants in such a capital- and technologically-intensive industry, started to become a reality in the 1970s, when the OPEC oil embargo boosted the

[3] Volvo History. http://www.volvoclub.org.uk/history/VolvoHistory-1924to2003.pdf, accessed April 28th 2011.
[4] IBID.
[5] http://www.emeraldinsight.com/journals.htm?articleid=858228&show=html
[6] Harley, Michael (2008-12-04). "Ford wants US$6 billion for Volvo". Autoblog.com. Retrieved 2010-11-23.

demand for smaller, more fuel-efficient vehicles. Better positioned to capture this new wave of market needs, European and Japanese carmakers were extremely favored vis-à-vis their American counterparts.

Notwithstanding its loss of power as oligopolistic leader, Ford remained one of the world's most profitable and innovative carmakers (in 1999, when Ford acquired Volvo, it was the world's most profitable carmaker). With increasing numbers of foreign global players, the equilibrium of the industry was changing – price-based competition arose from international carmakers, who took advantage of better manufacturing capabilities, lower fixed costs, and higher-quality vehicles better suited to the consumers' evolving tastes. The establishment of rebates, preferred-financing options, and long-term warranties lured in customers, but also put enormous pressure on the profit margins for vehicle sales[7]. This fierce competition gave way to a "Prisoner's dilemma" scenario, where carmakers, in order to recover lost share, had to offer more perks and additional features, therefore squeezing even further their profit margins, and driving them to operate near break-even for years. With the onset of the increased pension and retirement plan costs by American carmakers, it became clear that this was an unhealthy stage of industry competition that the Big Three were not capable of coping with.

Ford's acquisition of Volvo followed the merger between Chrysler and Daimler-Benz, in a quick reactive move in the increasingly concentrated auto industry in the late 1990s. With the aggressive international competition scenario of the car industry, Ford decided to reposition Volvo's brand towards the more luxurious segment, so as to take advantage of Volvo's reputation of innovation, reliability, and high standards of safety. This brand repositioning strategy sounded like a great idea, especially given the synergies of supply parts and distribution channels, which could lead to further savings and higher margins to both firms. Moreover, this repositioning would minimize the cannibalization of sales between Ford and Volvo, to the extent that growth would be achieved by eroding competitors' shares, rather than by redistributing market-shares between Ford and Volvo. However, although the repositioning strategy was sound, customers' perceptions of this 70-year old brand was of a reliable, popular, safe car – hard to believe that customers' willingness-to-pay would suddenly skyrocket and match BMW's and Mercedes'

[7] Investopedia: http://www.investopedia.com/features/industryhandbook/automobile.asp, accessed April 29th 2011.

levels. As of 2008, when Ford decided to sell Volvo, Volvo's brand appeared to be caught between the high-quality Japanese family cars and the Germany luxury brands[8].

Synergies

The bulk of the synergies between Volvo and Geely consists in progressively producing and selling a significant percentage of Volvo cars in China. Currently the retail price of imported cars in China is higher than that paid in Western countries, due to hefty import taxes that companies incur because their cars are produced outside of China. China-produced Volvos would fetch the same net price as their Western counterparts, while being more competitive on consumer prices than imported vehicles (as no import taxes are charged) and arguably commanding a higher willingness to pay than cars that cannot boast a Western brand such as Volvo's.

The main synergies to be considered are those of labor and material costs sourced domestically in China. A suggested ramp-up schedule of production and sourcing based on announced CAPEX increases and projections of rapidly growing Chinese demand[9] is presented in the next sub-sections.

Labor

It might seem that direct labor represent a small part of the total cost of making a car, due to the elevated level of automation that modern automotive plants boost. However, it is not so once one takes into account the indirect and overhead costs of labor such as health and retirement plans.

Table 1 presents the breakdown of price and cost in a Western economy, based on a 1996 presentation of Dr. Chris Borroni-Bird of Chrysler Corporation:

[8] "Unsafe Times for Volvo". Forbes, http://www.forbes.com/2008/10/14/volvo-ford-sweden-oped-cx_jf_1014flint.html, accessed April 30th, 2011.
[9] Widely believed to grow at a 20% CAGR over the next 20 years

Table 1 – Cost breakdown for a western carmaker

COST CATEGORY	COST CONTRIBUTOR	SHARE OF MSRP
Vehicle Manufacturing	Material Cost	.425
	Assembly Labor and Other Manufacturing	.065
Fixed Cost	Transportation/Warranty	.050
	R&D & Engineering	.065
	D&A	.055
Overhead	Retirement and Health	.070
Selling	Distribution, Marketing, Dealer Support, Dealer Discount	.245
	Sum of Costs	**.975**
	Profit	***.025***

We see that labor accounts in total for 13.5% of the retail price of a car, of which 6.5% is direct and 7% is through overhead such as health and retirement plans. A proxy for the magnitude of savings in these two categories is given by productivity-adjusted labor compensation in the two countries[10] (see Table 2).

Table 2 – Productivity-Adjusted Labor compensation in the US and China

LABOR	AVERAGE HOURLY COMPENSATION	PRODUCTIVITY INDEX (US = 100)	PRODUCTIVITY-ADJUSTED LABOR COMPENSATION	ADJUSTED COST AS % OF US
US	$23.17	100	$23.17	100.0%
China	$0.57	13.7	$4.16	18.0%

Materials Cost

The main raw materials used in car manufacturing are high-quality steel sheets, carbon and steel. Like the finished product, their cost is higher than in the Western world when imported. However, China now has the capability to produce the materials in the required grades and quality. A weighted average of the percentage savings for materials yields a range of 30%-40% savings on the cost item (which

[10] From "The Economics of the China Price", in *China Perspectives*, by Peter Navarro.

represents about 75% of COGS). However, it is fair to assume that Chinese sourced materials can only be used for China-produced cars and that sourcing cannot be immediate but has to be ramped up in time.

Based on CAPEX estimates from Geely sources,

Table 3 presents our best guess of the ramp-up of Chinese production and material sourcing as a percentage of all Volvo production.

Table 3 – Ramp-up of Chinese Production and material sourcing

RAMP-UP	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
% cars produced in China	0%	5%	10%	20%	30%	40%	50%	50%	50%	50%
% materials sourced in China	0%	10%	20%	35%	50%	70%	90%	90%	90%	90%

Merger Possibilities

After talks with Volvo management, Geely had an ambitious projection that after the acquisition, Volvo would turn around and start to make profits in 2011 and realize an EBIT of USD 703 million by 2015. At the same time, the sales of Volvo in China are expected to reach 200,000 by 2015, accounting for 20% of China's luxury car market.

Geely would reduce operation costs by increasing procurement in China. 16 out of its 20 largest suppliers of auto parts and components have factories in China. With the new facilities in China, Geely is expected to bring down its procurement cost by tens of millions within the next 5 years. Furthermore, Geely is planning to launch a new R&D center in China to cut down the cost for human capital and product development.

After the acquisition, Geely would obtain the patented technologies of Volvo, which would in turn enhance the technological strength and R&D capabilities of Geely. Meanwhile, the brand name of Volvo would enhance the brand recognition of Geely, which would lead to brand name premium and increased profit.

However, the acquisition not only brings about the prospect of profits, but also entails difficulties and risks.

After Volvo was acquired by Ford, its share in the global luxury car market dropped from 14.9% in 1995 to 8.2% and it has experienced losses for five consecutive years since 2005, with annual losses of over USD 1 billion. Volvo's financial performance further deteriorated after the outbreak of the international financial crisis, disclosing a loss of USD 1.465 billion in 2008 and USD 653 million in 2009. The global sales volume of Volvo plunged from 458,323 in 2007 to 374,297 in 2008, and dropped further to 334,808 in 2009. Therefore, the first and foremost task after Geely's acquisition of Volvo is to turn around Volvo's downward spiral.

As for the business performance of Geely, based on the financial statements of Geely Automobile which is listed on SEHK, with the rapid expansion of the auto industry in China, the sales volume of Geely hit 330,000 in 2009, ranking after Chery, BYD and Brilliance. As is disclosed in the interim financial statements of Geely, it had a total liability of USD 1.03 billion, total assets of USD 2 billion and it featured a debt ratio of 51.2% and working capital of USD 276 million. Its debt ratio rose to 69% after its bond issuance to Goldman Sachs, surpassing the 65% international warning line. The financing of the acquisition was therefore extremely difficult and it was no easy task to convince investors and lenders to set up an acquisition consortium and financing platform.

At the beginning of the negotiations between Geely and Ford, many labor unions and former senior managers of Volvo made public announcements that they were against the deal with the belief that Chinese culture cannot be the right prescription for Volvo. Without the support of the labor unions, it would be extremely difficult for Geely to turn around the sinking vessel of Volvo.

All of these uncertainties and worries haunted Li Shufu at the 2010 Spring Festival. He sat down in front of the table but relapsed into deep thoughts about the future.

Assignment

It is early 2010 and you have just started working as a financial advisor handling Volvo's acquisition. Develop a valuation spreadsheet and a (maximum) 3-side single spaced page discussion. Use both WACC and APV methods for 2010 – 2019 and a Terminal Value for after 2019 (using cash flow multiple method). Perform another valuation based upon ratios for comparables (Exhibit 2). Valuation should be as of 1st January 2010 using the supplied financials.

For WACC, assume that Volvo's weighted average cost of capital will be a blend between the European WACC and the Chinese WACC, based on sales forecasts for 2015, which is of 740,000 units worldwide, of which 200,000 units will be sold in China alone (27%).

Use the Valuation guidance below for the Discounted Cash Flow valuation model. Please answer the following questions:

1. What is your best estimate of Volvo's total enterprise value and equity value? Do the valuation as of 1st January 2010. How does this compare with the offer made by Geely of $1.8 billion?

2. What Beta did you use to calculate the WACC and why? How does changing this Beta alter the value of WACC?

3. Perform the following two sensitivity analyses on Enterprise Value in two separate tables: vary the Beta and tax rates in one table, and the beta and terminal value revenue growth in a second table.

4. Is Volvo over or undervalued compared to the $1.8 billion offer using the WACC and APV valuation methods? Give a selection of combinations of growth rates and discount rates, which would provide close to the suggested market price valuation? Comment on the reasonableness of these growth and discount rate combinations. What is driving Volvo's value?

5. Which of the methods APV, WACC or comparables yields more accurate valuations in this context? Why?

6. Which of the listed companies in Exhibit 2 are the best comparables with Volvo and why?
Please keep your answer concise.

7. If Volvo is to issue debt so as to keep D/(D+E) at 30%, how will your valuation using WACC methods change?

8. Taking into account potential synergies, how would your answers be changed?

9. How much would you bid for Volvo in a single round closed-bid auction?

Exhibit 1

Volvo's Financial Statement

Fiscal Year Ending **Dec. 31th** (in USD millions)

Assets	**2008**	**2009**
Receivables	399	440
Inventory	1,630	1,276
Net property	4,422	4,943
Goodwill	1,150	1,241
Other Intangibles	198	204
Other Assets	615	469
Impairment of carrying value		(650)
	8,414	**7,923**
Liabilities		
Payables	1,626	1,982
Pension	560	387
Warranty	494	358
Other liabilities	2,807	2,629
	5,487	**5,356**

Income Statement	**2008**	**2009**
Sales/Revenue	14,723	12,495
COGS	(14,098)	(11,748)
SG&A	(1,566)	(1,305)
Interest Expense	-	(217)
Depreciation and Amortization	(742)	(152)
Amortization of intangibles	(7)	(7)
Income before taxes	(1,690)	(934)

Other Information	**2008**	**2009**
CAPEX	547	420
Tax Rate	35%	35%

Exhibit 2

Comparable Companies

Hong Kong based companies

CNY Million

Company	Beta of equity	Beta of debt	D/E	Income Tax rate	Sales
BYD CO LTD	0.839	0	2.67%	15.00%	39,469.45
Denway Motors LTD	0.952	0	0.23%	15.00%	637.54
Brilliance China Automotive	0.964	0	20.05%	15.00%	6,148.96

European based companies

Euro Million

Company	Beta of equity	Beta of debt	D/E	Income Tax rate	Sales
Daimler	1.155	0	79.46%	30%	34,353
Volkswagan Group	0.984	0	17.33%	30%	32,206
BMW Group	0.972	0	124.09%	30%	37,980

Exhibit 3

Market Data

Market Index	Date	Index	Change%
Hong Kong Heng Seng Index	1998/12/30	10,049	-6.29%
	1999/12/30	16,962	68.80%
	2000/12/30	15,096	-11.00%
	2001/12/30	11,397	-24.50%
	2002/12/30	9,321	-18.21%
	2003/12/30	12,576	34.92%
	2004/12/30	14,230	13.15%
	2005/12/30	14,876	4.54%
	2006/12/30	19,965	34.20%
	2007/12/30	27,813	39.31%
	2008/12/30	14,388	-48.27%
	2009/12/30	21,873	52.02%

Market Index	Date	Index	Change%
DAX (Germany)	1982/12/30	553	n/a
	1983/12/30	774	40.01%
	1984/12/30	821	6.06%
	1985/12/30	1,366	66.43%
	1986/12/30	1,432	4.84%
	1987/12/30	1,000	-30.18%
	1988/12/30	1,328	32.79%
	1989/12/30	1,790	34.83%
	1990/12/30	1,398	-21.90%
	1991/12/30	1,578	12.86%
	1992/12/30	1,545	-2.09%
	1993/12/30	2,267	46.71%
	1994/12/30	2,107	-7.06%
	1995/12/30	2,261	7.32%
	1996/12/30	2,889	27.78%
	1997/12/30	4,250	47.11%
	1998/12/30	5,002	17.71%
	1999/12/30	6,958	39.10%
	2000/12/30	6,434	-7.54%
	2001/12/30	5,160	-19.79%
	2002/12/30	2,893	-43.94%
	2003/12/30	3,965	37.08%
	2004/12/30	4,256	7.34%
	2005/12/30	5,408	27.07%
	2006/12/30	6,597	21.98%
	2007/12/30	8,067	22.29%

	2008/12/30	4,810	-40.37%
	2009/12/30	5,957	23.85%

Market Index	Date	Index	Change%
DOW JONES (USA)	1982/12/30	1,047	n/a
	1983/12/30	1,259	20.27%
	1984/12/30	1,212	-3.74%
	1985/12/30	1,547	27.66%
	1986/12/30	1,896	22.58%
	1987/12/30	1,939	2.26%
	1988/12/30	2,169	11.85%
	1989/12/30	2,753	26.96%
	1990/12/30	2,634	-4.34%
	1991/12/30	3,169	20.32%
	1992/12/30	3,301	4.17%
	1993/12/30	3,754	13.72%
	1994/12/30	3,834	2.14%
	1995/12/30	5,117	33.45%
	1996/12/30	6,448	26.01%
	1997/12/30	7,908	22.64%
	1998/12/30	9,181	16.10%
	1999/12/30	11,497	25.22%
	2000/12/30	10,787	-6.18%
	2001/12/30	10,022	-7.09%
	2002/12/30	8,342	-16.76%
	2003/12/30	10,454	25.32%
	2004/12/30	10,783	3.15%
	2005/12/30	10,718	-0.61%
	2006/12/30	12,463	16.29%
	2007/12/30	13,265	6.43%
	2008/12/30	8,776	-33.84%
	2009/12/30	10,428	18.82%

Market Index	Date	Index	Change%
SEK (Sweden)	1982/12/30	309	n/a
	1983/12/30	497	61.21%
	1984/12/30	429	-13.83%
	1985/12/30	557	30.05%
	1986/12/30	815	46.14%
	1987/12/30	697	-14.42%
	1988/12/30	1,074	54.07%
	1989/12/30	1,413	31.52%
	1990/12/30	997	-29.43%

1991/12/30	1,100	10.30%
1992/12/30	1,170	6.43%
1993/12/30	1,873	60.05%
1994/12/30	1,959	4.59%
1995/12/30	2,300	17.42%
1996/12/30	3,209	39.48%
1997/12/30	4,162	29.71%
1998/12/30	4,788	15.05%
1999/12/30	8,970	87.35%
2000/12/30	7,734	-13.78%
2001/12/30	6,178	-20.12%
2002/12/30	3,517	-43.07%
2003/12/30	4,675	32.92%
2004/12/30	5,785	23.75%
2005/12/30	7,489	29.46%
2006/12/30	9,047	20.80%
2007/12/30	8,428	-6.83%
2008/12/30	5,008	-40.58%
2009/12/30	7,242	44.61%

Exhibit 4: Assumptions to be used for Valuation

LINE	DRIVER	ASSUMPTION	PERIOD
Revenue	Sales growth rate	**7.2%**	2010-2019
COGS	**Savings in Labor and Materials Cost when produced/sourced in China**		
	Labor Cost (if index=100, cost driver grows at the same rate of revenues)	COGS index: Produced in the Western World **100** Produced in China **80.22**	
	Material Cost	**35%** savings in materials if sourced in China, 0% otherwise	
	Materials as a % of COGS	**76%** (per Table 1)	
	China production ramp up	See **table 3**	
	China material sourcing ramp up	See **table 3**	
SG&A	Growth rate	**1.29%**	2010-2019
D&A	Constant as a % of CAPEX	Same % as 2009	2010-2019
Tax rate	Estimated future corporate tax rate (based on comps)	**22%**	2010-2019
Working Capital	2009 Working Capital	**$1,716** millions	2009
Working Capital	Growth Rate	**4%**	2010-2019
CAPEX	Steady state growth rate	**4%**	2010;2015-2019
CAPEX	Expansion growth rate	**8%**	2011-2014
WACC	**Weighted average between Hong Kong and Europe**	**Europe 73%** **Hong Kong 27%**	
	Beta (Europe)	Use comparables	
	Beta (Hong Kong)	Use comparables	
	Rd (both)	**4.55%**	
	Rf (Europe)	**3.39%**	
	Rf (Hong Kong)	**2.60%**	
	Market Premium	Historical Average plus Dividend yield	
	Dividend Yield	**1%** (both Europe and Hong Kong)	
	E/V (both Europe and HK)	**82.07%** (Geely's 2009)	
	D/V (both Europe and HK)	**17.93%** (Geely's 2009)	
	Tax Rate for WACC purposes	**14.93%** (Geely's 2009)	
APV	Ra and Rf: Weighted average between Hong Kong and Europe	Europe **73%** Hong Kong **27%**	
	Target Debt Ratio	**40%**	
	Tax Rate for CAPM purposes	**14.93%** (Geely's 2009)	
	Tax Rate for Tax Shield Valuation purposes	**22%** (future tax rate estimate, same as DCF one)	

FORMULA SHEET FOR FINAL EXAM

Present value formulas:

Basic formula:

$$PV = \sum_{t=1}^{n} \frac{C_t}{(1 + r_t)^t}$$

Perpetuity:

$$PV = \frac{C}{r}$$

Growing perpetuity:

$$PV = \frac{C}{r - g}$$

Discount factor:

$$DF(t \text{ years}, r\%) = \frac{1}{(1 + r)^t}$$

Future value factor:

$$FV(t \text{ years}, r\%) = (1 + r)^t$$

Annuity factor:

$$AF(t \text{ years}, r\%) = \frac{1}{r}\left(1 - \frac{1}{(1 + r)^t}\right)$$

Growing annuity:

$$PV = \frac{C}{r - g}\left(1 - \frac{(1 + g)^t}{(1 + r)^t}\right)$$

Interest r per year compounded q times a year for t years:

$$C_t = PV\left(1 + \frac{r}{q}\right)^{qt}$$

Continuously compounded:

$$PV = e^{-r_c t} C_t$$

Continuous/annual relationship

$$r_c = \log_e(1 + r); \; r = e^{r_c} - 1$$

Reinvestment rate:

$$(1 + r_{1,2}) = \frac{(1 + r_2)^2}{(1 + r_1)}$$

Basic stock valuation formula:

$$P_0 = \sum_{t=1}^{\infty} \frac{DIV_t}{(1+r)^t}$$

Constant growth case:

$$P_0 = \frac{DIV_1}{r - g}$$

Internal Rate of Return:

$$C_0 + \frac{1}{1 + IRR} C_1 + \frac{1}{(1 + IRR)^2} C_2 + \ldots + \frac{1}{(1 + IRR)^t} C_t = 0$$

Profitability Index: $PI = \frac{\text{NPV of project}}{\text{Initial Investment}}$

Payback: Payback = Period initial investment is recovered within

Inflation:

$$\text{Real discount rate} = \frac{1 + \text{nominal rate}}{1 + \text{inflation rate}} - 1$$

$$\text{Nominal cash flow} = \text{Real cash flow} \times (1 + \text{inflation rate})^t$$

$$\text{Real cash flow} = \text{Nominal cash flow} / (1 + \text{inflation rate})^t$$

Statistics formulas:
Expectation:

$$EX = \sum_{i=1}^{n} p_i x_i$$

$$E[f(X)] = \sum_{i=1}^{n} p_i f(x_i)$$

If a is constant:

$$E(aX) = aE(X)$$

$$E(X + Y) = E(X) + E(Y)$$

Variance: $$\text{Var } X = \sigma_X^2 = E\left[(X - EX)^2\right] = \sum_{i=1}^{n} p_i (X_i - EX)^2$$

Standard deviation: $$SD_X = \sigma_X = \sqrt{\sigma_X^2}$$

Covariance: $$\text{Cov}(X, Y) = \sigma_{XY} = E\left[(X - EX)(Y - EY)\right] = \sum_{i=1}^{n} p_i (x_i - EX)(y_i - EY)$$

Correlation coefficient: $$\rho_{XY} = \text{Corr}(X, Y) = \frac{\sigma_{XY}}{\sigma_X \sigma_Y} = \frac{\text{Cov}(X, Y)}{SD_X SD_Y}$$

Beta: $$\beta_i = \frac{\sigma_{iM}}{\sigma_M^2} = \frac{\text{Cov(Stock i, M)}}{\text{Var M}}$$

<u>Portfolio formulas</u>:

Mean and Variance of a portfolio with π in A and $1 - \pi$ in B (i.e. two assets)

Mean: $$\text{Mean}_{port} = \pi EA + (1 - \pi)EB$$

Variance: $$\text{Var}_{port} = \pi^2 \text{ Var } A + (1 - \pi)^2 \text{ Var } B + 2\pi(1 - \pi)\text{Corr}(A, B)SD_A SD_B$$

Mean and Variance of a portfolio with π_i in X_i, (i.e. N assets)

Mean: $$\text{Mean}_{port} = \pi_1 EX_1 + \pi_2 EX_2 + \ldots + \pi_N EX_N$$

Variance: $$\text{Var}_{port} = \sum_{i=1}^{N} \pi_i^2 \text{ Var } X_i + \sum_{i=1}^{N} \sum_{j=1_{i \neq j}}^{N} \pi_i \pi_j \text{Cov}(X_i, X_j)$$

For a well-diversified portfolio: $$SD_{port} = \beta_{port} SD_M$$

Beta: $$\beta_{port} = \pi_1 \beta_1 + \pi_2 \beta_2 + \ \ldots \ + \pi_N \beta_N$$

For portfolios on the Capital Market Line: $\beta_{port} = \pi$; $SD_{port} = \pi SD_M$

CAPM: $$r = r_F + \beta(r_M - r_F)$$

Certainty Equivalent Formulae:

$$CEQ_t = a_t C_t$$

$$PV = \frac{CEQ_t}{(1 + r_F)^t}$$

When the CAPM holds:

$$a_t = \left(\frac{1 + r_F}{1 + r}\right)^t$$

Rights Issues:

$$\text{Value of a share} = \frac{\text{Total value of equity}}{\text{Number of shares}}$$

Capital Structure

MMI: With no taxes and perfect capital markets, the value of a firm is independent of its capital structure.

MMII: $r_E = r_A + \frac{D}{E}(r_A - r_D)$

Risk: $\beta_E = \beta_A + \frac{D}{E}(\beta_A - \beta_D)$

With taxes and costs of financial distress:

Value of firm = Value if all-equity financed

+ PV tax shield - PV costs of financial distress

Adjusted Discount Rate:

Weighted Average Cost of Capital: $r_{WACC} = \frac{D}{D+E}(1 - T_c)r_D + \frac{E}{D+E}r_E$

Adjusted Present Value:

APV = Base-case NPV if all-equity financed

+ NPV of financing decisions caused by project's acceptance

Formulas relating β_{ASSETS}, β_D, and β_E

With no taxes: $$\beta_{ASSETS} = \frac{D}{D+E}\beta_D + \frac{E}{D+E}\beta_E = \frac{D/E}{D/E+1}\beta_D + \frac{1}{D/E+1}\beta_E$$

With taxes:

$$\beta_{ASSETS} = \frac{E}{(1-T_c)D+E}\beta_E + \frac{(1-T_c)D}{(1-T_c)D+E}\beta_D = \frac{1}{(1-T_c)D/E+1}\beta_E + \frac{(1-T_c)D/E}{(1-T_c)D/E+1}\beta_D$$

Options:

Discrete States:

Hedge ratio: $$m = \frac{\text{Number of calls to be sold}}{\text{Shares purchased}}$$

$$= \frac{U - D}{C_U - C_D}$$

Call Valuation:

$$C = \frac{1}{m}\left(P - \frac{(D - mC_D)}{1 + r_F}\right)$$

Put-Call parity formula:

$$Put = C - [P - PV(EX)]$$

where $PV(EX) = EX/(1+r_F)$ in discrete time and $PV = EXe^{-r_F t}$ in continuous time.

Continuous States: Using the Black-Scholes formula

The value of a call is

$$C = P \times N(d_1) - EX \times e^{-r_F t} \times N(d_2)$$

where

$$d_1 = \frac{\log_e\left(\frac{P}{EX}\right) + r_F t + \frac{\sigma^2 t}{2}}{\sigma\sqrt{t}}$$

$$d_2 = d_1 - \sigma\sqrt{t}$$

N(d) = cumulative probability density function

EX = option exercise price

t = time to exercise date

P = price of stock now

σ^2 = variance per period of continuously compounded rate of return on stock

r_F = (continuously compounded) risk-free rate of interest

Put-Call parity formula:

$$Put = C - \left(P - EXe^{-r_F t}\right)$$

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FNCE 601 Franklin Allen

Example Final Exam 1

Instructions: You have 2 hours to answer all six questions. The total number of points is 100. Remember to read every question carefully, to state any assumptions you make and be neat.

1. (10 points) Westchester Ball Valve has constructed a table, shown below, that gives expected cash inflows and certainty equivalent adjustment factors for these cash flows. These measures are for a new asset that lasts five years and requires an initial investment of $100,000.

Year	Cash Inflows	Certainty Equivalent Adjustment Factor
1	35,000	1.0
2	40,000	0.8
3	35,000	0.6
4	28,000	0.6
5	36,000	0.2

The beta of the firm's current assets is 1.3, the risk free rate is 9 percent, and the return on the market portfolio is 15 percent. The firm pays no corporate taxes. Should the firm purchase the new asset?

2. (15 points)
US Airways needs to raise $10M in new equity by means of a rights offering with an issue price of $100 per share. The stock currently sells for $200 per share and there are 1M shares outstanding.

(i) How many new shares will US Airways issue?

(ii) How many rights will be required to buy one share?

(iii) What is the ex-rights price if the issue is fully subscribed to?

(iv) Suppose 25% of the rights issued are not exercised. What is the ex-rights price then?

(v) Suppose the firm anticipated that 25% of the rights issued won't be exercised. What number of right should the firm require for the purchase of one share at the issue price of $100 assuming it wants the issue to succeed in raising $10M? What would be the ex-rights price in this case?

3. (15 points)
Consider a world with no taxes and perfect capital markets. The WW Corporation is currently all equity financed. Its earnings are $10M per year and will stay that way in perpetuity. The value of the firm is $120M. The firm is considering issuing risk-free debt worth $50M and maturing in 10 years at an interest rate of 6% and using it to repurchase $50M of equity.

(i) If it did this what would the total value of the firm (i.e., debt and equity) be after the refinancing?

(ii) What would the return on equity be after the refinancing?

(iii) Ivan owns $1.5M of the stock of WW before the refinancing. By how much would his total lending or borrowing change when the firm refinances assuming he wants the same returns both before and after? What is the new value of his stock in WW?

(iv) How would your answer to (i) be different if there were a corporate tax with interest deductibility and the corporate tax rate was 40%? How much better off would Ivan be?

4. (15 points)
Consider the following idealized world. There are no corporate or personal taxes. Capital markets are perfect. There are no bankruptcy costs. Individuals and corporations can both borrow at 10 percent. The Woozer Corporation is currently all-equity financed. It has 1 million shares which are each valued at $20. Jack and Jill's current dollar holdings of Woozer shares and their overall borrowing and lending positions are as follows.

	$ Value Woozer Shares	Total Borrowing ($)	Total Lending ($)
Jack	30,000	5,000	0
Jill	75,000	0	10,000

(a) Suppose Woozer issues debt to repurchase 20 percent of its shares. What would Jack and Jill's new positions be, assuming their initial positions were optimal? Give your answer in the same format as the above table.

(b) Suppose there were a corporate tax rate of 20 percent: debt interest is tax-deductible for corporate taxes, but dividends are not. Apart from this the model is as above. The firm is initially all equity financed. It then issues $1M of perpetual debt and uses it to repurchase equity. How much does the value of the firm increase? How much does Jack and Jill's total wealth increase assuming their initial positions are as in the table above?

5. (30 points)

National Foods is considering producing a new gelatin dessert, Tasty, of which management believes consumers will buy 15,000 units each year for 3 years. The price of Tasty will be $2.00 per unit at t=0 and will remain constant in real terms. New equipment to produce Tasty will cost $45,000 (real) with no salvage value, while land will be bought at t=0 for $100,000 (nominal) and sold at t=3 for $100,000 (nominal). In addition, production of Tasty will make use of a machine National Foods already owns which has been fully depreciated and which could be sold for a total after-tax cash flow of $25,000 (real) at t=0. It would have no salvage value if used for the project. National expects production costs to be $12,000 (real) in every year. In addition overheads and sales expenditures are expected to be $5,000 (real) in the first year and then are expected to increase at 5% per year in real terms. The firm faces a 40% income tax rate and uses straight-line depreciation. The cost of equity for the firm is 14% and the nominal rate for the debt is 5%. National's target debt ratio is 30%. The expected inflation rate is 7%. All cash flows occur at year's end. The firm has other profitable ongoing operations.

(a) Give a table of nominal cash flows with one column for each year's end.

(b) What is the firm's weighted average cost of capital?

(c) What is the NPV of the project calculated using the weighted average cost of capital?

6. (15 points)

(i) The current price of a stock is $35. It can either go up to $65 with probability 0.5 or it can go down to $25 with probability 0.5. The risk free rate of Interest is 6%. What is the value of a call on the stock with an exercise price of $35 which expires in 1 year's time? What is the value of a put with an exercise price of $30?

(ii) A stock is currently selling for $160. The variance of the continuously compounded annual returns of the stock is 0.8. The continuously compounded annual risk free rate is 8% per annum. The assumptions of the Black-Scholes model are satisfied. What is the value of a call with exercise price $150 if the time remaining before expiration is 27 days.

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Solutions

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1. Use the certainty equivalent adjustment factors to calculate NPV.

t =	C_t x adj. factor	Disc. at 9%
1	35,000	32,110
2	32,000	26,934
3	21,000	16,216
4	16,800	11,902
5	7,200	4,680
	112,000	91,842

NPV = -100,000 + 91,842 = -8,158
The firm should not purchase the asset.

2.

(i) Number of new shares = $\frac{10M}{100}$ = 100,000

(ii) Number of rights to buy 1 new share
$= \frac{1M}{100,000} = 10$

(ii) New value of company = 200×1M + 10M = 210M
New number of shares = 1M + 0.1M = 1.1M
Ex-rights price = $\frac{210M}{1.1M}$ = \$190.91

(iv) Number of new shares exercised = 75,000

New value of company = 200M + 7.5M = 207.5M
New number of shares = 1M + 0.075 = 1.075M

Ex- rights price = $\frac{207.5}{1.075}$ = \$193.02

(v) X = number of new shares to be issued to raise \$10M

$0.75 \times X \times \$100 = 10M$
$X = \frac{10M}{75} = 133,333$

Rights needed to by new share = $\frac{1M}{0.13333M} = 7.50$

New value of share = $\frac{200M + 10M}{1.10M} = \$190.91$

3.

(i) Given that the assumptions of MM I are satisfied, the total value of the firm would still be \$120M.

(ii) MM II: $r_E = r_A + (D/E)(r_A - r_D)$

Now $r_A = 10/120 = 0.0833$

$r_E = 0.0833 + (50/70)(0.0833 - 0.06) = 0.1$

(iii) Firm borrows $\frac{50M}{120M} = 0.4167$

Amount Ivan should lend to offset this = 0.4l67×1.5M = 0.625M.

Ivan's total holdings of WW = 1.5M - 0.625M = 0.875M

(iv) PV tax shield = 0.4×0.06×50M×AF(10 yrs,6%)

= 0.4×0.06×50M×7.36 = 8.832M

Total value of the firm increases by 8.832M.

New Value of firm = 128.832M

Amount Ivan's shares go up

$\frac{1.5M}{120M} \times 8.832 = 0.1104M.$

4.

(a) The firm issues debt and repurchases 20 percent of its shares.

Jack: The firm is effectively borrowing 0.2×30,000 = 6,000 on his behalf, so he should reduce his borrowing/increase his lending by $6,000.

Jill: The firm is effectively borrowing 0.2×75,000 = 15,000 on her behalf. She should reduce her borrowing/increase her lending by $15,000.

Given this and the fact that their total wealth is unchanged (MMI), and offsetting lending and borrowing their new positions are

	$ Value Woozer Shares	Total Borrowing ($)	Total Lending ($)
Jack	24,000	0	1,000
Jill	60,000	0	25,000

(b) The world described corresponds to MM adjusted for corporate taxes.

PV of firm = PV if all equity financed.
+ PV tax shield from debt.

PV of tax shield from perpetual debt = $\frac{T_C r_D D}{r_D} = T_C D$

= 0.2 x 1M = 0.2M

Therefore, the value of the firm increases by 0.2M.

Proportion of the firm owned by Jack = $\frac{30{,}000}{20M} = 0.00015$

Increase in his wealth = 0.00015×0.2M = 300

Proportion of the firm owned by Jill = $\frac{75{,}000}{20M} = 0.00375$

Increase in her wealth = 0.00375×0.2M = 750

5. (a) Do all calculations in nominal terms

t	0	1	2	3
Quantity		15,000	15,000	15,000
Price grows at 7% nom.	2.00	2.14	2.29	2.45
Revenue before tax		32,100	34,350	36,750
Costs grow at 7% nom.		12,840	13,739	14,701
Overheads and sales grows at 5% real = 12.35% nom.		5,350	6,011	6,753
Before Tax operating income		13,910	14,600	15,296
After Tax operating income (BT Op. Inc. x 0.6)		8,346	8,760	9,178
Equipment to be bought	-45,000			
Tax shield from Depreciation	(0.4 x 45,000)/3	= 6,000	6,000	6,000
Land	-100,000			+100,000
Opp. costs of machine it owns	-25,000			
After tax cash flows	-170,000	14,346	14,760	115,178

(b) Now $$r_{WACC} = \frac{D}{D+E}(1-T_c)r_D + \frac{E}{D+E}r_E$$

$$r_{WACC} = 0.3(1-0.4)0.05 + 0.7 \times 0.14 = 0.107$$

(c) Base case NPV = $$-170,000 + \frac{14,346}{1.107} + \frac{14,760}{1.107^2} + \frac{115,178}{1.107^3} = -60,092$$

6. (i)

(a) Hedge ratio: $m = \frac{U - D}{C_u - C_d}$

Value of call: $C = \frac{1}{m}\left(P - \frac{D - mC_d}{1 + r_f}\right)$

Price = \$35 U = 65 D = 25

Exercise price = \$35

$C_u = 30$ $C_d = 0$

$r_F = 6\%$

$m = \frac{65 - 25}{30 - 0} = 1.333$

$C = \frac{1}{1.333}\{35 - (25/1.06)\} = 8.56$

(b) Exercise price here is 30 not 35. Recalculate call price as above then use the put-call parity formula.

C = 9.99

Put-call Parity formula: $\pi = C - (P - PV(EX))$

$\pi = 9.99 - \{35 - (30/1.06)\} = 3.29$

(ii)

P = \$160 EX = \$150

$\sigma^2 = 0.8$ so $\sigma = 0.8944$

$r_F = 0.08$

$t = \frac{27}{365} = 0.07397$

The value of a call is $C = P \times N(d_1) - EX \times e^{-rt} \times N(d_2)$

where $d_1 = \frac{\log_e\left(\frac{P}{EX}\right) + rt + \frac{\sigma^2 t}{2}}{\sigma\sqrt{t}}$; $d_2 = d_1 - \sigma\sqrt{t}$

First find d_1 and d_2

$$d_1 = \frac{\log_e\left(\frac{160}{150}\right) + 0.08 \times 0.07397 + 0.8 \times 0.07397/2}{\sqrt{0.8 \times 0.07397}} = 0.41126$$

$$d_2 = 0.41126 - \sqrt{0.8 \times 0.07397} = 0.167995$$

Looking in Appendix Table 6 of Brealey and Myers gives

N(0.41)=0.6591; N(0.17)=0.5675

Substituting in the formula

$$C = 160 \times 0.6591 - 150 \times e^{-0.08 \times 0.07397} \times 0.5675 = 20.83$$

UNIVERSITY OF PENNSYLVANIA

FNCE 601 Franklin Allen

Example Final Exam 2

Instructions: You have 2 hours to answer all six questions. The total number of points is 100. Remember to read every question carefully, to state any assumptions you make and be neat.

1. (15 points) FE is a major conglomerate with three divisions. The first produces jet engines for aircraft and constitutes 25% of the firm's assets. The second produces diesel locomotives and constitutes 40% of the firm's assets. The third is involved in the construction business and constitutes the remaining 35% of the firm's assets. The firm pays no taxes. It has a capital structure with 40% debt and 60% equity. The beta of FE's equity is 1.5 and the beta of its debt is 0.1. The beta of assets of firms focusing only on jet engines for aircraft is 1.1. The beta of assets of firms focusing only on the construction business is 1.2. The market risk premium, r_M-r_F, is 8%. The risk free rate, r_F, is 5%. Assume the CAPM holds.

   (a) What is the beta of assets of FE for the firm as a whole (i.e. for the three divisions taken together)?

   (b) What is the beta of assets of FE's diesel locomotive division?

   (c) What discount rates should each of the three divisions use in evaluating projects in their current line of business?

2. (12 points) Stanzine is a major drug company. It currently has 100 million shares outstanding with each share having a price of $40. It is developing new drugs. Give the share price just after each of the following events assuming financial markets are semi-strong efficient and that all external factors relevant for the pricing of the stock such as interest rates and so forth remain constant.

   (a) At date 1 Stanzine's research scientists discover a new cholesterol-reducing drug. The NPV of this drug is expected to be $500 million. The discovery is not publicly announced.

   (b) At date 2 Stanzine makes a public announcement that the drug has been discovered and that its NPV is expected to be $500 million.

   (c) At date 3 they issue $100 million of stock at the price prevailing just after the announcement in (b) to allow them to build a plant to produce the new drug.

   (d) At date 4 another drug with an NPV of $150 million is discovered and announced immediately.

3. (10 points) Several months ago European Internet which is based in Frankfurt announced an investment program. It has now announced that it intends to raise the funds using a rights issue. It plans to raise 50 million Euro. The issue price will be 40 Euro per share. The firm's current stock price is 60 Euro per share and it has 40 million shares outstanding.

   (a) How many new shares should European Internet issue?

   (b) How many rights will be required to buy one share assuming one right is issued for each of the initial 40 million shares?

   (c) What is the ex-rights price of the stock assuming all rights are exercised and the total value of the firm rises by the amount of new funds raised?

   (d) How would your answer to (c) be changed if only 80% of the rights issued are exercised?

4. (20 points) The SI Corporation operates in an economy with no taxes and perfect capital markets so there are no costs of bankruptcy or any other kind of friction. It has an expected operating income of $100 million per year. The expected amount paid to debtholders is $40 million per year and the expected amount paid to equityholders is $60 million per year. The debt of the firm is a perpetuity. The expected rate of return on the firm's assets is 12%. The CAPM holds. The rate of return on the market portfolio is 16% and the risk free rate is 6%. The firm's debt currently has a beta of 0.4. The firm has decided to change its debt/equity ratio by issuing equity and using the funds to repurchase debt. After this change in capital structure the remaining debt will be risk free and have a beta of 0 and the expected amount going to debt will be $20 million per year.

   (a) **Before** the change in capital structure what is the total value of the firm's
   (i) debt;
   (ii) equity?

   (b) **After** the change in capital structure what is the total value of the firm's
   (i) debt;
   (ii) equity?

   (c) What is the expected return on the equity of the firm after it changes its capital structure?

   (d) Consider a shareholder who initially has an optimal portfolio with total value $10,000 consisting of the equity and debt of the firm in the same proportions as the firm has equity and debt. What will be the optimal value of her holdings of equity and debt of the firm after the firm changes its capital structure?

5. (18 points) Consider an economy with three types of investor. There are individuals who are taxed at high rates on dividend income and low effective rates on capital gains, corporations that pay a high effective tax rate on capital gains and a low rate on dividends and institutions that pay no taxes on dividends or capital gains. There are three types of stock in this economy and the before-tax payouts on each are as follows.

	Low payout	Medium payout	High payout
Before-tax payoffs per period are:			
Dividends	$5	$5	$30
Capital Gains	$15	$5	$0

These payoffs are expected to persist in perpetuity. The tax rates of the three types of investor for dividends and capital gains are as shown below.

	Individuals	Corporations	Institutions
Tax rate on:			
Dividends	50%	5%	0%
Capital Gains	15%	35%	0%

There is $100 billion of the low payout stock, $50 billion of the medium payout stock, and $120 billion of the high payout stock. The total holdings of stock of individuals is $80 billion and the total holdings of stock by corporations is $10 billion. The remainder is held by the institutions. All three groups are risk neutral and choose the stocks they invest in to maximize their after-tax income.

(a) Which is the marginal group in this economy that determines the prices of the stocks?

(b) Suppose the after-tax opportunity cost of capital for this marginal group is 12 percent what are the prices of the low, medium and high payout stocks?

(c) Give a table showing the after-tax payoffs (i.e. including after-tax dividends and after-tax capital gains) **as a percentage of price** of the three types of stock for the three groups.

(d) Give a table showing the dollar amounts of low, medium and high payout stock held by each of the three groups.

6. (25 points) The current date is 12/31/X0. USE-commerce is thinking of developing a new website specially designed for selling gifts. Users will be able to access the site and browse a whole range of different types of gift, pay by credit card and have them shipped directly to the person they are for. The initial investment today is $1 million. It will then take 1 year to set up the website so it will be ready for use on 1/1/X2. The website will be in use for 2 years. The initial cost can be depreciated over these 2 years using straight-line depreciation. The salvage value on 12/31/X3 is $250,000. The first year's revenue, which will be received on 12/31/X2, is anticipated to be $2.2 million. This is expected to grow at 20% per year for the next year. The costs for the first year, which will be paid on 12/31/X2, are expected to be $1.5 million. These will grow at 10% per year for the next year. The site where the website and other parts of the project will be housed can be rented for $100,000 per year paid at the beginning of each of the three years. The firm has a corporate tax rate of 35 percent. The opportunity cost of capital for the project if it is all equity financed is 15 percent. The debt rate is 7 percent. Assume that the firm has other profitable ongoing operations. Except where otherwise stated assume all cash flows occur at year's end.

(a) Give a table of cash flows with one column for each year's end.

(b) Calculate the project's base-case NPV at 12/31/X0 assuming the project is all-equity financed.

(c) Calculate the project's APV at 12/31/X0 assuming that in all three years the optimal debt capacity of the firm is increased by 40 percent of the project's base-case PV and this is the only financial side effect.

UNIVERSITY OF PENNSYLVANIA
FNCE 601

Example Final Exam 2 Franklin Allen

Solutions

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1. (15 points total)

a) (4 points)

$$\beta_{ASSETS} = \frac{E}{D+E} \cdot \beta_E + \frac{D}{D+E} \cdot \beta_D = 0.60 \times 1.5 + 0.4 \times 0.1 = 0.94$$

b) (5 points)

$$\beta_{ASSETS} = \pi_{JE} \cdot \beta_{JE} + \pi_{DL} \cdot \beta_{DL} + \pi_{CB} \cdot \beta_{CB}$$

$$0.94 = 0.25 \times 1.1 + 0.4 \times \beta_{DL} + 0.35 \times 1.2$$

Therefore, $\beta_{DL} = \dfrac{0.94 - 0.25 \times 1.1 - 0.35 \times 1.2}{0.4} = 0.6125$

c) (6 points)
Discount rates for the divisions should depend on the risk of each division. This can be found using the **CAPM:**

$r_{JE} = 0.05 + 1.1 \times 0.08 = 13.8\%$;
$r_{DL} = 0.05 + 0.6125 \times 0.08 = 9.9\%$; and
$r_{CB} = 0.05 + 1.2 \times 0.08 = 14.6\%$.

2. (12 points total)
Current Value of Company = \$40 · 100 million = \$ 4 billion. Since markets are **semi – strong** efficient, they reflect all *public* information.

a) (3 points) Since the discovery is not publicly announced, there is **no** stock price reaction.
b) **(3 points)** At the announcement the stock price changes to reflect the new public information:
New Total Value = \$4 billion + \$500 million = \$4.5 billion, and
New Share Value = \$4.5 billion / 100 million = \$45 per share.

c) (3 points) Since it is issued at the current price and there is no new information, the value of the shares and the number of shares expand by the same amount, hence price remains \$45 per share.

New Total Value of Firm = \$4.6 billion,
Number of New Shares Issued = \$100 million / \$45 = 2.222 million. Hence,
New Share Price = \$4.6 billion / 102.2222 million = \$45.

d) (3 points) After the event is announced, value of the firm goes up by \$150 million.
New Share Price = \$ (4.6 + 0.15) billion / 102.2222 million = \$46.47

3. (10 points total)

a) (2 points) Number of New Shares = 50 million / 40 = 1.25 million

b) (2 points) 40 million / 1.25 = 32 Rights per share

c) (3 points) Ex – Rights Price = $\frac{60 \times 40 + 50}{40 + 1.25} = 59.39 Euro$

d) (3 points) Ex – Rights Price = $\frac{60 \times 40 + 50 \times 80\%}{40 + 1.25 \times 80\%} = 59.51 Euro$

4. (20 points total, 5 points each part)

SI's total expected operating income = \$100 million, Debt = \$40 million (perpetuity) and Equity = \$60 million. Before the change of capital structure,
$r_D = 0.06 + 0.4 \times (0.16 - 0.06) = 0.10$

a) Total Firm Value = \$100 million / 0.12 = \$833.33 million
Value of Debt = \$40 million / 0.10 = \$400 mil.
Value of Equity = \$833.33 - \$400 = \$433.33 mil.

b) By MM, total firm value remains at \$833.33 mil.
Value of Debt = \$20 million / 0.06 = \$333.33 mil.
Value of Equity = \$833.33 - \$333.33 = \$500 mil.

c) Return on Equity = \$80 / \$500 = 16%.
Note: We can do the following check – By CAPM,
$0.12 = 0.06 + \beta_{ASSETS} \cdot (0.16 - 0.06)$, so $\beta_{ASSETS} = 0.6$
On the other hand, $\beta_{ASSETS} = 0.6 = \frac{333.33}{833.33} \cdot \beta_D + \frac{500}{833.33} \cdot \beta_E$. We know $\beta_D = 0$.
Therefore, $\beta_E = 0.6 \times \frac{833.33}{500} = 1$, and it checks.

d) The shareholder obtains the stream of returns as the assets. If she held the same proportions of debt and equity as the firm she will do the same after the change in firm's capital structure, i.e., she will have 500/833.33 = 60% in equity and 333.33/833.33 = 40% in debt. She will hold \$6000 in equity and \$4000 in debt.

5. (18 points total)

a) (3 points) The institutions are the marginal group.

b) (6 points) The prices are:

Low Payout Stock = \$20 / 12% = \$166.67;
Medium Payout Stock = \$10 / 12% = \$83.33;
High Payout Stock = \$30 / 12% = \$250

c) (6 points)

	Low	Medium	High
Individuals	$\frac{0.5\times 5+0.85\times 15}{166.67}$	$\frac{0.5\times 5+0.85\times 5}{83.33}$	$\frac{0.5\times 30}{250}$
	= 9.15%	= 8.10%	= 6%
Corporations	$\frac{0.95\times 5+0.65\times 15}{166.67}$	$\frac{0.95\times 5+0.65\times 5}{83.33}$	$\frac{0.95\times 30}{250}$
	= 8.7%	= 9.6%	= 11.4%
Institutions	12%	12%	12%

d) (3 points) All figures are in billions of dollars.

	Low	Medium	High
Individuals	$80	0	0
Corporations	0	0	$10
Institutions	$100 - $80 = $20	$50	$120 - $10 = $110

6. (25 points total)

a) (10 points) Table of Cash Flows:

Item/Year	*12/31/X0*	*12/31/X1*	*12/31/X2*	*12/31/X3*
Initial Investment	(1 mil.)			
Salvage Value				250,000
Deprec. Tax Shield[1]			131,250	131,250
Revenue			2.2 mil.	2.64 mil.
Costs			1.5 mil.	1.65 mil.
After-tax Profit[2]			455,000	643,500
After-tax Rent Loss[3]	(65,000)	(65,000)	(65,000)	
Cash Flow	(1.065 m)	(65,000)	521,250	1,024,750

Notes:

1. To calculate annual deprec. tax savings(*DTS*), we use the following formula:
$$\text{DTS} = \text{t}\times\left[\frac{1\text{M} - 250{,}000}{2}\right] = 35\%\times\$375000 = \$131{,}250\ .$$
2. After-tax profit is given by: (Revenue – Total Cost) · (1-t).

3.There are 3 payments with the first one collected *today*, and there is *no* payment on 12/31/X3.

b) (5 points)

$$\text{Base – case NPV} = -1{,}065{,}000 - \frac{65{,}000}{1.15} + \frac{521{,}250}{1.15^2} + \frac{1{,}024{,}750}{1.15^3} = -\$53{,}592.09$$

c) (10 points)

Dates	**0**	**1**	**2**	**3**
Cash Flows		- $65,000.00	$521,250.00	$1,024,750.00
Base-case PV[1]	$1,011,407.90	$1,228,119.09	$891,086.96	
Amt. Borrowed[2]	$404,563.16	$491,247.64	$356,434.78	
Tax Shield[3]		$9,911.80	$12,035.57	$8,732.65

Notes:

1. Working backwards, we first calculate Year 2 PV = $\frac{\$1024750}{1.15} = \$891086.96$, then Year 1 PV = $\frac{\$521250 + 891086.96}{1.15} = \$1228119.09$, and finally Year 0 PV = $\frac{-\$65000 + 1228119.09}{1.15} = \$1011407.90$
2. Amount Borrowed = Base-case PV · 40% .
3. Tax Shield = Amount Borrowed · 7% · 35% .

PV Tax Shield = $\frac{9,911.80}{1.07} + \frac{12,035.57}{1.07^2} + \frac{8,732.65}{1.07^3} = \$26,904.14$

Finally,
APV = - $53,592.09 + $26,904.14 = - $26,687.95

- The End -

UNIVERSITY OF PENNSYLVANIA

FNCE 601 Franklin Allen

Example Final Exam 3

Instructions: You have 2 hours to answer all six questions. The total number of points is 100. Remember to read every question carefully, to state any assumptions you make and be neat.

1. (15 points) GET has two major divisions. The first is involved in telecommunications. The beta of assets in this industry is 0.8. The division constitutes 60 percent of the value of the firm. The second division is involved in the cable television industry. The beta of assets in this industry is 1.2. The division constitutes 40 percent of the value of the firm. GET is financed with 30 percent debt and 70 percent equity. The debt is risk free. It pays no taxes and operates in perfect capital markets. The CAPM holds. The risk free rate is 5 percent and the expected return on the market is 12 percent.

   (a) What is the expected return on GET's equity?

   (b) The telecommunications division is considering a project with cash flows:

Date 0	Date 1	Date 2	Date 3
-20,000	5,000	8,000	10,000

   What is the NPV of this project?

   (c) GET is considering acquiring a firm called TAR which has 75 percent of its assets in the telecommunications industry and 25 percent in the cable industry. This firm also pays no taxes and operates in perfect capital markets. What discount rate should GET use when calculating the total value of TAR for the all-equity financed case?

2. (10 points) Bubble.com is an internet company that went public two years ago. Its initial public offering was very successful. It has 22 million shares outstanding. The current price of each share is $54. The company has never had a positive cash flow. As a result of its continuing losses, it has decided to undertake a rights issue. It wishes to raise $230 million. It decides to set an offer price of $42 per share.

   (a) Assuming all rights are exercised, how many shares will Bubble.com need to issue?

   (b) What will be the ex-rights price of each share of Bubble.com if all rights are exercised?

   (c) If the actual ex-rights price turns out to be $52 how many shares did Bubble.com succeed in selling?

3. (15 points) Consider an economy with three types of investor. There are individuals who are taxed at high rates on dividend income and low effective rates on capital gains, corporations that pay a high effective tax rate on capital gains and a low rate on dividends and foreigners who pay no taxes on dividends or capital gains. There are three types of stock in this economy and the before-tax payouts on each share one year from now are as follows.

	Low payout	Medium payout	High payout
Dividends	$0	$50	$70
Capital Gains	$80	$30	$10

These payoffs are expected to grow at a constant rate of 3 percent in perpetuity. The tax rates of the three types of investor for dividends and capital gains are as shown below.

	Individuals	Corporations	Foreigners
Tax rate on:			
Dividends	30%	10%	0%
Capital Gains	10%	40%	0%

There are 1 billion shares of the low payout stock, 0.5 billion of the medium payout stock, and 0.8 billion of the high payout stock. The total holding of stock by individuals is $1,000 billion and the total holding of stock by corporations is $200 billion. The rest of the stock is held by foreigners. All three groups are risk neutral and choose the stocks they invest in to maximize their after-tax income. Short sales and borrowing are not possible.

(a) Which is the marginal group in this economy that determines the prices of the stocks?

(b) Suppose the after-tax opportunity cost of capital for the individuals is 4 percent, for the corporations is 5 percent and for foreigners is 9 percent. What are the prices of the low, medium and high payout stocks?

(c) Give a table showing the dollar amounts of low, medium and high payout stock held by each of the three groups.

4. (15 points) The Phantom Corporation is financed with debt and equity. It has $320 million of equity and $60 million of risk free debt. Currently, the expected return on the equity is 12 percent and the risk free return on the debt is 7 percent. The firm decides to issue another $70 million of risk free debt and use the proceeds to repurchase equity. There are no taxes and capital markets are perfect.

   (a) What is the return on the equity of the Phantom Corporation after the refinancing?

   (b) Hui initially had $2.5 million of Phantom's equity and she had borrowed $1 million at the risk free return of 7 percent. These holdings gave her the optimal combination of risk and return. What will her optimal holdings be after the refinancing?

   (c) Suppose that after the refinancing the corporation announces a new investment costing $10 million. It has a positive NPV of $3 million. This project is not anticipated by investors. Half the cost of the project is financed with equity and half with debt. What is the total value of equity that the firm has outstanding after this?

5. (25 points) The G&P Corporation is thinking of buying a plant to make packets of laundry detergent. The current date is 12/31/X0. The plant costs $10 million. It will be ready for production immediately and is expected to last for three years. At the end of its life the salvage value will be $3 million. The plant will produce 1 million packets of laundry detergent during each year. The price of each packet is currently (i.e. on 12/31/X0) $5 and is expected to increase at 4 percent per year. The raw materials currently cost $1 per packet and are expected to increase at 3 percent per year. The total labor costs to run the plant are currently $200,000 per year and these are expected to remain constant. If the plant is bought, the extra head office expenses are expected to be $100,000 in the first year, $150,000 in the second year and $175,000 in the third year. All costs and expenses are tax deductible. All figures are given in nominal terms. The firm has a corporate tax rate of 35 percent and uses straight line depreciation. The firm's required return on equity is 15 percent. The nominal debt rate is 7 percent. The target debt ratio for the firm is 40 percent. Assume all cash flows occur at year's end and that the firm has profitable ongoing operations.

   (a) Give a table of cash flows with one column for each year's end.

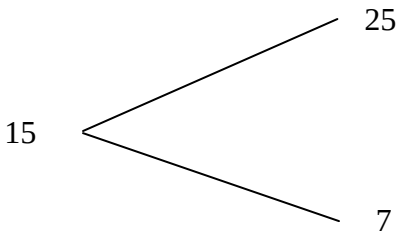
   (b) What is the firm's weighted average cost of capital?

   (c) What is the NPV of the project calculated using the weighted average cost of capital?

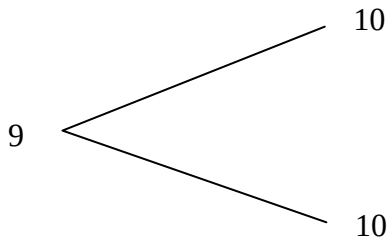
6. (20 points) **(The two parts are separate)**

(a) Consider a stock and a bond with the following price movements between t=0 and t=1?

Stock



Bond



(i) What are the date t=1 payoffs of a put on the stock which has an exercise price of 12?

(ii) What portfolio of stocks and bonds gives the same payoffs as a put with an exercise price of 12?

(iii) What is the price of a put with an exercise price of 12?

(b) A stock is currently selling for $50. The variance of the continuously compounded annual returns of the stock is 0.3. The continuously compounded annual risk free rate is 5 percent. The assumptions of the Black-Scholes model are satisfied. What is the value of a call with an exercise price of $45 that expires in 160 days (assume there are 365 days in the year)?

UNIVERSITY OF PENNSYLVANIA
FNCE 601

Example Final Exam 3 Franklin Allen

Solutions

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1. (15 points total)

a) (5 points) We first calculate Beta for the firm's total assets,
$\beta_{Assets} = 0.8 \times 60\% + 1.2 \times 40\% = 0.96,$ then we have
$\beta_{Equity} = \frac{D+E}{E} \times \beta_{Assets} = \frac{0.96}{0.7} = 1.3714,$ by the CAPM, we know
$r_{Equity} = 0.05 + 1.3714 \times 0.07 = 14.6\%.$

b) (5 points) First by CAPM, $r_{Tele} = 0.05 + 0.8 \times 0.07 = 10.6\%,$ using this discount factor, we have

$$NPV(Tele.) = -20{,}000 + \frac{5{,}000}{1.106} + \frac{8{,}000}{1.106^2} + \frac{10{,}000}{1.106^3} = -\$1{,}547.64 < 0.$$

c) (5 points) For TAR, we calculate Beta for the firm's total assets,
$\beta_{Assets}(TAR) = 0.8 \times 0.75\% + 1.2 \times 25\% = 0.9,$ then by the CAPM, we know
$r_{Equity}(TAR) = 0.05 + 0.9 \times 0.07 = 11.3\%.$

2. (10 points total)

a) (2 points) Total shares required: $\frac{230}{42} = 5.4762$ Million.

b) (4 points) Ex-Rights Price $= \frac{22 \times 54 + 230}{22 + 5.4762} = \$51.61,$ assuming 100% exercise.

c) (4 points) We can solve for the fraction (x) of the 5.4762 million shares that is exercised, by using the formula for Ex-Rights Price:
$52 = \frac{22 \times 54 + x \times 5.4762 \times 42}{22 + 5.4762x},$ then we have x = 80.35%. Therefore, a total of 80.35% × 5.4762 = 4.4 million shares were actually exercised.

3. (15 points total)

a) (3 points) Marginal Group is the Foreigners.

b) (6 points) We have the following table illustrating after-tax payoffs of each stock for the three groups:

	$Low	**$Med**	**$High**
Indiv.	72	35+27=62	49+9=58
Corp.	48	45+18=63	63+6=69
Foreign	80	80	80

To calculate the price of **ALL** 3 stocks, by the no-arbitrage condition, we use the Marginal Group's evaluation:

$$P_{Low} = P_{Med} = P_{High} = \frac{80}{0.09 - 0.03} = \frac{80}{0.06} = \$1333.33$$

c) (6 points) Equilibrium holdings of the stocks by the three groups,

In $ amount (billion):

Indiv	1000	0	0
Corp	0	0	200
Foreign	0.25×1333.33 =333.33	0.5×1333.33 =666.67	0.65×1333.33 =866.67
Total	1333.33	666.67	1066.67

In Number of Shares (billion):

	Low	**Med**	**High**
Indiv	0.75	0	0
Corp	0	0	0.15
Foreign	0.25	0.5	0.65
Total	1 billion	0.5 billion	0.8 billion

4. (15 points total)

a) (5 points) We first calculate the return on firm's total assets, which remains constant before and after the restructuring:

$$r_{Assets} = \frac{320}{380} \times 12\% + \frac{60}{380} \times 7\% = 11.22\%, \text{ then we have}$$

$$r_{Equity}(after) = 11.22\% + \frac{130}{250} \times (11.22\% - 7\%) = 13.414\%.$$

b) (5 points) Since the firm levered up (debt ratio increases), the investor should levered down (lend more or hold debt). Assume that she holds $\$x$ amount of firm's equity after the restructuring, then we must have

$$\frac{2.5}{320} = \frac{x}{250}, \text{ hence } x = \$1.9531 \text{ mil.}$$

Since she started out with a net wealth of \$1.5 mil (and borrowed \$1 mil. to finance the \$2.5 mil. in equity investment), she only needs to borrow \$1.9531 -\$1.5 = \$0.4531 mil. to finance her equity position in the restructured firm.

c) (5 points) Since the new project is *NOT* anticipated by the investors, the firm's total value should increase, both by the amount of capital needed to raise to finance the project, and the NPV of the project.

Total Value of **Equity** = \$250 + \$5 + \$3 = \$258 mil.

5. (25 points total)

a) (17 points) The cash flow is presented in the following table:

	12/31/X0	**12/31/X1**	**12/31/X2**	**12/31/X3**
Initial Cost	-10			
Salvage				3
Sales ($5 price)		5*1.04	g=4% →	
Material ($1 price)		(1*1.03)	g=3% →	
Labor		(0.2) →		
HQ Cost		(0.1)	(0.15)	(0.175)
Before-Tax		3.87	3.99	4.1566
After- Tax (t=35%)		2.5155	2.5935	2.7018
Depreciation		(10-3)/3 →		
DTaxShield=Depre*35%		0.8167	0.8167	0.8167
Cash Flow	-10	3.3322	3.4102	6.5185

b) (5 points)

$$r_{WACC} = \frac{D}{D+E}(1-T_c)r_D + \frac{E}{D+E}r_E$$

$$r_{WACC} = 0.4(1-0.35)0.07 + 0.6 \times 0.15 = 0.1082$$

c) (3 points)

$$NPV = -10 + \frac{3.3322}{1.1082} + \frac{3.4102}{1.1082^2} + \frac{6.5185}{1.1082^3} = \$0.573185$$

6. (20 points total)

a) (10 points) Option pricing using the binomial tree model:

i) (2 points) The pay-off for the Put option, when the stock price rises, is

$P_U = Max(EX - S,0) = Max(12 - 25,0) = 0,$ and its pay-off when the stock price falls is

$P_D = Max(EX - S,0) = Max(12 - 7,0) = \$5.$

ii) (4 points) We need to construct a replicating portfolio for the Put option, using X shares of the stock and Y (riskless) bonds. Portfolio must satisfy:

$X\,x\,U + Y\,x\,B = P_U,$ and $X\,x\,D + Y\,x\,B = P_D.$

Substituting for U, D and B gives

25 X +10 Y = 0 and 7 X + 10Y = 5

Solving these two equations, we have

$$X = \frac{P_U - P_D}{U - D} = -\frac{5}{18}, \text{ and } \quad Y = \frac{25}{36}$$

Hence, by shorting 5/18 shares of stock and holding 25/36 worth of bonds, an investor can replicate the pay-off of the put option with exercise price \$12.

iii) (4 points) by the no-arbitrage condition, the price of the put has to equal to the portfolio that replicates its pay-off, hence

$$\text{Put} = X \times 15 + Y \times 9 = -\frac{5}{18} \times 15 + \frac{25}{36} \times 9 = \$2.08.$$

Remark: We can verify whether the above price is correct, by using the Put-call Parity property. One can easily show that the value of a call with the same parameters is worth \$6.28; then we have

$Put = Call - [P - PV(EX)] = 6.2833 - 15 + 12 \times 0.9 = 2.08.$

b) (10 points) The **Black-Scholes** option pricing formula: We first list all the given parameters, $P = \$50$, $EX = \$45$, $r = 5\%$, $t = 160/365 = 0.4384$ year, and $\sigma^2 = 0.3$. By the B-S formula, we have $C = P \times N(d_1) - EX \times e^{-rt} \times N(d_2).$ To apply the formula, we first calculate

$$d_1 = \frac{\ln\left(50/45\right) + 0.05 \times 0.4384 + 0.3 \times 0.4384 \div 2}{\sqrt{0.3 \times 0.4384}} = 0.5325, \text{ and}$$

$d_2 = d_1 - \sigma\sqrt{t} = 0.5325 - \sqrt{0.3 \times 0.4384} = 0.1698.$ Then,

$$Call = 50 \times N(0.5325) - 45 \times Exp(-0.05 \times 0.4384) \times N(0.1698)$$
$$= 50 \times 0.7019 - 45 \times Exp(-0.02192) \times 0.5675 = \$10.11$$

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FNCE 601 Franklin Allen

Example Final Exam 4

Instructions: You have 2 hours to answer all six questions. The total number of points is 100. Remember to read every question carefully, to state any assumptions you make and be neat.

1. (10 points) The BTG Company is a company that manufactures electronic goods. It pays no taxes. The beta of the firm's current assets is 1.2. The risk free rate is 5% and the expected return on the market portfolio is 15%. The firm is currently considering whether or not to undertake an investment project in its regular line of business. The project is quite innovative and as a result the risks associated with the project vary through time in an unusual way. The table below summarizes the expected cash flows for the five years of the project and the certainty equivalent adjustment factors associated with them.

Date	Expected cash flow	Certainty Equivalent adjustment factors
0	-$1,235,000	1
1	$175,000	0.8974
2	$255,000	0.8054
3	$329,000	0.6487
4	$185,000	0.5821
5	$185,000	0.5224

What is the NPV of the project? Should BTG undertake the project?

2. (15 points) General Mining produces copper. The total value of the firm is $1.4 billion. This consists of $300 million of risk free debt and $1.1 billion of equity. There are 100 million shares outstanding. The financial markets where General Mining's shares trade are semi-strong form efficient but not strong form efficient. At date 1 the company finds reserves of copper in the Torell field that it estimates are worth $500 million in terms of present value at date 1. Assume that interest rates and all other external factors remain the same. The dates are sufficiently close together that there is no need to discount between dates (i.e. the discounting is negligible). The debt remains risk-free throughout.
   (i) What is the stock price (i.e. price of each share) for General Mining at date 0?
   (ii) At date 1 an announcement concerning the find is made. What is the stock price after this announcement?
   (iii) At date 2 the firm repurchases 10% of its shares in the open market at the price that prevails in the market. What is the stock price after the repurchase?
   (iv) At date 3 the firm finds that the value of the copper reserves in the Kubana field is in fact lower by $300 million than previously announced. What is the stock price at this stage if no announcement is made?
   (v) At date 4 it is announced that the value of the reserves in the Kubana field is $300 million lower than previously announced. What is the stock price after the announcement?

3. (15 points) TCE is a financial institution that trades on the New York Stock Exchange. It is thinking of making a rights issue to raise $400 million. The current price of its stock is $35 per share. TCE has 80 million shares outstanding. The issue price will be $25 per share.
   (a) How many shares would TCE issue?
   (b) How many rights will be required to buy one share at the issue price assuming one right is issued for each of the initial 80 million shares?
   (c) What is the ex-rights price of the stock assuming all rights are exercised and the total value of the firm rises by the amount of new funds raised?
   (d) How would your answer to (c) be changed if only 90 percent of the rights are exercised?
   (e) Suppose that the firm anticipates that only 90 percent of the rights issued will be exercised and adjusts the number of shares that it announces will be made available for sale at the issue price so that the issue will succeed in raising $400 million. What will be the ex-rights price in this case?

4. (16 points) On 1/1/X7 Vladimir bought 1000 shares of stock C and 1000 shares of stock D. The price of each stock on that date was $200. From 1/1/X7 until 12/31/X7 both stocks appreciated in value by 20%. Firm C then repurchased 10% of its stock at the end of the day on 12/31/X7, at the prevailing market price of the share but paid no dividends. In contrast firm D did not repurchase but paid dividends of 10% at the end of the day on 12/31/X7 and the stock price fell the full amount of the dividend. Both stocks appreciated in value by 10% in the following year. Both firms paid a dividend of 10% on 12/31/X8 and the stock price fell by 10%. Vladimir's tax rate on capital gains is 15% and his tax rate on dividends is 25%.

   (a) How much stock would Vladimir have needed to sell in firm C on 12/31/X7 to have the same after tax amount as from his dividends from stock D at that date?

   (b) If he had followed the strategy in part (a) what would have been the total remaining after tax receipts (i.e. including dividends and proceeds from selling shares) from his positions if he sold all his remaining shares in C and D on 12/31/X8 after the 10% dividend had been paid and after the price had fallen 10%

   (c) If the middle-of-the-roaders' theory holds did firm C or firm D have an optimal dividend policy in terms of maximizing firm value?

   (d) How could Vladimir have improved his after tax payoff on both stocks by changing the timing of his final sales of stock in C and D from 12/31/X8?

5. (19 points) The current date is date 0. The Scallywag Corporation has debt outstanding. The total amount that it will have to pay to bondholders in one year's time at date 1 is $100 million. The firm's position since it issued the debt five years ago has steadily deteriorated. Its only remaining asset is $25 million in cash. If it does nothing the bondholders will receive all the cash and any interest the cash might earn. The firm has the option to undertake one of the following projects.

   Project A

   Cost at date 0 is $25 million.

   Payoffs at date 1: $200 million with probability 0.05 and 0 with probability 0.95.

   Project B

   Cost at date 0 is $25 million.

   Payoffs at date 1: $50 million with probability 0.6 and $30 million with probability 0.4.

   The risk of both projects is such that an applicable discount rate is the risk free rate of 10% (i.e., all the risk is unique risk).

   (a) What are the date 0 NPV's of projects A and B?

   (b) What are the present values of the debt and equity of the firm at date 0 if it commits to
      (i) reject both projects A and B and put the $25 million cash in the bank at 10%;
      (ii) accept project A (and reject B);
      (iii) accept project B (and reject A).

   (c) If the firm operates in the interests of the shareholders which strategy (i.e. (i), (ii) or (iii) in part (b)) will be chosen?

6. (25 points) The current date is 12/31/00. The Stopwhining Corporation has decided that manufacturing voting machines will become a boom business. It has access to two designs. The first involves punching holes in cards. If produced the machine will be Dimple-free. Some people believe this technology is superior as it allows hand recounts of votes. The second type of machine is a fully automatic electronic machine. Some people believe that this technology is superior because it is error free so no recounts will ever be necessary. These machines will be called Right-way if produced.

The plant to produce Dimple-free machines will cost $10 million to purchase. It will be ready for production on 1/1/01. It will manufacture 10,000 machines in the first and second years after purchase. These can all be sold for $1000 per machine. At the end of the second year the plant will cease production. It will have a salvage value of $2 million. The raw material and labor costs together are $300 per machine.

The plant to produce Right-Way machines will cost $8 million to purchase. It will be ready for production on 1/1/01. It will manufacture 7,742 machines in the first and second years after the purchase. These can all be sold for $1,200 per machine. At the end of the second year the plant will cease production. It will have a salvage value of $1 million. The raw material and labor costs together are $400 per machine.

All figures are given in nominal terms. The firm has a corporate tax rate of 35 percent and uses straight line depreciation. The nominal opportunity cost of capital for this type of project is 12 percent. The nominal debt rate is 6 percent. Assume all cash flows occur at year's end and that the firm has profitable ongoing operations.

(a) Give a table of cash flows with one column for each year's end for the plant to produce Dimple-free and the plant to produce Right-way.

(b) Calculate the base-case NPV of each plant at 12/31/00 assuming each is all-equity financed.

(c) Calculate the APV of each plant at 12/31/00 assuming that in every year the optimal debt capacity of the firm is increased by 30 percent of the project's base-case PV and this is the only financing side effect.

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Example Final Exam 5

Instructions: You have 2 hours to answer all six questions. The total number of points is 100. Remember to read every question carefully, to state any assumptions you make and be neat.

1. (15 points) The Hiraki Corporation operates in an economy where there are no taxes, perfect capital markets and the capital asset pricing model holds. It has two divisions. One manufactures consumer electronics and the other sporting goods. The beta for the division manufacturing consumer electronics is 0.5. This division constitutes 40 percent of the assets of the corporation with the remaining 60 percent being the division that manufactures sporting goods. The firm has a capital structure with 35 percent debt and 65 percent equity. The beta of the debt is 0.1 and the beta of the equity is 1.3. The risk free rate is 5 percent and the expected market risk premium is 9 percent.

   (a) What is the beta of the assets for the firm as a whole?

   (b) What is the beta of the assets for the division that manufactures sporting goods?

   (c) What are the discount rates the Hiraki Corporation should use to evaluate projects in the division that manufactures

      (i) consumer electronics;
      (ii) sporting goods?

2. (15 points) The UL Corporation makes household products. Last year it announced its plan to build a new plant. At that time the stock price jumped to reflect the anticipated NPV of the plant. It is just about to start building the plant and has decided to raise $250 million using a rights issue. It currently has 120 million shares outstanding, which are selling for $45 per share. The issue price for the rights issue will be $30.

   (a) Suppose the company anticipates all rights will be exercised. What will the ex-rights price be?

   (b) Suppose that in fact only 96 percent of rights are actually exercised. What will the ex-rights price be?

   (c) Suppose the company anticipates that 10 percent of the rights will not be exercised and adjusts the number of shares it announces it will issue to ensure that $250 million is raised at $30 per share. What will the ex-rights price actually be if it turns out that 94 percent of the rights the firm announces are exercised?

3. (15 points) Consider an economy with three types of investor. There are rich individuals who are able to avoid all taxes. There are poor individuals who are taxed at high rates on dividend income and low effective rates on capital gains. Finally there are corporations that pay a high effective tax rate on capital gains and a low rate on dividends. There are three types of stock in this economy and the before-tax payouts on each share one year from now are as follows.

	Low payout	Medium payout	High payout
Dividends	$0	$50	$150
Capital Gains	$50	$50	$0

These payoffs are expected to stay constant in perpetuity. The tax rates of the three types of investor for dividends and capital gains are as shown below.

	Rich Individuals	Poor Individuals	Corporations
Tax rate on:			
Dividends	0%	25%	10%
Capital Gains	0%	10%	30%

There are 2.2 billion shares of the low payout stock, 0.8 billion of the medium payout stock, and 0.5 billion of the high payout stock. The total holding of stock by poor individuals is $1,200 billion and the total holding of stock by corporations is $500 billion. The rest of the stock is held by rich individuals. All three groups are risk neutral and choose the stocks they invest in to maximize their after-tax income. Short sales and borrowing are not possible.

(a) Which is the marginal group in this economy that determines the prices of the stocks?

(b) Suppose the after-tax opportunity cost of capital for the rich individuals is 8 percent, for the poor individuals is 6 percent and for corporations is 4 percent. What are the prices of the low, medium and high payout stocks?

(c) Give a table showing the dollar amounts of low, medium and high payout stock held by each of the three groups.

4. (15 points) Consider the following economy.

	t = 0 investment		t = 1 payoffs
Safe asset:	For each 1 invested	---------->	1.3
Risky asset: (real estate)	Fixed supply 1	---------->	1 with prob. 0.8 4 " " " 0.2

All investors are risk neutral so there is no risk premium.

(a) What is the price of the risky asset in the case where markets are efficient and everybody invests their own wealth?

(b) People put their money in banks and this is then lent to investors at a rate of 20 percent. Investors in the safe asset and risky asset can borrow 1 and must pay back 1.2 if they are able to. What is the price of the risky asset in this intermediated case?

5. (15 points) The ZD Corporation and HD Corporation have earnings with a correlation of +1. Both companies are expected to earn $120 million per year in perpetuity. Each company distributes all its earnings. HD's debt has a market value of $400 million and provides a return of 6 percent on market value. It also has 10 million shares worth $60 each. ZD has 30 million shares worth $40 each and no debt. There are no taxes, and capital markets are perfect.

(a) Is a riskless arbitrage opportunity available?

(b) Give a riskless portfolio that yields a positive profit today assuming that you can go short in either of the stocks $1 million, long in either of the stocks as much as you want and you can lend or borrow as much as you want at 6 percent. After today the net payment from the portfolio at each date should be zero in perpetuity.

(c) How much profit does your strategy in (b) generate today?

6. (25 points) A large travel agent is thinking of setting up a subsidiary called Wharton Social Trek (WST) to arrange pleasure treks all around the world for Wharton students, faculty, staff and their friends for the next three years. The trip to Rio for Carnival in February is expected to be particularly popular. One professor has already put down a deposit. The current date is 12/31/X1. The office equipment for WST costs $800,000. It is expected to last for three years. At the end of its life the salvage value will be $200,000. The average price of each trip is currently (i.e. on 12/31/X1) $1,450 and is expected to increase at 3 percent per year. The average cost of providing each trip is currently (i.e. on 12/31/X1) $1030 and is expected to increase at 3 percent per year. They expect to be able to sell 1,000 trips each year for the next three years. The total labor costs to run the project are currently (i.e. on 12/31/X1) $120,000 per year and these are expected to increase at 3 percent per year. The space needed for the travel agency is expected to cost a constant $20,000 per year for each of the three years. The rent is paid at the beginning of each year. The firm has a corporate tax rate of 35 percent and uses straight-line depreciation. The nominal opportunity cost of capital for this type of project if it is all-equity financed is 12 percent. The firm's nominal debt rate is 6 percent. All costs and expenses are tax deductible. All figures are given in nominal terms. Assume all cash flows occur at year's end except where otherwise stated and that the firm has other profitable ongoing operations.

   (a) Give a table of cash flows with one column for each year's end.

   (b) Calculate the project's base-case NPV at 12/31/X1 assuming it is all-equity financed.

   (c) Calculate the project's APV at 12/31/X1 assuming that in every year the optimal debt capacity of the firm is increased by 30 percent of the project's base-case PV and this is the only financing side effect.

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THE WHARTON SCHOOL

FNCE 601

CORPORATE FINANCE

LECTURE NOTES

Franklin Allen

Fall 2011

QUARTER 2 - WEEK 2

Tu: 11/1/11 and Th: 11/3/11

III. Financing Decisions and Market Efficiency

Introduction

So far we have concentrated on investment decisions and have said very little about how these are financed. In this part of the course we shall be looking at financing decisions, taking investment decisions as given. We start by looking at the operation of securities markets where firms obtain their finance and how these markets operate. We next look at the type of securities corporations issue and how they issue them. Then we consider what dividends firms should pay and what their debt-equity ratio should be. In Part IV, we bring the theories of investment and financing together and look at the interaction between the two.

Section 10: Market Efficiency

Read Ch 13 BMA

Motivation example

Consider the following situation.

	t = 0 investment		t = 1 payoffs
Safe asset:	For each 1 invested	---------->	1.5
Risky asset: (real estate)	Fixed supply 1	---------->	1 with prob. 0.75 6 " " " 0.25
	Price P		Expected payoff =2.25

All investors are risk neutral so there is no risk premium.

Can the price of the risky asset be above 2.25? For example, could it be 3?

Discussion

What the motivation example is essentially asking is "Can there be a 'bubble'?" In other words, can the price of an asset be above the discounted present value of its payoffs. The example is given in terms of real estate but we can also think about it in terms of stocks since in the short run at least the supply of these is fixed. This is clearly a crucial question.

If you believe that bubbles can occur then a lot of what has happened in recent years from Japan in the late 1980's onwards through to Indonesia, Malaysia, Thailand and South Korea in the fall of 1997 and, of course, the internet and technology bubble in the U.S. become a manifestation of this phenomenon. In this view, on occasion stock prices do not reflect underlying fundamentals. People buy in the expectation that they can sell at a higher price and will be better off from participating in the bubble. Stock markets are potentially damaging in this case. Resources are wasted when the bubble is at its peak and investment is misdirected. When the bubble bursts it causes many problems. Some people obviously lose a lot of money. The fall in value of any assets used as collateral may weaken the banking system. The firms whose stock prices have fallen may be negatively affected and may have to lay off employees.

If you don't believe in bubbles then events in Japan and South East Asia can be explained by the deficiencies of these economies such as nepotism and cronyism in Indonesia and Thailand and ineffective industrial and financial systems in Japan and South Korea. In this view the rise in internet and technology stock prices and their dramatic collapse were a result of expectations that the sectors would grow at fast rates. The collapse in prices was due to a change in these expectations because new information came in.

Before coming to these examples of bubbles in detail let's start by considering the conventional academic finance view that *markets are efficient*.

Why should markets be efficient?

The simplest definition of market efficiency is that the prices of stocks and bonds are equal to the discounted expected payoffs, i.e., they are determined by economic fundamentals.

Efficient Markets Hypothesis:

A firm's stock market value is determined by the discounted value of its cash flows.

This is based on stock markets being competitive and having many profit-seeking investors. The following example illustrates the basic idea.

Example 1

Consider a firm which for simplicity only lasts for two periods and that has per share cash flows which are paid out to shareholders as follows:

C_1	C_2
1.25	1.40

The opportunity cost of capital is 10 percent.

$$\text{Discounted cash flow} = \frac{1.25}{1.1} + \frac{1.40}{1.1^2} = 2.29$$

What would happen if the stock was selling in the market at 2.00? How could investors make money? Suppose an investor borrowed 2.00 and bought one share. Since the discounted present value of the payments on the stock is 2.29 the investor will be able to pay back the loan and make a profit in term's of today's dollars of 0.29. To see this another way

t=	0	1	2
Debt to buy share (including interest)	2.00	2x1.1 = 2.2	0.95x1.1 = 1.045
Less payment		- 1.25	- 1.40
End of period debt		= 0.95	= - 0.355

In other words the investor is left with 0.355 at date 2 which is equivalent to

$$0.355/1.1^2 = 0.29$$

at date 0. Everybody will therefore try to borrow and buy shares. The price will be bid up to 2.29.

Suppose the price was 2.35 what should somebody who owns the stock do? The owner should clearly sell since this gives 2.35 whereas if the stock was held onto it would pay off 2.29 in terms of today's money. If everybody who owns the stock tries to sell the price will fall until it is equal to 2.29.

Whenever prices get out of line with discounted cash flows there will be profit opportunities. The efficient markets hypothesis is essentially arguing these can't last for long because of arbitrage.

If stock market prices reflect discounted cash flows then this implies the following.

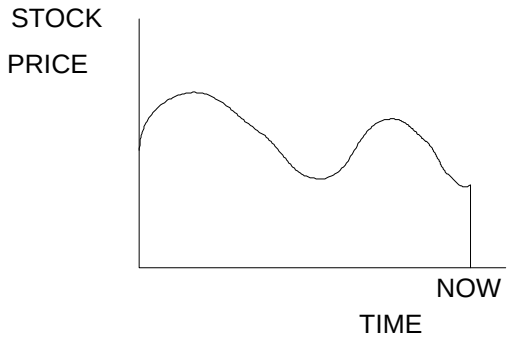
Implication of Efficient Markets Hypothesis:

If a positive NPV project is accepted the value of the firm will increase by the amount of the project's NPV.

Hence accepting positive NPV projects leads to an increase in stock price and the creation of shareholder wealth. Rejecting negative NPV projects avoids a fall in share price and the destruction of shareholder wealth. This is the key idea that underlies the analysis developed in previous sections.

Forms of Market Efficiency

What are the alternatives to market efficiency? *Technical analysts* believe that stock prices follow patterns. If you can identify the patterns then you can make money over and above the risk adjusted return from taking appropriate positions. One of the (simple) ways that technical analysts undertake try to uncover patterns is to plot the movement of stock prices against time and try to predict future cycles.



Suppose you discover a cycle, and at the present moment the stock is at the bottom of a trough. What should you do? You should buy the stock in anticipation of it going up. But what happens if there are a lot of technical analysts and many people do this? The price rises until it

offers only a normal rate of return. In other words, any cycles will self-destruct because many people will be doing this. People will again arbitrage away profit opportunities.

Competition in technical research will tend to ensure that current prices reflect all information in the past sequence of prices and that price changes cannot be predicted from past prices.

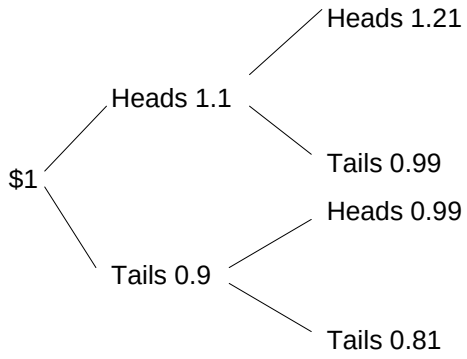
This is called the weak form of market efficiency: current prices reflect all the information contained in the record of past prices. Predictable cycles such that you can make money are eliminated because otherwise positive NPV transactions would exist. If this is the case, why do stock prices change? Efficient markets theory argues they change because new information is received. They must change as soon as the information is received and fully reflect this information, otherwise positive NPV transactions would again exist. The semi-strong form of market efficiency is that current prices reflect not only past prices but all other public information. The strong form of efficiency is when prices reflect not just public information but all the information such as inside information and information that can be acquired by painstaking fundamental analysis of the company and the economy.

New information cannot by definition be predicted ahead of time since otherwise it would not be new information. Therefore, price changes cannot be predicted ahead of time. Series of price changes must be random. To put it another way, if stock prices already reflect all that is predictable, then stock price changes must reflect only the unpredictable--they must be random.

What sort of path of prices do you get if price changes are random and occur only when there is new information? You get something called a random walk. What is this? Consider the following example.

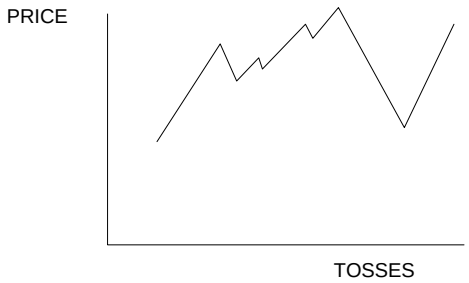
Example

Consider a stock with a price of $1. A coin is tossed. If it is heads the price goes up by 10%, if it is tails the price goes down by 10%. The coin is tossed again and the exercise is repeated. The path of prices can be represented on the following diagram.



This process is a random walk with no drift, which means that the expected return is 0. (A 10% drift would mean a 10% expected return.)

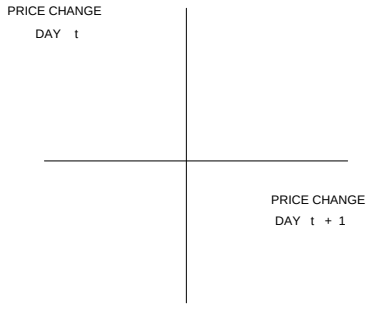
If you were to try a Monte Carlo Type experiment and do something like this, then you are likely to get a series of runs, e.g., H H H T T H T H H T T T T, etc. which might look like:



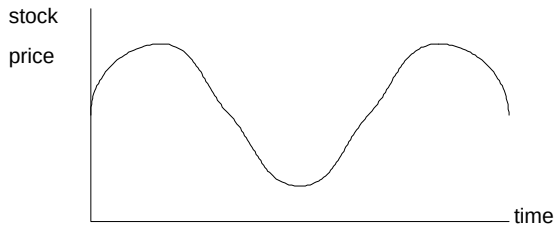
In other words, you get some apparent cycles. Hence the fact that you appear to get cycles doesn't rule out the fact that a sequence is the result of a random walk.

To summarize what we've done so far: we have a strong theoretical reason to believe that prices follow a random walk because of competition among analysts. Arbitrage ensures prices are driven to present values. However, prices may appear to be cyclical in nature. How can we test to see whether prices are random or do follow cycles?

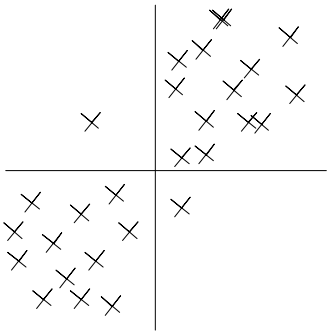
One of the things you might do to test whether there are cycles is draw a scatter diagram of changes in successive days for various stocks.



Now suppose you had a cycle like this:

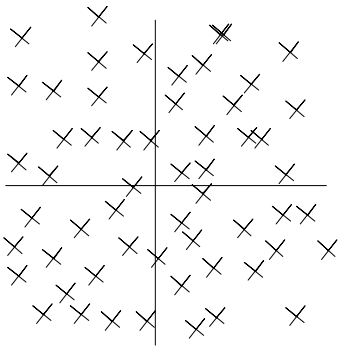


What would you get if you plotted this on our scatter diagram?



On upward slopes of the cycle you would get ++ points. At the top you would get one +-, on the way down you would get -- and then at the bottom you would get one -+.

On the other hand if prices are random you would expect to get a uniform scatter.



People have done this for many types of stock and on the whole the evidence is strongly in favor of the latter distribution so that there is substantial empirical evidence that price changes are random. Putting this another way the serial correlation of stocks (i.e the correlation of returns in period t and in period t+1) is zero as we mentioned in Section 7. This is essentially the basic theory and evidence for weak-form efficiency.

What about semi-strong-form efficiency? The notion here is that if people could make money from publicly announced information they would do so. But what would happen if everybody did this? Prices would adjust so that it was not possible to make money from publicly announced information any more. For example, suppose you read in the Wall Street Journal that Microsoft has had a good quarter. Do you expect to be able to make money on this? The answer is no because everybody else will also know about this so prices will already have adjusted.

What is the evidence for semi-strong-form efficiency? There are many studies that look at the effect of public announcements and find that markets are efficient. A well-known example is a paper by Kaplan and Roll who studied what happens to stock prices when companies boost their reported earnings by switching from accelerated depreciation to straight-line depreciation. This switch is purely cosmetic. It reduces the reported depreciation but it does not affect the

company's tax bill--the tax authorities allow firms to use accelerated depreciation for tax purposes but straight-line depreciation for reporting purposes.

They found that the preliminary announcement of increased earnings seems to prompt a slight abnormal rise in the stock price, but this could simply be because investors were not informed at that stage of the accounting change. Within 3 months of the earnings announcement investors appear to have concluded that the accounting cosmetics were a sign of weakness rather than strength.

The changes were sufficiently small that it was not possible to cover transactions costs and make money on the basis of this information. Similarly for other publicly announced information.

What about strong-form efficiency? The theory here is again that if a lot of people do painstaking research on companies then prices will tend to adjust and reflect this. Once they fully reflect all the information that can be gained by painstaking research, it will not be possible for people to make profits from doing research. What is the empirical evidence for strong form efficiency? Again there are many studies. Carhart found that from 1962-1992 about half of mutual funds did worse than the market. If you adjust for risk the same result holds. The funds earned a lower return than the appropriate risk adjusted benchmarks after expenses. Subsequent updates find similar results.

Interestingly, the conclusion from studies of international mutual funds is different. Tkac found that a large percentage of managers do outperform their benchmark indices. This suggests that markets outside the US may not be as efficient as in the US.

To summarize, we have said that theoretically prices should reflect all available information since otherwise people would be able to make arbitrage trades and profit from them.

Another way of thinking about efficient markets is that the purchase or sale of a security at the prevailing market price is a zero NPV transaction. Most finance academics would agree that empirically there appears to be strong support for this proposition.

The efficient market hypothesis has a number of implications that go against what many people commonly suppose about financial markets. We shall now take a brief look at some of the most important of these.

1. There are no financial illusions.

In an efficient market there are no financial illusions. Investors are concerned with their entitlement to a firm's cash flow. This implies that any attempt to mislead investors by, for example, changing accounting conventions to boost EPS will be unsuccessful.

2. Markets have no memory.

We have argued that there are no true cycles. Hence the notion that now is a good time or now is a bad time to do something is essentially false. For example, there may just have been a long series of rises so that you think it is the top of the market and therefore a good time to sell. However, we know if this was true, everybody would already have sold and the market would not be where it now is. You cannot outguess the market using information available to everybody else.

3. Values of stocks depend on cash flows.

We have argued that the value of stocks depends on expectations of cash flows not on the supply and demand on any particular day. In other words, you should be able to sell large blocks

of stocks at close to the market price as long as you can convince other investors that you have no private information, i.e., that you're not getting out while the going is good.

Scholes did a study of a large sample of secondary offerings, which confirmed the ability of the market to absorb large blocks of stock. The average effect of the offerings was to reduce the stock price slightly, but the decline was almost independent of the amount offered.

4. Trust market prices.

In an efficient market you can trust prices. They incorporate all the available information about the value of each security. This means that in an efficient market there is no way for most investors to achieve consistently superior rates of return.

Are markets really efficient - can't people make money and what about bubbles?

The notion that markets are efficient is one that has dominated finance textbooks for 20 years. Although there were historical instances that appeared difficult to explain in terms of efficient markets these had by and large happened many years ago and it was widely believed, among academics at least, that they could not happen again.

On Wall Street the notion of market efficiency has not been as widely accepted. One of the implications of efficient markets is that investment fund managers can't do better than the market portfolio and it is better to just adopt passive investment strategies such as buying the market portfolio. Taken to an extreme this meant that fund managers were an expensive way for investors to waste their money. Possibly as a result of this implication, the theory of market efficiency has never been very popular on Wall Street; it is widely believed there that many inefficiencies exist.

Over the years there have been a number of studies that cast doubt on the belief that the efficient markets hypothesis is always satisfied. A number of authors found that it was indeed possible to identify strategies that allow money to be made. One of the earliest was a study by Jaffe which showed that if you used the publicly available information on trades by directors of companies in their own shares you could make more than the risk adjusted return. A number of other anomalies were also found. For example, Keim found that by going short in large stocks and long in small stocks for the first few days in January you could make a lot of money. This is the so-called January effect. As discussed above, studies of international mutual funds suggest that many managers do beat the market. There are a number of other examples of strategies that make money. These studies lead many people to have some doubts about the efficient markets hypothesis.

Among macroeconomists there has been considerable doubt about market efficiency for some time. Keynes, for example, had a chapter in his famous book The General Theory where he argued that the stock market was just a gambling casino for the rich. It involved "beauty contests" where the trick in valuing stocks was not so much to try and look at underlying economic fundamentals such as cash flow generating potential but to try and work out the stocks that other people might think are good stocks. Where did this view come from? To get some perspective on this it is helpful to get a historical perspective on how assets are priced in the stock market, real estate market and other markets.

Historic examples of bubbles are the Dutch Tulipmania in 1635, the South Sea bubble in England 1720, the Mississippi bubble in France in 1720 and the Great Crash of 1929 in the United States. These extreme historic events had a very important effect on the development of financial systems in different countries. In Britain the South Sea Bubble led to an Act of

Parliament that effectively ruled out the stock market as a place where private companies could raise funds. It was not until the beginning of the nineteenth century when the demand for capital to build the railways became large that this act was repealed.

The South Sea bubble and the Mississippi bubble are not the only ones that led to the introduction of regulation. Most of the financial regulation that we have today in the U.S. resulted from the reaction to the Great Crash of 1929 which is regarded by many as an example of a bubble.

One of the most interesting examples of a bubble is the crash on Black Monday October 19, 1987 when stock prices in the U.S. fell by about a third in a single day. What happened? Did interest rates rise dramatically so reducing the present value of the discounted stream of dividends? No. The bond market in fact did quite well that day with interest rates actually falling. What about expected cash flows, what was the information coming in that day? The main story other than the crash was the shelling of some old oil platforms in the Gulf by the US Navy. The second story was that Nancy Reagan was going to go into hospital. It's difficult to believe that either of these events could really justify taking hundreds of billions of dollars off the value of US companies.

A more recent episode is the dramatic rise in real estate and stock prices that occurred in Japan in the late 1980's and their subsequent collapse in 1990. Norway, Finland and Sweden had similar experiences in the 1980's and early 1990's. In emerging economies financial crises of this type have been particularly prevalent since 1980. Examples include Argentina, Chile, Indonesia, Mexico, and most recently the South East Asian economies of Malaysia, Indonesia, Thailand and South Korea. Perhaps the most famous recent example of bubbles are the internet and NASDAQ bubbles in recent years. Figure 1 at the end of the section illustrates these.

These bubbles in asset prices typically have three distinct phases. The first phase starts with financial liberalization or a conscious decision by the central bank to increase lending or some other similar event. The resulting expansion in credit is accompanied by an increase in the prices for assets such as real estate and stocks. This rise in prices continues for some time, possibly several years, as the bubble inflates. During the second phase the bubble bursts and asset prices collapse, often in a short period of time such as a few days or months, but sometimes over a longer period. The third phase is characterized by the default of many firms and other agents that have borrowed to buy assets at inflated prices. Banking and/or foreign exchange crises may follow this wave of defaults. The difficulties associated with the defaults and banking and foreign exchange crises often cause problems in the real sector of the economy that can last for a number of years. It is this real spillover that causes bubbles to be so potentially damaging.

The Japanese bubble in the real estate and stock markets that occurred in the 1980's and 1990's provides a good example of the phenomenon. Financial liberalization throughout the 1980's and the desire to support the United States dollar in the latter part of the decade led to an expansion in credit. During most of the 1980's asset prices rose steadily, eventually reaching very high levels. For example, the Nikkei 225 index was around 10,000 in 1985. On December 19, 1989 it reached a peak of 38,916. A new Governor of the Bank of Japan, less concerned with supporting the US dollar and more concerned with fighting inflation, tightened monetary policy and this led to a sharp increase in interest rates in early 1990. The bubble burst. The Nikkei 225 fell sharply during the first part of the year and by October 1, 1990 it had sunk to 20,222. Real estate prices followed a similar pattern. The next few years were marked by defaults and retrenchment in the financial system. The real economy was adversely affected by the aftermath

of the bubble and growth rates during the 1990's were mostly slightly positive or negative, in contrast to most of the post war period when they were much higher.

Many other similar sequences of events can be recounted. As mentioned above, Norway, Finland and Sweden also experienced this type of bubble. In Norway lending increased by 40 percent in 1985 and 1986. Asset prices soared while investment and consumption also increased significantly. The collapse in oil prices helped burst the bubble and caused the most severe banking crisis and recession since the war. In Finland an expansionary budget in 1987 resulted in massive credit expansion. Housing prices rose by a total of 68 percent in 1987 and 1988. In 1989 the central bank increased interest rates and imposed reserve requirements to moderate credit expansion. In 1990 and 1991 the economic situation was exacerbated by a fall in trade with the Soviet Union. Asset prices collapsed, banks had to be supported by the government and GDP shrank by 7 percent. In Sweden a steady credit expansion through the late 1980's led to a property boom. In the fall of 1990 credit was tightened and interest rates rose. In 1991 a number of banks had severe difficulties because of lending based on inflated asset values. The government had to intervene and a severe recession followed.

It seems as though bubbles are fairly pervasive events. How can they be understood? Let's return to the motivation example.

The Motivation Example

Consider the following situation.

	t = 0 investment		t = 1 payoffs
Safe asset:	For each 1 invested	---------->	1.5

Risky asset:	Fixed supply		
(real estate)	1	---------->	1 with prob. 0.75
			6 " " " 0.25
	Price P		Expected payoff =2.25

All investors are risk neutral so there is no risk premium.

What is the price of the risky asset?

Efficient markets case

The standard assumption in asset pricing theories is that everybody invests their own wealth. Suppose each investor has wealth 1 initially and invests her own wealth directly. Since everybody is risk neutral (i.e. there is no risk premium – if there was a risk premium it would lower prices) the marginal returns on the two assets must be equated.

$$\frac{2.25}{P_F} = \frac{1.5}{1}$$

or

$$P_F = \frac{2.25}{1.5} = 1.5.$$

The value of the asset is simply the discounted present value of the payoff where the discount rate is the opportunity cost of the investor. This is the classic definition of the fundamental and the way that we have been valuing assets. The benchmark value of the asset is thus 1.5 and any price above this is termed a bubble.

Intermediated Case

Suppose next that investors have no wealth of their own. They can borrow to buy assets at a rate of 33 1/3 percent. The most they can borrow is 1. If they borrow 1 they repay 1.33 if they are able to. If they are unable to pay this much the lender can claim whatever they have. Lenders can't observe how loans are invested and this leads to an agency problem.

Can P = 1.5 be the equilibrium price?

Consider what happens if an investor borrows 1 and invests in the safe asset.

$$\text{Marginal return safe asset} = 1.5 - 1.33 = 0.17$$

Suppose instead she borrows 1 and invests in the risky asset. She purchases 1/1.5 units of the asset. When the payoff is 6 she repays the loan and interest of 1.33 and keeps what remains. When it is 1 she defaults and the entire payoff goes to the lender so she receives 0.

$$\text{Marginal return risky asset} = 0.25\left(\frac{1}{1.5}\times 6 - 1.33\right) + 0.75\times 0 = 0.67.$$

The risky asset is clearly preferred when P = 1.5 since 0.67 > 0.17. This is the risk shifting problem. The expected payoff on the two investments in 1 unit of the safe asset and 1/1.5 units of the risky asset is the same at 1.5. The risky asset is more attractive to the borrower though. With the safe asset the borrower obtains 0.17 and the lender obtains 1.33. With the risky asset the borrower obtains 0.67 while the lender obtains 0.25[1.33]+0.75[1 x (1/1.5)] = 1.5

- 0.67 = 0.83. The risk of default allows 0.5 in expected value to be shifted from the lender to the borrower. If the lender could prevent the borrower from investing in the risky asset he would do so but he cannot since this is unobservable.

What is the equilibrium price of the risky asset given this agency problem?

In an equilibrium where the safe asset is used, the price of the risky asset, P, will be bid up since it is in fixed supply, until the expected profit of borrowers is the same for both the risky and the safe asset:

$$0.25\left(\frac{1}{P}\times 6-1.33\right)+0.75\times 0=1.5-1.33$$

so

$$P = 3.$$

There is a bubble with the price of the risky asset above the benchmark of 1.5.

The amount of risk that is shifted depends on how risky the asset is. The greater the risk the greater the potential to shift risk and hence the higher the price will be. To illustrate this, consider the previous example but suppose the return on the risky assets is a mean-preserving spread of the original returns.

	t = 0 investment	t = 1 payoffs
Safe asset:	For each	
(T-bills)	1 ---------->	1.5
	invested	
Risky asset:	Fixed supply	
(real estate)	1 ---------->	0 with prob. 0.75
		9 " " " 0.25
	Price P	Expected payoff =2.25

Now the price of the risky asset is given by

$$0.25\left(\frac{1}{P}\times 9-1.33\right)+0.75\times 0=1.5-1.33$$

so

$$P = 4.5.$$

More risk is shifted and as a result the price of the risky asset is bid up to an even higher level.

It is interesting to note that in the recent U.S. bubble it was high volatility stocks that had the highest prices. In other words technology stocks tend to be high volatility and the internet stocks have even higher volatility. It was these stocks whose price rose the highest and then fell the most. The same was true in the Great Crash of 1929. In those days the volatile high tech stocks were radio, automobiles and utilities.

Why would banks be willing to lend to people who might invest in this way? Consider again the original example with P = 3. When investors borrow 1 they can therefore buy 1/3 units of the risky asset. Suppose that in equilibrium the quantity of the fixed supply and the value of the risky asset is such that 30 percent of the borrowers put their money in risky assets and 70 per cent in the safe asset.

$$\text{Bank's payoff} = 0.3[0.25\times 1.33+0.75\times(1/3)\times 1]+0.7[1.33]=1.11.$$

The first term is the payoff to the bank from the 30 percent of investors in the risky asset. If the payoff is 6, which occurs with probability 0.25, the loan and interest is repaid in full. If the payoff is 1, which occurs with probability 0.75, the borrower defaults and the bank receives the

entire proceeds from the 1/3 unit owned by the borrower. The payoff is thus (1/3) ×1. The 70 percent of investors in the safe asset are able to pay off their loan and interest of 1.33 in full.

If the banking sector is competitive the receipts from lending, 1.11, will be paid out to depositors. In this case it is the depositors that bear the cost of the agency problem. In order for this allocation to be feasible markets must be segmented. The depositors and the banks must not have access to the assets that the investors who borrow invest in. Clearly if they did they would be better off to just invest in the safe asset rather than put their money in the bank. The way to think of this is that the investors are like money managers, investment banks and hedge funds. They earn higher returns than in banks. People with money in the bank can't easily get these kinds of returns.

What this analysis shows is that when the people investing are doing so with borrowed money they have very different incentives than people investing with their own money. The predictions for the pricing of assets are very different. It is not just with borrowed money that this kind of incentive occurs. Money managers also have this kind of incentive. If they do well they get a large amount of assets in the future and make a lot of money. There is a limit to how badly they can do because they are investing with other people's money. The worst that can happen is that they lose their reputation and get fired. This leads to a risk shifting problem in the same way as does borrowing – there is a lot of upside potential if you do well and limited downside potential if you do badly. These incentives become important when risk is high so that risk shifting can be large.

In normal times incentives provided by reputation and legal restrictions will keep people from undertaking these strategies but when there is a lot of uncertainty this will not be the case. There appears to be a threshold where risk is such that the usual mechanisms to don't work. In

this case it seems that bubbles can appear. Below this threshold markets seem to be fairly efficient.

This kind of theory can help explain how asset prices of real estate and stocks can get so high when there is a great deal of uncertainty. The losses are born by the lender not the investor. When considered in this light, recent crises such as the one in Japan and the tech bubble are much more understandable.

It's important to stress that this is not a universally held view. Among finance academics it is still widely believed that financial markets are efficient and prices are determined by discounted payoffs. The crisis has changed some people's minds but many believe these are just exceptional times.

What conclusions can be drawn from all of this? In the long run there probably is a tendency for stock prices to revert to discounted payoffs as the efficient markets theory suggests. In the short run though there can be substantial deviations. This is particularly true if investments are being made with other people's money and there is a lot of uncertainty so risk shifting can become important. The implication for investors is that the stock market is a place to invest in for the long run not the short run.

Another important implication of the traditional evidence on market efficiency is that it's difficult to make money by beating the stock market. There is some truth in this. Most managers aren't able to beat the market. However, there do appear to be some people that can such as Warren Buffet. He is clearly exceptional. At a more mundane level some people are able to beat the market by searching out inefficiencies. The good performance of many international fund managers relative to their benchmarks is evidence of this. Understanding

when markets are likely to be efficient or inefficient is crucial to being able to figure out areas where money can be made.

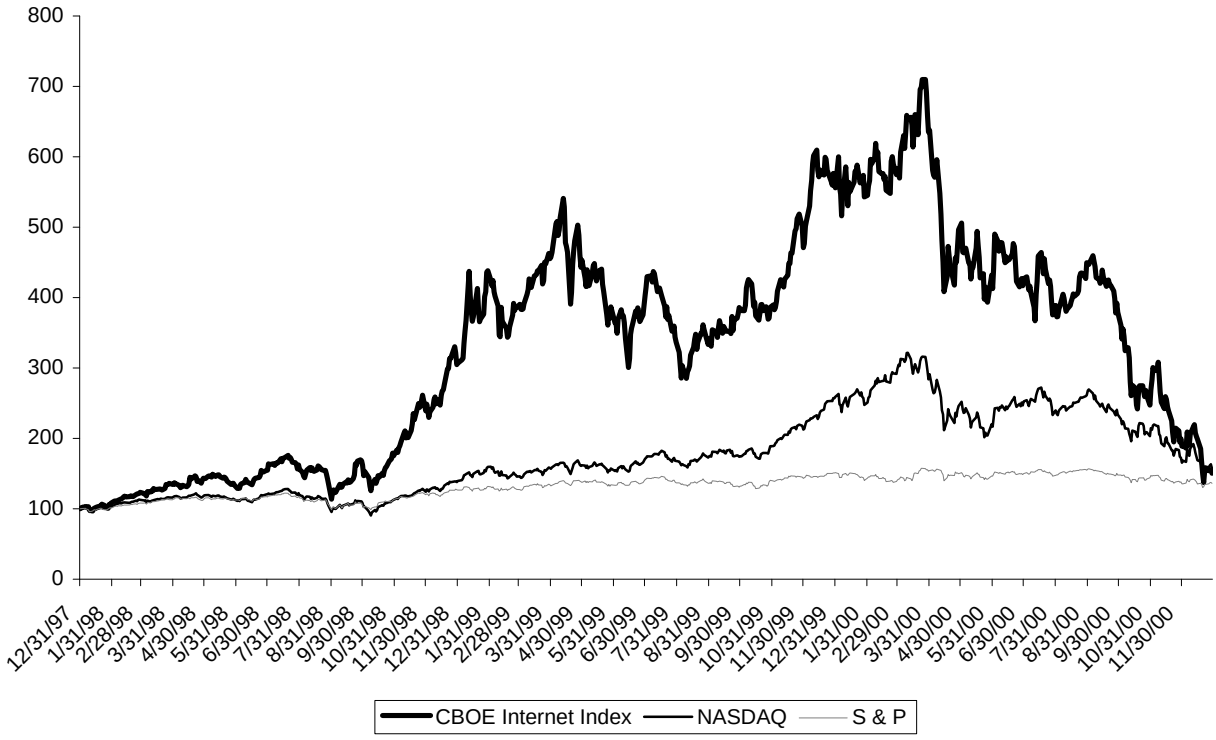


Figure 1

The Internet and NASDAQ Bubbles

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THE WHARTON SCHOOL

FNCE 601

CORPORATE FINANCE

LECTURE NOTES

Franklin Allen

Fall 2011

QUARTER 2 - WEEK 2 (Part 2) and WEEK 3 (Part 1)

Th: 11/3/11 and Tu: 11/8/11

Section 11: Issuing Securities

Section 11A . Types of Securities

Read Chapter 14 BMA

Motivation Example

Introduction

What are the main types of security that firms issue? The most important in many ways is equity or common stock.

Common Stock

The common stockholders are the owners of the corporation. They therefore have a general preemptive right to anything of value that the company may wish to distribute. In most countries they also have the ultimate control of the company's affairs. In practice this control is limited to a right to vote either in person, or by proxy, on appointments to the board of directors. The owners of common stock receive dividends in exchange for supplying capital. The level of dividends is discretionary and is set by the Board of Directors who are elected by shareholders.

Long Term Debt and Preferred Stock

Long term debt and preferred stock are fixed income securities in that they both provide the investor with a stipulated promised series of payments in the future. The interest and face value are specified for the bonds, and a given dividend rate is stipulated for the preferred stock. The firm must pay the interest and the maturity values on its debt as agreed upon in the original debt contract or the company defaults and is subject to legal action. Junk bonds are high yield bonds.

With preferred stock the firm promises to pay dividends on the preferred stock. If it fails to it is not bankrupt, however. It cannot pay dividends to common stockholders until the dividends to preferred stock are paid. Bondholders have a prior claim to the company's income and to the firm's assets if the company liquidates. The claim of holders of preferred stock comes after bondholders but before that of equityholders.

The table at the end of Section 11A shows the relative importance of the three types of security. It can be seen that debt is by far the most important in terms of quantity issued, equity is next and finally preferred stock is relatively insignificant.

Convertible Securities

Corporations often issue securities with terms that can be altered subsequently at the option of the holder of the security. For example, convertible bonds can be transformed into the common stock of the corporation at the option of the holder. The purchase of a warrant entitles the holder to purchase the company's common stock at a specified price on any date preceding the warrant's expiration.

I will leave you to read the intimate details of the types of security.

Table 1 - Main Sources of Domestic Long Term Financing by U.S. Firms, 1970-2010						
Year	Aggregate Domestic External Financing (billions $)	Percentage Represented by Common Stock (%)	Percentage Represented by Preferred Stock (%)	Debt (%)	Percent Change in S&P 500 Index During Year (%)	Average of Yields on AA-Rated Corporate Bonds (%)
1976	53356	15.6	5.2	79.2	19.15	8.75
1977	53792	14.6	7.3	78.1	-11.50	8.24
1978	47230	15.9	6.0	78.1	1.06	8.92
1979	51102	15.2	7.1	77.7	12.31	9.94
1980	73694	22.9	4.9	72.2	25.77	12.50
1981	70441	33.4	2.6	64.0	-9.73	14.75
1982	84198	30.2	6.1	63.7	14.76	14.41
1983	119849	37.0	6.0	57.0	17.27	12.42
1984	132531	14.0	3.1	82.9	1.40	13.31
1985	201269	14.4	3.2	82.4	23.93	11.82
1986	381936	13.2	4.7	82.1	16.84	9.47
1987	367863	11.8	6.3	81.9	2.03	9.68
1988	385625	9.3	5.7	85.0	12.40	9.94
1989	325034	8.0	4.1	87.9	27.25	9.46
1990	340049	5.7	6.1	88.2	-6.56	9.56
1991	465243	10.3	5.9	83.8	26.31	9.05
1992	559827	10.2	5.6	84.2	4.46	8.46
1993	754969	10.9	4.1	85.0	7.06	7.40
1994	582569	8.2	6.4	85.4	-1.54	8.15
1995	673779	13.9	1.0	85.1	34.00	7.72
1996	773110	11.9	4.0	84.2	20.26	7.55
1997	929256	9.7	3.0	87.3	31.08	7.47
1998	1128491	8.7	2.5	88.8	26.68	6.80
1999	1072866	10.5	1.8	87.7	19.52	7.35
2000	1079727	12.4	NA	87.5	-10.13	7.80
2001	1541821	8.3	NA	91.6	-13.04	7.30
2002	1432548	7.7	NA	92.3	-23.36	6.90
2003	1819401	6.9	NA	93.1	-23	6.10
2004	2070680	6.9	NA	93.1	20.87	5.9
2005	2438989	4.7	NA	95.3	3	5.37
2006	2619935	4.3	NA	95.7	13.62	5.8
2007	2389101	7.1	NA	92.9	3.53	5.9
2008	1067972	19	NA	79	-38.5	6.1
2009	1171218	19.9	NA	78.1	23.45	5.74
2010	1113799	12	NA	88	12.79	5.1
	Source: Federal Reserve Bulletin			Source: S&P	Source : Moody's	

Section 11B: Issuing Securities

Read Chapter 15 BMA, and Fenn, Liang and Prowse article on Webcafe

Motivation

In Section 11A we considered the various types of securities that are issued. Here we go on to look at how they are issued.

One of the most critical components in the success of any firm is the strategy it uses for financing its investments, particularly in its first few years. A good example is provided by Google. Founders Larry Page and Sergey Brin met in 1995 when Larry went to see whether he should accept Stanford's offer to become a graduate student in computer science. Sergey was already a student there. Together they developed a search technology that is the basis of Google. Initially they wanted to license the technology to an existing firm. They offered it to Excite for $1.6 million. Excite passed on it. They also offered it to Yahoo who said no as well. In late 1998 they met with Andy Bechtolsheim, who was a founder of Sun, and he provided an initial investment of $100,000. As Google started to become famous the founders attracted almost another million dollars of finance from various *angel investors*. These were well-connected and wealthy Valley businesspeople such as Jeff Bezos, CEO of Amazon. In early 1999 Google obtained formal venture capitalist support. They chose two of the top-tier venture capital firms, Sequoia Capital and Kleiner Perkins Caulfield & Byers (KPCB). Sequoia had previously invested in Yahoo while KPCB had invested in AOL and Excite so they had considerable experience with the internet. The venture capitalists led a group that provided $25 million based on a $100 million valuation of the company. Michael Moritz from Sequoia and John Doerr from KPCB had seats on Google's board. The company continued to grow very quickly. In June 2004 they went public by making an unseasoned issue or Initial Public Offering. They did it in a rather unusual way. They had an auction rather than the usual book

building method. We'll be spending some time looking at how this works. (See *The Search* by John Battelle Portfolio Publishers (2005) for a good account of Google's history).

It is likely that Google will return to the markets soon as it continues to grow and continues to challenge Microsoft's dominance. It could make a seasoned issue of equity. Alternatively it could use convertible bonds or straight bonds. Many growing companies use convertible bonds to take advantage of lower interest rates than on straight debt in exchange for part of the equity should the company be successful.

Let's look at the various different ways that firms can raise money.

The Private Equity Market and Venture Capital

The term private equity is used to refer to securities that are not registered with the SEC. Other types of private equity in addition to venture capital are "angel" capital and leveraged buyout funds. Angel capital is used to refer to the situation where wealthy individuals invest in small closely held companies. Many of these individuals have experience operating similar companies. There is very little documentation of this sector but it is usually argued it is several times larger than the venture capital market. Leveraged buyout funds provide financing to acquire control of existing mature companies. A good example is provided by Kohlberg, Kravis and Roberts or KKR as they are known.

As we saw with Google angel capital often plays a key role right at the start of a company. It is not documented as well as venture capital as it tends to be much more informal. Some estimates put the volume of angel capital at several times that of venture capital. Usually the investment takes the form of equity and providers often have a seat on the board. Once the firm starts to be successful it is subsequently funded by venture capital.

Many successful firms were funded through venture capital. Examples are Microsoft, Oracle, Intel and Sun Microsystems. As Table 1 illustrates, venture capital appears to have played a crucial role in allowing the U.S.'s high tech economy to develop. This has raised interest among investors about venture capital and more generally about private equity.

Venture capital is used to describe the situation where professionally managed organizations (usually limited partnerships) raise money from individuals and institutions for investment in early stage firms. There are a number of important differences between venture capital and other sources of finance. One of the most important is that the providers tend to have a very close relationship with the firms they back. They provide management and business advice as well as capital. Funds are allocated in stages. Another important difference is the probability distribution of returns. Many of the firms that are backed are unsuccessful and yield no return. However, at the other end of the spectrum it is possible to make huge returns. Venture capitalist Arthur Beck, who invested $57,600 in Apple when it was founded saw his investment grow to $14 million in 3 years.

Venture capital comes from many sources. Historically the tax code has provided incentives to wealthy individuals to form partnerships. Typically these partnerships have a total capital of $5-$30 million to invest in several firms. The reason that it has been attractive to wealthy individuals to do this in the past is that most of the return comes in the form of capital gains and this has usually been taxed at a lower rate than ordinary income. Much of the debate about the capital gains tax has been concerned with the possibility that it would reduce the amount of venture capital available to starting businesses. In recent years, venture capital and other types of private equity have been increasingly undertaken by professional private equity managers on behalf of institutional investors.

As we will see one of the major costs of issuing securities is registering the issue with the SEC. To avoid this you can make what is called a "private placement." Private placements are

usually made by small, closely held companies and held by institutions like life insurance companies and pension funds to whom a lack of liquidity is unimportant. In addition to reduced costs of issuance private placements have other advantages. More restrictive covenants can be used since the buyers are more sophisticated. Renegotiation in the event of a default is easier because it involves a few buyers rather than the many thousands possibly involved in a public issue. For all these reasons private placements have been used more over the years.

The reading on Webcafe by Fenn, Liang and Prowse contains a description and details of the development of the private equity market if you are interested in finding out more.

Issuing Public Securities: IPOS

Successful firms usually reach a point in their development where their needs for capital are sufficiently large that they have to turn to the public markets to obtain the level of financing they need. The first public issue by a company is known as an unseasoned issue or initial public offering (IPO). Once the firm has done this it can make additional public offerings of its securities.

One of the interesting features of IPOs is that they tend to be underpriced on average. The amount of the underpricing is substantial, the average is around 15% of the value of the issue. In other words, the first day after the issue the price on average rises by 15%. This is rather puzzling since it essentially means that for every $1 million raised the issuers are giving $150,000 to the initial purchasers. Why would firms do this? This was a very active area of research a few years ago. One theory is that this is a way that firms can signal they're good. It "leaves a good taste in investors' mouths" and allows the firm to sell subsequent issues at higher prices.

Table 2 shows the amount of money raised by IPOs in recent years. It can be seen that it is highly variable.

The Role of the Investment Bank

Typically investment banks play an important role in the issuing of securities. Table 3 lists the top investment banks in terms of underwriting globally. Having decided that it needs to raise a certain amount of money to fund its investments one thing the company could do is simply offer a block of its securities to the investment bank that makes the highest bid. This procedure is called a competitive bid. Only the largest firms on the NYSE find it worthwhile to use this method. The investment banks know these firms' securities well and do not have to engage in costly research to evaluate them. For smaller firms this is not the case. The investment banks would have to spend a lot of resources valuing the securities and this would not be worthwhile unless they were sure of obtaining the deal. The procedure that is most commonly used is therefore a negotiated deal where the firm retains a particular investment banking house or a syndicate and the terms of the issue are negotiated.

In a negotiated deal there are two types of arrangement that are typically used. In a best efforts arrangement, the banker does not guarantee that the securities will be sold and that it will get the cash it needs. It simply agrees to use its best efforts to sell the securities. Hence if conditions change in the market while the securities are being sold it is the firm that bears the risk. In an underwritten arrangement with the investment bank the proceeds of the issue to the firm are guaranteed and it is the investment bank that bears the risk of price changes while the shares are being sold. For example, if interest rates are raised there will be a significant drop in the price of securities and the underwriter will bear this loss.

Having chosen an investment bank or group of banks and the type of agreement to use there are a number of ways in which firms can issue securities. They can use a general cash offer or a rights issue. No matter which they use they must register the securities.

After the Great Crash of 1929 the Securities and Exchange Commission was set up in 1933, among other things, to regulate new issues and protect the public from unscrupulous promoters. The SEC has jurisdiction over all interstate offerings of securities of more than $1.5 million. Certain general procedures must be followed regardless of the type of security involved.

1. Newly issued securities must be registered with the SEC at least 20 days before they are publicly offered. The registration statement provides information about the proposed uses of the funds obtained, the firm's history, existing business and plans for the future. A prospectus, which is used in the marketing of the securities, summarizes this information. See Table 4 for an example of a prospectus from a recent offering by Centene. Both the registration statement and the prospectus are checked for any misleading or inadequate statements by the SEC. If they find any deficiencies they may delay or stop the offering.
2. During the 20-day waiting period preliminary prospectuses may be distributed to potential purchasers. This preliminary prospectus is called a "red herring" because of the statement printed in red ink on the front denying that the firm is trying to sell securities before the registration is effective.
3. Odds and ends: appoint registrar to record issue and prevent fraud, check that issue complies with state "blue sky" laws and so on.

Shelf Registration and other reforms

Since 1982 when the SEC adopted Rule 415 shelf registrations have to a large extent replaced the traditional method of offering securities described above. In a shelf registration a company can get approval for financing plans up to two years in advance. It states details about the firm as in the standard procedure and the total amount of finance it anticipates needing over this

period. Whenever it needs to raise money during this time it can simply go to an investment bank and raise the required amount until the amount issued reaches its originally declared amount.

In 1998 the SEC issued a proposal to significantly alter the way in which large companies would raise finance. In the end only relatively limited reforms were enacted. These allow firms to switch after an issue between a private placement and a public offering if demand is unexpectedly high. Switching between a public issue and private placement when demand turns out to be unexpectedly low is also possible.

Costs of a Public Issue

The administrative costs of preparing the documents and so on are high. There may also be the costs of underwriting the issue. As mentioned above, this involves guaranteeing the price of the issue to the issuing firm by the investment bankers handling the sale. The costs of issuing various types of security are shown in Table 5 at the end of the section.

The table illustrates two important points about the costs of a public issue:

1. It is more expensive to issue common stocks than bonds because of higher administrative costs and greater risk in underwriting.
2. A large part of the issue cost is fixed, and so it is something you should avoid having to do too often. You should issue large amounts rarely, rather than small amounts frequently.

General Cash Offers and Rights Issues

There are two ways a firm can issue securities. They can use general cash offers, which are sold to investors at large, or rights issues which are sold directly to the firm's existing stockholders.

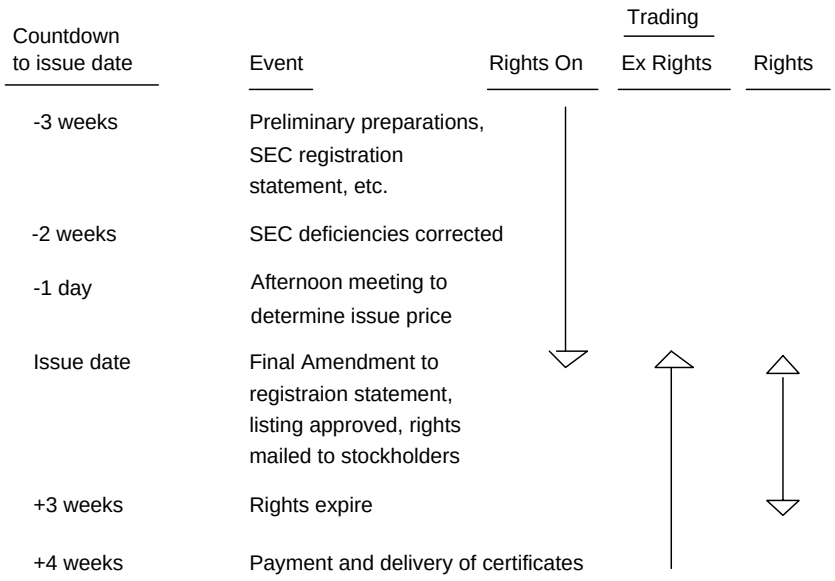
Virtually all debt is sold by general cash offer. Equity may or may not be. In recent years in the US cash offers have been increasingly used. About 90% of cash offers are underwritten. In a general cash offer, the securities are sold to all investors at a fixed offering price.

Firm's articles of incorporation often state that shareholders have a preemptive right to subscribe to new offerings. The historical rationale for this is that managers have the potential to defraud shareholders by selling shares cheaply to relations and friends. Rights issues are a way to prevent this by giving shareholders the opportunity to buy. The firm issues a right for each share held by a shareholder. Given a certain number of rights it is possible to buy a new share at the issue price. In recent years they have not been used much in the U.S. except by financial intermediaries. However, they are used extensively in other countries, particularly in Europe where they form a substantial part of equity capital markets issuance. In addition to being important outside the US, rights issues provide a good introduction to thinking through corporate finance issues.

We turn next to the sequence of events that occurs when there is a rights issue which are summarized in the diagram below. Preliminary stages are much the same as those discussed above. The difference is in selling procedures. The original shareholder receives a right for each share on the issue date. The old shares are referred to as rights on for this reason. When rights are issued, it becomes possible to use the rights to buy the new shares at the exercise price. Since the owners of shares no longer receive rights, the shares are now known as ex-rights. Once rights have been issued, all shares trade at the new market price or ex-rights price as it is also called.

We can summarize the sequence of events leading to the issue of shares using the following diagram.

Sequence of Events in a Rights Issue



Example of a Rights Issue

Usually rights issues are concerned with the issue of equity. To get some idea of how they work we shall go through an example. The key thing to remember in this context is the apparently obvious point that

$$\text{Value of a share} = \frac{\text{Total value of equity}}{\text{Total number of shares}}$$

In the example below things are simplified by assuming there is no debt, so this simplifies to

$$\text{Value of a share} = \frac{\text{Total value of firm}}{\text{Total number of shares}}$$

The Crown corporation is considering a rights offering to raise $5M. The current position of the firm is as follows.

Shares outstanding	1,000,000
Market price per share	$25
Total value of shares outstanding (1,000,000 shares x $25)	$25,000,000

A right is an option to purchase stock at the issue price of the new shares. One right is issued for each share of currently outstanding common stock. In the example 1 million rights are therefore issued. You need a certain number of rights to purchase a new share at the issue price. How this number is determined will be seen below.

In order to ensure that all rights are exercised, the firm will set the issue or exercise price for the new shares at a level somewhat below the market price of $25. If the exercise price were set near $25, say $24, a small decline in the stock's market price (e.g. to $23) would prevent any rights from being exercised (since no one would pay $24 for a share selling in the market at $23) and the issue would be a failure. Therefore Crown's managers set the subscription price for new shares at $20. Since the firm plans to raise $5M in new funds and will receive $20 per new share, it follows that

$$\text{Number of new shares} = \frac{\text{Funds to be raised}}{\text{Subscription price per new share}}$$

$$= \$5M/\$20 = 250{,}000 \text{ shares}$$

It can be seen then that

$$\text{Number of rights to buy a new share} = \frac{\text{Number of rights issued}}{\text{Number of new shares}}$$

$$= \frac{\text{1M rights}}{250{,}000}$$

$$= 4 \text{ rights per new share}$$

Therefore a stockholder must surrender four rights plus pay the subscription price of $20 to obtain one new share. If a stockholder does this, it is known as exercising his right. Alternatively, he could sell his right since there are well-organized markets for rights.

The Effect of a Rights Issue on Stock Price

In what follows we start by assuming that the new project the firm is using the issue to finance has NPV = 0. The new value of the company is thus equal to the old value plus the value of the new investment, which in the case we are looking at is equal to the value of the money raised.

$$\text{New PV of firm} = \text{Old PV} + \text{Value of money raised}$$

Given this, how does a rights issue affect the stock price?

Consider a stockholder who owned 4 shares of Crown stock just prior to the rights issue when the price was $25. Initially,

$$\text{Her proportionate share of the firm} = 4/1\text{M}$$

$$\text{PV of her shares} = \frac{4}{1\text{M}} \times 25\text{M}$$

$$= 4 \times 25$$

$$= \$100$$

Suppose she uses her 4 rights to purchase a new share at $20. Her proportionate share of the firm after the shares have been issued

$$= \frac{5}{1.250M} = \frac{4}{1M}$$

She therefore owns the same proportion as before. What about the value of her holdings? The new value of the firm is the old value plus the amount raised (since we are assuming NPV=0), i.e. 25M + 5M = 30M so the value of her holding is

$$\text{PV of her shares} = \frac{4}{1M} \times 30M$$

$$= \$120$$

$$= \$100 \text{ for initial shares} + \$20 \text{ for new share}$$

In other words, the PV of her investment (including her purchase of the new shares) remains constant. However, now

$$\text{Ex rights Price per share} = \frac{120}{5} = \$24$$

In other words, the price per share has fallen from $25 with rights on to $24 with rights off. Therefore since the only difference between a rights-on share and an ex-rights share is the right it follows that

$$\text{Value of right} = \$1$$

We can confirm this by imagining a second investor who didn't own any rights-on shares. He could buy 4 rights in the rights market and then buy a share at $20. Hence,

Total price paid for ex-rights share = 20 + 4 x 1 = $24

In general it can be seen that

Value of right = Rights on price – Ex-rights price

So far in this section we have been assuming that the project is such that NPV = 0. If NPV > 0 the theory is exactly the same except the value of the rights-on share now also reflects the positive NPV contributed by the project. The rights-on share price adjusts to reflect the positive NPV contributed by the project as soon as the project is announced not when the rights are issued.

The Irrelevance of Issue Price Provided Rights Are Exercised

The value of a share is the total new PV of the firm divided by the new number of shares. Rights are allocated on an equal basis to existing owners, that is, on the basis of the number of shares owned. If you think about it, provided all the rights are exercised, the number of new shares issued and their price do not matter to existing shareholders. In either case they receive the same wealth. To see this consider our example above, but instead of a 1-for-4 trade at an issue price of $20 we could have raised the same amount by a 1-for-2 trade and an issue price of $10. Clearly in these cases

$$\text{Amount raised} = \frac{1M}{4} \times 20 = \frac{1M}{2} \times 10 = \$5M$$

The position of the investor is as follows:

	Terms	
Details	1 for 4 at $20	1 for 2 at $10
Before issue:		
Number of shares held	4	4
Share price rights-on	25	25
Total value of holding	100	100
After issue:		
Number of new shares	1	2
Amount of new investment	$20	2 x $10 = $20
Total value of holding	$120	$120
Total number of shares	5	6
Ex-rights share price	$120/5 = $24	$120/6 = $20
Value of a right	25 – 24 = $1	25 – 20 = $5

All that has changed are the numbers of shares issued and hence their prices. Since they change an appropriate compensating amount, nothing real has changed. The real plant and equipment remain unchanged.

An important assumption in this argument that share price is irrelevant is that all rights are exercised. In practice, only about 95 percent of rights are exercised. About five percent of the recipients of rights simply let them lapse. A number of explanations are put forward for this. One is that people may be on holiday when the rights are sent out. Another is that they don't know what rights are and simply throw them away. In either case, when some rights are not exercised then issue price does matter because it determines how much the people who don't exercise lose. Who benefits from the people that don't exercise? It is the original owners that do exercise since they end

up owning a larger fraction of the firm. To see how things work in this situation consider the following example.

Example 2

Pinkhampton Inc. needs to raise $10M in new equity by means of a rights offering with an issue price of $100 per share. The stock currently sells for $200 per share and there are 1M shares outstanding.

(a) How many new shares will Pinkhampton issue?

(b) How many rights will be required to buy one share?

(c) What is the ex-rights price if the issue is fully subscribed to?

(d) Suppose 5% of the rights issued are not exercised. What is the ex-rights price then?

(e) Suppose the firm anticipated that 5% of the rights issued won't be exercised. What number of rights should the firm require for the purchase of one share at the issue price of $100 assuming it wants the issue to succeed in raising $10M? What would be the ex-rights price in this case?

Solution

(a) Since they wish to raise $10M at a price of $100 per share,

$$\text{Number of new shares} = \frac{10M}{100} = 100{,}000$$

(b) Since there are already 1M shares and 100,000 are to be issued

$$\text{Number of rights to buy 1 new share} = \frac{1M}{100{,}000} = 10$$

(c) Given the shares are currently trading at $200 per share and there are 1M of them and $10M is being raised

$$\text{New value of company} = 200 \times 1M + 10M = 210M$$

Since there are 100,000 shares being issued in addition to the original 1M,

$$\text{New number of shares} = 1M + 0.1M = 1.1M$$

The value per share is the total value of the company after the issue divided by the new number of shares

$$\text{Ex-rights price} = \frac{210M}{1.1M} = \$190.91$$

(d) In the case where only 95% of the new shares are issued

Number of new shares exercised = 95,000

Hence,

New value of company = 200M + 9.5M = 209.5M

and

New number of shares = 1M + 0.095 = 1.095M

so similarly to before,

$$\text{Ex- rights price} = \frac{209.5}{1.095} = \$191.32$$

(e) Let X = number of new shares to be issued to raise \$10M

Then,

$$0.95 \times X \times \$100 = \$10M$$

so

$$X = \frac{10M}{95} = 105{,}263$$

Hence,

$$\text{Rights needed to buy new share} = \frac{1M}{0.105263M} = 9.50$$

The actual number of shares issued is 0.95x105,263 = 100,000 and the actual amount raised is \$10M so

$$\text{Ex-rights price} = \frac{200M + 10M}{1.10M} = \$190.91$$

Tables for Section 11B

Table 1

Venture and non-venture backed firms by industry
1991-93

Industry	Venture-backed		Non-venture-backed	
	Number	%	Number	%
Computer-related	102	30	48	11
Medical and health	122	35	62	15
Manufacturing (not computer-related)	28	8	65	15
Retail and wholesale	26	8	95	22
Telecomm-unications	16	5	18	4
Other business services	35	10	19	4
Other	35	10	133	30
Total	346	100	440	100

Table 2

Volume of Initial Public Offerings, 1995-2010

(Dollar Amounts in Millions)

	Initial Public Offerings			S&P 500 Index	
Year	Number	Aggregate Value	Average size	Beginning of Year	Change During Year
1975	5	176	35.2	68.6	31.5
1976	40	337	8.4	90.2	19.2
1977	31	221	7.1	107.5	-11.5
1978	38	225	5.9	95.1	1.1
1979	62	398	6.4	96.1	12.3
1980	149	1387	9.3	107.9	25.9
1981	347	3055	8.8	135.8	-9.7
1982	122	1339	10.9	122.6	14.7
1983	683	12438	18.2	140.6	17.3
1984	355	3808	10.7	164.9	1.4
1985	353	8348	23.6	167.2	26.3
1986	702	18088	25.8	211.3	14.6
1987	522	17109	32.8	242.2	2
1988	228	5940	26.1	247.1	12.4
1989	209	6082	29.1	277.7	27.3
1990	172	4519	26.3	353.4	-6.6
1991	367	16411	44.7	330.2	26.3
1992	517	24138	46.7	417.1	4.5
1993	709	41721	58.8	435.7	7.1
1994	607	28341	46.7	466.5	7.1
1995	575	21447	37.3	459.266	-7.2
1996	869	38004	43.734	620.717	161.5
1997	624	22401	35.9	737.012	116.3
1998	367	17726.1	48.3	975.039	238
1999	509	38887.6	76.4	1228.1	253
2000	384	35827	93.3	1455.19	227
2001	97	8012.2	82.6	1283.27	-172
2002	94	8065.2	85.8	1148.8	-134.5
2003	82	14053.3	171.3	879.819	-268.981
2004	233	44867.7	192.5	1111.916	232.097
2005	189	20983	141.7	1211.92	100.04
2006	190	3251.1	176.55	1248.29	36.37
2007	202	36164.1	183.4	1418.30	170.01
2008	33	21696.7	102	1468.36	50.06
2009	66	25200 .0	365.85	903.25	-565.11
2010	168	37500.0	232.3	1116.56	213.31

Source: Euromoney, S&P, Thomson Financial, IPO Monitor

source -S&P

Table 3

Leading Underwriters

Underwriter	Value of Issues ($ billions)	Number of Issues
Deutsche Bank AG	327.5	1271
JP Morgan	327	1204
Barclays Capital	307	951
Bank of America Merrill Lynch	280	1087
Citi	249	893
Morgan Stanley	235	968
Goldman Sachs & Co	233	671
UBS	199	822
Credit Suisse	188	785
BNP Paribas SA	187	665

The top managing underwriters January 2011 to October 21 2011. Values include global debt, equity and equity-related issues. Figures in billions.
Source: Thomson One Banker

Table 4

Example of CENTENE Corporation Prospectus

(on following pages)

PROSPECTUS

3,000,000 Shares

Common Stock

We are offering 3,000,000 shares of common stock.

Our common stock is quoted on the Nasdaq National Market under the symbol "CNTE". On August 7, 2003, the last reported sale price of our common stock on the Nasdaq National Market was $25.35 per share.

Investing in our common stock involves risks. See "Risk Factors" beginning on page 5.

	Per Share	Total
Public offering price	$25.00	$75,000,000
Underwriting discount	$ 1.25	$ 3,750,000
Proceeds to Centene (before expenses)	$23.75	$71,250,000

We have granted the underwriters a 30-day option to purchase up to 450,000 additional shares of common stock on the same terms and conditions as set forth above to cover over-allotments, if any.

Neither the Securities and Exchange Commission nor any state securities commission has approved or disapproved of these securities or passed upon the adequacy or accuracy of this prospectus. Any representation to the contrary is a criminal offense.

The underwriters expect to deliver the shares on or about August 13, 2003.

Joint Book-Running Managers

LEHMAN BROTHERS **SG COWEN**

THOMAS WEISEL PARTNERS LLC

STIFEL, NICOLAUS & COMPANY
INCORPORATED

August 7, 2003

TABLE OF CONTENTS

You should rely only on the information included or incorporated by reference in this prospectus. We have not authorized anyone to provide you with information that is different from that contained in this prospectus. This prospectus is not an offer to sell or a solicitation of an offer to buy shares in any jurisdiction where such offer or any sale of shares would be unlawful. The information in this prospectus is complete and accurate only as of the date on the front cover of this prospectus, regardless of the time of delivery of this prospectus or of any sale of shares.

PROSPECTUS SUMMARY

This summary highlights information included elsewhere or incorporated by reference in this prospectus and does not contain all of the information you should consider in making your investment decision. You should read this summary together with the more detailed information, including our consolidated financial statements and the related notes, included elsewhere or incorporated by reference in this prospectus.

Centene Corporation

We provide managed care programs and related services to individuals receiving benefits under Medicaid, including Supplemental Security Income, or SSI, and the State Children's Health Insurance Program, or SCHIP. We have health plans in Wisconsin, Texas, Indiana and New Jersey. We believe our local approach to managing our health plans, including provider and member services, enables us to provide accessible, high quality, culturally-sensitive healthcare services to our members. Our disease management, educational and other initiatives are designed to help members best utilize the healthcare system to ensure they receive appropriate, medically necessary services and effective management of routine health problems, as well as more severe acute and chronic conditions. We combine our decentralized, local approach with centralized finance, information systems, claims processing and medical management support functions.

Our Approach

Our approach to managed care is based on the following key attributes:

- ***Medicaid Expertise.*** Over the last 19 years, we have developed a specialized Medicaid expertise that has helped us establish and maintain strong relationships with our constituent communities of members, providers and state governments. We have implemented programs developed to achieve savings for state governments and improve medical outcomes for members by reducing inappropriate emergency room use, inpatient days and high cost interventions, as well as by managing care of chronic illnesses. We do this primarily by providing nurse case managers who support our physicians in implementing disease management programs and by providing incentives for our physicians to provide preventive care on a regular basis. We recruit and train staff and providers who are attentive to the needs of our members and who are experienced in working with culturally diverse, low-income Medicaid populations. Our experience in working with state regulators helps us to implement and deliver our programs and services efficiently and affords us opportunities to provide input on Medicaid industry practices and policies in the states in which we operate.
- ***Localized Services, Support and Branding.*** We provide access to healthcare services through local networks of providers and staff who focus on the cultural norms of their individual communities. Our systems and procedures have been designed to address these community-specific challenges through outreach, education, transportation and other member support activities. We use locally recognized plan names, and we tailor our materials and processes to meet the needs of the communities and the state programs we serve. Our approach to community-based service results in local accountability and solidifies our decentralized management and operational structure.
- ***Collaborative Approach with States.*** Our approach is to work with state agencies on redefining benefit levels, eligibility requirements and provider fee schedules in order to maximize the number of uninsured individuals covered through Medicaid and SCHIP while maintaining adequate levels of provider compensation.
- ***Physician-Driven Approach.*** We have implemented a physician-driven approach in which our physicians are actively engaged in developing and implementing our healthcare delivery policies and strategies. Our local boards of directors, which help shape the character and quality of our organization, have significant provider representation in each of our principal geographic markets. This approach is designed to eliminate unnecessary costs, improve service to our members and simplify the administrative burdens on our providers. It has enabled us to strengthen our provider networks through improved physician recruitment and retention that, in turn, have helped to increase our membership base.

- ***Efficiency of Business Model.*** We have designed our business model to allow us to readily add new members in our existing markets and expand into new regions in which we may choose to operate. The combination of our decentralized local approach to operating our health plans and our centralized finance, information systems, claims processing and medical management support functions allows us to quickly and economically integrate new business opportunities.
- ***Specialized Systems and Technology.*** Through our specialized information systems, we are able to strengthen our relationships with providers and states, which help us to grow our membership base. These systems also help us identify needs for new healthcare programs. Physicians can use our claims, utilization and membership data to manage their practices more efficiently, and they benefit from our timely and accurate payments. State agencies can use data from our information systems to demonstrate that their Medicaid populations are receiving quality healthcare in an efficient manner.
- ***Complementary Business Lines.*** We have begun to broaden our service offerings to address areas that we believe have been traditionally underserved by Medicaid managed care organizations. Effective March 1, 2003, we acquired a 63.7% interest in Group Practice Affiliates, a behavioral health services company, and purchased contract and name rights of ScriptAssist, a medication compliance company. We believe other business lines, such as our NurseWise triage program, will allow us to expand our services and diversify our sources of revenue.

Our Strategy

Our objective is to become the leading national Medicaid managed care organization. We intend to achieve this objective by implementing the following key components of our strategy:

- increase penetration of existing state markets;
- develop and acquire additional state markets;
- address emerging state needs;
- diversify our business lines; and
- leverage our information technologies to enhance operating efficiencies.

Additional Considerations

Nearly all of our revenues come from Medicaid premiums paid by the states of Wisconsin, Texas, Indiana and New Jersey. Our operating results depend significantly on Medicaid program funding, premium levels, eligibility standards, reimbursement levels and other regulatory provisions established by the federal government and the governments of the states in which we operate. Because we operate in a limited number of markets, any termination of, or failure to renew, our existing contracts or any regulatory changes affecting those markets could materially reduce our revenues and profitability. Moreover, because the premiums we receive are established by contract, our profitability depends on our ability to predict and effectively manage the costs of healthcare services delivered to our members. For a discussion of these and other risks relating to an investment in our common stock, see ‘‘Risk Factors’’ below.

Corporate Information

We were organized in Wisconsin in 1993 and reincorporated in Delaware in 2001. We initially were formed to serve as a holding company for a Medicaid managed care line of business that has been operating in Wisconsin since 1984. Our corporate office is located at 7711 Carondelet Avenue, Suite 800, Saint Louis, Missouri 63105, and our telephone number is (314) 725-4477. The address of our website is *www.centene.com*. **The information on our website is not part of this prospectus.**

‘‘CENTENE’’ and ‘‘NURSEWISE’’ are our registered service marks, and the Centene logo is our service mark. We have also filed an application with the U.S. Patent and Trademark Office to register ‘‘START SMART FOR YOUR BABY’’ as our trademark. This prospectus also contains trademarks, service marks and trade names of other companies.

The Offering

Common stock offered by Centene	3,000,000 shares
Common stock to be outstanding after the offering.....	19,606,059 shares
Nasdaq National Market symbol	CNTE
Use of proceeds.....	We intend to use our net proceeds of this offering for working capital and other general corporate purposes, which may include acquisitions of businesses, assets and technologies complementary to our business.

The number of shares of common stock to be outstanding after the offering is based on 16,606,059 shares of common stock outstanding as of July 28, 2003. It excludes:

- 717,216 shares subject to options vested as of July 28, 2003 and having a weighted average exercise price of $3.28 per share;
- 1,533,428 shares subject to options unvested (or exercisable only to acquire restricted shares that would be subject to future vesting) as of July 28, 2003 and having a weighted average exercise price of $12.42 per share; and
- 2,450,765 additional shares reserved as of July 28, 2003 for future issuance under our stock plans.

Except where we state otherwise, the information we present in this prospectus:

- *reflects a three-for-two split of our common stock effected as a common stock dividend paid as of July 11, 2003; and*
- *assumes the underwriters do not exercise their over-allotment option.*

Summary Consolidated Financial and Operating Data

You should read the following summary consolidated data in conjunction with our consolidated financial statements and related notes included elsewhere in this prospectus.

	Six Months Ended June 30,		Year Ended December 31,		
	2003	2002	2002	2001	2000
	(in thousands, except share data)				
Statement of Operations Data:					
Premiums(1)	$ 359,112	$ 203,152	$ 461,030	$ 326,184	$ 216,414
Services	4,554	211	457	385	4,936
Total revenues	363,666	203,363	461,487	326,569	221,350
Medical costs	299,311	167,053	379,468	270,151	182,495
Cost of services	3,588	168	341	329	135
General and administrative expenses	40,284	22,162	50,072	37,617	32,200
Total operating expenses	343,183	189,383	429,881	308,097	214,830
Net earnings	14,869	9,533	25,621	12,895	7,728
Net earnings attributable to common stockholders	14,869	9,533	25,621	12,428	7,236
Net earnings per common share:					
Basic	$ 0.91	$ 0.62	$ 1.63	$ 5.98	$ 5.35
Diluted	$ 0.83	$ 0.56	$ 1.47	$ 1.07	$ 0.76
Weighted average common shares outstanding:					
Basic	16,409,291	15,311,427	15,716,040	2,078,099	1,352,289
Diluted	17,829,558	17,152,775	17,466,116	12,029,246	10,229,393
Operating Data:					
Health benefits ratio(2)	83.3%	82.2%	82.3%	82.8%	84.3%
General and administrative expenses ratio(3)	11.1%	11.0%	10.9%	11.6%	14.6%
Members at end of period	438,700	278,600	409,600	235,100	194,200

(1) Premiums consist of payments we receive from states to provide health benefits to members and do not include investment income.

(2) Health benefits ratio represents medical costs as a percentage of premiums.

(3) General and administrative expenses ratio represents general and administrative expenses as a percentage of total revenues.

	June 30, 2003	
	Actual	As Adjusted
	(in thousands)	
Balance Sheet Data:		
Cash, cash equivalents and short-term investments	$ 52,827	$123,552
Total assets	220,414	291,139
Long-term debt	—	—
Total stockholders' equity	117,825	188,550

The preceding table summarizes our balance sheet data at June 30, 2003:

- on an actual basis; and
- as adjusted to reflect our sale of the 3,000,000 shares of common stock offered by us, after deducting the underwriting discount and our estimated offering expenses, and the application of our estimated net proceeds.

Table 5

Average Gross Underwriting Spread and Out-of-Pocket Expenses as Percentage of Registered Domestic Public Offerings, 1977 to 2001*
(Source: Emery and Finnerty (2004)

	Common Stock			Preferred Stock			Convertible Preferred and Convertible Debt			Bonds		
Issue Size (Millions)	Gross Underwriting Spread (%)	Out-of-Pocket Expenses(%)	Total (%)	Gross Underwriting Spread (%)	Out-of-Pocket Expenses(%)	Total (%)	Gross Underwriting Spread (%)	Out-of-Pocket Expenses(%)	Total (%)	Gross Underwriting Spread (%)	Out-of-Pocket Expenses(%)	Total (%)
Under 10.0	7.69	5.94	13.63	4.69	3.65	8.34	8.51	6.15	14.66	2.04	1.91	3.95
10.0 to 24.9	5.99	2.70	8.69	3.05	1.24	4.29	4.55	1.94	6.49	1.29	1.11	2.40
25.0 to 49.9	5.52	1.57	7.09	2.33	0.57	2.90	3.42	0.98	4.40	0.95	0.68	1.63
50.0 to 99.9	5.13	0.89	6.02	2.06	0.28	2.34	2.63	0.55	3.18	0.96	0.43	1.39
100.0 to 199.9	4.68	0.59	5.27	2.76	0.28	3.04	2.40	0.39	2.79	0.90	0.30	1.20
200 to 500	4.16	0.41	4.57	2.63	0.17	2.80	2.17	0.19	2.36	0.84	0.16	1.00
Over 500	3.49	0.14	3.63	2.62	0.10	2.72	1.57	0.09	1.66	0.57	0.08	0.65

*****Excludes rights issues, issues callable or putable in under one year, and issues which are not underwritten. Source: Thomson Financial

UNIVERSITY OF PENNSYLVANIA

THE WHARTON SCHOOL

FNCE 601

CORPORATE FINANCE

LECTURE NOTES

Franklin Allen

Fall 2011

QUARTER 2 - WEEK 3 (Part 2) and WEEK 4 (Part 1)
Th: 11/10/11 and Tu: 11/15/11

Section 12: Payout Policy

Read Chapter 16 BMA

Introduction

In Section 4 we argued that the value of a firm's equity is the discounted stream of dividends.

$$\text{Value of equity} = \sum_{t=1}^{\text{infinity}} \frac{\text{Dividends}_t}{(1+r)^t}$$

Clearly if dividends are increased the value of the equity goes up. We were making the implicit simplification here that

$$\text{Total equity payouts}_t = \text{Dividends}_t$$

In general

$$\text{Value of equity} = \sum_{t=1}^{\text{infinity}} \frac{\text{Total equity payouts}_t}{(1+r)^t}$$

If we increase equity payouts equity value goes up. Dividends are not the only form of equity payout. Another example is share repurchases. If we take these into account

$$\text{Total equity payouts}_t = \text{Dividends}_t + \text{Share Repurchases}_t$$

Payout policy is concerned with the issue of whether total equity value can be increased holding total payouts constant by switching from dividends to repurchases and vice-versa.

Motivation:

It can be seen from Table 1 and Figure 1 that over the years U.S. corporations have changed their payout policies substantially. In the 1970s and early 1980s payout was primarily in the form of dividends. Repurchases played very little role. In aggregate, up until the mid 1980's the amount repurchased every year is a small fraction of the amount paid out in dividends. In the mid 1980's the amount of repurchases went up significantly. It can also be seen from

Table 1 that dividends as a proportion of earnings have moved around but usually stay around 40-50% of earnings. Repurchases went up dramatically in the mid 1980s and have stayed high relative to the previous period. Figure 1 shows that dividend yield has steadily fallen but total yield including repurchases has not gone down nearly as much.

The question we're going to consider in this lecture is whether firms should pay dividends or not. How many of you think:

(i) firms should pay dividends;

(ii) firms should not pay dividends but should repurchase shares;

(iii) it doesn't matter whether or not firms pay dividends?

At the end of the lecture we'll see if any of you have changed your minds.

Modigliani and Miller

Before 1961 the argument that increasing dividends would increase share price was widely accepted. In 1961 Modigliani and Miller argued that this type of approach was essentially ad hoc: there was no underlying economic theory. What they did was to carefully separate out the dividend decision from other financial decisions and then analyze the effect of dividend policy on firm value. In order to illustrate their reasoning consider the following simple example.

Example

Consider a firm whose shareholders have an opportunity cost of capital of 10%; in other words they can lend or borrow at 10%. Hence, their objective is to maximize the PV of their investments or equivalently their wealth; this pushes out their budget constraint and makes them as well off as possible no matter what their preferences. There are no personal or corporate taxes.

At $t = 0$ the firm's situation is as follows.

Cash	$100
Number of shares	100

The firm also has access to three projects which it can invest in. The investments, payoffs which occur with certainty, present values and net present values of the projects are:

Project	Investment at t = 0	Payoff at t = 1	Pres. Val. at 10%	Net Pres. Val. at 10%
A	$50	$77	$70	$20
B	$40	$55	$50	$10
C	$10	$10	$9	-$1

These are the only investments the firm can make. Suppose initially:

(i) the firm cannot borrow or lend;

(ii) cannot issue or repurchase equity.

What should the firm do? Three of its alternative strategies are:

1. Invest $50 in Project A and pay the remaining $50 in dividends.
2. Invest $90 in projects A and B and pay out the remaining $10 in dividends.
3. Invest $100 in Projects A, B and C and pay out nothing in dividends.

It can readily be seen that the firm's optimal strategy is 2; it should do both A and B but not C. Why is this? Is it best because paying out dividends of $10 is best for shareholders? No, it is best because both A and B have a positive net present value but C does not so that strategy 2

maximizes the wealth of shareholders at $70 + $50 + $10 = $130. Even though dividends differ in the three strategies given, which is best is determined by the investment decision. If the NPV's of the three projects were all zero so that investment did not matter investors would be indifferent between the three strategies. In determining which dividend policy maximizes the value of the firm, it is therefore clearly important to separate the investment decision from the dividend decision so as not to confuse the benefits of the two. This can be done by holding investment constant. In what follows it is assumed strategy 2 is undertaken so the firm does projects A and B.

Suppose next we relax (i) and assume the firm can borrow or lend up to $60 at 9% but no more than this; however, it cannot issue or repurchase any equity. What should it do now (taking its investment as given at $90). Two of its alternatives are:

a. Invest $90 in A and B, borrow nothing and pay out $10 in dividends.
b. Invest $90 in A and B, borrow $60 and pay out $70 in dividends.

It can be seen that the firm should undertake strategy b. Why is this? Is it because dividends are $70 instead of $10? No, it's because the firm can borrow at 9% whereas the shareholders opportunity cost of capital (i.e. the rate at which they can invest at) is 10% so the firm should borrow as much as possible and pay it out to shareholders so they can invest at a higher rate. If the firm could borrow at 10% the shareholders would be indifferent between the two strategies so it is the borrowing possibilities of the firm that make b the best strategy not the difference in dividends. Again it is important to separate out the effects of borrowing from the effects of dividends by holding borrowing as well as investment constant. In what follows it is assumed that capital markets are perfect so that the firm can borrow at the same rate as

individuals, namely 10%. In this case borrowing does not affect the value of the firm. For simplicity we shall assume the firm does not borrow at all.

If investment and borrowing are held constant, what is the appropriate tradeoff to consider? So far we have excluded changes in equity capital. Modigliani and Miller defined dividend policy to be the trade-off between dividends and equity capital. Thus in our example two alternatives the firm faces are:

(i) Invest \$90 in A and B, borrow nothing and pay \$10 in dividends.
(ii) Invest \$90 in A and B, borrow nothing and repurchase \$10 in shares.

Which of these strategies is best? It can be seen that the shareholder is indifferent. In the case of (i), the PV of shareholder's wealth is \$130 which consists of the \$10 dividend at t = 0 and the \$70 + \$50 = \$120 present value of the payout at t = 1.

What about (ii)? In this case the total present value of payouts received by shareholders is again \$130; this consists of the \$10 repurchase at t = 0 and the payoffs at t = 1 which have PV of \$120. The share price initially is therefore \$1.3. The firm needs to repurchase

$$10/1.3 = 7.69 \text{ shares.}$$

Suppose it buys equally from all shareholders (individual shares are divisible if necessary) so that the number of shares they hold are

$$(100 - 7.69)/100 = 92.31 \text{ percent}$$

of the number they held before the repurchase. However, the total number of shares is also 92.31 which is 92.31 percent of what it was before. Each shareholder's proportionate holding in the firm therefore remains unchanged. Of course, in actual repurchases all shareholders may choose not to end up with the same proportionate holdings because their personal circumstances

have changed, but the important point here is that they have the opportunity to maintain their proportionate share.

In the example, therefore, whether the firm pays dividends or repurchases shares the value of the firm is the same as far as shareholders are concerned. In both cases how much cash do the shareholders receive? They receive $10 in total. What is the value of the firm after the dividend payout or share repurchase? The firm has projects A and B with present value of $120 and so is worth $120. Hence their total wealth is $130 in either case.

Two features of our example are important for this result. The first is that there are no taxes. If dividends are taxed differently from share repurchases then shareholders won't be indifferent between the forms of payout. The other critical assumption is that there are perfect capital markets. If capital markets are imperfect and shareholders have to pay brokerage commissions when they sell shares, for example, then the shareholders may prefer the firm to pay out the cash as dividends which involve no brokerage commissions if they wish to use the money to consume.

These are the basic ideas behind:

Modigliani and Miller Dividend Irrelevance Theorem

The payout policy of the firm does not affect its value provided there are no taxes and perfect capital markets.

To summarize, the first part of Modigliani and Miller's contribution was to separate out the effects of dividend policy from investment policy and borrowing policy. The second part was to show that given this separation of dividend policy from investment and borrowing policy it is irrelevant provided there are no taxes and capital markets are perfect.

Market Imperfections and Taxes

The Modigliani-Miller argument is now widely accepted. It does not, however, mean that in the real world people think dividends are irrelevant since the assumptions of perfect capital markets and no taxes are clearly not satisfied. Instead its importance is to focus attention on these aspects and their importance as far as dividends are concerned.

Roughly speaking, there are three positions forming a spectrum from right to left on dividend policy. We shall consider these one by one.

The Rightist Position

If you took a person off the street and asked this person whether firms should pay high or low dividends, it is likely that he or she will say that they should pay high dividends since this benefits their shareholders. Before MM this was, roughly speaking, the conventional view.

Now that we have the MM argument, is there any justification for holding the view that stocks which have a higher proportion of their earnings paid out in dividends have a higher value than stocks which have a lower proportion of their earnings paid out in this form? The rightists argue that in reality capital markets are imperfect and in particular the information available concerning firms' prospects is very poor. In some European countries investors receive very little reliable information about a firm's earnings. In the U.S. creative accounting sometimes means that it is also difficult to find out what is happening. In such cases how are investors to find out which firms are good investments and which are not?

The rightist's most plausible argument in favor of the positive relationship between dividends and value is the notion that dividends provide a signal of the firm's position. Large dividends provide solid evidence that a firm is doing well.

People who disagree with the rightist position argue that the other channels of information concerning firms are sufficiently good that dividends do not have an important role to play in this respect.

What is the empirical evidence in support of the rightist's position? Researchers have been almost unanimous in finding a positive association between Price/Earnings multiples and payout (Dividends/Earnings) ratios. This suggests that a high payout ratio "causes" a higher price for given earnings. The problem is that simple tests like this do not isolate the effects of dividend policy: there are many other things going on.

For example, suppose that a firm which customarily distributes half its earnings suffers a strike which cuts earnings in half. Because the setback is regarded as temporary, its management maintains the normal dividend. The payout ratio for that year turns out to be 100%, not 50%.

The temporary earnings drop also affects the price/earnings ratio. Stock price may drop because of the strike, but it does not drop to one half its pre-strike value. The lost earnings from the strike are a relatively small proportion of the discounted future stream. Investors recognize the strike as temporary and the ratio of price to this year's earnings rises. Thus, the firms' labor troubles end up creating both a high payout and a high P/E ratio, which results in a spurious association between dividend policy and market value. The same thing happens whenever reported earnings underestimate or overestimate the true earnings that both dividends and stock prices are based on.

When people have devised more elaborate tests to overcome this type of problem, they have usually been unable to find any relationship between a high payout ratio and firm value.

Overall, therefore, although there are some theoretical arguments in favor of the extreme rightist position, there is little empirical evidence.

The Leftist Position and Taxes

So far we have been treating dividend payment and stock repurchases as equivalent. Provided we don't have any taxes, this is the case. However, in the type of tax system we have in the U.S. and in many other countries there is an important difference between them. When dividends are received by shareholders they are taxed as ordinary income. Share repurchases are taxed on a capital gains basis and at various times, this has involved a lower rate than ordinary income. Currently they are both taxed at the same rate. We will consider both cases.

Consider a person in a 50% tax bracket with 10 shares of a firm's stock which he purchased a year ago so that any realized capital gain will be treated as long term. The share price when the person purchased the shares was $90. The firm has accumulated $10 per share in cash during the year which it wishes to pay out to shareholders. This change in its cash holdings is the only change that has occurred during the year so that the firm's share price (before any payout) is currently $100.

Person has 50% tax rate on dividend income

Capital gains rate is 20%

Owns 10 shares

Price per share when purchased just over 1 year ago = $90

Cash earned per share during year = $10

Current price per share (before any payout) = $100

If the firm pays dividends of $10 per share or 10% the shareholder will have to pay taxes at the full marginal rate and so his total tax payment will be 0.5 x 10 x $10 = $50 and his total after-tax receipts will be 10 x $10 - $50 = $50. The value of the remaining shares is 10 shares priced at $90 for a total of $900.

In contrast, if the firm repurchases 10% of its shares the shareholder can sell one of his for $100. The long-term capital gain on this share is $10. Suppose that the rate on long-term capital gains is 20%. The taxes paid in this case are 0.2 x $10 = $2 and the person's total after-tax receipts are $100 - $2 = $98. The value of the shares that are still owned is 9 shares priced at $100 each for a total of $900.

Thus by paying out the money using a share repurchase the firm saves the shareholder $48 in taxes. In summary:

Taxes if dividends of 10% per share paid

when capital gains rates are below rates for dividends

Before-tax receipts from 10 shares = 10 x $10 = $100

Taxes paid on dividends from 10 shares = 0.5 x 10 x $10 = $50

After-tax receipts from dividends on 10 shares = $100 - $50 = $50

Ending value of shares = 10 x $90 = $900

Taxes if 10% of shares are repurchased

when capital gains rates are below rates for dividends

Before-tax receipts from selling 1 share = $100

Capital gain on share = $100 - $90 = $10

Tax paid on capital gain = 0.20 x $10 = $2

After-tax receipts = $98

Ending value of shares = 9 x $100 = $900

One important point is that even if dividends and capital gains are all taxed at the same rate, there is still a significant tax advantage to repurchasing shares rather than paying dividends. Suppose that now the shareholder's tax rate is 15% but that everything else remains the same. In this case the shareholder's tax liability if dividends are paid is 0.15 x 10 x $10 = $15; if shares are repurchased it is 0.15 x $10 = $1.50. Hence there is a tax advantage to repurchase even though dividends and capital gains are taxed at the same rate.

Taxes if dividends of 10% per share paid

when capital gains rates equal rates for dividends

Before-tax receipts from 10 shares = 10 x $10 = $100

Taxes paid on dividends from 10 shares = 0.15 x 10 x $10 = $15

After-tax receipts from dividends on 10 shares = $100 - $15 = $85

Ending value of shares = 10 x $90 = $900

Taxes if 10% of shares are repurchased

when capital gains rates equal rates for dividends

Before-tax receipts from selling 1 share = $100

Capital gain on share = $100 - $90 = $10

Tax paid on capital gain = 0.15 x $10 = $1.50

After-tax receipts = $98.50

Ending value of shares = 9 x $100 = $900

The advantage to repurchase is greater if the rate applied to capital gains is less than the rate applied to ordinary income. Nevertheless, even if dividends and capital gains are taxed at the same rate there is still a significant advantage to repurchase provided the investor intends

to keep holding the stock. Notice that if all the shares were liquidated at the end of the year the tax liability would be the same.

There are restrictions on the use of share repurchases. If they are done on a regular basis and it is transparent that they are a substitute for dividends then they will be taxed as dividends. It is usually argued that this provision can fairly easily be avoided by repurchasing infrequently and irregularly. There is also a provision that allows a tax to be imposed if firms retain earnings to avoid paying taxes on dividends. Again it is usually argued that this provision is ineffective; firms can typically provide good business reasons for retaining earnings. Thus it would seem that firms have significant scope to transform payouts from dividends to repurchases. The only apparent restriction on them is that they mustn't be paid regularly and be an obvious substitute for dividends.

The basic point made by the leftist position is that corporations can transmute dividends into capital gains by shifting their dividend policies. Since dividends are more heavily taxed then capital gains, investors should welcome the reduction in their tax payments. Firms that do this should therefore be worth more than those that don't, according to leftists.

A shareholder who wishes to consume more than the dividends that are paid out by the firm can sell shares as needed and pay less in taxes. Hence by lowering dividends, firms can always do better for shareholders who pay taxes at normal rates.

Several empirical studies have borne out the views of the leftists. For example, Litzenberger and Ramaswamy, and others, have found that firms that pay out a large proportion of their earnings as dividends tend to have a lower price than similar firms that pay a low proportion of their earnings as dividends.

Not many people deny that taxes are an important factor. The question is whether firms can further increase their value by switching from dividends to retained earnings. The

characterizing feature of the leftist position is that they believe this to be the case. Middle-of-the-roaders, to whom we turn next, do not believe this.

Middle-of-the-Roaders: Clientele Model

The middle-of-the-roaders maintain that even with taxes a company's value is not affected by its payout policy.

So far we have just considered the normal low payout stocks because of the tax differentials between dividend income and capital gains. The tax differentials are much less for financial institutions, many of which (e.g. pensions funds and insurance companies) operate free of all taxes and therefore have no reason to prefer capital gains to dividends or vice versa.

Also, not only do individuals hold stocks directly or indirectly, corporations also do. They have a tax reason to prefer dividends: they pay corporate income tax on only a small part of any dividends received. Corporations have typically paid corporate income tax on 30% of the dividends they receive so the effective rate is 0.3 x 0.35 = 10.5% whereas they pay the full 35% on any realized capital gains.

The middle-of-the-roaders thus argue that there may be some people who want low payout stocks, but this clientele has already been satisfied. High payout stocks are owned by corporations. This type of model is an example of a "clientele" model. Taxpayers in different groups hold different types of assets.

Group	Asset
High tax bracket individuals	Low payout stocks
Corporations	High payout stocks
Tax free institutions	Any assets

How are assets priced in this model? The relevant question here is who are the marginal holders since these are the people who will determine the price. The tax free institutions appear to hold all types of security so it would seem they are the marginal holder. They will only do this if the assets are priced as though taxes didn't matter i.e. prices only depend on before tax income not after tax income. To see how this works, consider the following example.

Example

Suppose there are three groups that hold stocks.

(i) Individuals who have high tax brackets. They pay 40% on dividends but only 20% on capital gains. Their after tax opportunity cost of capital from investing in real estate is 7%.

(ii) Corporations pay 10% on dividends and 25% on capital gains. Their after tax opportunity cost of capital from investing in real estate is 8%.

(iii) Institutions that pay no taxes. Their (before and after tax) opportunity cost of capital from investing in real estate is 10%.

All these groups are risk neutral so risk is not an issue; all that matters is the after-tax returns to the stocks. The groups cannot borrow.

There are three types of stock with the following before-tax dividends and capital gains. Their after-tax total payoffs per share, including dividends and capital gains, are then as shown. They are expected to be the same each period in perpetuity. The reason the equilibrium prices are $1,000 is explained below.

	High Payout	Medium Payout	Low Payout
Dividends	\$100	\$50	\$0
Capital gains	\$0	\$50	\$100
Before-tax payoff/share	\$100	\$100	\$100
Taxes			
(i) Individuals	0.4x\$100 =\$40	0.4x\$50+0.2x\$50 =\$30	0.2x\$100 =\$20
(ii) Corporations	0.1x\$100 =\$10	0.1x\$50+0.25x\$50 =\$17.5	0.25x\$100 =\$25
(iii) Institutions	\$0	\$0	\$0
After-tax payoff/share			
(i) Individuals	\$60	\$70	\$80
(ii) Corporations	\$90	\$82.5	\$75
(iii) Institutions	\$100	\$100	\$100
Equilibrium price/share	\$1,000	\$1,000	\$1,000

It can be seen that given this situation the individuals with high tax brackets will put all their money in low payout shares, the corporations will put all their money in the high payout shares and the institutions will be prepared to hold all three. The institutions are the *marginal holders*. They are marginal in the sense that if prices change a little bit they will want to change their holdings. It is their opportunity cost of capital of 10% that is the relevant discount rate. Since the payoffs are in perpetuity we can use this discount rate to value the stocks.

$$PV = \frac{\$100}{0.10} = \$1{,}000$$

To see why the shares must all be priced at the same level of \$1,000, suppose the price of low payout shares was \$1,050, what would happen? What would institutions do? They won't

be prepared to hold low payout stocks at this price since the return on them is \$100/\$1,050 = 9.52% which is less than the 10% (\$100/\$1,000) they can get on the other two stocks. But this means there will be an excess supply of the low payout stock since the institutions will sell. Hence the price must fall from \$1,050 to \$1,000 so institutions will be willing to hold it and equilibrium will be restored. If the price of low payout stocks were \$950, what would happen? In this case, institutions would all want to buy since the return is \$100/\$950 = 10.53%. There will be excess demand and the price will rise to \$1,000 per share so equilibrium is restored. A similar argument holds for why the prices of the other stocks are also \$1,000. Institutions are the marginal holders and since they pay no taxes, all stocks are equally priced.

The individuals and the corporations are also happy to hold the low payout stocks and high payout stocks, respectively. The individuals earn an after-tax return of 80/1,000 = 8% which is higher than their opportunity cost of 7%. They are happy with the situation. In fact if they could borrow at 7% and invest at the 8% they would do so but they can't. The corporations earn an after-tax return of 90/1,000 = 9% which is higher than their opportunity cost of 8% so they are also happy. Both the individuals and corporations are not marginal holders. If prices change a little bit they will still want to keep their holdings.

What is the implication of this theory for firms? It can be seen that price is independent of payout policy and so dividend policy is irrelevant. This is the middle-of-the-roaders position.

Black and Scholes provide empirical support for the position that dividend policy is irrelevant. They ran regressions of dividend policy against firm value and found there was no relationship. As with many empirical studies in finance others have argued that the Black and Scholes study is flawed and if you do it properly you do find an effect.

Given this disagreement, is there any other evidence we can use? If you look at actual holdings of stock what do you find? There have been a number of studies of this. Although

there is some evidence of clienteles, it does seem that the high tax bracket individuals do hold a significant amount of high payout stocks. Table 2 documents this. It can be seen that many individuals receiving dividends have incomes above $50,000 and are likely to be in high tax brackets.

The question that then arises is can this pattern of wealth holding by individuals be reconciled with the middle-of-the-roaders position that dividend policy is irrelevant? It has been argued by a number of authors that the fact that high bracket individuals own so much dividend paying stock does not necessarily mean that the clientele model is incorrect. The reason is that there existed many ways to avoid taxes on dividends (and other types of income) under the old law. Since the Tax Reform Act of 1986 there has been a shift towards repurchases that lasted until the recent tax changes which made taxes on dividends and capital gains low.

We shall consider two types of tax avoidance to give you some idea of how they worked.

(i) Income splitting

(ii) Tax shelters in real assets through the use of limited partnerships.

(i) Income Splitting

Income splitting involves making use of the fact that the tax system is progressive so that the marginal tax rate increases with the level of income and different family members may be in different tax brackets. By redistributing income from those in high brackets to those in low brackets, taxes can be reduced. There are a number of ways in which such redistributions can be achieved.

Before the Tax Reform Act of 1986 the simplest way to transfer investment income from one family member to another was clearly gifting. By simply transferring assets to members of the family in low tax brackets taxes could be avoided. However, there are at least

two deficiencies of this method. The first is that the gifts if sufficiently large would be subject to gift tax. Second, and perhaps more importantly if the gifts are to children, the original owner permanently loses control of the assets.

These disadvantages could be overcome to some extent using Clifford Trusts. In this case instead of giving directly to family members, so-called Clifford Trusts could be created which distributed income to the family members. Provided the property in trust did not return to the grantor within 10 years and certain other stipulations concerning control of the trust were satisfied the income of the trust was not treated as the grantor's. After ten years the principal could be returned to the original owner and in the meantime the income distributed was taxed as that of the beneficiary of the trust. The disadvantage remained that the income distributed by the trust was subject to the gift tax. Nevertheless it was a widely used tax avoidance vehicle. However, the Tax Reform Act of 1986 severely restricted the use of both gifting and Clifford Trusts as a means of tax avoidance.

(ii) Tax Shelters

Before the Tax Reform Act of 1986, sole proprietorships, ordinary partnerships, limited partnerships and subchapter S corporations shared the characteristic that their tax gains or losses passed directly through to their owners and tax losses could be offset to an unlimited extent against other types of income. This feature allowed individuals to make use of the provisions of the tax code concerned with the taxation of direct investments such as depreciation provisions, to avoid taxes. The essential reason is that the deductions do not usually correspond to their true economic values. In cases where the deductions are greater than the real costs incurred, it is possible to use any excess to shelter income; if the artificial deductions are sufficiently high, there can be accounting losses that could be used to avoid taxes on income from other sources.

For example, with any asset where people have different information or different expectations, there is a wide range of values that can be assigned to the asset. These valuation problems provide a possibility for the abuse of the depreciation provisions. By making the selling price of assets as large as possible, artificially high deductions and credits can be obtained. It might be thought that such possibilities are not a problem because people paying too much for an asset will incur real losses. However, by the use of non-recourse loans it is possible to structure deals so that this is not the case.

One of the areas where valuation is extraordinarily difficult is movies. A few films do extremely well but most do not even cover their costs. It is very difficult to tell before a movie is released which category it will fall into. As a result of these valuation problems movies were a very popular vehicle for tax avoidance in the early 1970's. How did a typical scheme work? To see this consider a simple example (the numbers are extreme to illustrate the point).

Suppose a producer makes a movie for $10M. It is then sold to a limited partnership for $90M. If this price is questioned by the IRS then the partnership gets experts to testify that they thought it was going to be a "blockbuster". The partners, who are all in the 70% tax bracket, get to depreciate the movie. Suppose they use straight line depreciation with an assumed life of 3 years and no salvage value. Then the annual depreciation is $30M per year. For simplicity suppose the movie makes no income and there are no other expenses or deductions. The net loss each year is $30M which allows the partners to avoid 0.70 x $30M = $21M in taxes altogether. Assuming a discount rate of 10%, this stream has a present value of $52.2M.

Cost of movie = $10M

Sale price of movie to partnership = $90M

Annual straight-line depreciation (3 year life, no salvage value)

= $30M

PV tax shield at 70% marginal rate = 0.70 x 30M x AF(3yrs, 10%)

= $52.2M

If the partnership paid $90M for the movies and only get tax shields worth $52.2M how are they better off? The partnership arranges to borrow $75M from the producer using a non-recourse loan. This means that the revenue generated by the box office (and other) receipts from of the movie are used to pay back the loan; if the revenues aren't sufficient to repay it and the interest fully then the provider of the loan has no recourse to any of the other assets of the partnership. In our example the revenues are zero and so the loan is not repaid at all. The partnership has borrowed $75M and put up $15M of their own money to buy the movie. In return for their $15M investment they receive $52.2M of tax shields so overall they are $37.2M better off. What about the producer? The movie cost $10M to make. It sold for $90M of which $75M was put up by the producer and none of which was repaid. This corresponds to a net payment of $15M so the producer makes a profit of $5M.

Amount of non-recourse loan lent by producer to partnership = $75M

Revenue from movie = $0

Receipts of movie producer = $90M - $75M = $15M

Profit of movie producer = $15M - $10M = $5M

Profit of partnership = $52.2M - $15M = $37.2M

Thus both parties to the transaction do very well despite the fact the movie doesn't raise any revenue. Who bears the cost? The government does. They raise $52.2M less in taxes than they otherwise would.

One of the main limitations on this type of scheme is the fact that the buyer must provide evidence that the price paid is realistic. This requirement imposes the least restraint

when the asset is traded in a thin market with widely divergent opinions on values. Movies are only one area where this is the case; any type of artistic commodity tends to have this feature. Thus books, records, prints and so on were widely used as the basis for this type of scheme.

In fact abuses of this type were sufficiently widespread that the so-called "at risk" limitations were imposed in the 1976 Tax Reform Act. These limited the losses resulting from artificially high depreciation deductions to the amount an investor has "at risk" in an activity, including contributions of money and other property and borrowed money for which the taxpayer is personally liable or for which he has pledged collateral. The "at risk" rules applied to all activities engaged in as a trade or business, except (1) the holding of real estate, and (2) the leasing of equipment by closely held corporations other than subchapter S corporations. These limitations made it more difficult to exploit valuation problems for tax purposes, but they did not eliminate the loophole. In particular, real estate and the leasing of equipment were specifically excluded so that the effect of the legislation was to shift this type of tax avoidance activity to this area, rather than prevent it. However, changes in the 1986 Tax reform Act did make it much more difficult to offset losses from one activity against other types of income.

Tax avoidance in recent years

Since the Tax Avoidance Act of 1986, avoiding taxes has become progressively more difficult. In recent years many people and accounting firms have been prosecuted for avoiding taxes. It is now difficult and risky to avoid taxes compared to twenty years ago. However, it is now no longer as necessary to avoid taxes. Currently in the US, the top rate on dividends and capital gains is 15 percent. There is little tax advantage from transforming dividends into capital gains.

Conclusions

How should corporations view payout policy? My own view is that the middle-of-the-roaders is probably the nearest of the three positions to the truth with some truth to the leftist position from the mid-1980s until the Bush tax changes. Prior to the mid-1980s there were apparently large tax benefits from transforming dividends into capital gains. However, the extent of tax avoidance in those days was probably large. As a result the apparent tax advantages were probably not there. This is why payout policy did not matter too much. In the mid-1980's share repurchases exploded. To some extent they started to replace dividends. This reflected the greater difficulty of avoiding taxes and was consistent to some degree with the leftist views. Since the recent change in tax law with both dividends and capital gains lightly taxed at 15 percent there has been a resurgence in dividend payments. Again the middle-of-the-roaders theory is probably more accurate.

In other countries tax regimes differ greatly. In many countries there is tax imputation which eliminates the double taxation of dividends. This tends to reduce the tax disadvantage of dividends in such cases. Hence in other countries too the middle-of-the-roaders' theory tends to hold.

For these reasons I find the middle-of-the-roaders' case the most persuasive of the theories of dividend policy. Probably the payout policy of firms is not too important in determining their value.

Appendix: Section 12

Table 1: Aggregate Cash Distributions to Equityholders

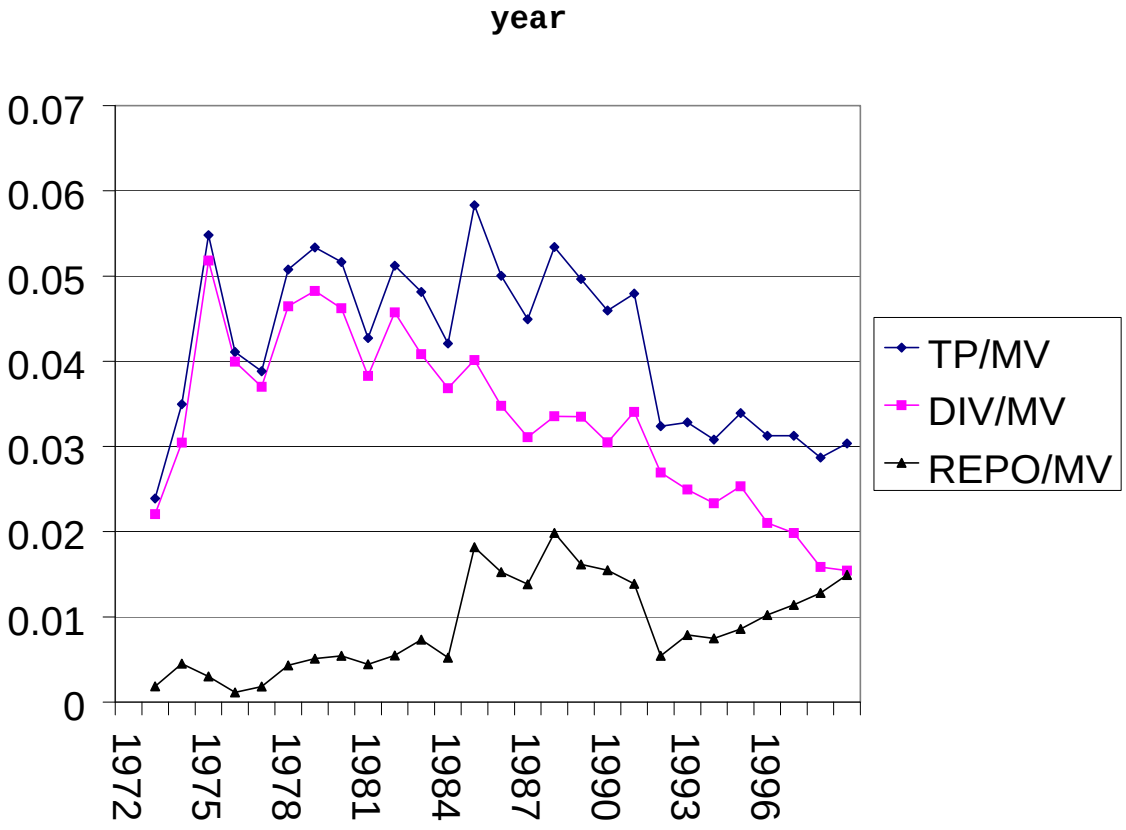
Aggregate cash-distributions to equityholders for a sample of US firms, by year. The data sample consists of all firm on COMPUSTAT over the period 1972-1998 that have available information on the following variables: REPO, DIV, EARN, and MV. REPO is the expenditure on the purchase of common and preferred stocks (COMPUSTAT item # 115) minus any reduction in the value (redemption value) of the net number of preferred shares outstanding (COMPUSTAT item # 56). DIV is the total dollar amount of dividends declared on the common stock (COMPUSTAT item #21). EARN is the earnings before extraordinary items (COMPUSTAT item #18). MV is the market value of common stock (COMPUSTAT item #24 times COMPUSTAT item # 25). TP is the average total payout (dividends plus earnings) across firms for a given year. The data sample contains 121,973 firm-year observations and excludes banks, utilities, and insurance companies.

Year	Number	EARN	MV	TP	DIV	REPO	TP/EARN	DIV/EARN	REPO/EARN	TP/MV	DIV/MV	REPO/MV
1972	2802	41437	803582	19122	17633	1488	46.1%	42.6%	3.6%	2.4%	2.2%	0.2%
1973	3107	57503	673974	23517	20470	3047	40.9%	35.6%	5.3%	3.5%	3.0%	0.5%
1974	3411	70139	500180	27508	25961	1547	39.2%	37.0%	2.2%	5.5%	5.2%	0.3%
1975	3573	65856	690795	28196	27389	807	42.8%	41.6%	1.2%	4.1%	4.0%	0.1%
1976	3600	84318	865569	33496	31917	1579	39.7%	37.9%	1.9%	3.9%	3.7%	0.2%
1977	3615	95147	825171	41768	38202	3566	43.9%	40.2%	3.7%	5.1%	4.6%	0.4%
1978	3536	106352	836025	44449	40193	4256	41.8%	37.8%	4.0%	5.3%	4.8%	0.5%
1979	3581	134988	999286	51525	46104	5421	38.2%	34.2%	4.0%	5.2%	4.6%	0.5%
1980	3868	136159	1306814	55978	50289	5689	41.1%	36.9%	4.2%	4.3%	3.8%	0.4%
1981	3972	132796	1143197	58064	51802	6262	43.7%	39.0%	4.7%	5.1%	4.5%	0.5%
1982	4574	103817	1313398	62294	52701	9593	60.0%	50.8%	9.2%	4.7%	4.0%	0.7%
1983	4461	130188	1648433	68282	59384	8899	52.4%	45.6%	6.8%	4.1%	3.6%	0.5%
1984	4686	151671	1554682	89327	61356	27971	58.9%	40.5%	18.4%	5.7%	3.9%	1.8%
1985	4721	141464	2082677	104606	71471	33136	73.9%	50.5%	23.4%	5.0%	3.4%	1.6%
1986	4719	133656	2436697	110569	74862	35707	82.7%	56.0%	26.7%	4.5%	3.1%	1.5%
1987	4908	185146	2581264	137014	84973	52041	74.0%	45.9%	28.1%	5.3%	3.3%	2.0%
1988	4895	220034	2878728	144980	96216	48765	65.9%	43.7%	22.2%	5.0%	3.3%	1.7%
1989	4804	227613	3610378	162795	107846	54949	71.5%	47.4%	24.1%	4.5%	3.0%	1.5%
1990	4781	213056	3331772	160245	113971	46275	75.2%	53.5%	21.7%	4.8%	3.4%	1.4%
1991	4780	168668	4255871	138124	115162	22962	81.9%	68.3%	13.6%	3.2%	2.7%	0.5%
1992	4934	171373	4385812	144268	110978	33289	84.2%	64.8%	19.4%	3.3%	2.5%	0.8%
1993	5120	209238	5155047	153834	117499	36334	73.5%	56.2%	17.4%	3.0%	2.3%	0.7%
1994	5588	303578	5548638	183147	136645	46503	60.3%	45.0%	15.3%	3.3%	2.5%	0.8%
1995	5860	354987	7373933	221218	148889	72330	62.3%	41.9%	20.4%	3.0%	2.0%	1.0%
1996	6289	433290	9077805	276917	175109	101808	63.9%	40.4%	23.5%	3.1%	1.9%	1.1%
1997	6293	448572	11479240	321619	177777	143842	71.7%	39.6%	32.1%	2.8%	1.5%	1.3%
1998	5174	362827	11785621	349555	174067	175488	96.3%	48.0%	48.4%	3.0%	1.5%	1.5%

Source: Based on Table 1 of Grullon and Michaely (2000), "Dividends, share repurchases and the substitution hypothesis."

Figure 1
Cash Distributions to Equityholders as a Percentage of Market Value

This figure depicts the average total payout (dividends plus repurchases) yield, the average dividend yeild, and the average repurchase yield (all relative to market value) for a sample of US firms. The data sample consists of all firm-year observations on COMPUSTAT (Full-Coverage, Primary, Secondary, Tertiary, Research, and Back Files) over the period 1972-1998 that have positive earnings and have available information on the following variables: REPO, DIV, and MV. REPO is the expenditure on the purchase of common and preferred stocks (COMPUSTAT item # 115) minus any reduction in the value (redemption value) of the net number of preferred shares outstanding (COMPUSTAT item # 56). DIV is the total dollar amount of dividends declared on the common stock (COMPUSTAT item #21). MV is the market value of common stock (COMPUSTAT item #24 times COMPUSTAT item # 25). The total payout is the sum of the dividend payout and the repurchase payout. The data sample contains 121,973 firm-year observations and excludes banks, utilities, and insurance companies.



Source: Based on Table 1 of Grullon and Michaely (2000), "Dividends, share repurchases and the substitution hypothesis."

Table 2: Cash Payout from the Corporate to the private sector

Year	Share of corporate equity owned by individuals	Total dividends paid by US corporations (In Billions of $)[b]	Dividends received by corporations[c]	Dividends received by Individuals[d] (% of total div)	Dividends received by individual with an adjusted gross income of over 50,000 relative to dividend received by all individual investors[e]
1973	0.774	29.9	9.4	18.7 (62%)	42%
1974	0.740	33.2	13.8	20.8 (63%)	44%
1975	0.727	33	8.8	21.9 (66%)	45%
1976	0.741	39	11.9	24.5 (63%)	46%
1977	0.718	44.8	13.9	27.8 (62%)	47%
1978	0.696	50.8	13.3	30.2 (59%)	50%
1979	0.708	57.7	16.8	33.5 (58%)	53%
1980	0.710	64.1	18.6	43.6 (68%)	54%
1981	0.690	73.8	17.4	48.1 (65%)	52%
1982	0.653	76.2	18.15	52.1 (68%)	55%
1983	0.624	83.6	19.7	48.6 (58%)	56%
1984	0.600	91.0	21.2	48.6 (53%)	57%
1985	0.572	97.7	16.9	55.0 (56%)	58%
1986	0.592	106.3	15.1	61.6 (58%)	61%
1987	0.578	112.2	13.8	66.8 (59%)	57%
1988	0.617	129.6	15.1	77.3 (60%)	64%
1989	0.612	155	15.4	81.3 (52%)	66%
1990	0.617	165.6	13.4	80.2 (48%)	66%
1991	0.630	178.5	13.1	77.3 (43%)	66%
1992	0.620	185.5	13.1	77.9 (42%)	67%
1993	0.611	203.2	13.6	79.7 (39%)	65%
1994	0.585	234.9	13.2	82.4 (35%)	66%
1995	0.579	254.2	22.8	94.6 (37%)	71%
1996	0.543	297.7	16.3	104.2 (35%)	73%

1997	0.513	333.7	NA	NA	NA
1998	0.485	348.6	NA	NA	NA
1999	0.495	364.7	NA	NA	NA

a. Authors' calculation with data on market value of domestic corporations and the holding (at market value) of households, personal trust and estates. Source Table L.213 from the Federal Reserve statistical release, Flow of Funds Accounts of the United States, March 2000.

b. From the federal reserve, Flow of Funds Accounts of the united States, Table f.7, March 2000.

c. We include only dividends received from domestic corporations. Internal revenue Service, SOI Bulletin, Corporations return, Table 2, various years

d Internal revenue Service, SOI Bulletin, Individuals Tax Returns, Table 1.4, various years.

e. Internal revenue Service, SOI Bulletin, Individuals Tax Returns, Table 1.4, various years

Example

There are perfect capital markets

There are no personal or corporate taxes

Shareholders want the firm to maximize NPV

Shareholders have an opportunity cost of capital of 10%

The firm is in the following situation:

Cash	$100
Number of shares	100

The firm has access to three investment projects:

Project	Investment at t = 0	Payoff at t = 1	Pres. Value at 10%	Net Pres. Value at 10%
A	$50	$77	$70	$20
B	$40	$55	$50	$10
C	$10	$10	$9	-$1

These are the only investments the firm can make. Suppose initially:

(i) the firm cannot borrow or lend;

(ii) cannot issue or repurchase equity.

I

Three of its alternative strategies are:

1. Invest $50 in Project A and pay the remaining $50 in dividends.

2. Invest $90 in projects A and B and pay out the remaining $10 in dividends.

3. Invest $100 in Projects A, B and C and pay out nothing in dividends.

What should the firm do?

II

Suppose next we relax (i) and assume the firm can borrow or lend up to $60 at 9% but no more than this; however, it cannot issue or repurchase any equity. Two of its alternatives are:

a. Invest $90 in A and B, borrow nothing and pay out $10 in dividends.

b. Invest $90 in A and B, borrow $60 and pay out $70 in dividends.

What should it do now (taking its investment as given at $90)?

III

Holding investment and borrowing constant and assuming shareholders can lend and borrow at 10% as before, two alternatives the firm faces are:

(i) Invest $90 in A and B, borrow nothing and pay $10 in dividends.

(ii) Invest $90 in A and B, borrow nothing and repurchase $10 in shares.

Which of these strategies is best?

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LECTURE NOTES

Franklin Allen

Fall 2011

QUARTER 2 - WEEK 4 and WEEK 5 (Part 1)

Tu: 11/15/11, Th: 11/17/11 and Tu: 11/22/11

Section 13: Capital Structure

Read Chapters 17 and 18 BMA

Introduction

The assumption behind most of the analysis we have done so far is that the firm is all equity financed. In practice, of course, firms use debt and many other types of security to finance themselves. In this section we are interested in whether using different types of security, in particular debt and equity, creates value for shareholders.

Motivation Example

The Saw Company is reviewing its capital structure. It pays no taxes and has access to perfect capital markets. The interest rate on debt is 10 percent. Its current position is as follows:

Data	Number of shares	100
	Price per share	$20
	Market value of shares	$2000
	Market Value of debt	$0

Possible Outcomes (unlevered):

	Sit 1	Sit 2	Sit 3
		(Expected Outcome)	
Operating income $	100	250	300
Earnings per share $	1	2.5	3
Return on equity %	5	12.5	15

The company has no leverage and all the operating income is paid out as dividends to the common stockholders.

The expected earnings and dividends per share are $2.50. This is an average; actual earnings could turn out to be more or less than $2.50. The price of each share is $20. Since the firm expects to produce a level stream of earnings in perpetuity, the expected return is given by:

$$r = \frac{EPS}{P} = \frac{2.50}{20} = 12.5\%$$

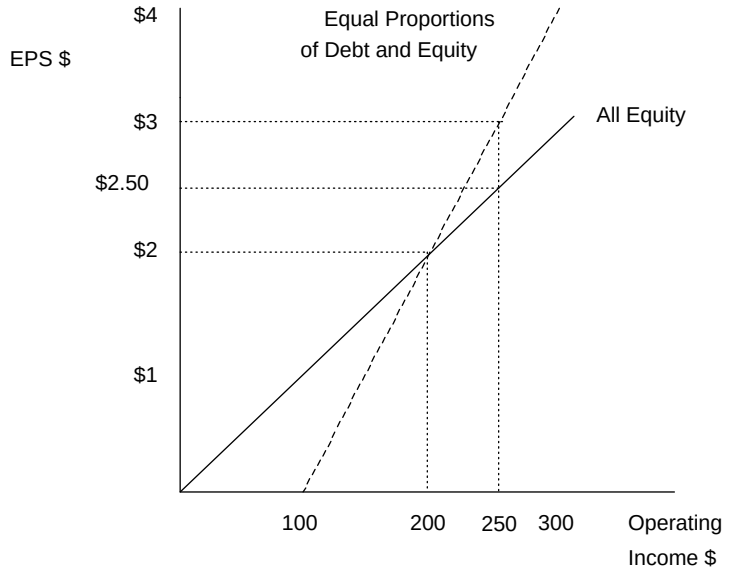
Mr. Modigliani, a Harvard MBA and the firm's president, has come to the conclusion that shareholders would be better off if the company had equal proportions of debt and equity. He therefore proposes to issue $1000 of debt at the risk free lending and borrowing rate of 10% and use the proceeds to repurchase 50 shares. To support his proposal Mr. Modigliani has analyzed the situation under the various different assumptions about operating income. The results are as follows:

Data	Number of shares	50
	Market value of debt	$1000
	r_D = 10%	

Possible Outcomes (levered)

	Sit 1	Sit 2	Sit 3
		(Expected Outcome)	
Operating income $	100	250	300
Interest $	100	100	100
Equity Earnings $	0	150	200
EPS $	0	3	4
Return on equity %	0	15	20
Return on debt %	10	10	10

We can plot this data on the following diagram:



Mr Modigliani argues as follows: "It can be seen from this diagram that the effect of leverage depends on the company's operating income. If this is greater than $200, the EPS are increased by leverage and our shareholders are better off. If it is less than $200, the EPS are

reduced by leverage. Our capital structure decision, therefore, depends on what we think operating income will be. Since on average we expect operating income to be $250 which is above the critical level of $200, the shareholders will be better off with levered capital structure."

Is this argument correct do you think?

Ms. Miller, who has recently graduated from Wharton and is a young executive on the fast track, counters Mr. Modigliani's argument as follows: "Leverage will help the shareholders as long as operating income is above $200. But your argument ignores the fact that shareholders have the alternative of borrowing on their own account. For example, suppose that a person borrows $20 and then invests a total of $40 in two unlevered Saw shares. This person has to put up only $20 of his own money. The payoff on the investment is as follows:

Possible Outcomes (using unlevered shares with personal borrowing)

	Sit 1	Sit 2	Sit 3
		(Expected Outcome)	
Earnings on the 2 shares $	2	5	6
Less interest at 10% on $20	2	2	2
Net earnings on inv. $	0	3	4
Return on $20 inv, %	0	15	20

By buying two shares in the unlevered company and borrowing $20 the returns are exactly the same as buying 1 share of the levered firm. Therefore a share in the levered company must sell for (2 x 20 - 20) = $20. If the company goes ahead and borrows, it will not allow its investors to do anything that they could not already do and so will not increase value."

It is this idea that is behind:

Modigliani Miller Proposition I

With perfect capital markets and no taxes, the total value of any firm is independent of its capital structure.

Thus Modigliani and Miller (MM) argue that with perfect capital markets and no taxes capital structure is irrelevant. You can't create value by borrowing or lending. Any combination of securities is as good as another; the value of the firm is unaffected by its choice of capital structure. The reason is individuals can essentially do or undo anything the firm can on their own. This is an extremely powerful argument. We have seen it in one particular situation but it works in a huge variety of situations.

Before leaving this area let's consider one more case. Continuing with our Saw example, suppose the firm was levered to start with and had fifty percent debt and fifty percent equity. How could somebody create the equivalent of unlevered equity using levered equity and debt?

Consider the following strategy.

Buy 1 levered share at $20

Lend $20 at 10%

} Invest $40 in total

What is the payoff to this strategy?

Possible Outcomes

	Sit 1	Sit 2	Sit 3
		(Expected Outcome)	
Earnings on 1 levered share $	0	3	4
plus interest at 10% on $20	2	2	2
Net earnings on inv. $	2	5	6
Return on $40 inv, %	5	12.5	15

It can be seen that the percentage returns on the portfolio are in fact just like the unlevered equity. The portfolio of buy one levered share and lend $20 is like two shares of unlevered equity. If you simply halved everything you would have the payoffs for one share; i.e. buy half a share of levered and lend $10 gives the same payoffs as one share of unlevered.

Given a firm has any level of leverage to start with any other level can be created by an investor by borrowing or lending on their own account. Investors will always hold their optimal required level of leverage. If the firm changes it's capital structure investors will simply take offsetting positions to undo what the firm has done so they can go back to their optimal level. Therefore a firm cannot create value by changing capital structure provided there are perfect capital markets and no taxes.

The Return-Leverage Relationship

Consider the expected returns on SAW stock in the two cases we looked at.

	All equity	50%D + 50%E
Expected EPS $	$2.5	$3
Price per share $	$20	$20
Expected return on share%	12.5%	15%

Intuitively, what is happening here? The firm can borrow at 10% and the return on its assets is 12.5%. It therefore makes 12.5% - 10% = 2.5% from borrowing against its assets. If it borrows half its value it makes 2.5% on the half it borrows plus 12.5% on the half it still owns which gives a total return of 2.5+12.5 = 15%.

This is a specific example. What we need to do next is to develop a general version of this. In other words, how does the return on equity vary with leverage? We can see this in the following way. The expected return on a firm's assets, r_A, is equal to the expected operating income divided by the total value of the firm which must be equal to the total market value of the firm's securities (otherwise there would be an arbitrage opportunity) so:

$$\text{Expected return on assets} = r_A = \frac{\text{Expected operating income}}{\text{Total firm value}}$$

The firm's borrowing decision does not affect its operating income; that is determined by the markets the firm operates in and the success of its business strategies. Proposition I implies that it does not affect the total firm value. Therefore r_A is independent of its debt decision.

Suppose that somebody were to hold a portfolio consisting of all of a firm's debt and all of its equity. The interest on the debt would cancel out and the investor would simply receive the firm's operating income. It follows from this that the expected return on the portfolio would be equal to r_A.

We know from Section 7 that the expected return on a portfolio of two stocks is equal to a weighted average of the expected returns on the individual securities. Therefore the expected return on a portfolio consisting of all the firm's debt and equity is

$$r_A = r_{port} = \frac{D}{D+E} r_D + \frac{E}{D+E} r_E$$

where D and E are the amount of the firm's debt and equity respectively. Rearranging,

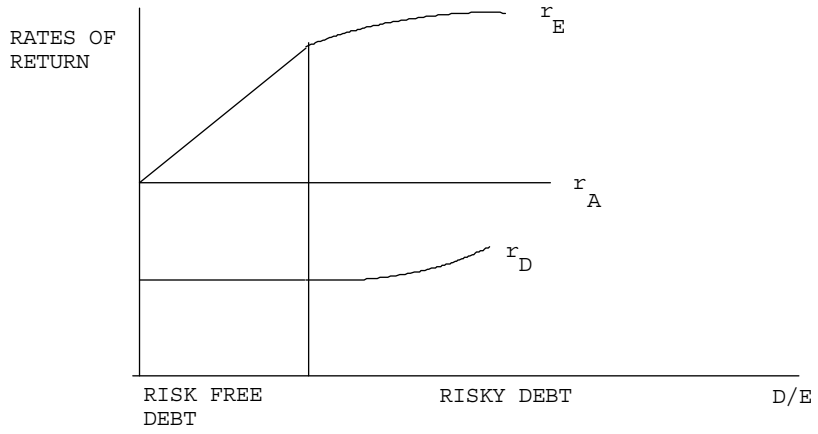
$$r_E = r_A + \frac{D}{E}(r_A - r_D)$$

This is the basis of MM's Proposition II.

MM Proposition II

The expected rate of return on the common stock of a levered firm increases in proportion to the D/E ratio expressed in market values; the rate of increase depends on the spread between r_A and r_D.

We can see the general implications of MM II graphically as below.



The figure assumes that the bonds are essentially risk free at low debt levels. Thus r_D is independent of D/E and r_E increases linearly as D/E increases. As the firm borrows more, the probability of default increases and some of the risk is transferred from stockholders to bondholders. The firm is required to pay higher rates of interest on debt. Proposition II predicts that when this occurs, the slope of the line is reduced so it flattens out.

The Risk-Leverage Relationship

We know from Proposition I that a firm's borrowing does not affect its value. We also know from Proposition II that the rate of return on equity increases as leverage increases. At first sight these results seem rather contradictory. How can they be reconciled?

What is happening is that risk is increasing as leverage increases. To see this intuitively, consider our example. Look at what happens to the risk of SAW shares if it moves from all equity to 50% debt and 50% equity.

	Operating Income	
	$100	$300
All equity: EPS $	$1	$3
Return on shares %	5%	15%
50% D + 50% E: EPS $	0$	$4
Return on shares %	0%	20%

The difference in operating income between situations 1 and 3 is $300 - $100 = $200 no matter what the leverage is. With all-equity financing this $200 change is spread over 100 shares so the variation in EPS is $2 per share. With 50% debt and equity, the same change in operating income is spread over 50 shares so the variation in earnings is $4 per share. The spread of percentage returns is also amplified; the percentage spread with leverage is 20% as opposed to 10% with all equity. Thus whatever beta of the firm's shares with all equity financing, it is twice as high with 50% debt and equity

$$2\beta_{\text{All Equity}} = \beta_{50\%D+E}$$

We can see how this works in general in the following way. As we know from our discussion of beta, the beta of the firm's assets is a weighted average of the betas of the individual securities:

$$\beta_A = \frac{D}{D+E}\beta_D + \frac{E}{D+E}\beta_E$$

Rearranging,

$$\beta_E = \beta_A + \frac{D}{E}(\beta_A - \beta_D)$$

When D/E = 1, so that we have a 50% debt ratio (i.e debt ratio is D/(D+E)), and the beta of the debt equals 0, we can see that the beta of the equity equals twice the beta of the assets where the beta of the assets is equal to the beta of the all-equity firm.

Importance of MM propositions

MM's propositions are again a starting point. Their importance is in indicating what we should and should not look for in determining optimal capital structure. Earnings per share and return on equity are not important in determining optimal capital structure. We can always make these large by borrowing more. We are not any better off, however, risk has gone up and this offsets the increase in expected return. What are important in determining optimal capital structure are market imperfections and taxes. We turn to these next.

The Effects of Taxes and Market Imperfections

We are going to next incorporate MM's insights into a more realistic model in which there are taxes and costs of bankruptcy. We are going to look at how firms should respond to these in well-functioning capital markets. We start with corporate taxes.

Corporate Taxes

Under the U.S. corporate tax code and in many other countries, there is an important difference in the way in which interest and dividends are treated. Historically, interest has been regarded as a cost of doing business and as a result it is tax deductible. In contrast dividends have been treated as the return to the owners and are therefore not tax deductible. This difference in treatment causes a bias toward debt finance.

To illustrate the effects of this consider the following simple example. Suppose there is certainty and the discount rate is 10%. There are two firms: U and L. The unlevered firm, U, has no debt, and the levered firm, L, has borrowed $200 at 10%. Otherwise they are the same. Firm L's debt is perpetual. The income statements for the firms, which are expected to continue in perpetuity, are:

	Income Statement of Firm U	Income Statement of Firm L
Operating income $	100	100
Interest to bondholders $	0	20
Pretax income $	100	80
Tax at 30% $	30	24
Net income to stockholders $	70	56
Value of equity $	700	560
Value of debt $	0	200
Value of debt and equity $	700	760

The tax bill of L is $6 less than that of U because of the tax shield provided by debt. The tax shields provided by debt financing are thus valuable assets. How do we value them? Given that the debt is permanent, then the value of the tax shield is the discounted value of the $6 stream of cash flows. What rate should these be discounted at? In the above example there was certainty so there is no problem choosing this: we just use the same 10% rate. Hence

$$\text{PV of tax shield} = \frac{6}{0.10} = \$60$$

In effect, the government assumes \$60 or 30% of the \$200 debt obligation of L.

In our example who is it that effectively pays the corporate income tax? It's the shareholders. It is they who benefit from the reduction in corporate taxes that arises when the firm levers up and reduces its taxes. To see this suppose the firm starts out with all equity so it is worth \$700. The firm then issues \$200 in debt and the cash received is paid out to shareholders. Shareholders have \$200 in cash and \$560 in equity for a total of \$760. They are \$60 better off as a result of the tax shield from the debt.

Risky Debt

How do we value the tax shields with risk? The most common assumption is that the risk of the tax shields is the same as that of the interest payments generating them. Thus, to generalize, if T_c denotes the corporate tax rate,

$$\text{Interest payment} = r_D D$$

$$\text{PV tax shield} = \frac{T_c r_D D}{1 + r_D} + \frac{T_c r_D D}{(1 + r_D)^2} + \ldots = \frac{T_c r_D D}{r_D} = T_c D$$

Thus, under these assumptions the PV of the tax shield is independent of r_D. This result depends on the debt being perpetual. If it is not the value of the tax shield will depend on r_D.

It follows from this analysis that Modigliani and Miller's theorem "corrected" to reflect the corporate income tax is the following.

The Modigliani-Miller Theorem with Corporate Taxes

If interest is deductible for corporations then

Total PV of firm = PV if all-equity financed + PV tax shield.

Corporate and Personal Taxes

So far we have concentrated on the effects of corporate taxes. But what is it that holders of securities are interested in? They are interested in the money they can actually spend. Since they must pay income tax on the receipts from securities, we must also consider the effects of personal taxes.

If the tax rate on income from equity is the same as the tax rate on the income from debt, then there is no change in our theory since personal taxes do not favor debt or equity. It can straightforwardly be shown that they do not alter present value since they simply "wash out".

To see this suppose that income from equity is taxed at the same 25 percent rate as income from bonds. Then in our example:

	Firm U	Firm L
Before personal tax receipts of stock- and bondholders $	70	56+20=76
After tax receipts $	0.75 x 70 = 52.50	0.75 x 76 = 57

In this case, the after tax value of the tax shield arising from the interest is 57 – 52.50 = $4.50. Suppose the tax shield is expected to persist in perpetuity as before. How should we value the tax shield?

We know that individuals can earn 10 percent before tax on investments with similar riskiness. Should we discount at this rate? No, because the figure the investor is interested in is

her after tax opportunity cost of capital. Therefore, we discount at the after tax cost of capital of (1 - 0.25) x 0.10 = 0.075. Hence, in this case

$$\text{PV tax shield} = \frac{4.50}{0.075} = \frac{6 \times 0.75}{0.1 \times 0.75} = \$60$$

Provided income from equity is taxed at the same rate as interest from bonds, personal taxes have no effect and we are back to the Modigliani and Miller theorem with corporate taxes.

Is there a problem with this argument? The problem is that, as we pointed out in the section on dividend policy, firms can help equityholders avoid taxes by paying money out in the form of capital gains. In this case, the taxes on income from debt and equity are different and there is a personal tax advantage to equity financing. When analyzing capital structure, we should therefore try to take personal as well as corporate taxes into account. The problem is that this effect is difficult to quantify. You should just remember that the personal tax advantage to equity may offset the corporate tax advantage to debt at least partially.

Even if the tax advantage to debt is less than considering corporate taxes alone, nevertheless it appears substantial. We are effectively back to the Modigliani Miller theorem with corporate taxes. Given this what should firms do? It would appear they should borrow as much as possible to gain the maximum possible tax shield. But in fact they do not borrow very much. On average corporations' debt ratio (i.e. debt/total value) has been around 30-40% in recent decades.

How can we explain why firms do not borrow more? To do this we must turn to capital market imperfections: the costs of financial distress such as bankruptcy costs.

Bankruptcy in an MM World

If firms have a capital structure with a high proportion of debt, they have a high probability of bankruptcy. How did bankruptcy figure into our Modigliani Miller analysis? There was nothing in our derivation of the MM propositions that said that firms could not go bankrupt in some situations. In an ideal world with perfect capital markets, what happens when a firm cannot pay its debt obligations? It would go bankrupt in the evening and during the night it would issue new securities and the bondholders would receive the proceeds. In the morning, the firm would continue as normal. Bankruptcy would not be costly at all and would not affect the total value of the firm. Thus with perfect capital markets the possibility of bankruptcy does not affect the debt/equity decision at all.

To see how bankruptcy works in an MM world with no taxes and perfect capital markets consider a simple example. The key point is that in an MM world information affects the total value of a firm but for given information the total value of the firm is unaffected by its capital structure.

Capital structure 1: Debt of 50

		Good news	Bad news
Total firm value	100	120	60
Debt	50	50	50
Equity	50	70	10

Capital structure 2: Debt of 70

		Good news	Bad news
Total firm value	100	120	60
Debt	70	70	60
Equity	30	50	0

With capital structure 1 the variation in value because of the news is borne entirely by the equityholders. With capital structure 2 it is borne by the equityholders when there is good news but by both groups when there is bad news. In this case the firm goes bankrupt since the total value is 60 which is less than the value of the debt of 70. The firm is relaunched with zero transaction costs. There may, for example, be an issue of 30 in equity and 30 in debt for the total of 60. All of these proceeds go to the original bondholder. The existence of bankruptcy doesn't affect total value. No matter whether the debt is 50 or 70 the total firm value is 100 initially, 120 with good news, and 60 with bad news.

Costs of Financial Distress

In practice, of course, bankruptcy does not work like this. It is a lengthy and costly process. In other words capital markets are imperfect. If a firm goes bankrupt it incurs the costs of bankruptcy. In our example the relaunching will cost something. Suppose you have to pay the investment bankers and lawyers 15 so the proceeds from the issues will not be 60 but 60-15 = 45. Now capital structure does matter. Debt has a cost.

Payments to bankers and lawyers are not the only costs of bankruptcy that can occur. These are discussed in greater detail below. Also, even if the firm doesn't go bankrupt there may be agency costs. We will also consider what these are below.

Together bankruptcy costs and agency costs are known as costs of financial distress. We can incorporate these into our analysis as follows.

The Modigliani-Miller Theorem with Taxes and Costs of Financial Distress

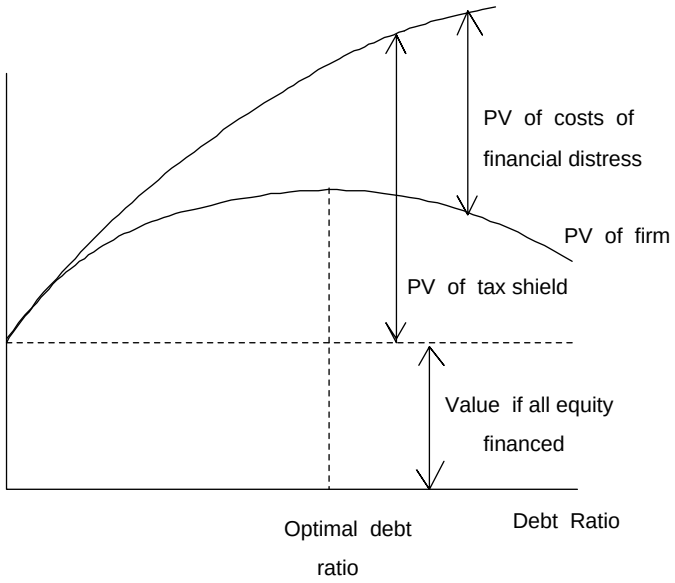
The value of the firm is:

Total PV of firm = PV if all-equity financed + PV tax shield

- PV costs of financial distress

The costs of financial distress depend on the probability of distress and the magnitude of costs encountered if distress occurs.

Taking the costs as given, the greater the leverage of the firm the greater the probability of financial distress. Hence there is a trade-off between the tax advantage of leverage and the disadvantage of leverage caused by the costs of financial distress.



The figure shows how optimal capital structure is determined. The PV of the tax shield increases as the firm borrows more. At low levels of debt, the probability of bankruptcy is zero

so the debt is risk free and there are no expected costs of financial distress. As debt levels rise, bankruptcy becomes a real possibility and the expected costs of financial distress rise. The optimal capital structure is when the PV of the firm is maximized.

What are the Costs of Financial Distress?

We turn next to consider exactly what the costs of financial distress are. They can be divided into three categories.

1. Direct costs of bankruptcy.
2. Indirect costs of bankruptcy.
3. Agency costs of financial distress.

Direct Bankruptcy Costs

There are two types of costs associated with bankruptcy: direct and indirect. The direct costs are the legal costs involved in invoking bankruptcy and liquidating the firm, and we start by considering these.

Evidence on Direct Bankruptcy Costs

In order to assess the importance of direct bankruptcy costs, to get a rough idea how important the costs are when most firms make capital structure decisions, we should have some idea of the magnitude of these.

Warner (1977, Journal of Finance, pp. 337-347) reported legal and administrative costs for 11 railroad bankruptcies. The reason railroad bankruptcies are of particular interest is that they are notoriously complicated. There are railroad cases where the time in bankruptcy court exceeded 20 years. On average, Warner found the direct costs were $2M. On average, this was

5.3% of the overall market value of the railroads' debt and equity estimated just before bankruptcy. The costs decline to 1.4% of overall market value estimated 5 years prior to bankruptcy when the railroads were in better health. These magnitudes are small relative to the tax advantage of debt.

The firms Warner looked at were fairly large. Bankruptcy costs are likely to be proportionately larger for small firms: there are economies of scale in going bankrupt as in many other economic endeavors. However, even in these cases it seems unlikely that they will be very large relative to the tax advantages of debt.

Indirect Costs of Bankruptcy

In addition to direct legal and administrative costs of bankruptcy, there are also indirect costs of bankruptcy, which are very difficult to measure. They reflect the difficulties of running a business while it is going through bankruptcy. The legal process of bankruptcy is complex and management must continually obtain permission from the court for any important decisions it makes. How big are these costs? They are probably fairly substantial, perhaps of the same order of magnitude as a strike. However, they are still small relative to the tax shield on debt.

Agency Costs of Financial Distress

Bankruptcy costs are not the only difficulty when firms have a high level of debt. Another important problem is that firms' incentives are distorted.

To see the basic problem suppose a firm has $1,000 in cash the day before its debt, which has a face value of $5,000, comes due. If the equity holders (or the managers acting on their behalf) do nothing then the firm will go bankrupt and they will get nothing. What should

they do? Suppose the equity holders took the cash and went to Atlantic City. If they win they might get $20,000 say. In that case they can pay off the $5,000 debt and still have $15,000 left over. If they lose they get nothing but they would have got nothing anyway so they are no worse off from gambling. The bondholders are of course worse off if the gambling is unsuccessful, they get nothing whereas they would have got $1,000 if the equity holders hadn't gambled. The problem is that when the firm is near bankruptcy the equity holders are gambling with the bond holders' money. They will therefore be prepared to invest in risky projects even though they are negative NPV. Although this example may seem rather extreme something rather like it happened early on in Federal Express' history. Fortunately in that case they won but they could just have easily lost.

As we shall see undertaking negative NPV projects is not the only problem; firms also have an incentive to forego positive NPV projects. To see these problems in more detail let's consider some simple examples.

Example where firm will accept negative NPV project

Firm has $1,000 in cash. Bonds with $5,000 owed.

Firm does nothing

$$V_{Bonds} = \$1{,}000$$

$$V_{Equity} = \$0$$

Firm can invest in project costing $1000

Probability = 0.02	Payoff = $20,000
Probability = 0.98	Payoff = $0

Expected payoff on project = -1,000 + 0.02 x 20,000 + 0.98 x 0

= -1,000 + 400 = -$600

This is a very bad project.

Firm does project

If it's successful,

V_{Bonds} = $5,000

V_{Equity} = $15,000

If it's unsuccessful,

V_{Bonds} = $0

V_{Equity} = $0

Therefore, before the outcome of the project is known

EV_{Bonds} = 0.02 x 5,000 + 0.98 x 0 = $100

EV_{Equity} = 0.02 x 15,000 + 0.98 x 0 = $300

Notice that the bondholders are worse off and the equityholders are much better off. Thus even though its a bad project, it's worth doing as far as the equityholders are concerned. The conclusion is:

The stockholders of levered firms gain when business risk increases.

Example where the firm will forego good projects

The problem here is that equityholders have to share rewards with bondholders if the firm has debt outstanding. Suppose the firm has no cash and has debt with face value of $10,000. If it does nothing, the firm will go bankrupt. Also suppose the firm has the following investment opportunity:

Project: Invest $2,000: Yields $11,000 with certainty

Expected payoff = -2,000 + 11,000 = +$9,000

This is clearly a very attractive project. Is it worth the firm doing it? If they do it, bondholders get $10,000. Equityholders will not be prepared to put up the money for investment since even though it's a very good project:

Payoff to equityholders = -2,000 + 1,000 = -$1,000.

This example illustrates the following conclusion

Holding business risk constant, any increase in firm value is shared among bondholders and stockholders.

Thus, only if bondholders are willing to put up most of the money will the firm undertake the investment. However, bondholders may get very imperfect information. They

may not be able to tell whether it's this type of project or the type that we had in the previous example.

The Cost of These Conflicts

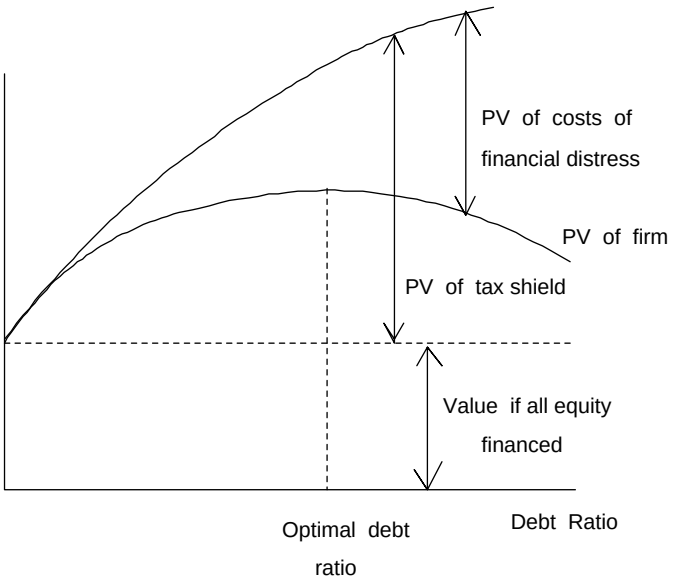
The more firms borrow, the more likely it is that these conflicts of interest will arise. Stockholders know this and put fine print into debt contracts to prevent situations from arising in which this is likely to occur. It's mainly a problem at high leverage levels, and therefore the fine print attempts to prevent borrowing so that these high debt equity ratios aren't reached. Thus agency costs can potentially be large and help explain why firms don't borrow very much.

Finding a Firm's Optimal Capital Structure

To briefly summarize where we are, we have argued

Total PV of firm = PV if all-equity financed + PV tax shield

- PV costs of financial distress



As the firm increases its debt ratio, it usually increases the value of the tax shield, but it also increases the costs of financial distress. Beyond some point, the additional tax shield is outweighed by the additional cost of financial distress.

How can this theory be applied in practice? The value if all-equity financed can be found using standard NPV techniques of the type we considered in Section 6. The PV of the tax shields can also be found by discounting each year's interest tax shields.

This leaves the costs of financial distress. These are much more difficult to find. They come from a variety of different sources and the indirect costs of bankruptcy and the agency costs of financial distress in particular are difficult to quantify. Direct measurement of the costs of financial distress is therefore not usually possible.

How can optimal capital structure be found given this? Over time a firm's managers are able to get some idea of their firm's costs of financial distress and choose the debt ratio taking this into account. Also in a typical industry, there is usually a range of different capital structures. If one capital structure is better than another, the firms using it will tend to do better.

Over time there are therefore a number of reasons to believe that firms will move toward an optimal capital structure. Hence one way of finding a firm's optimal debt ratio is to look at the historic debt ratio for the firm and for other similar firms in the industry.

The trade-off theory of capital structure outlined here is very important. The reason is that it underlies many techniques of capital budgeting and valuation that are used in practice. Modigliani and Miller is subtle and it takes a while to sink in but only with a proper understanding can you understand how to adapt valuation techniques in various circumstances.

Short-term versus Long-term Capital Structure

The analysis above takes into account long term factors. In the short term there may be other factors such as *asymmetric information* which are important. How can this affect capital structure decisions?

To see this, consider the following situation. Suppose a firm is considering an acquisition. Outsiders (i.e. the market) think the acquisition the firm is considering is worth 100. The managers of the firm thinking about doing the acquisition have superior information and think it's worth 200. Should the firm use debt or equity to finance the acquisition?

Suppose the firm has funds of 10 and must raise 90 to finance the acquisition. For simplicity, assume the acquisition is the only thing the firm is thinking of doing. Two possible strategies: issue debt of 90 or equity of 90. Which of these is best?

Issue debt of 90

True value of holding = 200 - 90 = 110

Issue equity of 90

Need to sell 90/100 = 90% of the firm's equity to outsiders

Acquirers retain 10%

True value of holding = 0.1 x 200 = 20

These figures demonstrate quite clearly debt is best if an acquiring firm has superior information. If equity is used the gains must be shared with other investors while with debt the originating firm gets all the benefits.

Similarly, if the firm is overvalued in the market it has an incentive to issue equity because losses are shared with other investors. This is why equity issues are often interpreted as a bad signal and stock prices fall when they are announced.

In general, short term factors can be quite different from long term factors. Hence in leveraged buyouts, for example, we often see large amounts of debt to start with. Once information becomes symmetric again the debt is paid off and a long term capital structure based on the factors in previous sections can be reestablished.

UNIVERSITY OF PENNSYLVANIA

THE WHARTON SCHOOL

FNCE 601

CORPORATE FINANCE

LECTURE NOTES

Franklin Allen

Fall 2011

QUARTER 2 - WEEK 5 and WEEK 6 (Part 1)

Tu: 11/22/11 and Tu: 11/29/11

Section 14. Investment and Financing Decisions

Read Chapter 19 BMA

Motivation

Introduction

In the first part of the course we considered investment decisions taking financing decisions as given. In the second part of the course we considered financing decisions taking investment decisions as given. In this part of the course we bring the two together and look at the interaction of financing and investment decisions.

In Sections 2-9 the procedure we used to value a capital investment project had three steps:

1. Forecast the project's incremental after-tax cash flow assuming all equity finance.
2. Assess the project's risk, i.e. its beta and estimate the opportunity cost of capital, that is, the best available rate of return that can be obtained on an equivalent-risk investment (i.e. one with the same beta) in the capital markets.
3. Calculate NPV.

In this section we're going to extend the analysis to include value contributed by financing decisions as well as value contributed by investment decisions. There are two ways to add in the financing effects. One is to adjust the cost of capital. We will start with the most common version of this, which is known as the weighted average cost of capital or WACC. This is the one that is most commonly used in practice. The second is known as the Adjusted Present Value or APV. Academics use it but it is not much used in practice yet. We will consider it briefly at the end.

Both approaches are based on the Modigliani and Miller theorem with taxes and costs of financial distress.

The Modigliani-Miller Theorem with Taxes and Costs of Financial Distress

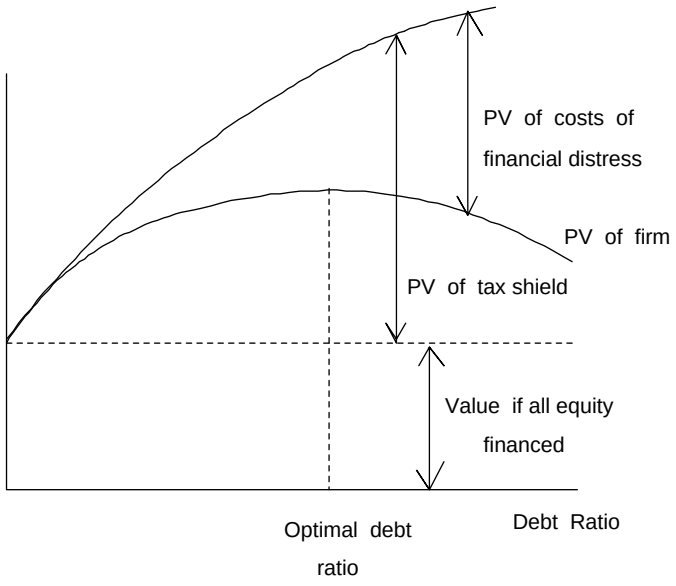
The value of the firm is:

Total PV of firm = PV if all-equity financed + PV tax shield

- PV costs of financial distress

The costs of financial distress depend on the probability of distress and the magnitude of costs encountered if distress occurs.

Taking the costs as given, the greater the leverage of the firm the greater the probability of financial distress. Hence there is a trade-off between the tax advantage of leverage and the disadvantage of leverage caused by the costs of financial distress.



The figure shows how optimal capital structure is determined. The PV of the tax shield increases as the firm borrows more. At low levels of debt, the debt is risk free and there are no costs of financial distress. As debt levels rise, bankruptcy becomes a real possibility and the costs of financial distress rise. The optimal capital structure is when the PV of the firm is maximized.

The Weighted Average Cost of Capital

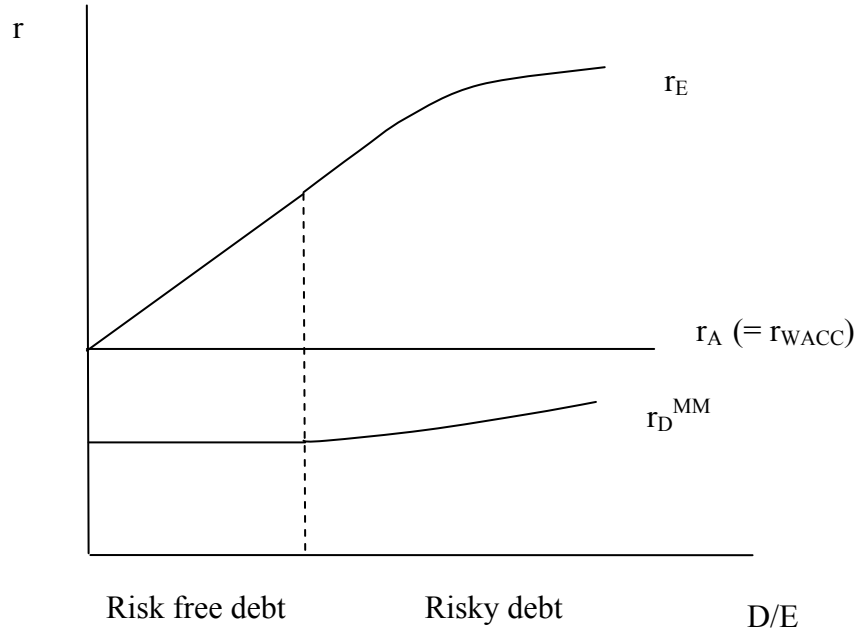
Another way of thinking about optimal capital structure is in terms of the weighted average cost of capital, r_{WACC}. This is given by

$$r_{WACC} = \frac{D}{D+E}(1-T_c)r_D + \frac{E}{D+E}r_E .$$

Where does this expression come from? Without taxes and bankruptcy costs we showed Modigliani and Miller Proposition II. The return on assets was given by

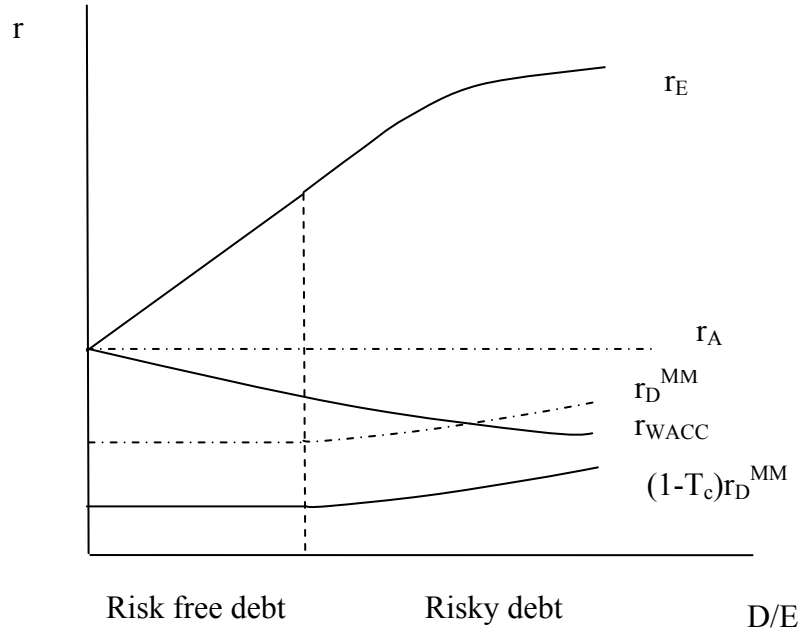
$$r_A = \frac{D}{D+E}r_D + \frac{E}{D+E}r_E$$

This is clearly the same as r_{WACC} when there are no taxes so $T_c = 0$ and capital markets are perfect so the r_D are the same. From Section 9 we know that we could use r_A (= r_{WACC}) as the opportunity cost of capital for projects that had the same risk as the firm. Graphically we had the following.



We have denoted the rate on debt r_D^{MM} to indicate that it is the debt rate that would occur with perfect capital markets. For low D/E ratios the debt is risk free so $r_D^{MM} = r_F$. As D/E rises eventually the debt becomes risky and $r_D^{MM} > r_F$. It is important to interpret r_D^{MM} correctly in this case. It is not the promised rate but rather the expected rate that reflects the risk of bankruptcy. The promised rate will be higher than r_D^{MM} because when the firm goes bankrupt the debt will not be paid (or will only partially be paid). The reason that r_D^{MM} starts to rise above r_F is that the debt is now risky in the sense that it has a beta. If the risk of bankruptcy was entirely diversifiable then it would not rise. However, bankruptcy usually occurs in recessions so the debt has market risk and a positive beta.

The next step is to add in the effect of taxes. The after tax cost of debt is now $(1 - T_c)r_D^{MM}$ as shown below.



Now r_{WACC} is a weighted average of the equity and debt costs. Rather than being a constant as before it falls as the D/E ratio goes up. The higher the debt the greater the tax shield and the lower the weighted average cost of capital.

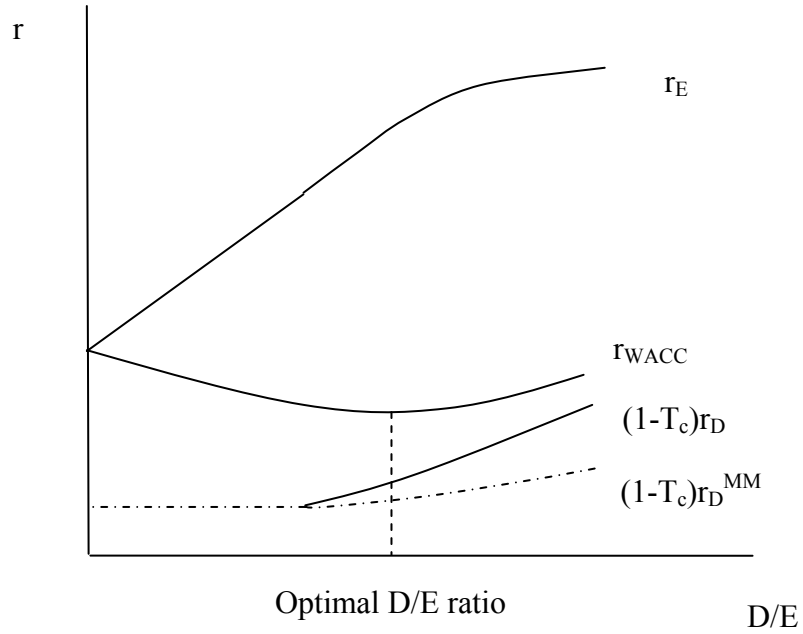
We next add in the effects of imperfect capital markets and in particular the costs of bankruptcy. The line representing the cost of debt is changed. Now the cost of debt is no longer $(1-T_c)r_D^{MM}$. Instead

$$\text{After tax cost of debt} = (1 - T_c)r_D$$

where r_D incorporates the cost of financial distress so for risky debt $r_D > r_D^{MM}$. The r_D term differs from r_D^{MM} because it incorporates costs of financial distress as well as systematic risk due to the beta of the debt. In other words when the firm is in financial distress or bankrupt the bondholders will bear costs. They recognize this when the debt is issued and demand a higher return to compensate them for these costs. i.e.

$$r_D = r_D^{MM} + \text{premium to cover expected costs of financial distress}$$

The weighted average cost of capital for the firm is then as shown below.



The effect of replacing $(1 - T_c)r_D^{MM}$ by $(1 - T_c)r_D$ is to make the weighted average cost of capital a u-shaped function of the D/E ratio. The optimal D/E ratio is where the weighted average cost of capital is minimized. This corresponds to the point at which the total PV of the firm is maximized in our previous diagram.

The value of the financing side effects, most importantly the tax shield and costs of financial distress, are accounted for by incorporating them in the discount rate through $(1 - T_c)r_D$. To see this another way suppose the firm produces a constant cash flow C in perpetuity then

$$\text{PV firm} = \frac{C}{r_{WACC}}.$$

The smaller r_{WACC} the larger is the value of the firm. The value of the firm is maximized when r_{WACC} is minimized.

Next consider a simple project with an initial cost and a cash flow C in perpetuity. Here

$$\text{NPV with financing adjustment} = -\text{Cost} + \frac{C}{r_{WACC}}$$

At the optimum capital structure $(1 - T_c)r_D < r_D^{MM}$ since otherwise the company will use an all equity capital structure. Hence $r_{WACC} < r_A$ (i.e. the return on assets with no taxes and perfect capital markets). The financial side effects relative to the all-equity case are thus incorporated by lowering the discount rate.

Next consider how WACC can be used in practice.

Example 1

The Tucker Corporation has the opportunity to invest in a project that is just like its other business. The cost of the project is $1,000 now (t = 0) and it expects an after-tax cash flow of $600 at t =1 and $700 at t = 2. Thus the after-tax cash flows are:

C_0	C_1	C_2
-1000	600	700

The betas of the debt and equity are $\beta_E = 0.9$ and $\beta_D = 0.075$. The cost of debt is $r_D = 0.08$. The risk free rate is $r_F = 0.05$ and $r_M = 0.15$. Tucker's target debt ratio for such a project is 33 percent. The tax rate is $t_c = 0.35$.

Should the firm undertake the project?

Solution using WACC

The first step is to find r_E. Using the CAPM

$$r_E = 0.05 + 0.9(0.15 - 0.05) = 0.14 .$$

We are now ready to find r_{WACC} using the formula above.

$$r_{WACC} = 0.33 \times (1 - 0.35) \times 0.08 + 0.67 \times 0.14 = 0.111$$

We then simply discount the cash flows at r_{WACC}.

$$NPV = -1{,}000 + \frac{600}{1.111} + \frac{700}{1.111^2}$$

$$= 107$$

The firm should undertake the project.

The advantages and disadvantages of WACC

The WACC thus has a number of advantages and disadvantages. It can be seen that it is easy to use. It also has the disadvantage that it is quite restrictive in a number of ways. The first is that that all variables in the WACC formula refer to the firm as a whole. As a result the formula gives the right discount rate only for projects that are the same as the firm undertaking them. Secondly the weighted average formula is only exact when the firm has a constant debt ratio. This is clearly restrictive. On the other hand it does allow the incorporation of bankruptcy costs and this is an advantage.

There are a number of other formulas for calculating the adjusted cost of capital. These include the Miller-Modigliani formula and the Miles-Ezzell formula. However, these are not used very much. The most widely used formula by far is the WACC formula.

Adjusted Present Value

Finding APV also involves applying MM with corporate taxes and costs of financial distress. The value of the firm is:

PV of firm = PV if all-equity financed (i.e. base case NPV) + PV tax shield

- PV costs of financial distress

The method involves splitting a project into two parts: the investment aspects and the financing aspects. These are valued separately and then added together. Here the financing side effects, again most importantly the tax shield and if possible the costs of financial distress, are taken care of by adding them to the present value of the project if all-equity financed or as we will start calling it the base case NPV.

For example, for a project with a cost at date 0 and then a cash flow of C in perpetuity:

$$\text{Base case NPV (i.e. NPV without financing adjustment)} = -\text{Cost} + \frac{C}{r_A}$$

The APV is then calculated by adding on the PV of the financing side effects

$$\text{APV (includes financing adjustment)} = -\text{Cost} + \frac{C}{r_A} + \text{PV of financing side effects}$$

In certain special cases the APV method can be shown to be the same as the WACC method if you have all the data.

To see how to find APV in practice, consider Example 1. To find the latter we need the discount rate r_A that reflects the risk of assets of the project that are being invested in. This is the discount rate that would apply if we had an all-equity capital structure. We can find it by unlevering β as described next.

Unlevering β_E and β_D to find β_A

The β of a stock will depend on the β of its assets and the amount of debt it has. The more leverage it has the greater will be the β of the equity. It is often important to find the β of a firm's assets so that the riskiness of its business can be compared with that of other firms. In order to do this we have to know how to unlever a β.

In an MM world with no taxes and perfect capital markets if you hold a portfolio consisting of all the debt and equity of the firm the beta of that portfolio is

$$\beta_{\text{Portfolio}} = \frac{E}{D+E}\beta_E + \frac{D}{D+E}\beta_D ,$$

since betas add. If you hold all the debt and equity of the firm then the return on the portfolio is the same as the return on assets of the firm so

$$\beta_{\text{Portfolio}} = \beta_A = \frac{E}{D+E}\beta_E + \frac{D}{D+E}\beta_D \qquad (1)$$

Even if there are taxes it is shown in the book (Chapter 20, p. 544, footnote 15) that this formula still holds provided the firm adjusts its capital structure continuously to maintain the same debt ratio D/(D+E). If the firm adjusts its capital structure once every period, as we shall assume here as it is arguably the more plausible case, then the formula must be changed. If corporate taxes are included the presence of debt creates a tax shield in the usual way. If the firm

has perpetual debt or equivalently keeps rolling over its debt, then the tax shield is T_cD. As a result the effective amount of debt is no longer D but rather $(1 - T_c)D$. The fact that debt interest is tax deductible means the corporation only bears $(1-T_c)$ of the cost of the debt and the government bears the remainder, T_c. Hence, replacing D by $(1-T_c)D$,

$$\beta_A = \frac{E}{(1-T_c)D+E}\beta_E + \frac{(1-T_c)D}{(1-T_c)D+E}\beta_D$$

Equivalently in terms of the debt-equity ratio D/E we have

$$\beta_A = \frac{1}{(1-T_c)D/E+1}\beta_E + \frac{(1-T_c)D/E}{(1-T_c)D/E+1}\beta_D$$

Solution to Example 1

Now D/E = 0.33(D+E)/0.67(D+E) = 0.33/0.67 = 0.5. Substituting in the formula above, we find

$$\beta_A = \frac{1}{0.65\times 0.5+1}0.9 + \frac{0.65\times 0.5}{0.65\times 0.5+1}0.075 = 0.7.$$

Using CAPM,

$$r_A = 0.05 + 0.7(0.15-0.05) = 0.12.$$

We can start by calculating base case NPV.

$$\text{Base case NPV} = -1000 + \frac{600}{1.12} + \frac{700}{(1.12)^2} = \$94$$

To find the value of the interest tax shields, which is the next step, we must find the amount borrowed each year. We are assuming the debt ratio is fixed in terms of base case PV. Each

year we need to calculate the base case PV, which is the PV of the remaining cash flows. We then borrow 33 percent of that.

Period	Base case PV	Contribution to Debt capacity = 0.33 x Base case PV
t = 0	$\frac{600}{1.12}+\frac{700}{1.12^2}=1{,}094$	361
t = 1	$\frac{700}{1.12}=625$	206

We can then calculate the PV of the tax shields by discounting the interest tax shields at $r_D = 0.08$. The reason we discount at r_D is that the riskiness of the tax shields is about the same as the riskiness of the debt.

$$\text{PV tax shield} = \frac{0.35\times 0.08\times 361}{1.08}+\frac{0.35\times 0.08\times 206}{1.08^2}=\$14$$

At date 0 the firm can borrow \$361. At the end of the year at date l it pays interest of 0.08 x 361. The tax savings from this are 0.35 x 0.08 x 361. This is then discounted back to date 0 by dividing by 1.08. The interest tax shield is the only valuation effect of using debt. The optimal debt is \$361 in the first year and \$206 in the second year. At the end of the year it pays down the debt from \$361 to \$206 by issuing \$155 equity. We can proceed similarly for the tax shield for the second year. At the end of the year at date l it pays interest of 0.08 x 206. The tax savings from this are 0.35 x 0.08 x 206. This is then discounted back to date 0 by dividing by 1.08^2.

Thus,

$$\text{APV} = 94 + 14 = \$108$$

It can be seen that this is greater than the NPV calculated using WACC, which was $107. This is often the case since the costs of financial distress are excluded.

The advantages and disadvantages of APV

As explained above the advantage of APV is its flexibility. The project doesn't have to have the same characteristics as the firm. It can have different risk and a different debt ratio. The debt ratio can also vary over time.

So far we have focused on the case where the only financing side effect is the tax shield from debt. The APV method allows other financing side effects such as bankruptcy costs to be included. The problem is that it is often very difficult to obtain estimates about bankruptcy costs. This is the main disadvantage of APV. In practice people are usually forced to ignore them as in Example 1.

Using unlevered cash flows

In Section 6 you may remember we argued you shouldn't deduct interest when calculating cash flows. We argued you would be "double-counting" if you did so. Now that we have seen the WACC and APV methods and the MM theorems they are based on it is hopefully possible to obtain a slightly deeper appreciation of why we work with unlevered cash flows.

In an MM world how we finance doesn't matter. It is therefore easiest to just work with unlevered cash flows and discount at the risk adjusted rate. In a world with imperfections where we use WACC or APV we continue to use this method and take account of the effects of debt financing by the $(1-T_c)$ term in WACC or adding in the side effects in APV.

Summary

Financing side effects should be taken into account in one of two ways. The first alternative is to use the weighted average cost of capital formula:

$$r_{WACC} = \frac{D}{D+E}(1-T_c)r_D + \frac{E}{D+E}r_E .$$

This is the most used adjusted cost of capital despite the fact that it is fairly restrictive. It works well in the circumstances it assumes (i.e. level perpetual cash flow and so forth) but these are narrow.

The second alternative is the adjusted present value method. This involves first calculating the present value of the project as if there were no important side effects. Then adjust present value to calculate the project's total impact on firm value. The rule is:

Accept if APV = Base case NPV + PV of financing side effects > 0.

Although this works in a wide range of circumstances in terms of a wide range of patterns of cash flows and so forth it is usually not possible to include bankruptcy costs.

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THE WHARTON SCHOOL

FNCE 601

CORPORATE FINANCE

LECTURE NOTES

Franklin Allen

Fall 2011

QUARTER 2 - WEEK 6

Tu: 11/29/11 and Th: 12/1/11

Section 15. Valuation of Firms

Read Chapter 19 of BMA

Optional additional reading to follow up if you would like:

T. Koller , M. Goedhart, and D. Wessels (2010). *Valuation: Measuring and Managing the Value of Companies*, Fifth edition. McKinsey and Company, John Wiley.

Pratt, S. P., R. F. Reilly and R. P. Schweihs (2008). *Valuing a Business: The Analysis and Appraisal of Closely Held Companies*, Fifth Edition, McGraw Hill.

Motivation

Introduction

Valuation is one of the most important topics in finance. The need for valuation arises in many areas. For example, in mergers and acquisitions (M&A) where one firm is acquiring another, valuing the target correctly is one of the most critical tasks facing the acquirer. In IPOs the investment bank must evaluate how much the firm is worth. Much of what analysts who do not believe in efficient markets do is to value firms in order to assess whether the current stock market value is correct.

There are commonly used methods of valuing firms. These are:

(i) discounted cash flow (DCF);

(ii) comparable M&A deals;

(iii) comparable publicly traded firms;

(iv) liquidation.

DCF identifies the marginal cash flows and discounts them back to the present at an appropriate discount rate. It is essentially similar to the standard evaluation of investment projects that we have covered in Sections 6, 9 and 14. Now the project is the firm as a whole. The method of comparable M&A deals looks at similar companies that have recently been acquired. It bases the estimate of value on various ratios such as the premium over stock market value two months before the acquisition was announced. The

method of comparable publicly traded firms identifies similar firms and uses various ratios such as the price/earnings ratios to value the firm. Liquidation value gives the value of the firm if it were broken up and sold piece by piece. Each method has advantages and disadvantages in particular circumstances.

It is helpful to illustrate the operation of these methods with an example.

DV Press Example

DV Press is a firm in the printing industry that was founded over 50 years ago. It is one of the fifty largest graphic arts printers in the U.S. producing catalog and magazine inserts, direct advertising material, periodicals (including TV Guide) and catalogs, cloth textbook covers and softbound books. The company's printing facilities employ state-of-the-art technology in the printing, folding, cutting and distribution portion of the industry. DV Press has five divisions: (i) Lithographers; (ii) Colortronics; (iii) Wolf; (iv) Houston and (v) Powellton.

The historical debt ratio of the firm (i.e. debt/total value) is around 25 per cent. It currently has $15 million of debt and 1.6 million shares of equity outstanding. The firm's cost of debt is 8.5 percent and the beta of its equity is 0.9. The beta of its debt is 0.3. The risk free rate is 5% and the market risk premium is 8.4%. The firm is expected to have a marginal tax rate (including federal and local taxes) of 37 percent. The EPS for DV Press is $2.75 per share.

The current date is 12/31/01. Table 1 shows the historical income statements and the projections for the next 10 years. Table 2 shows similar information for the balance sheet. In both tables the numbers are in thousands of dollars. The expected growth rate of cash flows after 2011 is 4%.

What is the value of the firm’s equity per share by the different methods?

(i) Discounted Cash Flow Analysis

The basic idea behind the DCF analysis is that the firm has value because it generates cash for the shareholders. It is this stream of cash flows and the rate at which they should be discounted which determines how much it is worth paying for a firm. The discounted cash flow thus involves two steps. The first is to find the cash flows and the second is to discount them at the appropriate discount rate.

Finding the cash flows

Tables 1 and 2 show the historical and projected income statements and balance sheets. (The Excel tables underlying these can be downloaded from Webcafe.) As mentioned above, these have been provided by management. The projections usually go for between 5 or 10 years since this is the most it is possible to reasonably expect accuracy at that level of detail. In this case ten years have been provided. To take account of the cash flows that occur after 10 years, a terminal value is calculated and discounted back to the present. The projections should be on an unlevered basis to enable you to find the total PV of the firm. The financial side effects of leverage are taken account of by adjusting the discount rate or adding them in separately.

The first problem is to go from this accounting data to the *cash flows* that are the relevant ones for shareholders. What should be included and what should be left out? The basic rules here are essentially the same as in Section 6 on finding the cash flows.

Rule 1: Cash flow after taxes, not net income, is the proper basis for analysis.

Rule 2: The timing of cash flows is critical.

Rule 3: Only incremental cash flows are analyzed (those which occur on the margin because you invest in the firm).

Rule 4: Be consistent in the treatment of inflation.

Using these rules gives the net cash flow or "free cash flow" as it is often called. It is the cash that is available to the owners of the firm including equity and debtholders that is generated on an ongoing basis. To summarize, the basic rule is:

Net cash flow = $(1 - T_c)$Earnings Before Interest and Taxes

+ Depreciation and Amortization

+ Change in deferred taxes

- Change in working capital

- Capital expenditures

Table 3 shows the application of these ideas and gives the resulting cash flows in the context of the example. It is these after-tax cash flows that need to be discounted back to give the value of the firm.

Discounting the cash flows using WACC

Finding the appropriate discount rate for valuations is similar to finding the discount rate in standard investment decisions. The most widely used formula for calculating the cost of capital is the weighted average cost of capital. The formula is

$$r_{WACC} = \frac{D}{D+E}(1-T_c)r_D + \frac{E}{D+E}r_E$$

where r_D is the cost of debt, T_c is the firm's corporate tax rate, D is the **market** value of the firm's debt, E is the **market** value of the firm's equity and D + E is the total value of the firm. Note that the market value of debt is often approximated by the book value but this cannot be done for equity. The WACC is just the weighted average of the after-tax cost of debt $r_D(1 - T_c)$ and the after-tax cost of equity r_E, where the weights depend on the proportions of debt and equity in the firm's capital structure.

Section 4 summarizes the data we need to solve the problem. From there the beta of the equity is 0.9. The first thing is to find the value of r_E using the CAPM.

$$r_E = 0.05 + 0.9(0.134-0.05) = 0.1256$$

The historic debt ratio is 25% and we will take this as the projected debt ratio. Hence the weighted average cost of capital for our DV Press example is

$$r_{WACC} = 0.25(1-0.37)0.085 + 0.75\times0.1256 = 10.76 \text{ percent}$$

To find the value due to the first 10 years, the net cash flows shown in Table 8 are discounted back at 10.76 percent.

$$PV(2002 - 2011) = \frac{8,166}{1.1076} + \frac{8,969}{1.1076^2} + \frac{8,416}{1.1076^3} + \frac{7,499}{1.1076^4} + \frac{8,292}{1.1076^5}$$

$$+ \frac{9,316}{1.1076^6} + \frac{9,391}{1.1076^7} + \frac{11,310}{1.1076^8} + \frac{11,171}{1.1076^9} + \frac{12,065}{1.1076^{10}}$$

$$= \$54,264$$

To find the terminal value representing the cash flows after 2011 we assume that they grow at a constant rate of 4 percent as stated in Table 4. This reflects the effect of inflation and the likely real growth rate in cash flows. For a growing perpetuity recall that

$$PV = \frac{C}{r - g}$$

where C is the cash flow 1 period away, r is the discount rate and g is the growth rate. In this case the cash flow in 2012, 1 period after 2011, is

$$C = 1.04\times12,065 = 12,545.$$

Hence

$$\text{Terminal value as of } 2011 = \frac{12{,}545}{0.1076 - 0.04} = 185{,}576$$

Since this is the terminal value as of 2011 and we are interested in the present value of this we must discount this back to the present.

$$\text{PV(Terminal value as of 2001)} = \frac{185{,}576}{1.1076^{10}} = \$66{,}820$$

Summing the present value of the 2002-2011 cash flows and the present value of the terminal value gives

The total value of the firm = \$54,264 + \$66,820 = \$121,084

Since the values from the tables that have been used are in thousands of dollars this implies that the value of the firm as estimated by discounted cash flow analysis is \$121.084 million.

Subtracting the value of the debt gives

Value of equity = \$121.084 million - \$15 million = \$106.084 million

Since there are 1.6 million shares

Value per share = 106.084/1.6 = \$66.30

Finding share value using APV

As we saw in Section 14, the APV method discounts the cash flows at the return on assets (i.e. the rate if the firm was all-equity financed) and then adds the financing side effects separately.

To find β_{Assets} we need to unlever the beta of the equity and debt. In Section 14 we saw that when there were no taxes

$$\beta_{Assets} = \frac{E}{D+E}\beta_E + \frac{D}{D+E}\beta_D .$$

When corporate taxes are included with adjustment of capital once a period it was shown that

$$\beta_A = \frac{1}{(1-T_c)D/E+1}\beta_E + \frac{(1-T_c)D/E}{(1-T_c)D/E+1}\beta_D$$

where the $(1\text{-}T_c)$ term in front of each D reflects the fact that debt interest is tax deductible. Now since we know that for DV Press D/(D + E) = 0.25 so E/(D+E) = 0.75 we have D/E = 0.25/0.75 = 1/3. Thus

$$\beta_{Assets} = \frac{1}{(1-0.37)(1/3)+1}0.9 + \frac{(1-0.37)(1/3)}{(1-0.37)(1/3)+1}0.3 = 0.796$$

Using this in the CAPM

$$r_{Assets} = 0.05 + 0.796\times 0.084 = 0.117$$

We then use this to find the base case NPV. This is shown in the first part of Table 8. The number at each date is the stream of future cash flows (from Table 3) discounted at 11.7%. It is assumed that after year 2011 there is a growing perpetuity with 4% growth. Thus the figure for 2001 is found from first finding the PV of the 2002-2011 cash flows and then adding the terminal value.

$$\text{Base Case PV} = \frac{8{,}166}{1.117} + \frac{8{,}969}{1.117^2} + \frac{8{,}416}{1.117^3} + \frac{7{,}499}{1.117^4} + \frac{8{,}292}{1.117^5}$$

$$+ \frac{9{,}316}{1.117^6} + \frac{9{,}391}{1.117^7} + \frac{11{,}310}{1.117^8} + \frac{11{,}171}{1.117^9} + \frac{12{,}065}{1.117^{10}} + \frac{1}{1.117^{10}}\left(\frac{12{,}545}{0.117-0.04}\right)$$

= \$106.133 million.

The advantage of the APV method compared to the WACC method is that you can vary the debt ratio. The numbers shown in Table 8 are one illustration of a possible sequence of debt. They correspond to an LBO profile of capital structure over time so there is high debt initially that goes down to the long run optimal level. They are derived using rough judgment rather than a mechanistic formula. Given a debt profile, we can calculate the debt tax shields for each of the years. The values of base case PV after 2001 and 1 are included to give you an idea what percentage of value various dollar amounts of debt are. It can be seen that

PV of tax shields 2002-2011 = $10.930 million

It is important to realize that this is just one possibility. You should do sensitivity analysis by looking at various other profiles of debt. What you will find in this case is that it doesn't make much difference so it is not something you need to worry about that much.

After 2011 we simplify by assuming a target debt ratio of 25% of base case PV and then calculate the tax shield using a growing perpetuity in the usual way.

PV of tax shields after 2011 = $12.617 million

Adding these to the base case PV we get

APV of firm = 106.133 million + 10.930 million + 12.617 million

= $129.680 million

Subtracting the $15 million debt and dividing by 1.6 million shares it can be seen that

PV Equity per share = $71.67

This is somewhat higher than WACC. This is not surprising since the only financing side effect that we have taken account of is the tax shield to debt. We have ignored bankruptcy costs. This is the disadvantage of APV. It will not always be the case that the APV number is higher than the WACC number since there are many other factors involved but often this will happen.

(ii) Comparable M&A Deals

One of the most widely used methods of valuation when there is an acquisition is to look at situations where comparable firms have been acquired. The basic idea behind the method is that in a competitive market similar firms should sell for similar amounts. This is because if there is a wide difference in selling prices buyers will tend to hold back and wait until a cheap firm comes along.

There are at least two major problems in applying this method to valuing firms. The first is that it is often very difficult to find firms which have been sold in the recent past and which are reasonably similar. The second is that even if such firms can be identified it will often not be possible to obtain reliable information on the terms of the transaction. These problems limit the usefulness of the method.

The first step in applying the method is to identify comparable firms. There are at least eight points of comparison.

1. The type of business activity in which the firm is engaged.
2. The size of the business.
3. The form of ownership - closely held or publicly held.
4. The capital structure.
5. The degree of profitability.
6. The competitive position within the industry.
7. The historical growth rate.
8. The physical facilities.

Having identified comparable firms using these criteria, the usual procedure is to look at various ratios and see what values this implies for the value of the firm of interest. For example, by looking at the ratio of the selling price to the stock price before the merger was announced, and multiplying this ratio by the pre-announcement stock market price it is possible to arrive at a value. If the firm's stock market valuation was $100M

and the ratio of the selling price to the stock price before announcement for the comparables was 1.35 (i.e. a premium of 35 percent), this would suggest:

The value of the firm's equity = \$100M × 1.35 = \$135M.

Other statistics concerning the selling price of the firm such as the multiple of sales, the multiple of book, the multiple of earnings, the multiple of cash flow and so on can be used to get some idea of what the firm's value is in a similar way. If there are a number of comparable transactions that are used in this exercise the weighting of these should be on the basis of how comparable the firms are.

Table 9 shows some of the financial details for three firms that have been recently acquired that are comparable to DV Press. The first line in each entry is the target and the second line is the acquirer. The details of the acquisitions of the three firms are as follows.

Foote and Davies: This firm engages in commercial printing. It employs about 1,400 people in its three locations in the U.S. FDI holdings acquired Foote and Davies through a leveraged buyout.

Pandick Inc.: The firm provides financial and corporate printing services. It was acquired in a leveraged buyout by FP acquisition which was founded by the management of Pandick for the purposes of undertaking the buyout.

Webb Company: Webb publishes eight agricultural magazines, a home improvement magazine, a motorcycle magazine, and a financial matters magazine. It also offers printing services. Webb was acquired by

a British company, Pegasus Press, through a cash tender offer and a subsequent merger.

The implied total values in Table 9 are found in the following way.

Sales

It can be seen from Table 9 that the valuation relative to sales based on the comparables is $82 million. This is given by the average ratio of target offer to sales for the comparables times the sales (TSALES) of DV Press. i.e.

The implied value of DV Press = 0.658 × 124.365 million

= $82 million.

Hence,

The value per share of DV Press = $82 million/ 1.6 million

= $51 per share

Premium over market value two months before

The other valuation method shown in Table 9, which is based on the premium of the comparables over stock market value 2 months before, gives a value of $79 million. The value two months before is used because this is usually before information has leaked out about the takeover and is therefore a good baseline. The implied value of DV's equity is given by the average multiple for the comparables of 1.384 times the market value of the DV Press two months before (TMKT2M) of $57.061 million.

The implied value of DV's equity = 1.384 × 57.061 million

= $79 million.

Hence,

The value per share of DV Press = $79 million/ 1.6 million

= $49 per share

It can be seen that based on these firms the range of values implied for DV Press is $49-51 per share. These figures represent what acquirers have paid for similar firms and thus provide some idea of what will be necessary to acquire DV Press. Taking these figures together suggests a value by comparables of around $50 per share. Note this is less than value by DCF. This might be expected because it's what you have to pay rather than what it's worth. Presumably if you are considering an acquisition you will need the DCF price to be higher than the comparable price.

(iii) Comparable Publicly Traded Firms

Another source of information on firm value is to look at the stock market valuation of comparable firms. Although the prices quoted are for shares in such companies rather than the company as a whole so the control premium is excluded they nevertheless provide useful information especially if there are very few or no comparable deals available. The principles for identifying comparable public firms and for using them as the bases of valuations are similar to those for comparable deals. The important point to remember in applying these comparisons of value when the entire business is being sold is that whole companies usually sell at a substantial premium to their stock market valuation. This is because the price on the stock exchange is for a small number of shares and does not include a control premium.

For example, by looking at the price earnings ratio, and multiplying this ratio by the earnings of the firm of interest it is possible to arrive at a value. Table 9 gives 3 comparable firms. If these had been identified before there was a chance of takeover then their ratios such as the price/earnings ratio can be used as a basis for valuation. It can be seen that the average P/E ratio is 15.798. Since the EPS for DV Press is $2.75 per share.

$$\text{Implied value per share of DV Press} = 15.798 \times \$2.75 = \$43$$

Other ratios can be similarly used. In practice the ratios that work well differ industry by industry.

(iv) Liquidation Value

The basic idea of the liquidation valuation approach is to look at a business as the sum of its component parts. The first thing to do is to compile a list of the firm's assets. This is usually difficult to do particularly if the management of the firm is not cooperating. Even if they are it is sometimes difficult to assemble the necessary information. Having arrived at a list of assets, they can be valued either in terms of replacement value or in terms of liquidation value. The replacement value technique provides an upper bound to firm value and the liquidation value technique a lower bound. The usefulness of this approach depends heavily on the quality of the information it is based on.

Table 10 lists the valuation of each division separately. Adding these together gives

The liquidation valuation = 15.8 + 14.1 + 25.6 + 5.3 + 14.2

= $75 million.

The liquidation valuation net of debt = $75 million - $15 million = $60 million

Implied value per share = $60/1.6 = $37.5 per share

Given this it can be seen it is better to keep the firm as a going concern. This is usually but not always the case.

Combining the valuation methods

The DCF analysis gives an idea of how much the firm is worth to the acquirer because it can take into account the synergies. These are the incremental cash flows that

result from acquiring the new firm. It also represents the maximum the acquirer should be willing to pay for the target. The value by comparables represents what the acquirer is likely to have to pay for the firm since it is based on actual transaction prices. Clearly, offers should only be made if the value by DCF is above the value by comparables.

The liquidation value gives the value of the firm if it is broken up into its component parts. If the liquidation value is above both the DCF value and the value by comparables it would be worth purchasing the firm and selling it off piecemeal. Even if there are no synergies and the liquidation value is above the value by comparables it would be worth doing this.

Bidding strategy

In deciding on bidding strategy one factor to take into account is what's called **the winner's curse**. If somebody's valuation of the company is high and they bid a large amount and acquire the target there are two possibilities. One possibility is the valuation is correct and they value the target the most in which case they will make money. Alternatively, the reason they won the bidding contest is that they made a mistake in the valuation and came up with a value that is too high. In this case they will lose money because they have paid too much. The winner's curse occurs when the winning is a result of a mistake. It is better to underbid and lose than to overbid and win. If somebody underbids and does not acquire the company they don't lose anything except the cost of preparing the bid. If they overbid they lose the difference between the bid and the true value as well as the cost of preparing the bid.

Discounted Cash Flow Analysis: Dollars in thousands

TABLE 1

	Historical			Forecast					Projected					
1. INCOME STATEMENT	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Net sales														
TV Guide				$12,000	$12,300	$12,608	$12,923	$13,246	$13,577	$13,916	$14,264	$14,621	$14,986	$15,361
All other				123,199	127,361	134,036	141,053	148,429	156,181	164,330	172,894	181,896	191,356	201,298
Total net sales	116,381	118,939	124,365	135,199	139,661	146,644	153,976	161,675	169,758	178,246	187,158	196,517	206,342	216,659
Cost of goods sold														
Materials			(51,340)	(58,433)	(59,007)	(61,957)	(65,055)	(68,308)	(71,723)	(75,309)	(79,074)	(83,028)	(87,180)	(91,539)
Labor			(21,944)	(23,348)	(23,533)	(24,709)	(25,945)	(27,242)	(28,604)	(30,034)	(31,536)	(33,113)	(34,769)	(36,507)
Production			(13,709)	(13,981)	(15,572)	(16,204)	(16,860)	(17,542)	(18,249)	(18,983)	(19,745)	(20,732)	(21,769)	(22,858)
Total cost of sales	(87,696)	(85,642)	(86,993)	(95,762)	(98,112)	(102,870)	(107,860)	(113,092)	(118,576)	(124,326)	(130,355)	(136,873)	(143,718)	(150,904)
Gross profit	28,685	33,297	37,372	39,437	41,549	43,774	46,116	48,583	51,182	53,920	56,803	59,644	62,624	65,755
Operating expenses														
Selling expense			(6,701)	(7,404)	(7,961)	(8,373)	(8,823)	(9,280)	(9,744)	(10,249)	(10,780)	(11,339)	(11,927)	(12,545)
Administrative expense			(14,963)	(14,029)	(15,572)	(16,351)	(17,168)	(18,027)	(18,928)	(19,874)	(20,868)	(21,912)	(23,007)	(24,158)
Total operating expense	(19,138)	(20,570)	(21,664)	(21,433)	(23,533)	(24,724)	(25,991)	(27,307)	(28,672)	(30,123)	(31,648)	(33,251)	(34,934)	(36,703)
Operating profit before depr.	9,547	12,727	15,708	18,004	18,016	19,050	20,125	21,276	22,510	23,797	25,155	26,393	27,690	29,052
Depreciation and amortization	(4,651)	(4,950)	(5,479)	(6,528)	(7,215)	(7,708)	(7,100)	(6,323)	(6,037)	(5,140)	(4,714)	(5,395)	(6,100)	(6,827)
Operating profit	4,896	7,777	10,229	11,476	10,801	11,342	13,025	14,953	16,473	18,657	20,441	20,998	21,590	22,225
Other income (expense)	461	1179	(278)	12	0	0	0	0	0	0	0	0	0	0
EBIT	5,357	8,956	9,951	11,488	10,801	11,342	13,025	14,953	16,473	18,657	20,441	20,998	21,590	22,225
Interest income	120	40	26	-	0	0	0	0	0	0	0	0	0	0
Interest expense	(2,548)	(2,539)	(1,153)	(1,114)	0	0	0	0	0	0	0	0	0	0
Pretax income	2,929	6,457	8,824	10,374	10,801	11,342	13,025	14,953	16,473	18,657	20,441	20,998	21,590	22,225
Income taxes	(770)	(2,715)	(3,465)	(4,855)	(3,996)	(4,196)	(4,819)	(5,533)	(6,095)	(6,903)	(7,563)	(7,769)	(7,989)	(8,224)
Net income	$2,159	$3,742	$5,359	$5,519	$6,805	$7,146	$8,206	$9,420	$10,378	$11,754	$12,878	$13,229	$13,601	$14,001

TABLE 2

2. BALANCE SHEET

Net assets	Historical 1998	1999	2000	Forecast 2001	2002	2003	2004	2005	Projected 2006	2007	2008	2009	2010	2011
Cash & equivalents	1,607	1,303	1,470	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Accounts receivable	21,925	21,334	19,795	23,497	23,671	24,441	25,663	26,946	28,293	29,708	31,193	32,753	34,390	36,110
Other receivable	608	578	607	581	581	581	581	581	581	581	581	581	581	581
Inventories	4,158	4,752	3,202	5,668	5,771	5,715	5,992	6,283	6,588	6,907	7,242	7,604	7,984	8,384
Other current assets	655	313	438	600	615	645	677	711	747	784	823	865	908	953
Current assets	28,953	28,280	25,512	31,346	31,638	32,382	33,913	35,521	37,209	38,980	40,839	42,803	44,863	47,028
Less: current liabilities (a)	(13,500)	(12,424)	(13,937)	(14,083)	(14,311)	(15,011)	(15,747)	(16,517)	(17,323)	(18,171)	(19,059)	(20,015)	(21,018)	(22,071)
Net working capital	15,453	15,856	11,575	17,263	17,327	17,371	18,166	19,004	19,886	20,809	21,780	22,788	23,845	24,957
P,P & E - gross	54,598	64,721	72,904	77,404	83,404	89,404	95,704	102,704	109,704	116,704	124,704	131,704	139,704	147,704
Accumulated depreciation	(16,110)	(20,203)	(24,925)	(31,453)	(38,667)	(46,376)	(53,476)	(59,799)	(65,836)	(70,975)	(75,689)	(81,084)	(87,184)	(94,012)
P, P & E - net	38,488	44,518	47,979	45,951	44,737	43,028	42,228	42,905	43,868	45,729	49,015	50,620	52,520	53,692
Other assets	(697)	(1,361)	(1,808)	(1,807)	(1,807)	(1,807)	(1,807)	(1,807)	(1,807)	(1,807)	(1,807)	(1,807)	(1,807)	(1,807)
Total net assets	$53,244	$59,013	$57,746	$61,407	$60,257	$58,592	$58,587	$60,102	$61,947	$64,731	$68,988	$71,601	$74,558	$76,842
Capitalization														
Short term debt	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Long term debt	25,730	25,560	16,569	15,032	0	0	0	0	0	0	0	0	0	0
Total debt	25,730	25,560	16,569	15,032	0	0	0	0	0	0	0	0	0	0
Deferred taxes	1,802	4,000	6,791	9,491	9,701	9,861	10,066	9,660	9,419	9,764	10,534	11,228	11,754	12,102
Preferred stock	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common equity	25,712	29,453	34,386	36,884	50,556	48,731	48,521	50,442	52,528	54,967	58,454	60,373	62,804	64,740
Total capitalization	$53,244	$59,013	$57,746	$61,407	$60,257	$58,592	$58,587	$60,102	$61,947	$64,731	$68,988	$71,601	$74,558	$76,842

TABLE 3

3. CASH FLOWS FOR VALUATION	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
EBIT	10,801	11,342	13,025	14,953	16,473	18,657	20,441	20,998	21,590	22,225
Taxes	3,996	4,197	4,819	5,533	6,095	6,903	7,563	7,769	7,988	8,223
Tax-effected EBIT	6,805	7,145	8,206	9,420	10,378	11,754	12,878	13,229	13,602	14,002
Depreciation and amortization	7,215	7,708	7,100	6,323	6,037	5,140	4,714	5,395	6,100	6,827
Change in deferred taxes	210	160	205	(406)	(241)	345	770	694	526	348
Operating cash flow	14,230	15,013	15,511	15,337	16,174	17,239	18,362	19,318	20,228	21,177
Change in working capital	(64)	(44)	(795)	(838)	(882)	(923)	(971)	(1,008)	(1,057)	(1,112)
Capital expenditures (i.e. change in P,P&E)	(6,000)	(6,000)	(6,300)	(7,000)	(7,000)	(7,000)	(8,000)	(7,000)	(8,000)	(8,000)
Net cash flow	8,166	8,969	8,416	7,499	8,292	9,316	9,391	11,310	11,171	12,065

TABLE 4

4. MISCELLANEOUS DATA FOR CALCULATION OF PV AS OF 12/31/01	
Beta of DV's equity	0.9
T-Bill rate	0.05
Expected return on the market portfolio	0.134
Expected market risk premium	0.084
Number of shares outstanding	1,600,000
Total debt outstanding	$15,000
Estimated growth rate of cash flows after 2011	0.04
DV's tax rate (including local and federal)	0.37

TABLE 5

5. WACC	
TARGET DEBT RATIO (i.e. debt/total value)	0.25
DV's Equity Rate (Using CAPM)	0.1256
DV's Debt Rate	0.085
WACC	0.1076

TABLE 6

6. PV CALCULATIONS USING WACC	
PV(2002,2011)	$54,264
PV(2011,inf)	$66,820
Total PV of firm	$121,084
Total PV of firm's Equity	$106,084
Equity value on a per share basis	$66.30

7. REQUIRED RETURN ON DV ASSETS

T-Bill rate	0.05
Expected return on the market portfolio	0.134
Expected market risk premium	0.084
Debt ratio (i.e. debt/total value)	0.25
Beta of Debt	0.300
Beta of DV's assets	0.7959
DV's required return on assets (using CAPM)	0.1169

TABLE 8

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Base Case PV (Using DV's required return on assets)	$106,133	$110,369	$114,297	$119,237	$125,671	$132,064	$138,180	$144,936	$150,562	$156,985	$163,264

TARGET DEBT RATIO AFTER 2011 (i.e. debt/total value) 0.25

DV's Debt Rate After 2011 0.085

PV of tax shields after 2011 (in 2001 $) $12,617 [To find the debt in 2012 you find 0.25xBase case PV at the start of 2012 which is is the same as Base Case PV in 2011. Now
Base case PV in 2011 = C2012/(ra-g)= (1+g) x C2011/(ra-g)
To get the interest tax shield in 2012 you multiply the debt by rD x tc
Finally, you take a growing perpetuity of the interest tax shield by dividing by rD-g and then discount 10 periods]

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
DV's TOTAL DEBT 2002-2011 (Dollars in thousands)	$70,000	$65,000	$60,000	$55,000	$50,000	$45,000	$40,000	$40,000	$40,000	$40,000
DV's Debt Rate 2002-2011	0.085	0.085	0.085	0.085	0.085	0.085	0.085	0.085	0.085	0.085
Interest tax shields (debt rate*total debt*tax rate)	$2,202	$2,044	$1,887	$1,730	$1,573	$1,415	$1,258	$1,258	$1,258	$1,258

PV of tax shields 2002-2011 $10,930

Total adjusted PV of firm $129,680

Total PV of firm's Equity $114,680

Equity value on a per share basis $71.67

TABLE 9
COMPARABLES FOR DV PRESS

		ANNDAT CLOSIN	TSIC TSIC1	VALTOT	TPRC2M	TSHOUT	TMKT2M	TLTME	TCEQTY	TASSET	TPE2M	TSALES	TBM2M	TL OFFER/ TL OFFER/ SALES	TL OFFER/ MKT VALUE 2 MONTHS
	Equivalent Information:														
	DV Press, Inc.		2751		34.750	1641	57.061	2.750	34.313	73.676	10.312	124.365	1.663		
	COMPARABLES														
1.	Foote & Davies	2/15/1998	2751	96.500	33.534	2156	72.30	16.510	61.705	80.327	13.466	164.200	1.172	0.588	1.335
	FDI Holdings Inc.	2/15/1998	NA												
2.	Pandick Inc.	11/12/1999	2752	250.889	16.250	9839	159.88	0.920	61.439	163.166	17.663	230.834	2.602	0.726	1.569
	FP Acquisition Inc.	12/31/1999	2751												
3.	Webb Co.	8/20/2000	2732	117.087	13.500	6951	93.84	0.830	51.510	127.201	16.265	177.340	1.822	0.660	1.248
	Pegasus Press Ltd.	11/12/2000	2721												
	Average			154.825	21.095	6315	109	6.087	58.218	123.565	15.798	190.791	1.865	0.658	1.384
	Implied equity value DV Press (millions)													$82	$79
	Implied value per share of Dv Press										$43			$51	$49

ANNDAT: Announcement date.
CLOSIN: Closing date.
TSIC: Target company's primary SIC code.
TSIC1: Target company's secondary SIC code.
VALTOT: Total consideration given to target by acquirer. (In millions).
TPRC2M: Target company's stock price two months prior to announcement.
TSHOUT: Target company's common shares outstanding.
TMKT2M: Target company's market value two months prior to announcement.
TLTME: Target company's earning per share.
TCEQTY: Target company's book value.
TASSET: Target company's assets.
TPE2M: Target company's price-to-earnings ratio two months prior to announcement.
TSALES: Target company's sales.
TBM2M: Target company's book multiple two months prior to date of announcement. (market value 2 months prior/book value).
TLOFFER: Offer for target company

Table 10

Liquidation Values for the Divisions of DV Press
($ millions)

(i)	Lithographers	15.8
(ii)	Colortronics	14.1
(iii)	Wolf	25.6
(iv)	Houston	5.3
(v)	Powellton	14.2
	Total	75.0

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CORPORATE FINANCE

LECTURE NOTES

Franklin Allen

Fall 2011

QUARTER 2 - WEEK 6 (Part 2) and WEEK 7 (Part 1)

Th: 12/1/11 and Tu: 12/6/11

Section 16: Risk Management and Pricing Derivatives

A. Risk Management

Motivation

Introduction

If correctly used derivatives such as options and futures can create significant benefits by allowing firms to hedge risks. However, if they are not fully understood particularly by senior management they create the potential for significant problems. The table below gives some recent examples of severe losses from derivatives.

As the table illustrates numerous high profile companies have had problems with derivatives. In many cases it seems that the senior management did not really understand what was going on. This led to situations where they ended up taking risks they did not want to or were defrauded by unscrupulous employees. Derivatives have significant potential benefits but they also have significant downside risks particularly if management is not familiar with the problems that can arise.

Derivatives Losses

Date	Organization	Event
1986-88	Hammersmith & Fulham local authority	Ran up losses of over £500m on sterling interest rate swaps
1991	Allied Lyons	Lost £150m in foreign exchange options
1993	Metallgesellschaft	Oil futures trading resulted in losses of up to DM2.3bn; the banks wound up the contracts
1994	Kashima Oil	$1.5bn losses on dollar derivatives
1994	Orange County	Lost $1.7bn in leveraged interest rate products

1995	Barings	£900m losses accrued on Nikkei index contracts in Osaka derivatives exchange, leading to the bank's bankruptcy
1997	NatWest	NatWest is one of the top four banks in the UK. It lost $127m from Swaptions.
1999	Ashanti	A large African gold mining company lost $570m in gold "exotics".
2003	Allied Irish Banks	Employee hid $691 million in trading losses
2005	Calyon	Loss of €250m from trader making unauthorized credit market bets
2007	WestLB	Loss of €600m from misguided investments by trading desk
2008	Société Générale	Loss of €4.9 billion after rogue trader takes bad bets on European futures indices

In the last twenty five years there has been a dramatic increase in the number of financial markets available for investors and firms to trade in. Important markets that have developed in Chicago, Tokyo and London are *financial futures* markets such as those on foreign currencies and interest rates. These allow an investor to lock in an exchange rate or interest rate for some date in the future. Another example is *options*. These are the right to buy or a sell a security or currency at some prespecified price before a certain date. One illustration of the rapid growth of these options markets is the fact that by 1984, eleven years after its founding in 1973, the Chicago Board Options Exchange (CBOE) had become second only to the New York Stock Exchange in terms of average daily volume. Financial futures and options are examples of *derivative securities* where the payoff on a security depends on an exchange rate, interest rate or price of some other security. Not all the markets that were introduced were formal exchanges,

many were over the counter markets where trades are made over the telephone or some other similar way. An illustration of this is the market for *swaps*. A swap allows, for example, quarterly payments in yen to be swapped for quarterly payments in dollars at a prespecified exchange rate.

Why has there been so much financial innovation since the beginning of the 1970's? One important factor was the collapse of the Bretton Woods exchange rate agreement. Under this agreement exchange rates had been fixed and changed only occasionally every few years. After its collapse exchange rates floated and changed daily. Another important factor was a change in the way in which governments conducted monetary policy. Historically, many governments stabilized interest rates and allowed the supply of money to adjust. In the late 1970's the U.S. government started to target the money supply more and allowed interest rates to fluctuate instead. These changes meant that whereas in the 1950's and 1960's firms faced a fairly stable economic environment, in the 1970's and 1980's they suddenly faced significant amounts of risk from fluctuations in exchange rates and interest rates. It was this that led to a demand for instruments to *hedge* (i.e. reduce) these risks and the financial innovation that has occurred in recent years.

In this section we will start by briefly considering how firms can use some of these new instruments to hedge risks and when it is sensible for them to do so. Hedging, which is the reduction of risks, and speculation, which is the taking of risks, are in some sense opposites. In practice, however, distinguishing between them is often very difficult and as we have seen at the start of the section there have been many scandals such as the Metalgesselschaft and Barings fiascos where huge amounts of money have been lost using derivatives.

A Modigliani-Miller Theorem for Risk Management

Similarly to capital structure the first issue that arises with corporations undertaking risk management is to understand precisely why is can create value for shareholders. It turns out that there is again the question of why can't shareholders manage risk on their own behalf, why do they need the corporation to do it for them? Provided there are no taxes and markets are perfect they can use homemade risk management just as before they used homemade leverage so we get a Modigliani-Miller type result.

MM-type theorem of risk management

Risk management will not affect total firm value if there are

(i) No taxes

(ii) Perfect capital markets

This raises the question of when does risk management create value. Similarly to the Modigliani-Miller theory of corporate finance risk will only matter because of frictions. Risk management can only create value for shareholders when frictions such as taxes, bankruptcy costs, agency costs and other types of imperfections are present. In practice it seems that bankruptcy costs and agency problems are particularly important justifications for risk management.

For example, consider a Japanese auto manufacturer that wants to build a plant to produce cars for export to the US. Costs are in yen and revenues are in dollars. This imposes great risks on the firm. If the yen strengthens against the dollar then it may no longer be

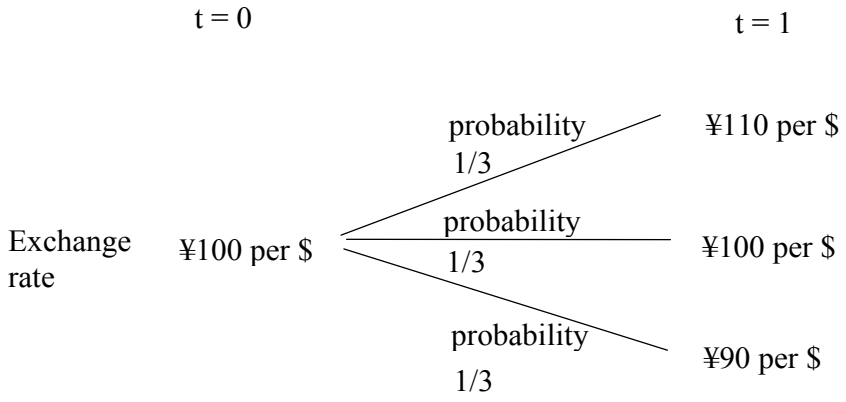
profitable to make the cars for export and the firm may go bankrupt. How can the manufacturer protect against this possibility?

Example

Suppose that Nippon Auto expects to sell 100,000 cars at $20,000 each. It therefore has revenue of

100,000 x $20,000 = $2 billion.

The exchange rate is currently at ¥100 per $. There is a 1/3 probability the exchange rate rises to ¥110 per $, a 1/3 probability the exchange rate stays the same at ¥100 per $ and a 1/3 probability the exchange rate falls to ¥90 per $. On average the exchange rate is still ¥100 per $. We can represent this in the following diagram.



Expected exchange rate = ¥100/$

Nippon Auto needs ¥190 billion to cover its costs. If the exchange rate stays at ¥100 per $ or goes to ¥110 per $ they will be fine. However, if it goes to ¥90 per $ they will go bankrupt and incur bankruptcy costs. How can they avoid this? One possibility is to use currency

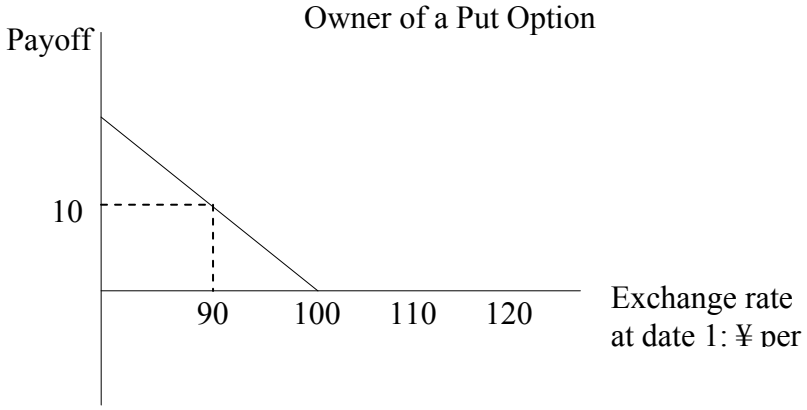
options. This will allow them to avoid bankruptcy and its associated costs and create value for shareholders.

Options

Options are traded on exchanges like futures. For each option there is a buyer and a seller. There are two basic types of option called *puts* and *calls*. We shall consider puts here since they hedge against downside risk which is what is necessary to avoid bankruptcy.

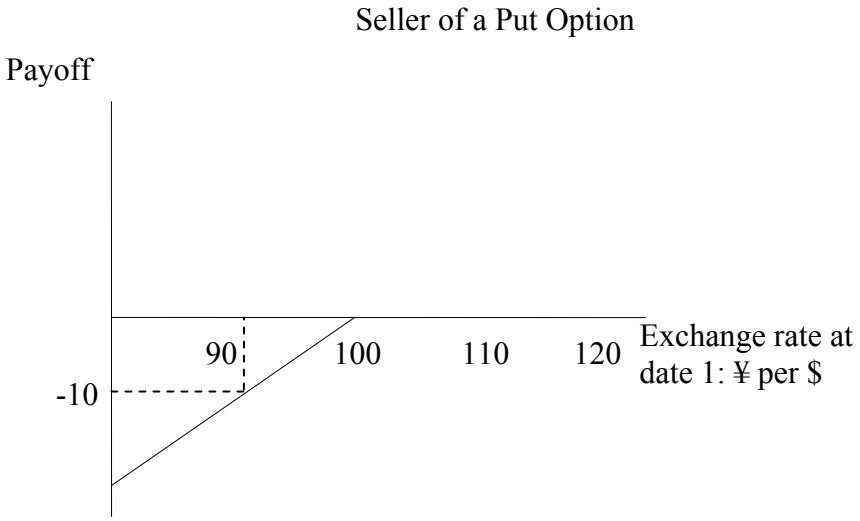
Puts

A put is a right to sell at the striking price on or before the maturity date. In our example, consider the case of a put which is the right to sell $1 at an exchange rate of ¥100. The payoff to the owner of such a put is shown below.



If the exchange rate is ¥90 and you own a put which allows you to sell $1 at ¥100 then you can buy $1 at ¥90 and sell it at ¥100 to make a profit of ¥10. Similarly for other exchange rates below ¥100. For exchange rates above ¥100 there is clearly no point in using the put since you wouldn't sell $1 at ¥100 if you could get more in the spot market.

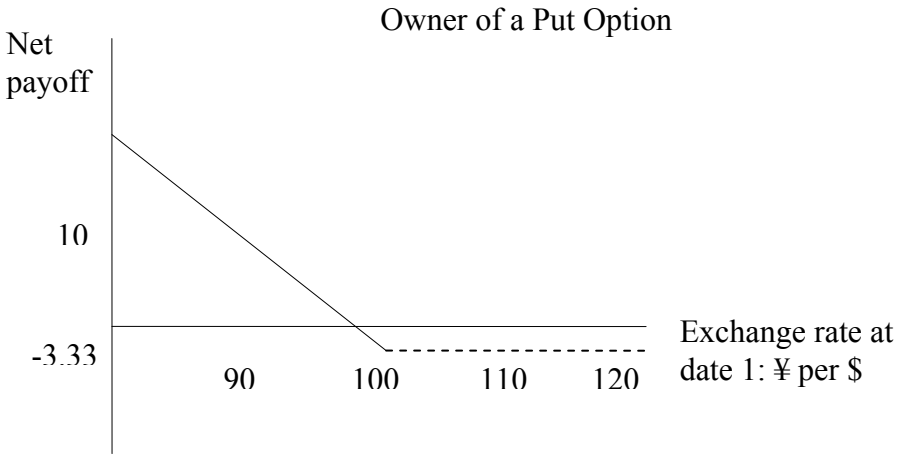
The payoff to the seller at date 1 is simply the opposite of that to the owner.

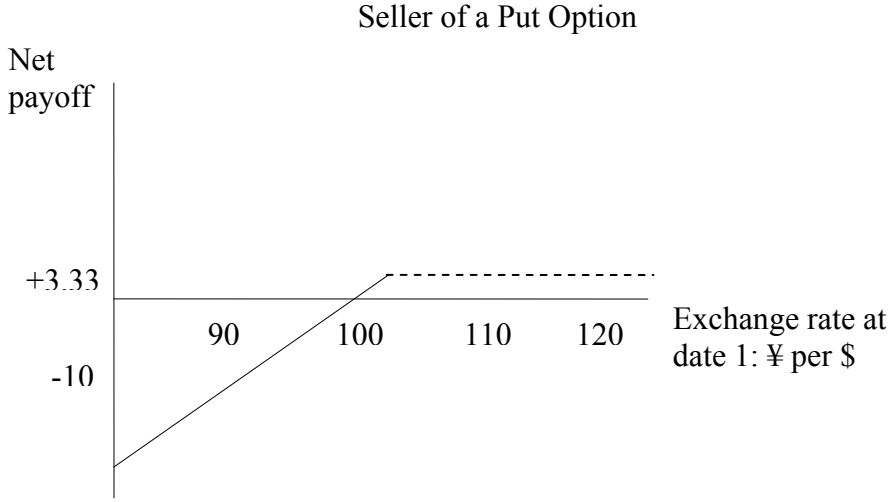


With regard to price, we will assume the simplest case where it is simply the discounted expected payoff of the put. This corresponds to assuming everybody is risk neutral. We assume a discount rate of 10%.

$$\text{Price of put} = \frac{1}{3}\left(\frac{100 - 90}{1.1}\right) = ¥3.03$$

This is in date 0 ¥. For the date 1 equivalent we need to multiply by 1.1 so we have 1.1 x 3.03 = 3.33. If the price of the put is included the net payoffs to buyer and seller are:





Hedging Nippon Auto's exposure with put options

How can the puts be used to hedge Nippon Auto's foreign exchange exposure? Puts protect against falls in the exchange rate so bankruptcy costs can be avoided. If it goes to ¥90 they will not make any money from the cars but if they own puts then they can make a profit on the puts so that there will be no bankruptcy costs and their value will be increased.

Suppose, for example, Nippon Auto buys 1 billion puts with a striking price of ¥100. Their gross payoffs before taking into account the cost of the puts is

¥90 per $	¥100 per $	¥110 per $
(Exercise puts)	(Don't exercise puts)	(Don't exercise puts)
1 billion (¥100-¥90) = ¥10 billion	0	0

When the exchange rate is at ¥90 per $ this ¥10 billion together with the $2 billion or equivalently the 2 billion x ¥90 = ¥180 billion revenue from selling the cars gives them the ¥190 billion they need to cover their costs and avoid bankruptcy. What about the cost of the puts?

Cost of puts at date 0 = ¥3.03 x 1 billion = ¥3.03 billion

$$\text{Expected revenue from puts in date 0 ¥} = \frac{1}{3}\left(\frac{10\text{ bn}}{1.1}\right) = ¥3.03\text{ billion}$$

So on average the expected payoff is zero. From a date 0 perspective the net effect of using the options is to avoid bankruptcy costs and create value for shareholders.

Put options are not the only kind of risk management tool that can be used in this case. Other kinds of derivative could also be used. For example, forward contracts or futures contracts would allow you to lock in the exchange rate. You would avoid upside as well as downside risk. Swaps where you can exchange a stream of one type of contract for another type of currency are another possibility. The choice between different instruments will depend on the details of the particular situation. Usually, this is a question of transaction costs. The one that should be used is the one that creates the most value for shareholders.

Derivatives are not the only way to manage risk. Another possibility would be for Nippon Auto to borrow in dollars, convert into yen now and then use the proceeds from selling the cars to pay off the loan. Yet another would be to build the plant in the US rather than Japan.

This relocation of production is in fact what most of the auto companies with extensive international sales have done. Unlike financial solutions which are difficult to do for more than a few years, relocating plants hedges the exchange rate risk for the life of the plant.

The discussion above has been in terms of hedging exchange rate risk. Another type of risk that is important, particularly for banks, insurance companies and other intermediaries is risks arising from changes in interest rates. Similar kinds of techniques can be used in this case.

Risk management is one of the most important uses of options and derivatives. We used a very simple model to price them which assumed everybody is risk neutral. This is clearly too simplistic. We turn next to how we price derivatives in more complex situations.

Section 16B: Pricing Derivatives

Read Chapters 20 and 21 BMA

Motivation

Introduction

In 1973 two important events occurred. The first was the opening of the Chicago Board Options Exchange and the second was the publication of pathbreaking papers by Black and Scholes and Merton on valuing options. In 1997 Scholes and Merton were awarded Nobel Prizes for their work (unfortunately, Black had died and so was not eligible).

Why was their work so important? Options are of some importance but are they that important? It was the ideas that their work introduced which were so significant. These ideas are applicable in many different contexts and have revolutionized the practice of finance. The two crucial components of their theory are *arbitrage* and *dynamic trading*. These allow

financial engineering which involves the manufacture of securities and portfolios with any desired payoffs.

We will consider these ideas in the context of options since this is where they were first introduced. Options are used in many settings and are useful because they allow *insurance*. For example, as we saw above options on foreign exchange allow firms to eliminate the bad effects from changes in exchange rates. In addition to options on foreign exchange there are options on stocks. Using these options together with stocks and bonds allows a desirable set of portfolio payoffs to be designed. For example, if an investor is worried about the possibility of a fall in stock prices they can buy puts to insure the downside risk. Markets for options on stocks are among the most active in the world. We will focus on these. The methodologies can be applied to other types of option such as those on foreign exchange.

A simple framework

- There are two dates, t = 0 and 1.

- The risk free interest rate between t = 0 and 1 is r

- At date 0 investors can buy or sell options issued by an options exchange. As with insurance a price or premium is paid

- The payoff on an option depends on the price of the stock at date 1 (i.e. an option is a *derivative*)

There are two types of option:

Put option: Purchaser of the option has the right if he wishes to **sell** a share of the stock from the seller of the option at a prespecified exercise price at date 1.

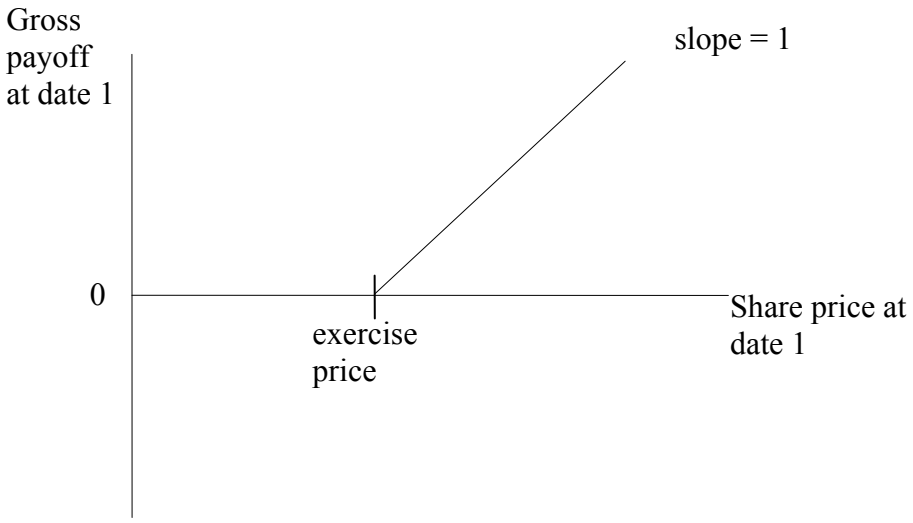
Call option: Purchaser of the option has the right if he wishes to **buy** a share of the stock from the seller of the option at a prespecified exercise price at date 1.

When should an option be exercised?

The decision to exercise an option depends on the difference between the market value of the asset the option is on and the exercise price of the option. Whether or not you exercise it is optional. It follows that it is only worthwhile exercising a call, for example, if the market share price is above the exercise price of the option at the expiration date. If the exercise price is $10, would you exercise a call if the market share price was $9? No, there's no point paying $10 when you can buy in the market at $9. If the exercise price was $10 but the share price was $11, would you exercise? Yes, since this would allow a profit of $11-$10 = $1.

Initially, consider the *gross payoff* of exercising at date 1 as a function of the stock price at date 1 ignoring the initial premium paid.

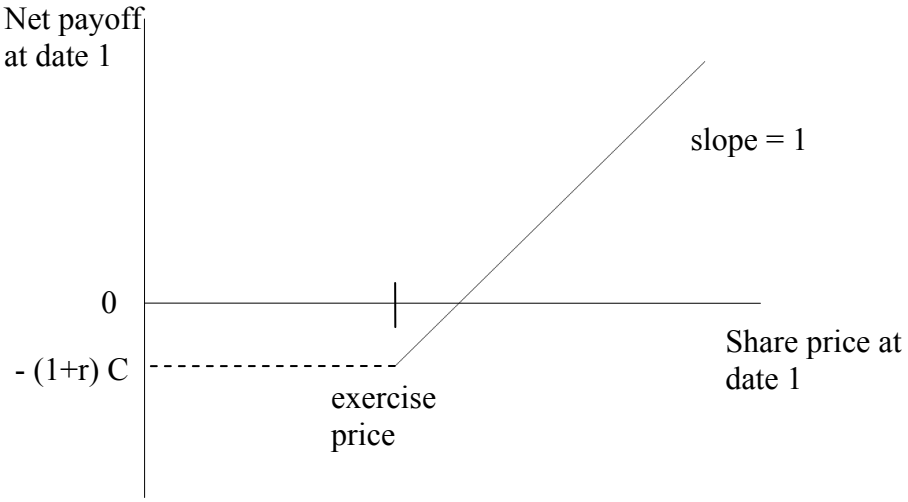
Gross payoff at date 1 to the buyer of a call:



To see where the graph comes from consider the example above with an exercise price of $10. The value of the call at the expiration date if the share price is $9 is $0. Similarly, for any share price below $10 so the graph is along the axis until the exercise price. At a share price of $11, the value of the call is $1. At $12 it is $12-$10 = $2. For each $1 increase in share price the value of the call rises by $1 so the graph goes up with a slope of 1.

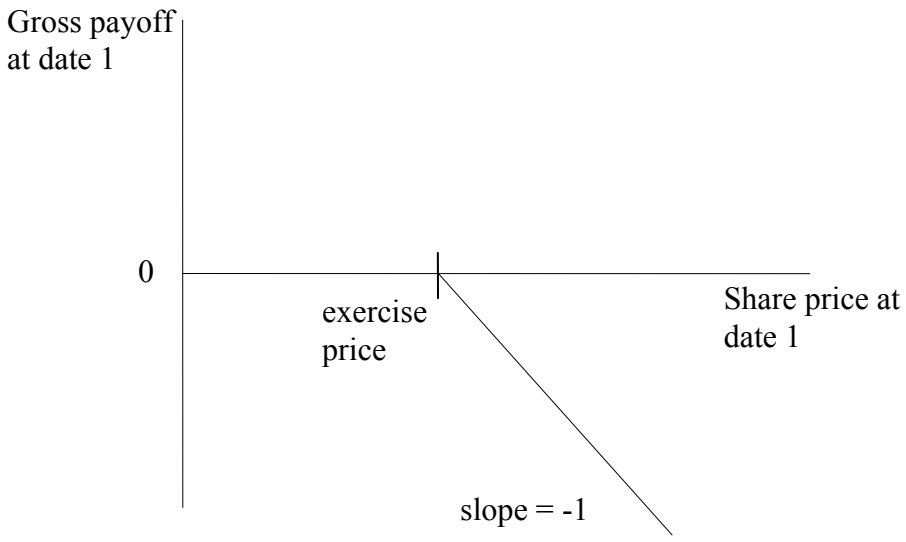
It is sometimes also useful to graph the *net payoff* of exercising the option including the initial premium paid. Since the premium is paid at date 0 the date 1 equivalent is (1+r)C where C is the premium, i.e. price, of the call. Since the buyer pays the seller C at date 0 the whole graph is shifted down by (1+r)C.

Net payoff at date 1 to the buyer of a call:

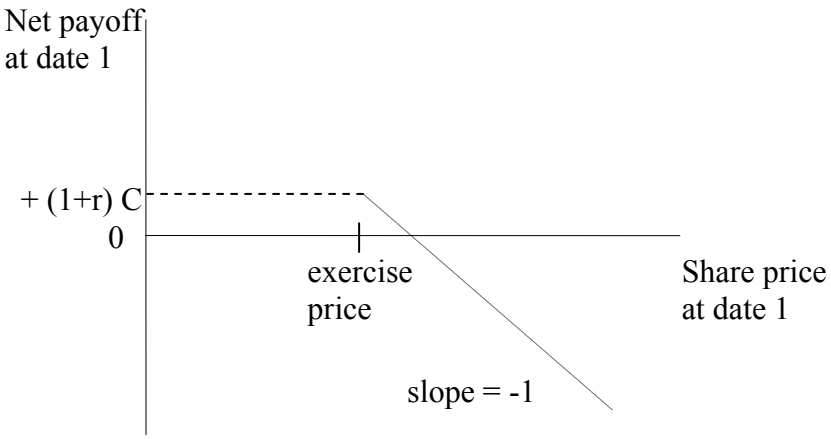


The seller of a call simply has the opposite position to the buyer. Hence, the seller's graph is just the negative of the buyer's. Whether it is better to use the gross payoff or the net payoff depends on the circumstances. Often gross payoff is better.

Gross payoffs to a seller of a call:



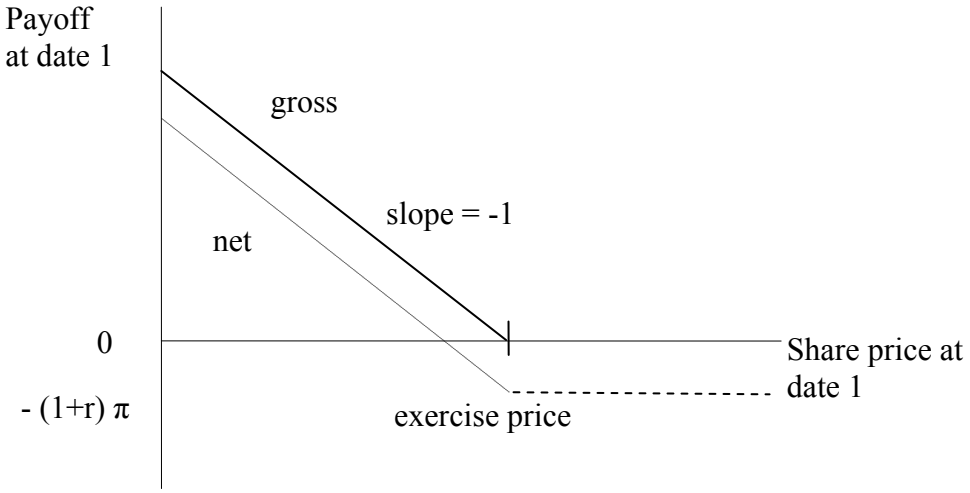
Net payoffs to a seller of a call:



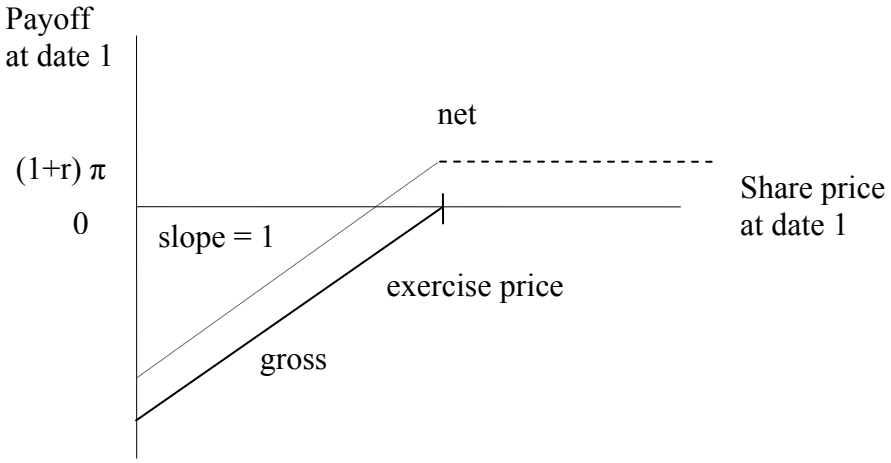
Note that the payoffs to seller are the exact opposite of the payoffs to the buyer.

For a put the logic is similar. The difference is that a put is valuable to the buyer if the share price is below the exercise price because it is a right to sell. In other words, if the exercise price is \$10 and the share price is \$9 the value of the put is \$10-\$9 = \$1 since you can buy a share in the market at \$9 and sell it with the put at \$10. If the share price is \$11, the put is worthless since there's no point in selling at \$10 with the put when you can sell in the market at \$11. The seller of the put is again the negative of the buyer.

Gross and net payoffs to a buyer of a put with premium (price) π:



Gross and net payoffs to a seller of a put with premium (price) π:



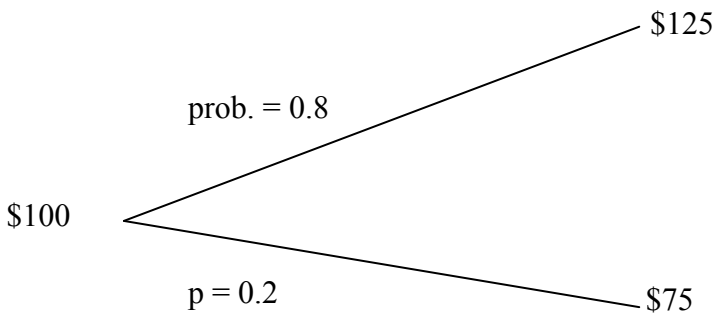
Pricing options through arbitrage

Now that we know what options are and that people trade them for insurance reasons, we can turn next to the issue of how their value is determined. We saw above how options could be priced in the very simplest case where everybody is risk neutral so we can simply discount the

expected payoff at the opportunity cost of capital. What happens though if everybody is risk averse?

We start by considering a very simple model called the **binomial model**. Stock price can either go up or down. Let's consider a simple example. Suppose the stock costs $100 and has the following payoffs:

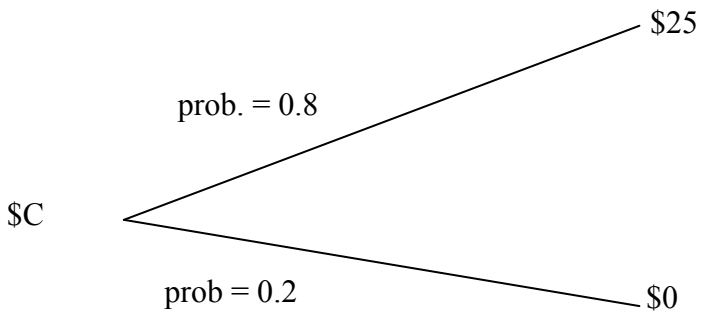
State	Stock price at option expiration date	Prob
1	$125	0.8
2	$75	0.2



Expected Price = 115; Expected return = 15%

Consider a call option with exercise price $100:

State	Value of option at expiration date
1	125 - 100 = $25
2	0



Let's also assume the risk free rate is 6%.

The crucial point is that options and common stock can be combined in such a way as to create a riskless investment or hedge. This allows us to calculate the value of the option since we know that the return on the riskless hedge must be equal to what? The risk free rate. Otherwise what would happen? There would be an arbitrage opportunity.

What is the way of combining the options and the stock to get a riskless investment? Suppose we bought a share for $100 and sold two call options for C each. Our total investment at date 0 is

Total investment = 100 - 2C

What's the payoff?

State	Hedge portfolio payoff at option expiration date 1
1	125 - 2 x 25 = $75
2	75 - 0 = $75

In other words, no matter what the state, we get a return of $75. We have a riskless investment. As we will discuss later, what we are effectively doing here is creating an artificial or "synthetic" bond. What's the PV of this?

$$\text{PV riskless investment} = \frac{75}{1.06}$$

If there's to be no arbitrage, we need

$$100 - 2C = \frac{75}{1.06} = 70.75$$

or

$$C = \frac{1}{2}\left(100 - \frac{75}{1.06}\right) = 14.62$$

What would happen if C = 15? Then by buying the share and selling two calls you'd invest 70 and have an investment worth

$$\frac{75}{1.06} = 70.75$$

so an arbitrage opportunity would exist.

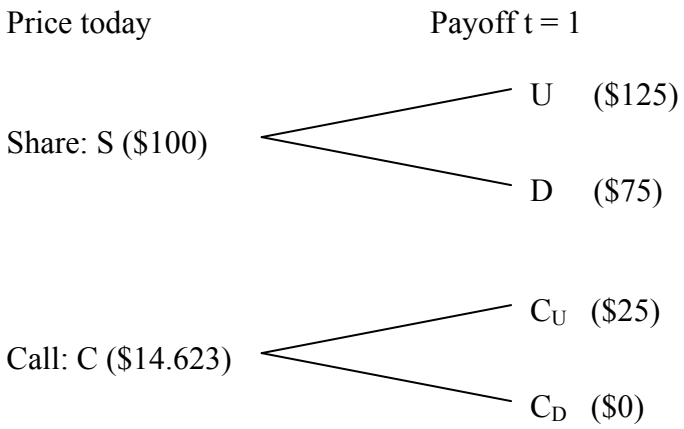
Hedge Ratios

In our example we bought a share and sold 2 calls for our hedge portfolio. Now, the number of calls you must sell for each share you buy in order to get a riskless investment is known as the hedge ratio.

Hedge ratio = Number of calls to be sold / Shares purchased

In our example the hedge ratio was 2. Where did this number come from? In other words, in general, in the simple 2-state case, how do you find the hedge ratio?

Notation



The figures in parentheses denote the numerical values for our example.

State	Stock Price at option expiration date	Payoff to call at expiration date
1	U	C_U = Max(0, U - EX)
2	D	C_D = Max(0, D - EX)

Let m = Hedge ratio.

We want the hedge portfolio, which involves buying 1 share and selling m calls, to be such that the payoff is the same no matter whether state 1 or state 2 occurs. The payoff in state 1 of the hedge portfolio is $U - m C_U$ and the payoff in state 2 is $D - m C_D$. Hence we need

$$U - m C_U = D - m C_D$$

so

$$m = \frac{U - D}{C_U - C_D}$$

In our example,

$$m = \frac{125 - 75}{25 - 0} = 2$$

Formula for Valuing Call

Denote the t = 0 price of the share P and the t = 0 price of the call at C. We can then use our hedge portfolio to give us a formula for valuing a call. The cost of buying a share and selling m calls is P - m C. The payoff to this hedge portfolio is U - m C_U or equivalently D - m C_D. If there are to be no arbitrage possibilities it must be the case:

$$P - mC = \frac{D - mC_D}{1 + r_F}$$

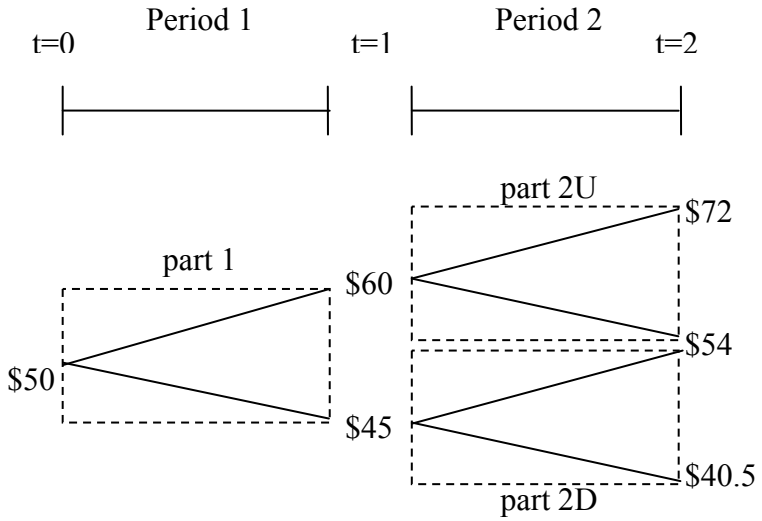
$$C = \frac{1}{m}\left(P - \frac{(D - mC_D)}{1 + r_F} \right)$$

So now we have a simple formula for valuing calls when there are two states. We can build on this and generalize to more complicated situations.

One important thing to notice with these valuation methods is that we don't use the probabilities at all. The crucial point is that you create a riskless hedge, and so the probabilities don't matter, and the expected return doesn't matter. We only need the risk free rate to value the option on the stock.

2-Period Example

Consider the following two-period example. At t = 0 the stock starts at a price of 50. During the first period one possibility is that the price goes to 60. If it does this, then during the second period it can go up to 72 or down to 54. The other possibility is that the stock price falls during the first period to 45. In this case it can go to 54 or 40.5 in the second period. The exercise price of the call is 55 and the risk free rate is 10%.



Exercise price of call = 55; r_F = 10%

Note that this has the feature that when price rises, it goes up by a factor of 1.2, and when it falls, it goes down by a factor of 0.9. This simplifies the analysis. You can do what we're going to do for examples which don't have this feature, they're just more complex.

What we do to solve this problem and value the call at t = 0 is break it up into three parts: 1, 2U and 2D. We use the value of the calls we get for 2U and 2D as C_U and C_D in our part 1 analysis. Therefore, we have to solve the problem backwards.

<u>Part 2U</u>

P = 60

U = 72 C_U = Max (0, 72 - 55) = 17

D = 54 C_D = Max (0, 54 - 55) = 0

$$m = \frac{72 - 54}{17 - 0} = 1.06$$

$$C = \frac{1}{1.06}\left(60 - \frac{(54-0)}{1.1}\right) = 10.29$$

Note that you would never exercise at date 1 since if you did exercise, you'd get 60 - 55 = 5; whereas you can sell it for 10.29.

Part 2D

P = 45

U = 54 $C_U = 0$

D = 40.5 $C_D = 0$

Here the payoff to the call is zero in both cases so the call value is

$$C = 0$$

If you exercised here, you'd get zero in both cases.

Now that we have solved the second stage of the problem we can go back to the first using the values of the calls that we found in parts 2U and 2D as the payoffs to the calls C_U and C_D respectively.

Part 1

P = 50

U = 60 $C_U = 10.29$

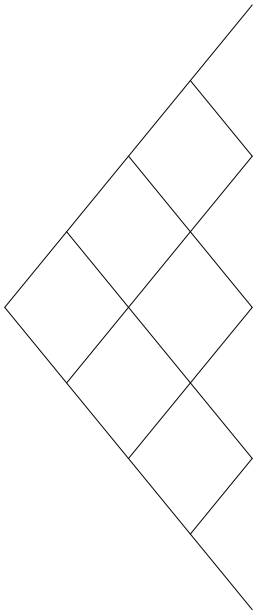
D = 45 $C_D = 0$

$$m = \frac{60-45}{10.29-0} = 1.46$$

$$C = \frac{1}{1.46}\left(50 - \frac{(45-0)}{1.1}\right) = 6.23$$

So the value of the call option at t = 0 is 6.23.

This is a much more general approach, as you can see. We can go on expanding the number of stages and go on solving backwards in a similar way. Methods that are used in practice assume a very large tree with many periods.



By making the time periods shorter and having more and more of them we can model increasingly more complicated situations. As we take the limit then we get continuous time models which represent the arbitrage equation as a partial differential equation. The Black and Scholes model is one example of this and we will consider it in more detail below.

One important thing to realize is that the hedge portfolio is not usually an optimal portfolio. It is a portfolio which is of interest because it is a way of valuing options by the lack of arbitrage opportunities. If prices do get out of line then the arbitrage portfolio will be a

profitable one but we would not expect such opportunities to last for very long.

Note that it's not worth a buyer exercising her option before the expiration date in this example. In fact this result holds in more general cases provided there are no dividends. To see why this assumption is important consider the following example. Suppose you have a call and the stock price is above its exercise price. If the call was exercised now the payoff would be positive. When a dividend is paid the stock price falls. If it falls below the call's exercise price the payoff from exercising the call becomes zero. In anticipation of this it's worth exercising early. However, in the absence of dividends the fact that you don't exercise means that European and American options have the same value. More advanced techniques allow the case where dividends exist to be dealt with.

Finally, notice that in the dynamic situation you have to change your hedge as you go through time and the stock price changes. You start out with a hedge of 1.46. If the price goes to 60, the hedge ratio goes down to 1.06. If the price goes to 45, the call becomes worthless in this case. This feature of the example that has the hedge portfolio changing through time is the fundamental idea that underlies many parts of modern finance.

Assumptions underlying the Black and Scholes Formula

There are a number of assumptions underlying the Black and Scholes formula.

1. There are no transaction costs and no taxes.
2. The risk-free rate is constant for the life of the option.
3. The market operates continuously (day and night).

4. The stock price moves continuously with no sudden jumps.
5. The stock pays no cash dividends.
6. The option can be exercised only at the expiration date.
7. The underlying stock can be sold short without penalty.
8. The distribution of returns on the underlying security (the common stock) are lognormal.

Based on these assumptions it is possible to derive the following formula.

The Black and Scholes Formula

$$C = P \times N(d_1) - EX \times e^{-rt} \times N(d_2)$$

where

$$d_1 = \frac{\log_e(\frac{P}{EX}) + rt + \frac{\sigma^2 t}{2}}{\sigma\sqrt{t}}$$

$$d_2 = d_1 - \sigma\sqrt{t}$$

N(d) =cumulative normal probability density function

EX =exercise price of option

σ^2 = variance per period of continuously compounded rate of return on stock

t =time to exercise date

r =continuously compounded risk free rate of interest

P = price of stock now

Using the Black Scholes Formula

Find the value of the call option with the following parameters:

$$P = 2.27$$

$$EX = 1.9$$

$$t = 23\,\text{days} = \frac{23}{365} = 0.0630\ \text{years}$$

$$\sigma = 0.40 \text{ (continuously compounded)}$$

$$r = 0.0925 \text{ (continuously compounded)}$$

Solution

The first step is to find d_1 and d_2. Now

$$\sigma\sqrt{t} = 0.4x\sqrt{0.0630} = 0.10$$

Hence

$$d_1 = [\ln(2.27/1.9) + 0.0925x0.0630 + 0.01/2]/0.1 = 1.89$$

$$d_2 = 1.89 - 0.1 = 1.79$$

Using Appendix Table 6 in BMA (see end of section for a copy) for the cumulative normal distribution

$$N(d_1) = 0.9706;\ \ N(d_2) = 0.9633$$

Now

$$e^{-0.0925x0.0630} = 0.99419$$

Hence substituting in the formula

$$C = 2.27x0.9706 - 1.9x0.99419x0.9633 = 0.38$$

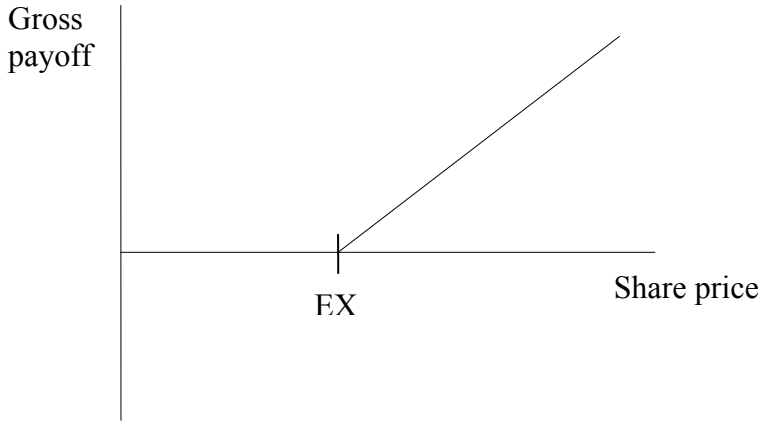
Put-Call Parity Formula

The Black-Scholes formula allows calls to be valued. How can we price puts? To do this we use something called the put-call parity formula. This is found by considering two portfolios which are equivalent in the sense that they have the same gross payoffs. Given this they must have the same value otherwise there would be an arbitrage possibility. The two equivalent portfolios are such that it is possible to price the put from the call and other known information.

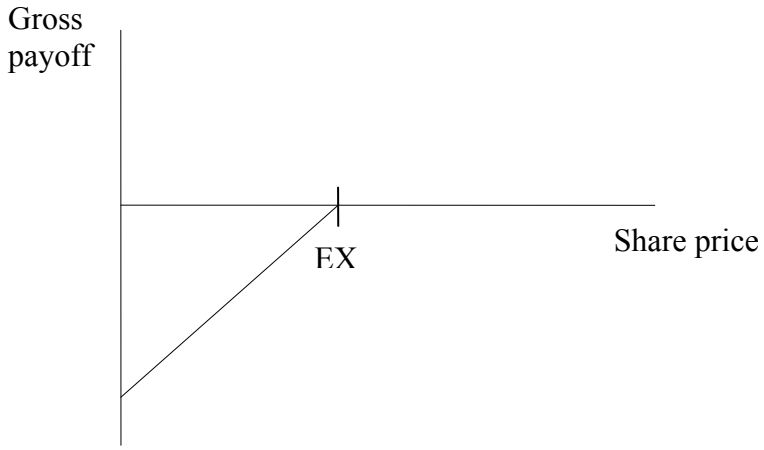
It can be seen from their gross payoff diagrams that the following two strategies are equivalent:

Strategy 1:

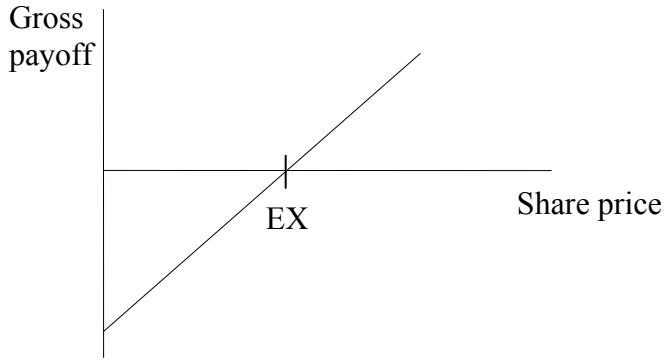
Buy a call



Sell a put with the same exercise price:

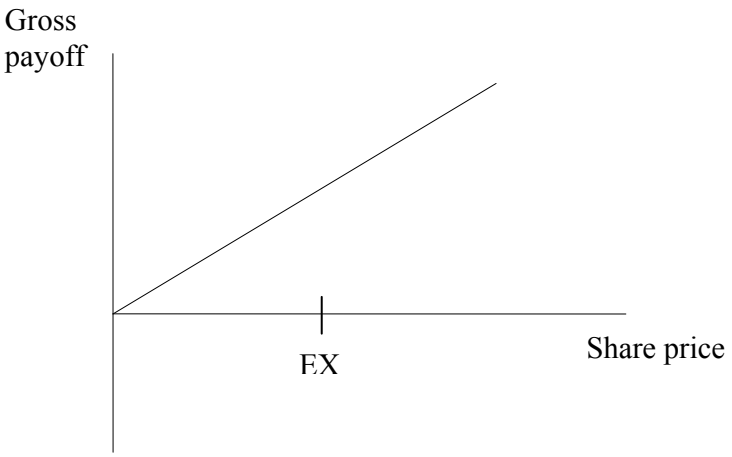


The combined payoff of the two:

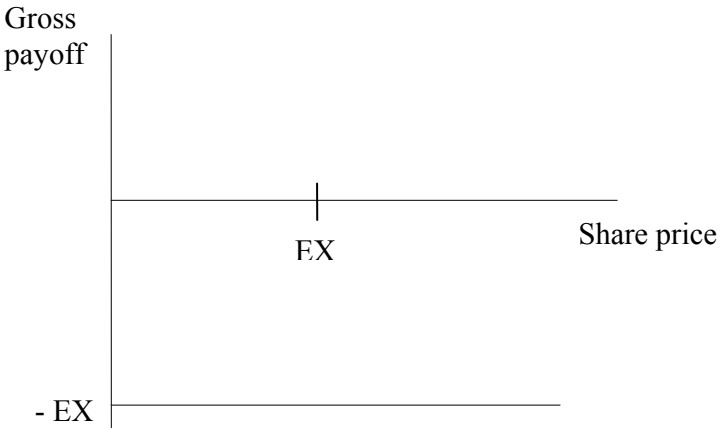


Strategy 2:

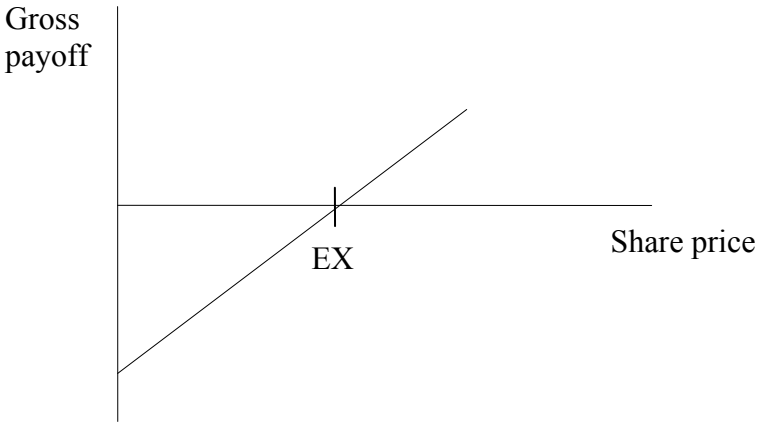
Buy a share



Borrow the present value of the exercise price



The combined payoff of the two:



The two strategies have the same gross payoffs and hence must have the same value otherwise there would be an arbitrage opportunity.

Cost of strategy 1:

$$\text{Value of Call} - \text{Value of put}$$

Cost of Strategy 2:

$$S - PV(EX)$$

Hence, equating the two and rearranging,

$$\text{Value of put} = \text{Value of call} - [S - PV(EX)]$$

This is the put-call parity formula. It can be used to price a put from the price of a call with the same maturity and exercise price and the risk free rate.

Concluding Remarks

The Black Scholes formula and extensions have been found to work well in practice. Despite what appear to be strong assumptions and the abstract nature of the model, the empirical evidence strongly supports the Black Scholes model and its extensions.

The basic idea behind Black Scholes is to create a dynamic trading strategy using the stock and bonds which is equivalent to a call. Not only calls can be dynamically synthesized. In

fact almost any kind of asset can be dynamically created. This is why the Black Scholes model has revolutionized finance. You can always create any arbitrary pattern of payoffs using an appropriate dynamic trading strategy. The basic principle can easily be seen in the context of our simple binomial model. Whenever you have two branches in a tree and two securities you can create any pattern of payoffs since you essentially have two equations in two unknowns. More sophisticated financial engineering uses the same basic principle but in more mathematically complex models. The binomial trees are more complicated but the basic idea is the same. You create a payoff pattern by structuring the dynamic portfolio appropriately. A lot of the financial engineering that investment banks do is of this type.

One famous example is *portfolio insurance*. This is nothing more than a synthetic put. People created dynamic strategies to synthesize a put. This was an attractive product to many portfolio managers because they could guarantee they would not have a performance below a certain level that they chose. When the crash of 1987 occurred though they couldn't execute the trades and the strategy failed. The purchasers had forgotten one of the most basic rules that models are only as good as their assumptions.

Appendix: Section 16

Formula for Valuing Calls when there are Two States

The number of calls you must sell for each share you buy in order to get a riskless investment is known as the hedge ratio.

Hedge ratio = m = Number of calls to be sold / Shares purchased

The payoffs to the shares and call are denoted as follows

State	Payoff to share	Payoff to call
1	U	$C_U = \text{Max}(0, U\text{-}EX)$
2	D	$C_D = \text{Max}(0, D\text{-}EX)$

We want the hedge portfolio, which involves buying 1 share and selling m calls, to be such that the payoff is the same no matter whether state 1 or state 2 occurs. The payoff in state 1 of the hedge portfolio is $U - m\,C_U$ and the payoff in state 2 is $D - m\,C_D$. Hence we need

$$U - m\,C_U = D - m\,C_D$$

$$m = \frac{U - D}{C_U - C_D}$$

Formula for Valuing Call

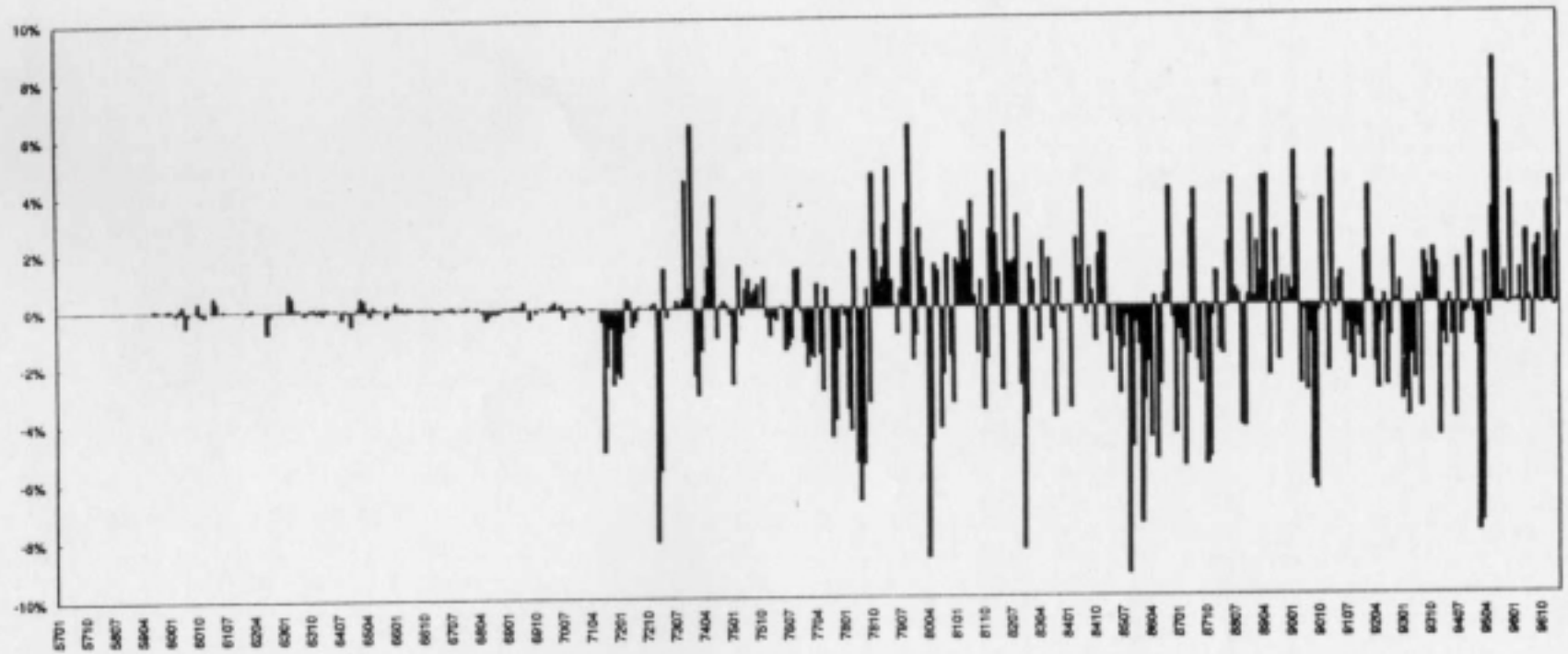
Denote the price of the share at t = 0, P and the price of the call at t = 0, C. We can then use our hedge portfolio to give us a formula for valuing a call. The cost of buying a share and selling m calls is P - m C. The payoff to this hedge portfolio is $U - m\,C_U$ or equivalently $D - m\,C_D$. If there are to be no arbitrage possibilities it must be the case

$$P - mC = \frac{D - mC_D}{1 + r_F}$$

or

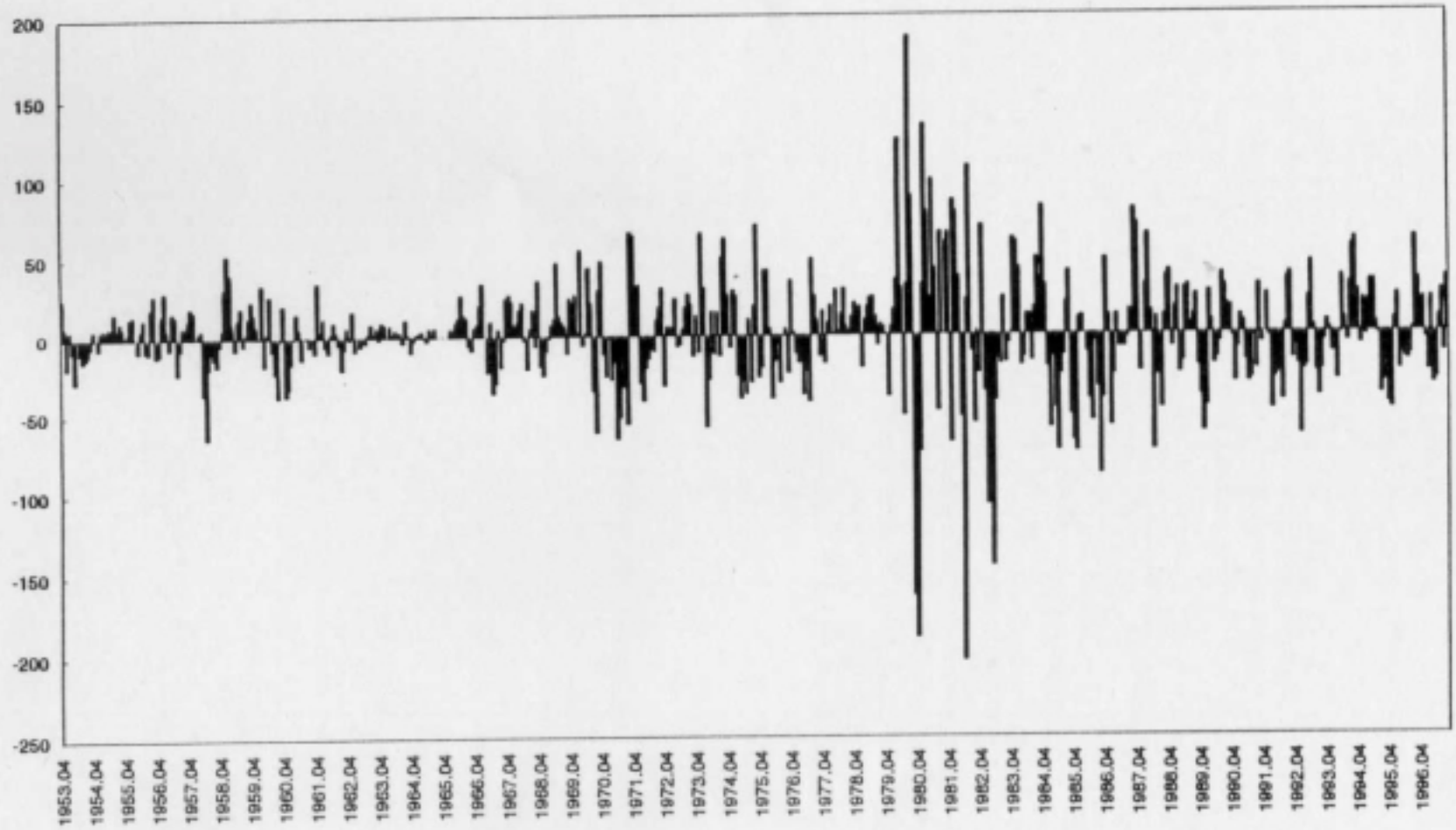
$$C = \frac{1}{m}\left(P - \frac{\left(D - mC_D\right)}{1 + r_F} \right)$$

Yen/$ U.S.- Monthly Exchange Rate Change (%)



Federal Reserve Economic Data

5-Year U.S. Treasury Notes: Monthly Basis Point Change



Federal Reserve Economic Data

APPENDIX TABLE 6

Cumulative probability [$N(d)$] that a normally distributed variable will be less than d standard deviations above the mean.

d	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
0.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
0.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
0.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
0.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
0.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
0.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
0.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
0.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
0.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9922	.9925	.9927	.9929	.9931	.9932	.9934	.9936
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952

Note: For example, if $d = .22$, $N(d) = .5871$ (i.e., there is a .5871 probability that a normally distributed variable will be less than .22 standard deviations above the mean).