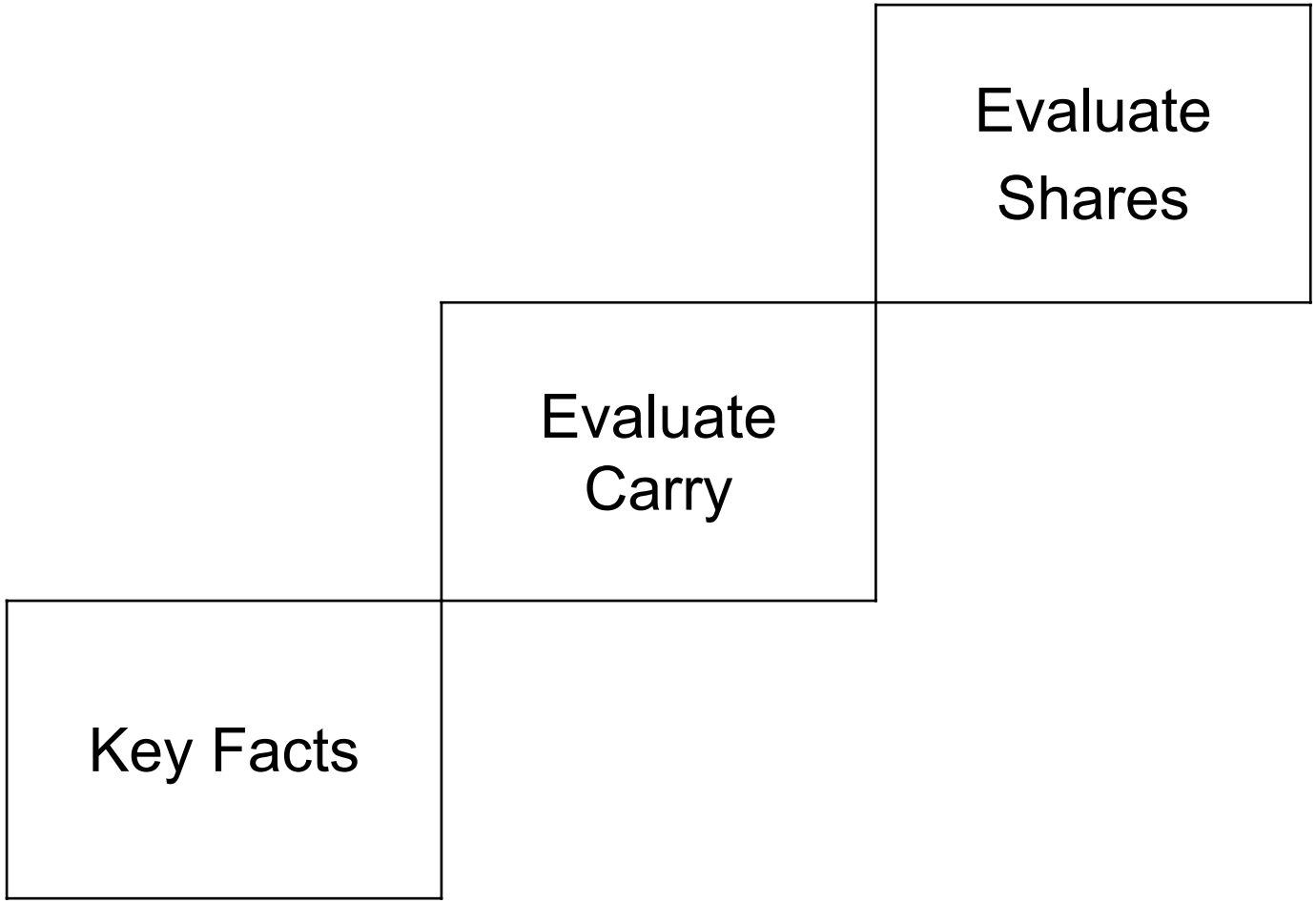
Options in Private Equity

Dietmar Leisen
University of Mainz

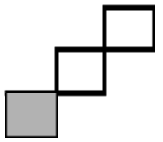
What is Private Equity?

- A long-term equity investment in an unlisted company.
- To be distinguished from public equity: an equity investment in an exchange listed company
- Variants:
  - Venture capital: investments in early-stage companies
  - Leveraged buyouts: investments in mature companies
- Many similarities, some differences
- Throughout this talk: focus on venture capital

Overview

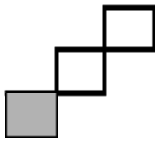


Investment Fundamentals



- Venture capital “funds” are in some aspects similar to an investment in a mutual fund
  - manager is the so-called venture capitalist (VC)
  - investing and harvesting the “fund’s” capital
- But, VCs are neither active nor passive investors in the usual sense:
  - They provide many crucial value-adding services to the venture

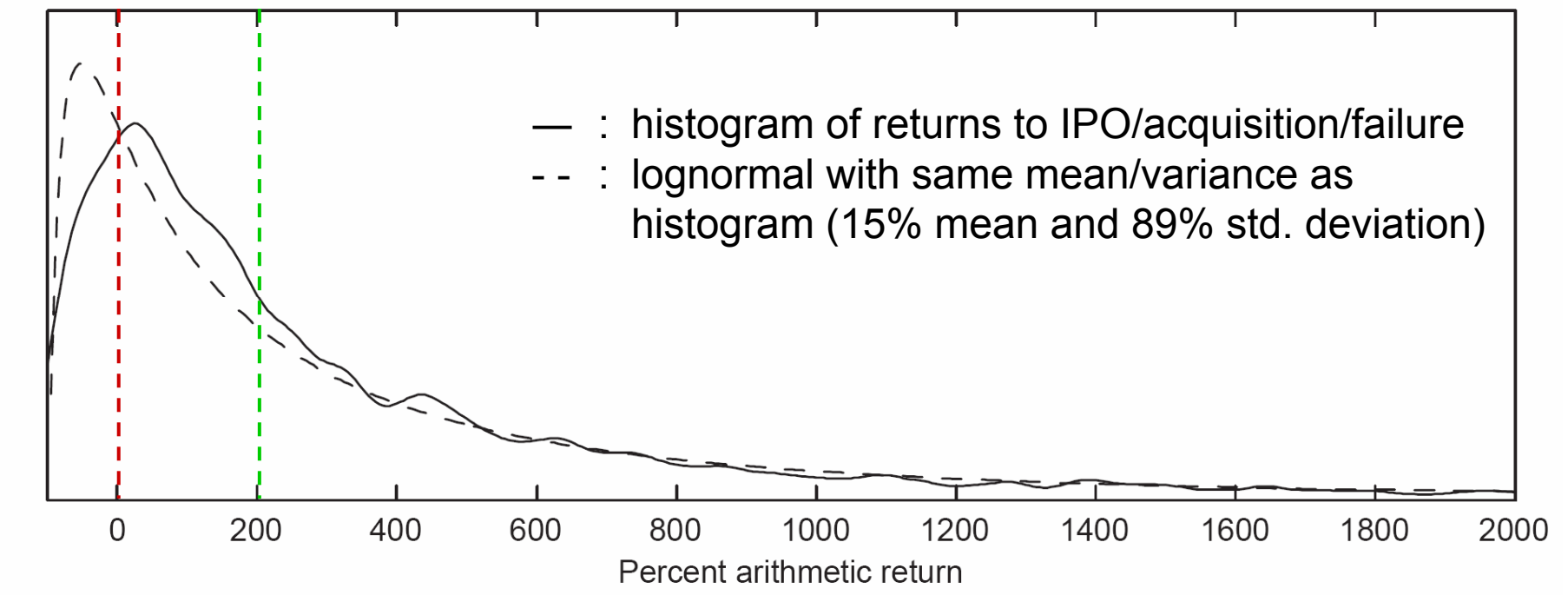
VC Company Risk and Return



	E[r] (p.a.)	σ (p.a.)	α (p.a.)	ρ	β
Cochrane, JFE, 2005	59%	107%	32%	27%	1.9
Hwang, Quigley, and Woodward, Contributions to Economic Analysis & Policy, 2005	8%	27%	4%	33%	0.6

- Lots of disagreement in the literature about characteristics
- Returns are fairly risky but maybe not so large
- A lot of idiosyncratic risk
- Fairly uncorrelated with S&P 500: ρ about 30%

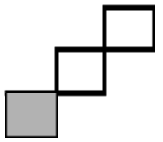
VC Company Returns



- Highly skewed return distribution, fairly well captured by a lognormal
- Venture capital investments are somewhat like options because they have a small chance of a huge payoff.

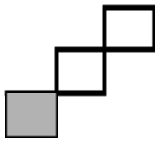
Source: Cochrane (2005), Figure 9

Value-adding Services



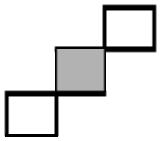
- The economic environment can change drastically while the VC is invested.
- There is no easy way out if things turn sour:
  - Investments are highly illiquid and typically kept in the portfolio for 5-6 years.
- So, the original business strategy may need to be rewritten:
  - The VC is highly familiar with the company's markets.
  - The VC is an insider to the company.
- In addition, the VC helps with management strategy, recruiting, etc.

Incentive Contracting



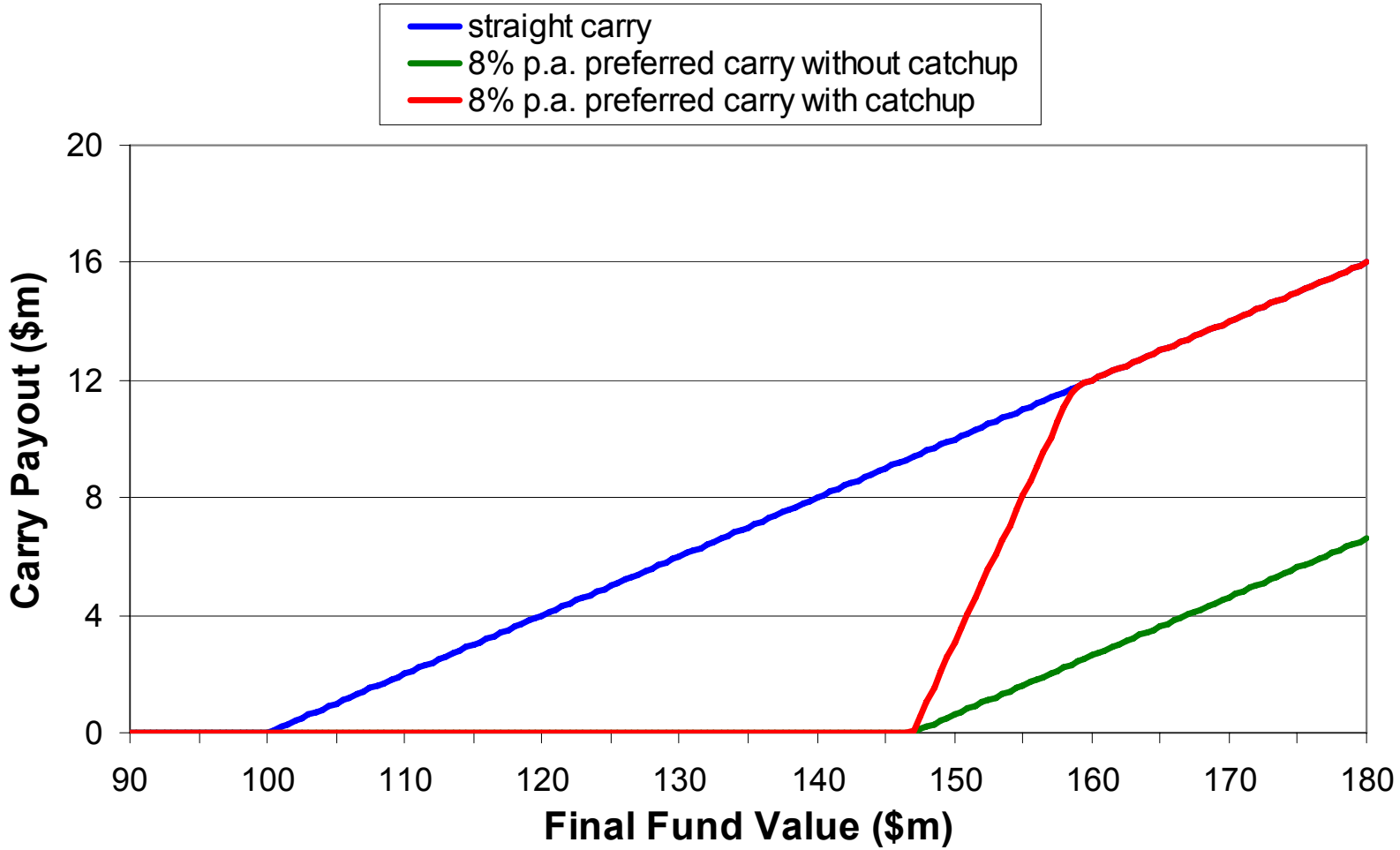
- Overall, the VC has a lot of influence on the venture's success.
- For success of new ventures, the VC's value-adding services appear crucial!
  - The hands-on approach by VCs differs from banks, which only monitor their credit customers.
- To provide appropriate incentive, the VC receives compensation in the form of profit sharing, so-called carried interest.

Carried Interest (“Carry”)



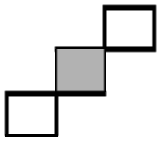
- Straight carry:
  - 20% share of net profits allocated to the fund’s manager.
  - The other 80% of profits go to investors as well as 100% of losses.
- Preferred carry is where the VC needs to clear a hurdle (typically 8% p.a.) before receiving any carry!
  - Sometimes a catch-up clause is invoked.

Carry Payout



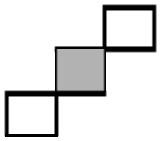
Assumption: $100m invested in fund

Evaluate Carry: Assumptions for Example



- Contributed capital to fund: $100m
  - All invested today
  - All investments to be liquidated in exactly 5 years
  - No payouts before fund liquidation.
- The Black-Scholes call price formula holds.
- Continuously compounded interest rate of 4%
- Need fund volatility
  - Cannot be calculated with available information: Diverging estimates for individual company volatility and cross-correlations unknown
  - Ignoring all idiosyncratic risk an estimate of fund volatility is 9%-30% (based on Cochrane beta = 1.9, Hwang, Quigley & Woodward beta = 0.6, std. deviation S&P 500 = 15%)

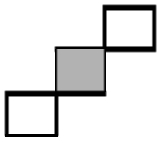
Evaluate Carry: Calculation for Example



	Cochrane	Hwang, Quigley & Woodward
Assumed fund volatility	**30%**	**9%**
Straight carry		
value of carry	$6,792,361	$3,931,423
relative value of carry	6.8%	3.9%
annual value of carry	1.3%	0.8%
Preferred carry (no catch-up)		
value of carry	$3,966,468	$427,345
relative value of carry	4.0%	0.4%

Hurdle for preferred is 8% p.a.

Ex-ante and Ex-post Total Fund Fees



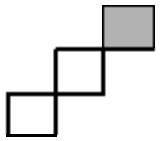
- We calculated that cost of carry is 0.1-1% p.a.
- In addition to carry, the VC receives compensation in the form of
  - Annual management fees: 2% p.a.
  - His own investment in the “VC fund”: “small”
- Total fees are therefore ex-ante 2-3% p.a.
- However, Phalippou and Gottschalg (2006) and Swensen (2000) estimated total fees to be 7% p.a. (with 8% p.a. hurdle) and 12% p.a. respectively.
- There is a mismatch, between ex-ante (1%) and ex-post costs (7-12%):
  - Rational investors should properly anticipate costs!

Risk-neutral and Objective Probabilities

- Our analysis is simply “confusing” real and objective probabilities.
- Expected costs under the objective probability should be 7-12% p.a., say 10% p.a.
- Using the fund volatility based on Cochrane’s numbers we get the following expected costs:

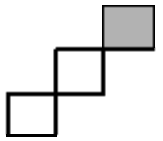
	Cochrane lognormal	**Fictitious**
	mean μ=15%	**mean μ=25%**
Straight carry		
annual value of carry	5.0%	9.2%
Total (with 2% mgmt fee)	7.0%	11.2%
Preferred carry (no catch-up)		
annual value of carry	4.0%	8.2%
Total (with 2% mgmt fee)	6.0%	10.2%

Share Valuation



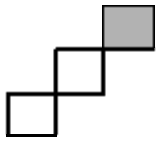
- Before IPO, shares can be valued reliably only in case of financing event.
- Usually the entrepreneur holds ordinary shares, while VC holds preferred shares
- Preferred shares:
  - Control rights: management appointments, director appointments, decision vetoes, etc.
  - Capital rights: liquidation preference, conversion to ordinary shares, etc.
  - Preference disappears in case of IPO.
- Typically, the company is valued as if all shares were equal

Description of Base Example



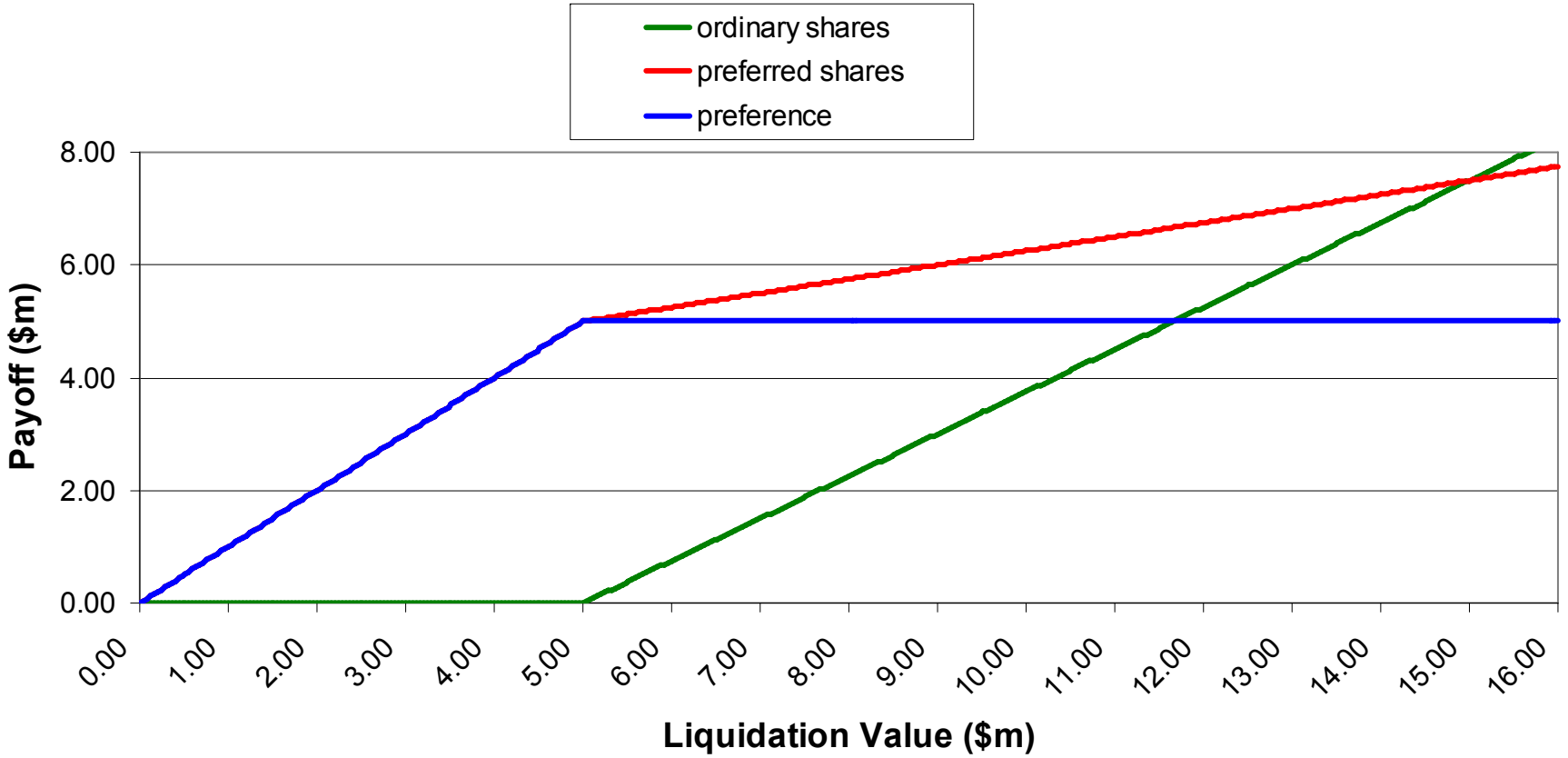
- XYZ company raises $4m from VC in exchange for 2m preferred shares
  - Preference is only about liquidation.
  - In case of liquidation, the VC will receive, prior to any other distribution, the invested sum in addition to annual interest of 5%.
  - Any additional sum will be distributed pro-rata among all shareholders (both ordinary and preferred).
- Entrepreneur holds 6m ordinary shares.

Typical Calculation

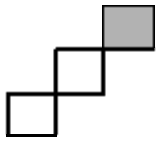


- As a result of the financing, ownership shares are
  - 25% VC, 75% entrepreneur
- Valuation steps
  - Company value is $16m
  - Share price is $4m/$2m=$2/share
- This calculation is misleading:
  - Only when the company value exceeds the cumulative preference compensation the entrepreneur will participate

Payoff from Ordinary and Preferred Shares

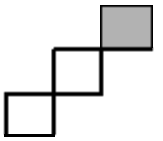


Analyzing Ordinary and Preferred Shares



- We look for the entire company value S_0
- Assume the liquidation event will take place in 5 years, the interest rate is 5%
  - We denote the price of a call with strike K and that maturity by $BS(S_0,K)$
- The payout from ordinary shares has the profile of a call option on assets with strike \$4m + 5% over 5 years = \$5m
- The value of all ordinary shares is
  $75\% \times BS(S_0, \$5m)$
- The value of all preferred shares is
  $\$4m = \text{value of liq. pref.} + 25\% \times BS(S_0, \$5m)$
- The liquidation preference is a capped call with strike 0 and \$5m cap, i.e. its value is
  $BS(S_0, 0) - BS(S_0, \$5m)$

Valuing Ordinary and Preferred Shares



- We value call options using the Black-Scholes formula
- Then we have the following results:

	value of all	per share
ordinary shares	$5,600,635	$0.93
liquidation preference	$2,133,121	$1.07
preferred shares	$4,000,000	$2.00
diff ordinary to preferred share price		-53%
typical simple valuation	$16,000,000	$2.00
S_0	$9,600,635	$1.20
diff to simple valuation	-40%	-40%

Conclusion

- Options come in Private Equity in many ways
  - Risk-return characteristics similar to options
  - Management compensation
  - Difference between ordinary and preferred shares
- Also very relevant, yet not discussed: Real options
- Preliminary analysis can be done by Black-Scholes theory