Valuing distressed firms

Our class today

- Characteristics of declining companies
- Distressed firm valuation
  - Distressed sale
  - When there are survival chances
  - Estimating probability of bankruptcy

Characteristics of declining firms

Figure 1: A Financial Balance Sheet for a Declining Business

Assets			Liabilities	
Existing Investments Generate cashflows today	Investments already made	*All of the value comes from existing assets, but some of these asset may be woth more liquidiated.*	Debt	*if the firm has high debt, there is the possibility of distress*
Expected Value that will be created by future investments	Investments yet to be made	*Little or no value from growth. Can even be negative, if firm pursues bad investments*	Equity	

Source: Damodaran 2009

Characteristics of declining firms

- Declining revenues
- Negative cash flows
- Shrinking or negative margins
- Asset divestitures
- Big payouts: Dividends or stock buy backs
- Difficulty servicing debt or unserviceable debt
- ***Discussion: What are the causes?***

Valuation issues

- Earning less than cost of capital
- Divestiture effects
- Discount rates
- Imploding terminal value
- Bankruptcy costs

Valuing distressed firms

- Distress sale/Liquidation of asset value
- Firm with survival chances
  - Equity as an option
  - Expected value per share = Value per share as going concern (1 – Prob. of distress) + Value of per share in distress (Prob. of distress)
  - Adjusted PV approach = Unlevered firm value + PV of tax benefits – Expected bankruptcy costs
- Estimating probability of bankruptcy

Las Vegas Sands: Background

- Las Vegas Sands owns and operates the Venetian Casino and Sands Convention Center in Las Vegas and the Sands Macau Casino in Macau, China. While the firm does not fit the classic profile of a declining company – its revenues increased from $1.75 billion in 2005 to $4.39 billion in 2008 and it had two other casinos in development – it ran into significant financial trouble in the last quarter of 2008. Fears about whether the firm would be able to meet its debt obligations pushed down both stock prices (almost 90%) and bond prices (about 40%) in 2008.
- By January 2009, the firm was operating under the threat of defaulting on its debt and both its debt and equity prices reflected that fear.

Las Vegas Sands: Background

- The debt was rated B2 by Moody's (and B+ by S&P) and a bond issued by Las Vegas Sands, expiring in 2015, was trading at a yield to maturity of 19.82%.
- Debt to total capital ratio = 74%
- The regression beta, estimated using two years of weekly returns from January 2007 to January 2009 was 2.78. Using a riskfree rate of 3% (the ten-year bond rate at the time of the analysis) and an equity risk premium of 6%, we derive a cost of equity of
- 19.68% for the firm.
- Cost of equity = 3% + 2.78 (6%) = 19.68%
- **Discussion: kd > ks, what does this mean?**

Distress sale

- What is the price another casino operator may pay?
- Using the average operating income of $401.91 million, estimated using four years of data from 2005 to 2008 for Las Vegas Sands, as a reasonable measure of earnings from existing assets, we used a corporate tax rate of 38% and the cost of capital of 9%

$$\text{Value of existing assets} = \frac{\text{EBIT}(1-t)}{\text{Cost of Capital}} = \frac{401.91(1-.38)}{.09} = \$2{,}769 \text{ million}$$

- What is the price of outright liquidation?
- Distress sale value = BV(1-price depreciation)(1-illiquidity discount) = 11,275 (1-0.4)(1-0.1) = 6,089 mn

- If outstanding BV debt is worth $10.47 bn and firm has cash of $3.04, how much would shareholders receive?

LVS: On-going vs distress value mix

- Performance history

Year	Revenues	Operating Income	Pre-tax Margin	Capital invested	ROC
2004	1197	233	19.47%	1575	9.17%
2005	1741	491	28.20%	1810	16.82%
2006	2237	577	25.79%	2791	12.82%
2007	2951	331	11.22%	2049	10.02%
2008	4390	209	4.76%	8974	1.44%

- Correction 2008 ROC
- = 209(1-0.26)/8,975= 1.72%

LVS: On-going vs distress value mix

Table 7: Expected Revenues and Operating Income – LVS

Year	Revenue growth	Revenues	Operating Margin	Operating Income	Tax rate	After-tax Operating Income
Current		$4,390	4.76%	$209	26.00%	$155
1	1%	$4,434	5.81%	$258	26.00%	$191
2	2%	$4,523	6.86%	$310	26.00%	$229
3	20%	$5,427	7.90%	$429	26.00%	$317
4	20%	$6,513	8.95%	$583	26.00%	$431
5	20%	$7,815	10.00%	$782	26.00%	$578
6	5%	$8,206	11.40%	$935	28.40%	$670
7	5%	$8,616	12.80%	$1,103	30.80%	$763
8	5%	$9,047	14.20%	$1,285	33.20%	$858
9	5%	$9,499	15.60%	$1,482	35.60%	$954
10	5%	$9,974	17.00%	$1,696	38.00%	$1,051

- Estimates based on advisor's assumptions.

LVS: On-going vs distress value mix

- Negative reinvestment rate = divestiture

Table 8: Expected Free Cash flow to Firm – LVS

Year	After-tax Operating Income	Reinvestment Rate	Reinvestment	FCFF
1	$191	-10.00%	-$19	$210
2	$229	-5.00%	-$11	$241
3	$317	0.00%	$0	$317
4	$431	5.00%	$22	$410
5	$578	10.00%	$58	$520
6	$670	10.00%	$67	$603
7	$763	20.00%	$153	$611
8	$858	25.00%	$215	$644
9	$954	30.00%	$286	$668
10	$1,051	33.30%	$350	$701

- FCFF = After tax Op Income - Reinvestment

LVS: On-going vs distress value mix

- The unlevered beta of 1.15 for casino companies as a starting point, and compute the levered beta, based on the company's existing debt to equity ratio of 277.34%, computed based upon the estimated market value of equity and debt at the time of the analysis. The market value of equity, based upon the prevailing stock price of $4.25 and the 641.839 million shares outstanding, is $2.728 billion.
- To estimate the market value of debt, we first estimated the cost of debt, by adding a default spread of 6% (based upon its rating of B+, from S&P) to the riskfree rate of 3%, and then used the current interest expenses ($422 million) and face value of debt ($10.47 billion) to arrive at a present value for the debt of $7.57 billion:

LVS: On-going vs distress value mix

$$\text{Estimated market value of debt} = \text{Interest Expense}\left[\frac{1-\frac{1}{(1+r)^n}}{r}\right] + \frac{\text{Face Value of Debt}}{(1+r)^n}$$

$$= 422\left[\frac{1-\frac{1}{(1.09)^{8.1}}}{.09}\right] + \frac{10,470}{(1.09)^{8.1}} = \$7,565m$$

Market Debt/Equity Ratio = 7565/2728 = 277.34%

Market Debt/Capital Ratio = 7565/ (7565+2728) = 73.5%

Levered Beta = 1.15 (1+ (1-.38) (2.7734)) = 3.14

Cost of equity = Riskfree Rate + Beta (Equity Risk Premium)

= 3% + 3.14 (6%) = 21.82%

LVS: On-going vs distress value mix

Since the firm has positive operating income still and is expected to recover, we will assume that it will be able to get the full tax benefits of debt (based upon the marginal tax rate of 38%).

Pre-tax cost of debt = Riskfree Rate + Default Spread = 3% + 6% = 9%

After-tax cost of debt = 9% (1-.38)= 5.58%

Using the current debt ratio of 73.50%, we estimate a cost of capital of 9.88% for Las Vegas Sands:

Cost of capital = Cost of equity (1- Debt ratio) + After-tax cost of debt (Debt ratio)

= 21.82% (.265) + 5.58% (.735) = 9.88%

LVS: On-going vs distress value mix

- Assumes debt ratio will decline and converge with industry average of 50%

Table 9: Costs of equity, debt and capital –LVS

Year	Beta	Cost of equity	Pre-tax Cost of debt	Debt Ratio	Cost of capital
1	3.14	21.82%	9.00%	73.50%	9.88%
2	3.14	21.82%	9.00%	73.50%	9.88%
3	3.14	21.82%	9.00%	73.50%	9.88%
4	3.14	21.82%	9.00%	73.50%	9.88%
5	3.14	21.82%	9.00%	73.50%	9.88%
6	2.75	19.50%	8.70%	68.80%	9.79%
7	2.36	17.17%	8.40%	64.10%	9.50%
8	1.97	14.85%	8.10%	59.40%	9.01%
9	1.59	12.52%	7.80%	54.70%	8.32%
10	1.20	10.20%	7.50%	50.00%	7.43%

LVS: On-going vs distress value mix

Table 10: Capital Invested and Return on Capital – LVS

Year	After-tax Operating Income	Reinvestment	Capital Invested	Return on capital
Current	$155		8975	1.72%
1	$191	-$19	$8,956	2.13%
2	$229	-$11	$8,944	2.57%
3	$317	$0	$8,944	3.55%
4	$431	$22	$8,966	4.81%
5	$578	$58	$9,024	6.41%
6	$670	$67	$9,091	7.37%
7	$763	$153	$9,243	8.26%
8	$858	$215	$9,458	9.07%
9	$954	$286	$9,744	9.79%
10	$1,051	$350	$10,094	10.41%

Capital invested in year n= Capital invested year n-1+ Reinvestment in year n

Note that the return on capital in year 10 is 10.41%, close to the target return on capital of 10%.

LVS: On-going vs distress value mix

- Assume ROC will be 10% in perpetuity and that g after year 10 will be 3% forever.
- Reinvestment rate = g(stable)/ROC(stable) = 3%/10% = 30%
- TV = After tax oper income(1+g)(1-reinvestment rate)/(WACC(s)-g(s))
- = 1051(1.03)(1-0.3)/(0.0743-0.03) = 17,129

Table 11: Value of operating assets – LVS

Year	FCFF	Terminal value	Cost of capital	Cumulated cost of capital	PV
1	$210		9.88%	1.0988	$190.79
2	$241		9.88%	1.2075	$199.54
3	$317		9.88%	1.3268	$239.25
4	$410		9.88%	1.4579	$281.12
5	$520		9.88%	1.6021	$324.88
6	$603		9.79%	1.7590	$342.71
7	$611		9.50%	1.9261	$316.98
8	$644		9.01%	2.0997	$306.52
9	$668		8.32%	2.2744	$293.72
10	$701	$17,129.27	7.43%	2.4433	$7,297.83
			Value of operating assets =		$9,793.34

LVS: On-going vs distress value mix

- Value per share = (PVCF + Cash – MVD)/tot. no.shares = (9,793 + 3,040 – 7,565)/641,839 = $8.21 per share
- Expected value per share = Value as going concern (1-prob distress) + value per share in distress (Prob distress) = 8.21(0.2344) + 0(1-0.2334) = $1.92

Estimating probability of bankruptcy

- In 2009, Las Vegas Sands had 6.375% coupon bond, maturing in 2015 trading at $529. The following estimates the probability of default (t-bond rate 3% used as risk-free)

$$529 = \sum_{t=1}^{7} \frac{63.75(1-\pi)}{(1.03)^t} + \frac{1{,}000(1-\pi)^7}{(1.03)^7}$$

$$\pi = 13.54\%$$

- Solving for probability of bankruptcy we get,
- Cumulative prob of surviving for 10 years = (1-0.1354)^10 = 23.34%
- Cumulative prob of distress over 10 years = 1 – 0.2334 = 76.66%

Estimating probability of bankruptcy

- In Jan 2009, Las Vegas Sands had a 6.375% coupon bond, maturing in Feb 2015, trading at $529. The following estimates of probability of default (using 3% risk-free rate as reference).

- Solving yields annual prob. of default = 13.54%.
- Cumulative prob. of surviving in 10 years = $(1 - 0.1354)^{10}$ = 23.34%
- Cumulative probability of distress over 10 years = 1 – 0.2334 = 76.67%
- Other approach:

- Logistic regression models
- Prob of default = 1/exp-(a+bZ)
- Z = c1 x (Working capital/ Total Assets) + c2 x (Retained Earnings/ Total Assets) + c3 x (EBIT/ Total Assets) + c4 x (Market value of equity/ Book value of total liabilities) + c5 x (Sales/ Total Assets)

Logistic Regression

- Similar to linear regression, two main differences
  - Y (outcome or response) is categorical
    - Yes/No
    - Approve/Reject
    - Responded/Did not respond
  - Result is expressed as a ***probability*** of being in either group.

Logisitic regression

p = Prob(y=1|x) = exp(a+bx)/[1+exp(a+bx)]

1-p =1/[1+exp(a+bx)]

$$\ln [p/(1-p)] = a + bx$$

where:

exp or *e* is the exponential function (e=2.71828…)

ln is the natural logarithm *(ln(e) = 1)*

p is probability that the event y occurs given x, and can range between 0 and 1

p/(1-p) is the ***"odds ratio"***

ln[p/(1-p)] is the log odds ratio, or "logit"

all other components of the regression model are the same

Odds Ratio

- Frequently used
- Related to probability of an event as follows:

  Odds Ratio = p/(1-p)

- Example:
  - Probability of firm going bankrupt = .25
  - Odds firm will go bankrupt = .25/(1-.25) = ***1/3 or 3 to 1***
  - This is how sports books calculate odds
    - (e.g., if odds of VU winning a championship are 2:1, probability is 1/3
- ln [p/(1-p)] = a + bx means that as x increases by 1, the natural log of the odds ratio increases by b, or the odds ratio increase by a factor of exp(b)

High leverage and default

$$\ln\left(\frac{P_i}{1-P_i}\right) = -0.2379 + 0.0531(\Delta T)$$

- What is the odds of default if the firm has D/E that is 20% above industry average?
- Ans: -0.2376+0.0531(20) =0.8246

- What is default if it takes D/E 30% above industry average?
- Ans: -0.2376+0.0531(30) = 1.3557
- P = exp(1.3557)/(1+exp(1.3557) = 0.7950

REAL OPTIONS

Investment Decision and Call Option

Investment Opportunity		Call Option
PV of project's operating assets to be acquired	S	Stock Price
Expense required to acquired the proj's assets	X	Exercise Price
Length of time the decision may be deferred	T	Time to Expiration
Time value of money	r_f	Risk-free Rate of Return
Riskiness of project assets	σ^2	Variance of Return on Stock

Basic Properties of Option Prices

- Option prices without assumptions about volatility and probabilistic behaviour of stock prices.
- Long position on European call is

$$\max(S_T - X, 0)$$

- Long position on European put is

$$\max(X - S_T, 0)$$

Basic idea of Black-Scholes-Merton Option Pricing Formula

- S is lognormally distributed. Define g(S) as the probability density function of S. It follows that,

$$E[\max(S-X),0]=\int_X^{\infty}(S-X)g(S)d(S)$$

- Now assume existence of risk free rate r, the call price is given by,

$$c=e^{-rT}E[\max(S_T-X),0]$$
$$c=e^{-rT}E[S_0e^{rT}N(d_1)-XN(d_2)]$$

Black-Scholes Option Pricing Formula without dividends

- Black-Scholes

$$c=S_0N(d_1)-Xe^{-rT}N(d_2)$$
$$p=Xe^{-rT}N(-d_2)-S_0N(-d_1)$$
$$c+Xe^{-rT}=p+S_0$$

where

$$d_1=\frac{\ln(S_0/X)+(r+\sigma^2/2)T}{\sigma\sqrt{T}}$$
$$d_2=d_1-\sigma\sqrt{T}$$

The cumulative normal distribution

- N(x) is the cumulative probability distribution function for a variable that is N~(0,1).
- The expression $XN(d_2)$ is the strike price times the probability of that the option will be exercised.
- The expression $S_0N(d_1)e^{rT}$ is the expected value of a variable that equals S_T when $S_T>X$ and is zero otherwise.

Black-Scholes Option Pricing Formula with dividends

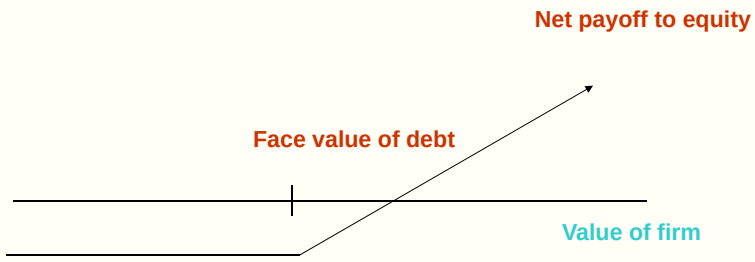
$$c=S_0e^{-\gamma T}N(d_1)-Xe^{-rT}N(d_2)$$
$$p=Xe^{-rT}N(-d_2)-S_0e^{-\gamma T}N(-d_1)$$
$$c+Xe^{-rT}=p+S_0$$

Where,

$$d_1=\frac{\ln(S_0/X)+(r-\gamma+\sigma^2/2)T}{\sigma\sqrt{T}}$$
$$d_2=d_1-\sigma\sqrt{T}$$

Valuing equity in troubled firms

- Payoff to equity on liquidation = V – D if V > D
- Payoff to equity on liquidation = 0 if V <= D



Valuing equity as an option

- A firm with assets currently valued at $100 mn, STD of asset value is 40%. The face value of debt is $80 mn. (Zero coupon with 10 year left to maturity) The 10 year RF is 10%. Use the call option pricing model to value the firm's equity.
- Value of underlying asset = S = $100 mn
- Exercise price = X = $80 mn
- Life of option = T = 10 years
- STD = 40%
- RF = 6%
- Value of call (Equity) = 100*(0.9003) – 80*[exp(-0.10)(10)](0.5073) = 67.76 mn
- Thus, value of outstanding debt = 100 – 67.76 = 32.24 mn

Valuing equity as an option

- Using the preceding example, assume that the firm value drops to $50 mn below face value of debt. What is the value of call (equity)?
- Value of equity = 50(0.7689) – 80*[exp(-
- 0.1)(10)](0.2987) = 25.35 mn
- Value of debt = 50 mn – 25.35 mn = 24.65

Inputs for valuing equity as an option

- Obtain market values of outstanding debt and equity. (Easy if both are traded)
- Estimate market values of firm's assets with DCF method.
- Compute variance of firm value.

$$\sigma^2_{Firm} = w^2_E\sigma^2_E + w^2_D\sigma^2_D + 2w_E w_D \sigma_{ED}$$

Examples of Real Options

Category	Description	Important in:
Option to Defer	Management has opportunity to wait to invest, and can see if markets warrant further investment.	Natural resources extraction, real estate, farming, technology.
Staged Investment	Staging investment creates the option to reevaluate and/or abandon at each stage.	R&D intensive industries, energy generation, start-up ventures.
Option to alter operating scale	If market conditions change, the firm can expand/contract or temporarily shut down.	Natural resources, fashion, real estate, consumer goods.
Option to abandon	If market conditions decline, management sells off assets	Capital-intensive industries, new product introductions in uncertain markets.
Option to switch	If prices or demand change, management can change product mix (product flexibility) or switch inputs (process flexibility)	Companies in volatile markets with shifting preferences, energy companies
Growth options	An early investment opens up future growth opportunities in the form of new products or processes, access to markets, or strengthening of core capabilities—like interproject compound options	High tech; industries with multiple product generations (drug companies, computers, strategic acquisitions).
Multiple Interacting Options	Projects involve a collection of various options—both put and call types. Values can differ from the sum of separate option values because they interact.	Many of the industries discussed above