Lecture 13: Supplementary Exercises

1) Preferred Exchangeable Redemption Cumulative Securities (PERCS) for common exchange. VideoServer is an all equity firm with 2000 shares outstanding. Next year the value of VideoServer's assets will be 100K, 200K, 300K, 400K, 500K, or 600K. The following question is long and very challenging. It has been included for those of you who want to push yourselves.

A) What will be the stock price conditional on VideoServer's value? What is the payoff to a call option on VideoServer stock with a strike price of $150 and one year until expiration?

VideoServer's Value	100K	200K	300K	400K	500K	600K
Stock Price						
Option Payoff (X=150)						

B) VideoServer has decided to execute a zero cost PERCS for common equity exchange. This means they will issue a PERCS to some of their shareholders in exchange for one share of common stock. The PERCS will be structured so that the market value of the PERCS is identical to the current price of the stock. After the exchange, VideoServer will have 1600 shares of common stock and 400 PERCS outstanding.

PERCS are like preferred equity minus an imbedded option. They pay a fixed dividend and have a priority higher than common stock. At the end of the year, the PERCS convert into common equity. However, the number of shares each PERCS converts into is a function of the stock price on that day. The number of shares each PERCS converts into is:

$$\text{Min}\left[\ 1\ ,\ \frac{150}{P_{Stock}}\ \right] \qquad \textbf{(1)}$$

Calculate the price of stock as a function of the value of the firm next year. First calculate the following numbers. Each one will depend upon the value of VideoServer's assets next year.

1) The payoff to one PERCS as a function of the value of the firm.
2) The total payoff to all PERCS
3) The total payoff to old common equity owners. This is the payoff to investors who own the common equity -- not the investors whose PERCS will convert into common equity.

To verify that you answer is correct, calculate the number of shares into which the PERCS convert. Then divide the total value of the firm by the total number of shares.

VideoServer's Value	100K	200K	300K	400K	500K	600K
Payoff to single PERCS						
Payoff to all PERCS						
Payoff to equity owners						
VS Stock price						
Number of common equity shares from PERCS						
Total number of shares						
VS Stock price						

C) A PERCS is a portfolio of a share of common stock minus a call option on the underlying common stock. In our example, the strike price of the call option is $150. When VideoServer announces the zero cost PERCS for common exchange, their stock price doesn't change. Since no money is being paid into or out of the corporation, the firm's assets do not change. The price of exchange traded options on VideoServer stock may change. These options are issued by traders on the options exchange, not by VideoServer. Should the price of these options rise, fall, or remain unchanged on the announcement of the exchange?

VideoServer's Value	100K	200K	300K	400K	500K	600K
VS Stock Price						
Payoff to exchange traded option						

D) Daniel Associates is a small investment banking boutique.[1] You are one of Daniel Associates new hires. Their client, VideoServer, wishes to execute the zero cost PERCS for common exchange. Daniel Associates will purchase the PERCS from VideoServer and then sell them to the market (VideoServer's shareholders). Since Daniel Associates will own the securities for several days, they will be exposed to risk. They have asked you to design a hedge. To do this you must construct a portfolio from traded securities which replicates the payoff to the PERCS. How would you construct such a portfolio. Be specific.

[1] An investment banking boutique is a small firm that specializes in only a few of the services usually offered by an investment bank. They are often created when someone leaves an investment bank to start their own firm. During the merger wave of the 1980s, some of the most productive investment bankers who specialized in mergers and acquisitions left the big investment banks to start their own merger and acquisition boutiques.

VideoServer's Value	100K	200K	300K	400K	500K	600K

E) Instead of working for a firm, you now are working for money managers. Assume that VideoServers does not execute a PERCS for common exchange. They are an all equity firm with 2000 shares outstanding.

1) Your client, the Northwestern University endowment, would like to purchase a PERCS on VideoServers. This is the security I described in B). The only problem is VideoServers board of directors has decided not to issue PERCS. Construct a PERCS from publicly traded securities. How will you price the security?

VideoServer's Value	100K	200K	300K	400K	500K	600K
VS Stock price (no PERCS)	50	100	150	200	250	300
Pseudo PERCS						

2) You have another client: Chicago Public Teachers Pension plan. They would like a security whose payoff mimics the stock of VideoServer if they had issued the PERCS. Remember, VideoServer's board has decided not to issue the PERCS. How would you construct the security that CPTPP wants and how would you price it?

VideoServer's Value	100K	200K	300K	400K	500K	600K
VS Stock price (no PERCS)	50	100	150	200	250	300
Pseudo VS stock with PERCS						

Lecture 13: Supplementary Exercise Answers

1) VideoServer's PERCS for common equity exchange.

A) The price of VideoServer stock is the value of the firm's equity divided by the number of shares (2000). Since there is no debt, the value of VideoServer's equity is also the value of their assets. The payoff to the option is the max(P_S - 150, 0).

VideoServer's Value	100K	200K	300K	400K	500K	600K
Stock Price	50	100	150	200	250	300
Option Payoff (X=150)	0	0	0	50	100	150

B) To calculate the payoff to a PERCS we must convert the number of common shares the PERCS holder will receive to a dollar value. For each PERCS the payoff in shares of common stock is:

$$\text{Min}\left[\ 1\ ,\ \frac{150}{P_{Stock}}\ \right] \qquad \textbf{(2)}$$

Since each share of stock is worth P_{stock}, the payoff to each PERCS is:

$$P_{Stock} * \text{Min}\left[\ 1\ ,\ \frac{150}{P_{Stock}}\ \right] = \text{Min}\left[\ P_{Stock}\ ,\ 150\ \right] \qquad \textbf{(3)}$$

The payoff to the PERCS is similar to the payoff to a share of common stock, however, the upside is capped at $150.

1) If VideoServer turns out to be worth less than $300K, the PERCS will have a payoff equal to the stock price. If VideoServer turns out to be worth more than $300K, the PERCS will have a payoff of $150.

2) Since there are 400 PERCS, the total payoff to the PERCS is 400 times the second row.

3) The common equity owners and the PERCS owners, own the entire firm. To calculate the total payoff to the common equity owners, subtract the payoff to the PERCS owners from the value of the firm.

4) The stock price is the total payoff to equity owners divided by the number of common shares outstanding (1600). Notice that for firm values of 300K and below, the payoff to the PERCS and the common equity is identical to the payoff of the common equity before the exchange. All the action occurs for firm values above 300K. For these values of the firm, the payoff to the PERCS is capped. The excess value flows to the equity owners. The excess value is why the stock price is higher in these states than it would be absent the PERCS for common exchange.

To verify the correct stock price, use an alternative method. First calculate the number of shares into which the 400 PERCS convert. When the firm value is less than 300K, the PERCS

convert into 400 shares of common stock. For firm values above 300K, the number of shares of common stock into which PERCS convert is:

$$\text{Number of shares PERCS} = \frac{400 * 150}{P_{\text{VS stock}}} \quad \textbf{(4)}$$

The total number of shares of common stock is equation (8) plus 1600 (see the seventh row of the table). Divide the total value of the firm by the total number of shares to get the stock price. The answer is the same as before.

VideoServer's Value	100K	200K	300K	400K	500K	600K
Payoff to single PERCS	50	100	150	150	150	150
Payoff to all PERCS	20K	40K	60K	60K	60K	60K
Payoff to equity owners	80K	160K	240K	340K	440K	540K
VS Stock price	50	100	150	212.50	275.00	337.50
Number of common equity shares from PERCS	400	400	400	282.35	218.18	177.78
Total number of shares	2000	2000	2000	1882.35	1818.18	1777.78
VS Stock price	50	100	150	212.50	275.00	337.50

C) To know if the option price has risen or fallen, look at the payoffs to the option and compare them to the payoffs calculated in A). The payoff to the option will remain unchanged for firm values of 300K and below and will rise for firm values above 300K. Since the payoffs to the call with PERCS are never smaller and may be larger than the payoff to the call without PERCS, the value of the call option will increase.

VideoServer's Value	100K	200K	300K	400K	500K	600K
VS Stock Price	50	100	150	212.50	275.00	337.50
Payoff to exchange traded option	0	0	0	62.50	125.00	187.50

D) A PERCS is a portfolio of a share of common stock minus a call option on the underlying common stock. The payoff to a PERCS is capped at $150. Thus a share of stock minus a call option with a strike price of $150 should be equivalent to a PERCS. This portfolio exactly replicates the payoff to one PERCS.

VideoServer's Value	100K	200K	300K	400K	500K	600K
VS Stock Price	50	100	150	212.50	275.00	337.50
- Payoff to option	0	0	0	62.50	125.00	187.50
Combined payoff	50	100	150	150	150	150

E) Replicating portfolios.

1) The Pseudo PERCS (PPERCS). Construct a portfolio which has a payoff equal to the stock price for values of VideoServer of 300K and below and a payoff of 150 if the value of VideoServer is above 300K. You have two securities to work with -- the stock of VideoServer and a call option on VideoServer. You calculated the payoff of these two securities in A); they are reproduced below. Purchasing a share of stock and selling a call option will produce exactly the payoff you seek. The cost of constructing the PERCS is the price of one share of VideoServer stock minus the price of a call option on VS stock with a strike price of 150. Of course, you want to sell the PERCS for more than your cost.

VideoServer's Value	100K	200K	300K	400K	500K	600K
VS Stock price (no PERCS)	50	100	150	200	250	300
Option on VS stock (X=150)	0	0	0	50	100	150
Pseudo PERCS	50	100	150	150	150	150

2) The PERCed up equity. Construct a portfolio whose payoffs mimic those of the common equity of VideoServer had they issued PERCS. You calculated these payoffs in B) above. There are still just two securities to work with -- the stock and the call option. The portfolio is long one share of stock and long a quarter of an option. The one quarter ratio comes from the number of PERCS (400) divided by the number of common shares outstanding before conversion (1600). When you add up the PERCS and the equity, the net investment in call options must be zero. If the 400 PERCS are each short an option, the 1600 shares of common stock must jointly be long 400 call options. Each one is long one quarter of an option. The cost of the security you constructed for CPTPP is the price of one share of VideoServer stock plus one fourth of the cost of a call option on VS stock with a strike price of 150.

VideoServer's Value	100K	200K	300K	400K	500K	600K
VS Stock price (no PERCS)	50	100	150	200	250	300
¼ Option on VS stock (X=150)	0	0	0	12.50	25.00	37.50
Pseudo VS stock with PERCS	50	100	150	212.50	275.00	337.50