

Final review session

(1) Short Answer Questions:

(A) Suppose that Starbucks is worried about further increases in the price of coffee. To hedge its coffee price risk, the CFO is considering engaging in transactions in the futures market. Should the CFO buy or sell coffee futures contracts? Explain. (10)

(B) Your investment advisor is recommending a portfolio called a Strap. It consists of a long position in two calls and one put on a specific stock, all with the same strike prices and exercise dates (to build this portfolio, you would buy two calls and one put). Does your investment advisor believe that a stock price increase or decrease is more likely? (20)

(C) You are on the board of directors of a large publicly traded company that is currently 100% equity financed. It has been proposed by another board member that the firm issue debt and repurchase shares. Discuss the advantages and disadvantages of the proposed debt issue. (10)

(D) There are no taxes. A firm consists of risky assets-in-place and cash. Suppose the cash is invested in a risky, positive NPV project. Evaluate the following two statements. (15)

- (i) The expected value of the firm's equity might increase.
- (ii) The expected value of the firm (equity plus debt) must increase.

- (2) XYZ Corp. is considering expanding their business. The project under consideration requires a \$100 million investment today and is expected to generate perpetual cashflows of \$13 million per year. The beta of the assets associated with the investment is 1.15. The risk-free rate is 6%, the market risk premium is 8.4% and the corporate tax rate is 34%. There are no expected costs of financial distress or personal taxes.
1. Assume that XYZ finances the project with 100% equity. Calculate the NPV of the proposed expansion. Should the expansion be undertaken? (20)
 2. Suppose that instead of financing the project with 100% equity, XYZ finances the expansion with \$100 million of perpetual debt. Based on the value of XYZ's existing assets, the debt is risk-free. However, lenders cannot assess the value of XYZ's existing assets and therefore demand a 7% expected return on the debt.
 - (i) What is the NPV of the tax shield associated with the debt issue? (10)
 - (ii) What is the NPV of the debt issue? (15)
 3. Based on your answers to parts A and B, calculate the APV of the project. What actions would you recommend that XYZ take? (Should they invest in the project? Should they issue debt?) (15)

- (3) KMM Inc. is an all equity firm with only two assets - assets in place and a positive NPV investment project. There are two possible states of the world--low demand and high demand. As indicated in the table below, the value of assets in place and the value of the investment project depend on the state of the world. Probabilities of each state occurring are also given in the table. In all states, the positive NPV investment project requires an initial investment of \$60. Throughout this problem, assume that managers try to maximize the wealth of original shareholders.

Asset Values

	Low Demand	High Demand
Probability	.5	.5
Value of Assets-In-Place (Machinery and Equipment)	60	140
NPV of Investment Project (=PV[cash inflows] - \$60 initial investment)	20	10

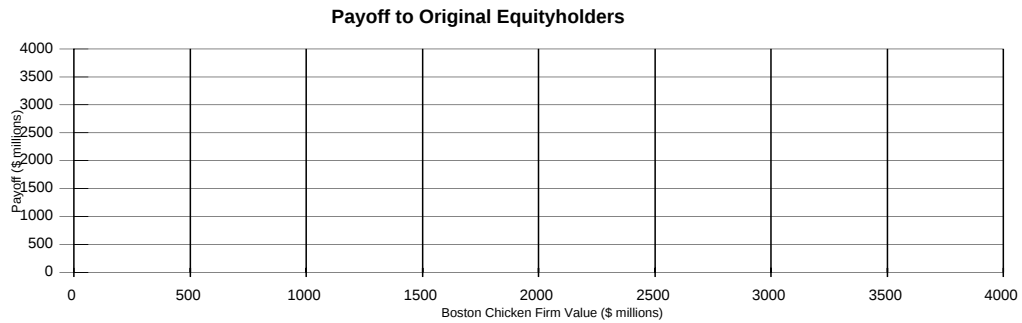
- In order to undertake the positive NPV project, the firm must raise \$60 in equity (assume the firm is credit rationed so debt is not an option). If managers must issue equity and invest before they know the level of demand, what percentage of the firm must original equityholders give up in order to raise the \$60 necessary to undertake the positive NPV project? Using this percentage, calculate the wealth of original shareholders for the various scenarios given in the table below (put your answers in the table) (15)

Wealth of Original Shareholders		
	Low Demand	High Demand
Do Nothing		
Issue Equity and Invest		

2. If managers observe the level of demand before deciding whether or not to invest, in which states will they invest? Why? (10)
- D. Assuming that managers observe the state of the world before issuing and investing, and that the market knows that the manager will decide after observing the state of the world what percentage of the firm must original equityholders give up in order to raise \$60? (20)
- E. As in part D assume that managers observe the level of demand before deciding whether or not to issue equity and invest. If managers announce their intention to issue equity and invest, what would you expect to happen to KMM's stock price? Explain. (15)

- (4) In 1983, two investment bankers at Merrill Lynch developed a security called a Liquid Yield Option Note (LYON). A LYON is a zero-coupon bond. Investors do not receive periodic interest payments. Instead, they have the option to receive \$1000 or a pre-specified number of shares of common stock on a pre-specified maturity date. In 1995, Boston Chicken (now Boston Market) issued 173,000 ten-year maturity LYONs at par. Each LYON had a face value of \$1000 and could be surrendered at maturity for 20 shares of Boston Chicken common stock. That is, investors had the option of receiving a \$1000 cash payment or 20 shares of common stock. Boston Chicken had 50 million shares of common stock outstanding before the LYON issue and committed to keep the number of shares at this level until the LYONs matured.
- A. In ten years, what would the value of Boston Chicken's assets have to be in order for LYON holders to choose common stock over the \$1000 payment? (10)

- B. Draw the payoff diagram to original equityholders after maturity of the LYONs as a function of the value of Boston Chicken's assets. Make sure your diagram is clearly and completely labeled. (15)

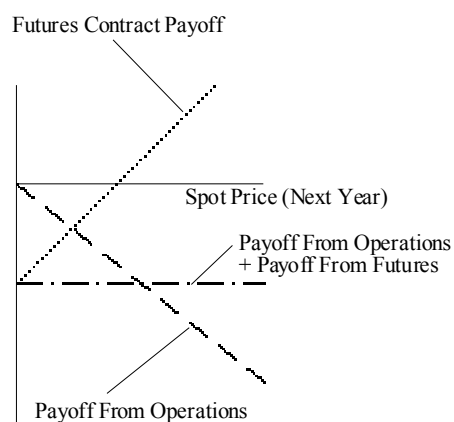


3. Instead of issuing LYONs Boston Chicken could issue straight debt. If it did, the debt would have an annual yield of 10%. What are the values of the bond and option portions of each LYON? Base your analysis on annual yields, not semi-annual yields. (15)
4. One of the advantages of convertible bonds is that they mitigate the risk-shifting problem. But unlike convertible bonds, LYONs make no coupon payments. Nevertheless, do LYONs also mitigate the risk-shifting problem? Explain. (10)
- E. David White, VP of Finance at Boston Chicken was quoted as saying Merrill has just done a tremendous job with this security. For us, it was an inexpensive way to sell equity. Do you agree or disagree? Explain. (10)

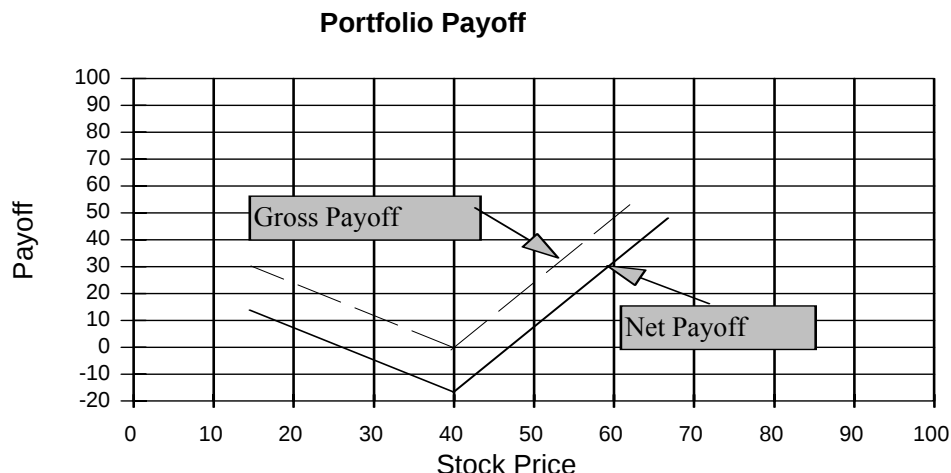
Solutions

(1) Short Answer Questions:

- (A) Starbucks should buy coffee futures. By doing so, Starbucks is agreeing to purchase coffee next year at a price specified today. If the spot price of coffee next year turns out to be high, then Starbucks will lose money from operations (it must buy coffee at a high price to sell to customers) However, they will make money on their futures position. On the other hand, if the spot price of coffee turns out to be low next year, Starbucks will make money on operations but lose money on its futures position. This is shown diagrammatically below. The net effect is that by buying coffee futures, Starbucks can completely insulate itself from coffee price fluctuations.



- (B) The graph below shows the payoff diagram to a portfolio consisting of two calls and one put all with the same exercise and strike prices (I have assumed a strike price of 40). Both gross and net payoffs are shown (the net payoff equals the gross payoff minus the initial cost of building the portfolio).



An investor in this portfolio must believe that there is going to be big move in stock price. The portfolio has a larger payoff if the move is positive (it increases 2 for 1 with stock price). Therefore, your investor advisor must believe that a stock price increase is more likely than a stock price decrease.

(C) We have discussed a number of advantages of debt. They include (1) tax advantages (Lecture 8 and the UST case) (2) reduction in wasteful spending of free cash flow (Lecture 11), and (3) alignment of incentives throughout the organization (Lecture 11 and the Sealed Air article). An advantage that we didn't touch on, but that some of you mentioned, involves signaling effects. By taking on debt, managers can signal that expected cashflows are big enough to meet interest payments.

We also talked about disadvantages of debt. If firms have high R&D or depreciation expenses, tax shields may not be valuable. Expected costs of financial distress were covered in general in Lecture 9 and specific costs were identified in the UST case. For example, high debt levels may cause firms to quickly liquidate assets at low prices. High levels of debt may also reduce flexibility. It may be handy to have capital reserves available when competitors experience negative business shocks (assuming cash is expensive to raise in the capital markets). Finally, we talked about the effect of debt on firms' investment decisions. If the debt is risky, equity becomes a call option on firm value. Managers seeking to maximize shareholder wealth will have an incentive to undertake risky projects (call option value increases with volatility). In some cases, these risky projects will have negative NPVs (Lecture 9).

(D) The first statement is true. Remember that equity is a call option on firm value with a strike price equal to the debt's face value. There are two cases to consider. The first is where firm value is well below the debt's face value. In this case, the gains from the project will accrue to debtholders. Equity value will increase a little bit--call option value increases as firm value gets closer to the strike price. The second case is where firm value is well above the debt's face value. In this case, the NPV from the project will accrue to equityholders and equity value will increase. For intermediate levels of firm value, the increase in equity value will be somewhere between zero and the magnitude of the NPV.

The second statement is also true. Because the project has a positive NPV, firm value will increase if it is undertaken. Whether this increase in firm value accrues to debtholders or equityholders is irrelevant for this part of the question.

- (2) A. The correct discount rate can be obtained from CAPM:

$$r = .06 + 1.15(.084) = .1566$$

Project NPV can then be calculated:

$$\begin{aligned} NPV &= -100 + \sum_{t=1}^{\infty} \frac{13}{(1 + .1566)^t} \\ &= -100 + \frac{13}{.1566} = -\$16.99 \text{ million} \end{aligned}$$

Since the NPV is negative, the project should not be undertaken.

- B. (i) Since the debt is perpetual and we are ignoring personal taxes, the NPV of the tax shield is:

$$\begin{aligned} NPV[\text{Tax Shield}] &= \sum_{t=1}^{\infty} \frac{r \tau D}{(1 + r_e)^t} = \sum_{t=1}^{\infty} \frac{(.07)(.34)(\$100M)}{(1 + .06)^t} \\ &= \frac{(.07)(.34)(\$100M)}{.06} = \$39.67M \end{aligned}$$

This calculation makes the standard assumption that the risk of the tax shield equals the risk of the debt. Other assumption may also be valid--full credit was given if you explicitly argued that the rate of return on debt and the tax shield discount rate were different. However, if you implicitly assumed that the discount rate for the tax shield was equal to the promised return on debt (7%) then you were marked down.

Note that had the bank charged the risk-free rate (i.e. if there was no information asymmetry) then the NPV of the tax shield would have been \$34M (=τD). The fact that the loan is mis-priced actually increases the value of the tax shield by \$5.67 million.

- (ii) The debt issue has a negative NPV. Since the debt is risk-free (this is given) it must have an expected return equal to the risk free rate of 6%. However, the bank requires an expected return of 7%. Therefore, the NPV of the debt issue is:

$$NPV[Debt Issue] = 100 - \sum_{t=1}^{\infty} \frac{(.07)(100)}{(1 + .06)^t}$$

$$= 100 - \frac{(.07)(100)}{(.06)} = -\$16.67 \text{ million}$$

3. The value of the project is in the tax shield. Both the project itself and the debt issuance have negative NPVs. If the project can be separated from the debt issuance (that is, if debt can be issued without undertaking the negative NPV project), then the firm should forgo the project and issue debt. Issuing debt gives the firm a positive NPV of \$23M (+\$39.67M from the tax shield and -\$16.67 from the debt issue). If the project and the debt issuance cannot be separated, then the firm should undertake the project and issue debt. The NPV in this case is $-\$16.99 + \$39.67 - \$16.67 = \6.01 million. Even in this case, the positive NPV of the tax shield outweighs the negative NPVs from the project and debt issuance.

- (3) A. The first step is to calculate firm value in each of the two states. In each state, firm value will equal the value of assets in place plus the NPV of the project plus \$60 contributed by new equity holders. Therefore, in the low demand state, firm value will be 140 and in the high demand state firm value will be 210. Since each state occurs with 50% probability, expected firm value is:

$$E[Firm Value] = (.50)(140) + (.50)(210) = 175$$

New shareholders will contribute \$60 cash in exchange for \$60 worth of equity. Therefore, new equity holders will demand k percent of the firm:

$$k * E[Firm Value] = 60$$

$$k = \frac{60}{175} = .343$$

Wealth of Original Shareholders		
	Low Demand	High Demand
Do Nothing	60	140
Issue Equity and Invest	92 $(=(1-.343)*140)$	138 $(=(1-.343)*210)$

2. When managers are better informed than the market (they know the level of demand before they decide to issue equity) they will only issue equity in the low demand state. When demand is low and equity is issued, original shareholders' wealth is \$92. This is greater than the \$60 wealth obtained via the alternative of doing nothing. However, in the high

demand state, equity is so mis-priced that original shareholders are better off if managers forgo the positive NPV project and refrain from issuing new equity. By doing nothing, original shareholders' wealth is \$140. This is greater than \$138 obtained by issuing equity and investing.

- C. New shareholders know that managers only issue equity when demand is low. Therefore, conditional on equity being issued, new investors conclude that the true (post-equity-issue) firm value is \$140. They will invest \$60 as long as they get \$60 worth of the firm. Therefore:

$$k * 140 = 60$$

$$k = \frac{60}{140} = .429$$

4. Prior to the equity issue announcement, the market estimates that assets in place are worth 100 (.5*60 + .5*140) and the positive NPV project is worth 15 (.5*20 + .5*10). Thus, the market's pre-announcement estimate of firm value is 115.

We know that management will issue and invest only in the low demand state. Therefore, as soon as the announcement that equity will be issued and the investment project will be undertaken (but before equity is issued) is made, the market updates its estimates of the value of assets in place and the value of the investment project. The market now knows with certainty that assets in place are worth 60 and the positive NPV project is worth 20. This implies a firm value of 80, down from the pre-announcement estimate of 115. Therefore, because of the negative signal regarding firm value, stock price will fall.

It is interesting to note that whether demand is low or high, *total* firm value will be 140. In the low demand state, original assets are worth 80 and cash contributed by new equityholders is worth 60. In the high demand state original assets are worth 140. But in the low demand state there will be more shares outstanding and therefore, stock price will be lower. It is tempting to attribute this low stock price to dilution. In fact, the difference in stock price is due to different asset values. Stock price falls as soon as the market updates its beliefs regarding the value of the firm's assets.

- (4) (A) LYON holders will take the option that maximizes their wealth. If they accept the cash payment, they receive \$173 million dollars. If they take common stock, they get (20 shares/bond)*(173,000 bonds) = 3.46 million shares. This represents 3.46 million/(50 + 3.46) million = 6.47% of the firm. Therefore, LYON holders will opt for common stock if the following inequality is satisfied:

$$\$173 \text{ million} < .0647 * \text{Firm Value}$$

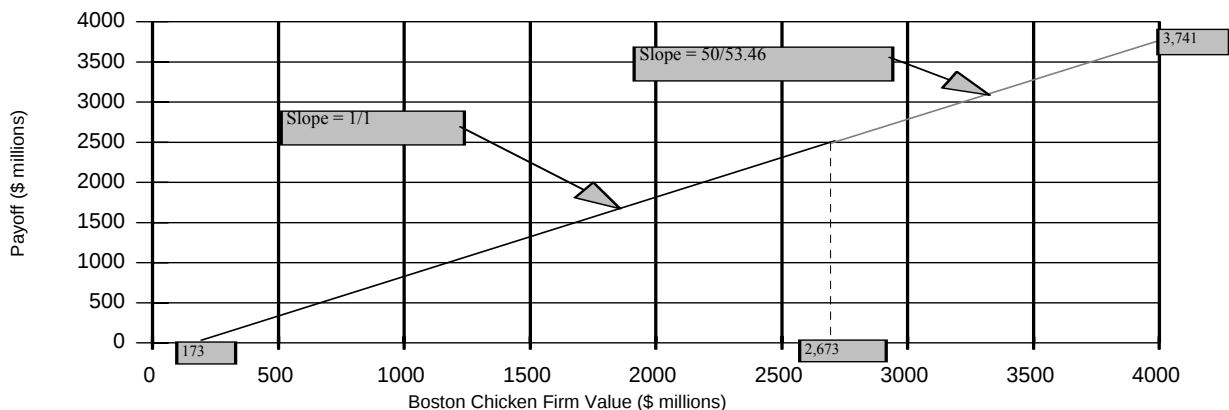
$$\text{Firm Value} > \frac{\$173 \text{ million}}{.0647} = \$2.673 \text{ billion}$$

As long as Boston Chicken's total asset value exceeds \$2.673 billion, LYON holders will forgo the \$1000 debt payment and convert their LYONs into common stock.

An alternate way to get the same answer is to view the problem on a per bond basis. In this case, LYON holders will take common stock as long as $\$1000 < 20 * P_{\text{stock}}$. That is, if P_{stock} exceeds \$50, LYON holders are better off taking stock than \$1000. At \$50 per share, the total value of Boston Chicken's assets would be $\$50 * (50 \text{ million} + 20 * 173,000) = \2.673 billion .

- (B) The payoff to original equity holders is shown below. When firm value is less than \$173 million, original equityholders payoff equals zero--LYON holders have priority. If firm value exceeds \$173 million but is less than the conversion point of \$2.673 billion, LYON holders elect to take the \$173 million face value repayment and original equity holders are left with the residual. Therefore, in this region, the slope of the payoff diagram is 1. For firm values above 2.673 billion, LYON holders will convert their bonds into stock. Thus, original shareholders must share increases in firm value with the LYON holders. Since LYON holders will own 3.46 million shares after conversion and since original shareholders own 50 million shares, the total number of shares outstanding will be 53.46 million. Original shareholders get 50/53.46 of every incremental dollar of firm value.

Payoff to Original Equityholders



- (C) To calculate the value of the bond portion of the LYON, just discount the promised payments at the promised rate of return from straight debt (10%). For LYONs there is only one promised payment--the face value payment at maturity. Therefore, the value of the bond portion is:

$$\text{Bond Portion Value} = \sum_{t=1}^{10} \frac{0}{(1 + .10)^t} + \frac{1000}{(1 + .10)^{10}}$$

$$= \$385.54$$

Since the LYONs sold for \$1000 (par), the option portion must be worth \$1000 minus the bond portion. Therefore:

$$\text{Option Portion Value} = \$1000 - \$385.54 = \$614.46$$

- (D) Coupon payments are not the aspect of convertible bonds that mitigate the risk shifting problem. Rather, it is convertible bondholders' ability to convert their shares into equity (thereby allowing them to share in the stock's upside) that limits equityholders' incentives to take overly risky negative NPV projects. Since LYON holders also have the option to convert their bonds into common stock, they can share in the stock's upside. Therefore, like convertible bonds, LYONs help to mitigate the risk shifting problem.
- (E) Presumably, Mr. White was comparing the sale of LYONs to the sale of straight equity. Since the LYONs conversion price is greater than the issue-date stock price (it has to be to avoid arbitrage), Mr. White viewed the sale of LYONs as cheap equity. However, this logic fails to account for the guarantee provided to LYON holders. The sale of LYONs is cheap equity only if the stock price reaches the \$50 mark at maturity. If the stock fails to reach this level, Boston Chicken is obligated to pay \$173 million to LYON holders. Thus when Boston Chicken issued LYONs, it sold equity PLUS a guarantee that the equity would be worth no less than \$173 million (unless BC defaults). Whether or not the sale of LYONs represents cheap equity depends on whether this guarantee was over or under priced. If investors over-priced the guarantee, then equity was cheap. However, if investors underpriced the guarantee, then equity was expensive. If the guarantee was perfectly priced, then equity was neither cheap nor expensive.