Finance of Innovation
[ITMDI 703]

Introduction to finance of innovation and the concepts of Venture Capital finance

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Finance of Innovation Principle #1

Real, Human, and Financial Capital Must be Rented from Owners
- Money has owners and therefore costs
- Time value
- Risk
- Expect to provide a return or the venture will not survive in a market economy
Finance of Innovation Principle #2

**Risk and Expected Reward Go Hand in Hand**
- Time value is not the only cost when using others’ funds
- More risk => More expected reward
- How much more? Market-determined!

Finance of Innovation Principle #3

**While Accounting is the Language of Business, Cash is the Currency**
- Two important reasons to employ accounting
  Tracking and accountability for actions taken
  Quantifying different visions of the future
- But, remember cash flow is a new venture’s lifeblood
  “Get enough accounting to see through the accruals to the cash account”
- Cash burn: gap between cash being spent and that being collected
- Cash build: excess of cash receipts over cash distributions
Finance of Innovation Principle #4

**New Venture Financing Involves Search, Negotiation, and Privacy**
- Public Financial Markets: standard contracts traded on organized exchanges
- Private Financial Markets: customized contracts bought and infrequently sold in inefficient private negotiations

Finance of Innovation Principle #5

**A Venture's Financial Objective is to Increase Value**
- Many objectives including personal ones
- But, the unifying *financial* objective is to increase value rather than price, margin or sales
  rather than profit, return or net worth
- (Market) Value derives from the ability to generate cash to pay capital providers for their capital
Finance of Innovation Principle #6

It is Dangerous to Assume that People Act Against Their Own Self-Interest

- Aligning incentives (investors, founders, employees, spouses, etc.) is critical
- As situations change, incentives diverge and renegotiation is important
- Owner-manager conflicts: differences between a manager’s self-interest and that of the owners who hired him/her
- Owner-debtholder agency conflict: divergence of the owners’ and lenders’ self-interests as the firm gets close to bankruptcy

Finance of Innovation Principle #7

Venture Character and Reputation Can be Assets or Liabilities

- Ventures have character that can be different from the individuals who founded or manage it
- Many entrepreneurs state that high ethical standards are one of a venture’s most important assets and are critical to long-term success and value
- Ventures can - and do - make meaningful societal contributions
- Many successful entrepreneurs are financially and personally involved in charitable endeavors
Role of Finance of Innovation

- Finance of Innovation
  - application and adaptation of financial tools and techniques to the planning, funding, operation, and valuation of an entrepreneurial venture
  - focuses on the financial management of a venture as it moves through its life cycle, beginning with its development stage & continuing through to when the entrepreneur exists or harvests the venture

Successful Venture Life Cycle

- Venture Life Cycle: stages of a successful venture’s life from development through various stages of revenue growth
  - Development Stage:
    period involving the progression from an idea to a promising business opportunity
  - Startup Stage:
    period when the venture is organized, developed, and an initial revenue model is put in place
Successful Venture Life Cycle

- Survival Stage:
  - period when revenues start to grow and help pay some, but typically not all, of the expenses
- Rapid-Growth Stage:
  - period of very rapid revenue and cash flow growth
- Maturity Stage:
  - period when the growth of revenue and cash flow continues but at a much slower rate than in the rapid-growth stage

Financing Through the Successful Venture Life Cycle

- Development Stage
  - Developing opportunities and seed financing
- Startup Stage
  - Gathering resources and startup financing
- Survival Stage
  - Gathering resources, managing and building operations and first-round financing
- Rapid-Growth Stage
  - Managing and building operations and second-round mezzanine, & liquidity stage financing
- Early Maturity Stage
  - Managing and building operations and obtaining bank loans, issuing bonds, & issuing stock
Selected Financing Definitions

- **Seed Financing:**
  funds needed to determine whether the idea can be converted into a viable business opportunity

- **Startup Financing:**
  funds needed to take the venture from having established a viable business opportunity to initial production and sales

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Selected Financing Definitions

- **Venture Capital:**
  early-stage financial capital often involving substantial risk of total loss

- **Venture Capitalists:**
  individuals who join in formal, organized firms to raise and distribute venture capital to new and fast-growing ventures

- **Business Angels:**
  wealthy individuals operating as informal or private investors who provide venture financing for small businesses

- **Investment Banker:**
  individual working for an investment bank who advises and assists corporations in their security financing decisions and regarding mergers and acquisitions
Selected Financing Definitions

- First Round Financing:
  equity funds provided during the survival stage to cover the cash shortfall when expenses and investments exceed revenues
- Second Round Financing:
  financing for ventures in their rapid-growth stage to support investments in working capital
- Mezzanine Financing:
  funds for plant expansion, marketing expenditures, working capital, and product or service improvements

Selected Financing Definitions

- Bridge Financing:
  temporary financing needed to keep the venture afloat until the next offering
- Initial Public Offering (IPO):
  a corporation’s first sale of common stock to the investing public
- Seasoned Securities Offering:
  the offering of securities by a firm that has previously offered the same or substantially similar securities
3 major questions

1. **VCs as fund managers and an asset class**: How do VCs and investors split revenues and profits? What is the risk-adjusted return in VC?

2. **Total valuation of portfolio companies**: How can we evaluate prospective portfolio companies with high growth prospects and high risk of failures?

3. **R&D projects with Uncertainty**: How can we evaluate R&D investments, often with real option values?
What is a VC? (1)

A VC is a financial intermediary, i.e., that they take the investors' capital and invest it directly in portfolio companies.

The Flow-of-Fund in the Venture Capital Cycle

VC Funds
Managed by
General
Partners
("VCs" or
"GPs")

Portfolio
Companies

Limited
Partners
(Investors or
"LPs")

"Exits": Sale of
Portfolio
companies
to public
markets (IPOs)
or to other
companies
What is a VC? (2)

(2) A VC will only invest in private companies. This means that once the investments are made, the companies cannot be immediately traded on a public exchange.
   - no simple mark to market
   - no liquidity

What is a VC? (3)

(3) A VC takes an active role in monitoring and helping the companies in his portfolio.
VC is a segment of Private Equity

ALTERNATIVE INVESTMENTS

Private Equity

Venture Capital  Mezzanine  Buyout  Distress

Hedge Funds

What is a VC? (4)

(4) A VC’s primary goal is to maximize his financial return by exiting investments through a sale or an initial public offering (IPO).
What is a VC? (5)

(5) VCs invest to fund the internal growth of companies (not acquisitions of existing companies)

U.S. VC investment ($ billions)

[Bar chart showing U.S. VC investment from 1995 to 2009, with two periods highlighted:
- **Boom era** (1995-1999): Investment values range from 7.9 billion to 104.0 billion.
- **Post-boom era** (2000-2009): Investment values range from 40.3 billion to 17.7 billion.]

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Stages of Growth

- Early-Stage
  - Seed/Startup
  - Early Stage

- Expansion Stage

- Later Stage

Investment by Stage
**Investment by Industry**


**U.S. VC Investment by Region (2008)**

*By location of portfolio company, not VC firm*

100% = $28 billion
Some Important Terms

- VC firm
- general partner (GP)
- VC fund
- limited partner (LP)
- committed capital
- early-stage, mid-stage, late-stage fund, multi-stage fund
- raised, closed
- vintage year
- capital call = drawdown = takedown

Who are the LPs?

- Historically, just under half of all committed capital comes from pension funds.
- The next two largest groups are financial institutions and endowments/foundations, each with about 1/6 of the total.
- Individuals/families and corporations make up the remainder, and are more fickle than the other types.
### Committed Capital by LP Type

![Graph showing committed capital by LP type](image)

### Example: Sierra Ventures

<table>
<thead>
<tr>
<th>Fund Name</th>
<th>Vintage Year</th>
<th>Committed Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sierra Ventures V</td>
<td>1995</td>
<td>$100M</td>
</tr>
<tr>
<td>Sierra Ventures VI</td>
<td>1997</td>
<td>$175M</td>
</tr>
<tr>
<td>Sierra Ventures VII</td>
<td>1999</td>
<td>$250M</td>
</tr>
<tr>
<td>Sierra Ventures VIII</td>
<td>2000</td>
<td>$500M</td>
</tr>
<tr>
<td>Sierra Ventures IX</td>
<td>2006</td>
<td>$400M</td>
</tr>
</tbody>
</table>
Performance varies greatly across vintage years

The key terms in VC partnership agreement

1. Compensation structure
   - Management fees
   - Carried interest

2. Covenants
   - Activities of the fund
   - Activities of the individual General Partners
Fees: definitions

- Annual management Fees
  - Level:
  - Basis: committed capital or net invested capital

- lifetime fees = The total amount of fees paid over the lifetime of a fund

- investment capital = committed capital - lifetime fees

- invested capital = cost basis for the investment capital of the fund that has already been deployed at a given point

- Net invested capital = invested capital - cost basis of all exited and written-off investments

Example

ABC Ventures has raised their $100M fund, ABC Ventures I, with management fees computed based on committed capital. These fees are 2 percent per year in the first five years of the fund, then fall by 25 basis points per year in each of the subsequent five years. The fees will be paid quarterly, with equal installments within each year.

Problem

Given this description, what are the lifetime fees and investment capital for this fund?
Exercise (p. 31)

Owl Ventures has raised their $500M fund, Owl Ventures IX. The management fees given in this appendix are as follows. Management Fees All management fees are computed based on committed capital. These fees are 2 percent in years 1 and 2, 2.25 percent in years 3 and 4, 2 percent in year 5, 1.75 percent in year 6, 1.50 percent in year 7, 1.25 percent in year 8, 1 percent in year 9, and 0.75 percent in year 10. These fees will be paid quarterly, with equal installments within each year.

Given this description, what are the lifetime fees and investment capital for this fund?

Answer

Solution This example uses a fee schedule that starts at 2 percent, and then increases to 2.25 percent in years 3 and 4 before falling by 0.25 percent in each subsequent year. Such “increasing then decreasing” schedules are not unusual, with the logic that fund expenses often reach their maximum in the middle years of the investment period. To compute the lifetime fees, we just add up the fees in each year. Thus,

\[
\text{Lifetime fees} = \text{committed capital} \times (0.02 + 0.02 + 0.0225 + 0.0225 + 0.02 + 0.0175 + 0.015 + 0.0125 + 0.01 + 0.0075) \\
= \text{committed capital} \times 0.1675 = $500M \times 0.1675 = $83.75M
\] (2.1)

Then,

\[
\text{Investment capital} = \text{committed capital} - \text{lifetime fees} = $500M - $83.75M \\
= $416.25M
\] (2.2)
Carried Interest: definition

- **Definition:** % of the realized fund profit, defined as cumulative distributions in excess of carry basis, that gets paid to GPs
  - **Level**
  - **Basis:** committed capital or investment capital
  - **Timing**
  - **Priority return**
  - **Catch-up**
  - **Claw back**

Example

- Sunny Bird Ventures is considering two alternative carry structures for its SBV II.
  1) 25% carry with a basis of all committed capital
  2) 20% carry with a basis of all investment capital

Committed capital = $250 M
Management fees = 2.0% of committed capital every year
Fund duration = 10 years

a) Suppose total cumulative distributions for 10 years = $400 M. How much carry would GP get under 1 and 2?
b) What is the breakeven amount of distributions that makes GP indifferent between structure (1) and (2)?
Carried interest

- Carried interest timing
  - Return all call carry basis (committed or investment capital) first (25%)
  - Return all contributed (or invested) capital plus priority return first (45%)
- Priority return: For some funds, some minimum rate of return (called priority return or hurdle rate) must be achieved by LPs before GPs receive carried interest
  - More common among late-stage funds than early-stage funds

Covenants on activities of the fund

- Investment focus: LPs want GPs to focus on their area of expertise
  - Limits investment in asset class other than private portfolio companies (e.g., public companies, other PE partnerships)
  - Limits investment in sector / stage other than the fund’s defined specialization
- Investment size
  - GPs have incentive to place big bets and increase variance in fund returns
  - Solution: to limit size of a single investment (10-25% of fund size)
- Co-investments across funds
  - Later funds may be used to salvage investment gone awry in earlier funds
  - GPs may especially want to do this when raising another fund!
  - Solution: To require approval by LPs, co-investment by earlier fund, or by third-party
- Reinvestments of profit: often permitted but restricted
  - Until invested capital reaches 100-125% of committed capital
Covenants on activities of the individual GPs

- Co-investments by GPs themselves
  - LPs don’t want GPs to spend all of their time on companies they’re personally invested with
  - Solution: to require LPs’ approval, restrict investment size, timing, and terms

- In general, LPs want GPs to be devoted to their fund
  - Future fundraising activities: not allowed till sufficient amount of investment is made for the current fund
  - Sale of GP interests: not easily allowed!
  - Inclusion of new GPs: restricted

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VC COMPENSATION (IN$ THOUSANDS)

<table>
<thead>
<tr>
<th>Title</th>
<th>2008</th>
<th>2009</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Salary</td>
<td>Bonus</td>
<td>Carry</td>
<td>Total</td>
</tr>
<tr>
<td>Managing GP</td>
<td>688</td>
<td>633</td>
<td>192</td>
<td>1,513</td>
</tr>
<tr>
<td>Senior Partner</td>
<td>595</td>
<td>350</td>
<td>155</td>
<td>1,100</td>
</tr>
<tr>
<td>Partner</td>
<td>375</td>
<td>150</td>
<td>35</td>
<td>560</td>
</tr>
<tr>
<td>Principal/VP</td>
<td>240</td>
<td>78</td>
<td>2</td>
<td>320</td>
</tr>
<tr>
<td>Senior Associate</td>
<td>155</td>
<td>46</td>
<td>0</td>
<td>201</td>
</tr>
<tr>
<td>Associate</td>
<td>105</td>
<td>33</td>
<td>0</td>
<td>138</td>
</tr>
<tr>
<td>Analyst</td>
<td>101</td>
<td>15</td>
<td>0</td>
<td>116</td>
</tr>
<tr>
<td>Venture Partner</td>
<td>250</td>
<td>0</td>
<td>43</td>
<td>293</td>
</tr>
</tbody>
</table>

*Useful for trends and pay differential between senior and junior positions; not an unbiased sample*
Fund-level returns: Data

- **Venture Economics**
  - Collects data from GPs, publishes vintage-year specific quartile performance data while keeping anonymity of individual funds

- **Freedom-of-Information-Act (FOIA) requests**
  - Forces public pensions to disclose performance of their fund holdings

- **Private Equity Performance Monitor**
  - Collects, packages and sells fund-specific performance data for a fee.
  - Assigns quartile rankings to funds

### VE Benchmarks

<table>
<thead>
<tr>
<th>Year</th>
<th>IRR (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>top quartile IRR</td>
</tr>
<tr>
<td>1991</td>
<td>top quartile IRR</td>
</tr>
<tr>
<td>1992</td>
<td>top quartile IRR</td>
</tr>
<tr>
<td>1993</td>
<td>top quartile IRR</td>
</tr>
<tr>
<td>1994</td>
<td>top quartile IRR</td>
</tr>
<tr>
<td>1995</td>
<td>Median IRR</td>
</tr>
<tr>
<td>1996</td>
<td>Median IRR</td>
</tr>
<tr>
<td>1997</td>
<td>Median IRR</td>
</tr>
<tr>
<td>1998</td>
<td>Median IRR</td>
</tr>
<tr>
<td>1999</td>
<td>Median IRR</td>
</tr>
<tr>
<td>2000</td>
<td>Median IRR</td>
</tr>
<tr>
<td>2001</td>
<td>Median IRR</td>
</tr>
<tr>
<td>2002</td>
<td>Median IRR</td>
</tr>
<tr>
<td>2003</td>
<td>Median IRR</td>
</tr>
<tr>
<td>2004</td>
<td>Median IRR</td>
</tr>
<tr>
<td>2005</td>
<td>Median IRR</td>
</tr>
</tbody>
</table>
**Return Definitions (1)**

- ***Internal rate of return*** = a rate of return that implies an NPV of 0 for a given cash flow stream

- ***Value multiple*** = realization ratio = investment multiple = multiple of money = times money = absolute return
  
  - **Value multiple** = \[
  \frac{\text{Total distributions to LPs} + \text{value of unrealized investments}}{\text{invested capital} + \text{management fees}}
  \]
  
  - **Realized Value multiple** = \[
  \frac{\text{Total distributions to LPs}}{\text{invested capital} + \text{management fees}}
  \]
  
  - **Unrealized value multiple** = \[
  \frac{\text{value of unrealized investments}}{\text{invested capital} + \text{management fees}}
  \]

**The IRR is not perfect**

- Cannot be compared to time-weighted returns

- Compounding of periodic returns

- Realized vs. unrealized investments

- Difficult to make risk adjustments
Industry Returns

- Industry returns are constructed as time-weighted returns (e.g., annualized compound returns)
  - Nice for comparison with market indices
  - Nice for making risk adjustments

- 3 sources:
  - Sand Hill Econometrics (SHE): portfolio comp level
  - Cambridge Associates (CA): fund level
  - Venture Economics (VE)
Return Definitions

- **Periodic returns** = \( R_t = \frac{(P_t + D_t)}{P_{t-1}} - 1 \)
- **Compound returns** = \((1+R_1)(1+R_2) \cdots (1+R_T) - 1\)
- **Annualized return** = \( \bar{R} = \frac{(1+\text{compound return})^{1/T}}{-1} \)
- **Gross returns** = returns before subtracting fees and carry
- **Net returns** = returns after subtracting fees and carry
- **Realized returns** = historical returns
- **Expected returns** = returns forecast for the future

Example: Largeco pension plan

The Largeco pension plan has invested in dozens of VC funds. The director of the pension plan is preparing his annual report to the Largeco board of directors. Summary information for Largeco’s VC portfolio is given in the following table

<table>
<thead>
<tr>
<th>Year</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginning Value</td>
<td>4,000</td>
<td>5,950</td>
<td>7,090</td>
<td>9,267</td>
<td>3,884</td>
</tr>
<tr>
<td>New Investments</td>
<td>2,000</td>
<td>1,000</td>
<td>1,000</td>
<td>1,000</td>
<td>1,000</td>
</tr>
<tr>
<td>Ending Value (before distributions)</td>
<td>7,200</td>
<td>8,340</td>
<td>10,517</td>
<td>5,134</td>
<td>7,814</td>
</tr>
<tr>
<td>Distributions to LPs</td>
<td>1,000</td>
<td>1,000</td>
<td>1,000</td>
<td>1,000</td>
<td>1,000</td>
</tr>
<tr>
<td>Distributions to GPs</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>Management Fees</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

The board has asked for a five-year report of net returns and gross returns by year, plus the compound returns and annualized returns for all five years. You can assume that all new investments and management fees are paid at the beginning of the year, and all distributions were paid at the end of the year.
Solution: Largeco pension plan

The gross returns are calculated by comparing the value at the beginning of each year with the value at the end of each year. (Note that the beginning value in year \( t \) is equal to the ending value in year \( t - 1 \) minus distributions to LPs and GPs. The management fee is paid separately by the LPs.) Thus, gross returns are \( 7,200/(4,000 + 2,000) - 1 = 20 \) percent for 2004, \( 8,340/(5,950 + 1,000) - 1 = 20 \) percent for 2005, and so on. For net returns, we must subtract the distributions to GPs (carried interest) from the numerator and add the management fees to the denominator: \( (7,200 - 250)/(4,000 + 2,000 + 100) - 1 = 13.9 \) percent for 2004, \( (8,340 - 250)/(5,950 + 1,000 + 100) - 1 = 14.8 \) percent for 2005, and so on. The answers for all years are given in Exhibit 3-2.

<table>
<thead>
<tr>
<th>Year</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net Return</td>
<td>13.9%</td>
<td>14.8%</td>
<td>25.4%</td>
<td>-52.9%</td>
<td>51.8%</td>
</tr>
<tr>
<td>Gross Return</td>
<td>20.0%</td>
<td>20.0%</td>
<td>30.0%</td>
<td>-50.0%</td>
<td>60.0%</td>
</tr>
</tbody>
</table>

The compound returns are as follows:

\[
\text{Gross compound return} = 1.20 \times 1.20 \times 1.30 \times 0.50 \times 1.60 - 1 = 49.8\% \quad (3.4)
\]

and

\[
\text{Net compound return} = 1.139 \times 1.148 \times 1.254 \times 0.471 \times 1.518 - 1 = 17.2\% \quad (3.5)
\]

The gross annualized return is \( 1.498^{(1/5)} - 1 = 8.4 \) percent, and the net annualized return is \( 1.172^{(1/5)} - 1 = 3.2 \) percent.

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A Gross-Return Index

[Graph showing data for Sand Hill Index and Nasdaq with percentages labeled as 12.8% and 7.9%]

Kleiner Perkins Returns

<table>
<thead>
<tr>
<th>Fund</th>
<th>Vintage Year</th>
<th>Committed Capital ($M)</th>
<th>Net IRR</th>
<th>Value Multiple</th>
<th>Date Reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>1980</td>
<td>65</td>
<td>50.6%</td>
<td>4.3</td>
<td>Mar-04</td>
</tr>
<tr>
<td>III</td>
<td>1982</td>
<td>150</td>
<td>10.2%</td>
<td>1.7</td>
<td>Dec-04</td>
</tr>
<tr>
<td>IV</td>
<td>1986</td>
<td>150</td>
<td>11.0%</td>
<td>1.8</td>
<td>Dec-04</td>
</tr>
<tr>
<td>V</td>
<td>1989</td>
<td>150</td>
<td>35.7%</td>
<td>4.0</td>
<td>Dec-04</td>
</tr>
<tr>
<td>VI</td>
<td>1992</td>
<td>173</td>
<td>39.2%</td>
<td>3.3</td>
<td>Mar-04</td>
</tr>
<tr>
<td>VII</td>
<td>1994</td>
<td>225(^1)</td>
<td>121.7%</td>
<td>32.0</td>
<td>Mar-04</td>
</tr>
<tr>
<td>VIII</td>
<td>1996</td>
<td>299</td>
<td>286.6%</td>
<td>17.0</td>
<td>Mar-04</td>
</tr>
<tr>
<td>IX</td>
<td>1999</td>
<td>550</td>
<td>-23.3%</td>
<td>See text</td>
<td>Mar-04</td>
</tr>
<tr>
<td>X</td>
<td>2000</td>
<td>625</td>
<td>-17.5%</td>
<td>0.6</td>
<td>Mar-04</td>
</tr>
<tr>
<td>XI</td>
<td>2004</td>
<td>400</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>XII</td>
<td>2006</td>
<td>600</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>XIII</td>
<td>2008</td>
<td>700</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

\(^1\)Only $170M of Fund VII was ever drawn.

Note: There have been no publicly available updates of KPCB funds since December 2004. Fund IX’s performance as of March 2004 (-23.3% IRR) does NOT reflect its subsequent profit from the investment it made in Google.
Cost of capital for VC

- Historically, annualized VC return index raw return is superior to those of public stock market indices.
- Individual investment outcomes vary greatly.
  - Venture = investments with high variance in outcomes
  - 30-40% go bankrupt
  - 20-25% return 5 times or higher

- What should investors expect to earn from investing in VC?
  - Not the entrepreneurs!
  - Not the venture capitalists!

- What’s missing so far?

Model

- Our starting point is the Capital-Asset-Pricing Model (CAPM). It states
  \[ r_i = R_i = R_f + \beta(R_m - R_f) \]
  where
  - \( r_i \) is the cost of capital for asset \( i \),
  - \( R_i \) is the expected return for asset \( i \),
  - \( R_f \) represents the risk-free rate,
  - \( R_m \) is the return on the whole market portfolio,
  - \( \beta \), or “beta”, is the level of risk for asset \( i \).
  The difference \( (R_m - R_f) \) is called the market premium.
We make a key distinction between two kinds of risks that are potentially present in any investments.

1. Beta risk = market risk = non-diversifiable risk = systematic risk = “covariance”

2. Idiosyncratic risk = diversifiable risk = firm-specific risk = residual risk = “variance”

• Why should we care which kinds of risks it is?
• Should investors demand higher returns for holding all risks?
• Why shouldn’t all high risks be associated with higher returns?

---

Consider an economy with 100 islands, 100 trees on each island, and 200 bananas per tree = 2M bananas every year.

There lives 1 person per island, 100 total, who only consume (and care about) bananas.

- Though they always like more bananas, their marginal utility from eating an additional banana is decreasing in the number of bananas they eat.

Suppose there is only one risk in this world: banana birds randomly land on half of all islands each year and eat all bananas.

- With 50% chance, an islander gets 20,000 bananas a year.
- With 50% chance, he/she gets 0 bananas.
- Globally, birds gets 1M bananas, and people get 1M.
Utility with Bird Risk

- With this serious banana bird risk, their expected utility is B, weighted average of A and D (50%*U(0) + 50%*U(20,000))
- B is worse than C (utility of getting 10,000 bananas with certainty)
- Can islanders do better?

Solution: diversification

- Each islander sets up a company holding 100 banana trees on the island, and issues 100 shares.
- Each sells 99 shares to all others, and buys 1 share each from all others.
- There are no transaction costs.
- Now, every islander has claims on 1 banana tree on every island
- Since banana bird risk is random, every islander will get 50%*100*200 = 10,000 bananas/year with certainty. Risk is diversified away.
- Expected return on these investments = 0.
Risk (2): Weather risk

- Now suppose that there are no banana birds, but instead there is the following risk every year:
  - 50% chance of sunny year, which produces 150 bananas per tree
  - 50% chance of rainy year, which produces 50 bananas per tree
- With this weather risk, islander’s expected utility $Y$, weighted average of $X$ ($U(5,000)$) and $Z$ ($U(15,000)$).

Diversifiable and non-diversifiable risk

- Weather risk affects the whole economy in a rainy year, so the previous solution would not work.
- There is perfect covariance among all islands.
- Some islanders may agree to sell rights to their bananas in a rainy year for rights to someone else’s bananas in a sunny year.
  - No one would give up 100 bananas in a rainy year for only 100 bananas in a sunny year.
  - To give up bananas in an already rainy year, they would demand a positive return on the deal.
  - E.g., 50 bananas in a rainy year in return for 150 bananas in a sunny year.
  - This is analogous to beta risk in CAPM model.
- In contrast, with the banana bird risk, nobody would earn extra return by agreeing to bear it, because it was free (as a group) to get rid of it.
**Estimating VC cost of capital**

- To estimate VC cost of capital according to CAPM model, we use historical aggregate VC industry return data and estimate the following equation:

\[ R_{vc,t} - R_{f,t} = \alpha + \beta(R_{m,t} - R_{f,t}) + e_{vc,t}, \]

where \( \beta, R_{vc,t}, R_{m,t}, \) and \( R_{f,t} \) are as defined before, except that previously the return variables represented expected returns, while here they represent realized (= historical) returns for period \( t \). The new elements in this equation are \( \alpha \), or “alpha”, the regression constant, and \( e_{vc,t} \), the regression error term.

Alpha represents the unexpected portion of the return, and positive alpha is interpreted as skills of portfolio managers.

**CAPM Estimation results**

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Monthly Data (SHE Index)</th>
<th>Quarterly Data (CA Index)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha (in % per year)</td>
<td>5.73***</td>
<td>6.10</td>
</tr>
<tr>
<td>Market Beta</td>
<td>0.81***</td>
<td>0.56***</td>
</tr>
</tbody>
</table>

***, **, and * Indicates statistical significance at the 1, 5, and 10% level, respectively.

- Two data sources
- Beta is smaller than 1 here, but CAPM is not perfect, and we will make further adjustments.
**Adjustment (1): The Fama-French Model (FFM)**

- The Fama-French (3-factor) Model has become part of a standard tool kit for cost of capital estimation (much like CAPM) in the last 25 years.

- It is based on empirical observations that certain styles of investments, such as “small stocks” or “value stocks” do not fit CAPM model well.

- Now the equation is
  \[ R_{vc,t} - R_f = \alpha + \beta * (R_{mf} - R_f) + \beta_{size} * SIZE_t + \beta_{value} * VALUE_t + e_{vc,t} \]

  where \( \alpha, \beta, R_{mf}, R_f, e_{vc,t} \) are defined as in the CAPM, \( SIZE_t \) and \( VALUE_t \) are the returns to portfolios of stocks that capture correlations with these styles, and \( \beta_{size} \) and \( \beta_{value} \) are the regression coefficients on these returns.

**Adjustment (2): The Pastor-Stambaugh Model (PSM)**

- Another relevant issue for VC is that investors may require premium for illiquid investments.

- The PSM model incorporates this illiquidity risk as the additional factor to the Fama-French 3-factor model.

- The equation is
  \[ R_{vc,t} - R_f = \alpha + \beta * (R_{mf} - R_f) + \beta_{size} * SIZE_t + \beta_{value} * VALUE_t + \beta_{liq} * LIQ_t + e_{vc,t} \]

  where \( LIQ \) is the new liquidity factor, \( \beta_{liq} \) is its regression coefficient, and all other variables are as defined before.

- More sensitive the return on an asset is to the change in this liquidity factor, the higher premium the investors demand when liquidity factor return is high in the economy.
Final estimation results (PSM)

<table>
<thead>
<tr>
<th>Total Coefficient</th>
<th>Monthly Data (SHE Index)</th>
<th>Quarterly Data (CA Index)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha (in % per year)</td>
<td>-2.11</td>
<td>0.13</td>
</tr>
<tr>
<td>Market Beta</td>
<td>1.63***</td>
<td>2.04***</td>
</tr>
<tr>
<td>Size beta</td>
<td>-0.09</td>
<td>1.04***</td>
</tr>
<tr>
<td>Value beta</td>
<td>-0.68***</td>
<td>-1.46***</td>
</tr>
<tr>
<td>Liquidity Beta</td>
<td>0.26**</td>
<td>0.15</td>
</tr>
</tbody>
</table>

Sample Period: Jan, 1989 to Dec, 2008 (240 monthly observations) | 1981:2q to 2008:q4 (111 quarterly observations)

***, **, and * Indicates statistical significance at the 1, 5, and 10% level, respectively.

- Market beta is now close to 2.
- Alpha is no longer significantly different from 0.
- Using both sets of estimates and taking the mid-point,
  
  \[
  0.04 (r_f) + 1.63 * 0.07 \text{ (Market)} - 0.090 * 0.025 \text{ (size)} - 0.68 * 0.035 \text{ (value)} + 0.26 * 0.05 \text{ (liquidity)}
  
  = 14.1\% \text{ (SHE estimates)}
  
  0.04 (r_f) + 2.04 * 0.07 \text{ (Market)} + 1.04 * 0.025 \text{ (size)} - 1.46 * 0.035 \text{ (value)} + 0.15 * 0.05 \text{ (liquidity)}
  
  = 16.6\% \text{ (CA estimates)}
  
- We use 15% as the cost of capital for VC in this course.

The Best VCs

- Does it matter? Yes.
- Hsu (2004) studies a sample of companies that receive multiple VC offers, and finds that “high-reputation” VCs
  
  - are more likely to have their offers accepted, and
  
- pay between 10 and 14 percent lower for shares than do “low-reputation” VCs.
Top-Tier Venture Capitalists

<table>
<thead>
<tr>
<th>Group</th>
<th>Name</th>
<th>Location</th>
<th>Founded</th>
<th>$ under management</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Accel Partners</td>
<td>Palo Alto, CA</td>
<td>1983</td>
<td>$6.0B</td>
</tr>
<tr>
<td></td>
<td>Benchmark Capital</td>
<td>Menlo Park, CA</td>
<td>1985</td>
<td>$2.9B</td>
</tr>
<tr>
<td></td>
<td>Charles River Ventures</td>
<td>Waltham, MA</td>
<td>1970</td>
<td>$2.4B</td>
</tr>
<tr>
<td></td>
<td>Kleiner Perkins Caufield &amp; Byers</td>
<td>Menlo Park, CA</td>
<td>1972</td>
<td>$3.3B</td>
</tr>
<tr>
<td></td>
<td>Matrix Partners</td>
<td>Waltham, MA</td>
<td>1982</td>
<td>$4.1B</td>
</tr>
<tr>
<td></td>
<td>Sequoia Capital</td>
<td>Menlo Park, CA</td>
<td>1971</td>
<td>$4.0B</td>
</tr>
<tr>
<td>B</td>
<td>Battery Ventures</td>
<td>Wellesley, MA</td>
<td>1983</td>
<td>$3.2B</td>
</tr>
<tr>
<td></td>
<td>Doll Capital Management (DCM)</td>
<td>Menlo Park, CA</td>
<td>1996</td>
<td>$2.0B</td>
</tr>
<tr>
<td></td>
<td>Draper Fisher Jurvetson</td>
<td>Menlo Park, CA</td>
<td>1986</td>
<td>$4.4B</td>
</tr>
<tr>
<td></td>
<td>Institutional Venture Partners</td>
<td>Menlo Park, CA</td>
<td>1974</td>
<td>$2.2B</td>
</tr>
<tr>
<td></td>
<td>InterWest Partners</td>
<td>Menlo Park, CA</td>
<td>1979</td>
<td>$2.8B</td>
</tr>
<tr>
<td></td>
<td>Menlo Ventures</td>
<td>Menlo Park, CA</td>
<td>1976</td>
<td>$4.0B</td>
</tr>
<tr>
<td></td>
<td>New Enterprise Associates</td>
<td>Baltimore, MD</td>
<td>1978</td>
<td>$10.7B</td>
</tr>
<tr>
<td></td>
<td>Summit Partners</td>
<td>Boston, MA</td>
<td>1984</td>
<td>$11.2B</td>
</tr>
<tr>
<td></td>
<td>Technology Crossover Ventures</td>
<td>Palo Alto, CA</td>
<td>1995</td>
<td>$7.7B</td>
</tr>
</tbody>
</table>

Key drivers of VC performance and reputation

- “Reputable VC” *may* translate to “high-performing VC” if VC reputation could play a direct role in future performance.
  - Screening advantage
  - Value-added advantage
**Screening value-added**

- VC investments are almost always syndicated
  - Outside investor important for certification of valuation
  - As funding needs grow, need more $$$ in later stage
  - Different expertise can be sought at different stage of growth
- Reputable VCs are better networked, more likely to join syndicates of promising ventures and get lower valuation
  - Elite funds reciprocate favors, often invest together
- Screening ability: Do good VCs screen more based on people/team or on the product/idea?
  - Kaplan et al (2008): Ideas stay unchanged, teams change more

**Value-Added Advantage**

- Board Representation
  - Reputable VCs more likely to get board seats
  - Tian and Wang (2010): IPO firms backed by more failure-tolerant VCs are significantly more innovative, even long after VCs exit the IPO firms. Suggests VCs’ attitude towards failure/innovation gets internalized as part of the firm’s culture.
- Staged financing: monitor and evaluate milestones
- Corporate Governance: tend to have more independent boards, guards against dictators
- Human Resources: Faster hiring of senior executives, adoption of stock options, and higher CEO turnover
- Matchmaking:
  - Lindsey (2008): Facilitate alliances among portfolio firms
The Global Distribution of High-Tech Private-Equity Investment, 2007, Top-20 Countries, in $Billions

<table>
<thead>
<tr>
<th>Region</th>
<th>World Rank</th>
<th>Investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td></td>
<td></td>
</tr>
<tr>
<td>USA</td>
<td>35.49</td>
<td>(1)</td>
</tr>
<tr>
<td>Canada</td>
<td>1.18</td>
<td>(15)</td>
</tr>
<tr>
<td>NA Total</td>
<td>36.67</td>
<td></td>
</tr>
<tr>
<td>Western Europe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UK</td>
<td>10.5</td>
<td>(2)</td>
</tr>
<tr>
<td>France</td>
<td>3.11</td>
<td>(5)</td>
</tr>
<tr>
<td>Sweden</td>
<td>2.52</td>
<td>(7)</td>
</tr>
<tr>
<td>Germany</td>
<td>2.18</td>
<td>(8)</td>
</tr>
<tr>
<td>Spain</td>
<td>1.20</td>
<td>(14)</td>
</tr>
<tr>
<td>Netherlands</td>
<td>1.03</td>
<td>(17)</td>
</tr>
<tr>
<td>Switzerland</td>
<td>0.71</td>
<td>(18)</td>
</tr>
<tr>
<td>Denmark</td>
<td>0.64</td>
<td>(19)</td>
</tr>
<tr>
<td>Finland</td>
<td>0.59</td>
<td>(20)</td>
</tr>
<tr>
<td>W. Europe Total (top 20 only)</td>
<td></td>
<td>22.48</td>
</tr>
<tr>
<td>Asia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>5.17</td>
<td>(3)</td>
</tr>
<tr>
<td>Korea</td>
<td>3.18</td>
<td>(4)</td>
</tr>
<tr>
<td>Singapore</td>
<td>2.89</td>
<td>(6)</td>
</tr>
<tr>
<td>New Zealand</td>
<td>2.13</td>
<td>(9)</td>
</tr>
<tr>
<td>Japan</td>
<td>1.93</td>
<td>(10)</td>
</tr>
<tr>
<td>China</td>
<td>1.41</td>
<td>(11)</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>1.24</td>
<td>(12)</td>
</tr>
<tr>
<td>Australia</td>
<td>1.07</td>
<td>(16)</td>
</tr>
<tr>
<td>Asia Total (top 20 only)</td>
<td></td>
<td>19.02</td>
</tr>
<tr>
<td>Middle East &amp; Africa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Israel</td>
<td>1.20</td>
<td>(13)</td>
</tr>
</tbody>
</table>


### Upsides for making VC investments outside the U.S.

1. Investment opportunities for high-growth tech start-ups
   - Regional / domestic consumer market potential ($$$$)
   - Cheaper and competitive local talent pool (Human capital)
   - Technological advantage

2. Competition with other VCs/Investors: Less money chasing deals
   - **But:** Sign of “too much money” in China already…

3. Main challenges include exit opportunities
   - **But:** improving track records of non-U.S. firm exits
   - U.S. IPOs (Israel, Chinese companies especially)
   - Non-U.S. IPOs (China, AIM, India, Taiwan, Japan)
   - Large M&A sales (e.g. skype, Alibaba)
What are remaining challenges?

1. Exits

2. Legal / Country Risk

3. Entrepreneurial Ecosystem

- Who has large capital markets?
- What do they have in common?
**Exits**

- **IPO exits**
  - IPOs have generated the most profitable exits for VCs
  - Success of non-U.S. VC-backed companies to exit via IPOs have been limited to a few:
    - China, India, other Asian countries
  - Success has been less sustainable elsewhere (e.g., Europe)

- **M&A exits**
  - More broadly available options and shorter time to exit, but average returns more muted

---

**Index of Protections Against Self-Dealing (higher = more protections)**

- Investor protections are again higher in UK law-based countries
- Lower in continental Europe & Latin America
- This index does not measure one’s ability to enforce contracts
- Nor does it measure the state’s power to override the rule of law
Attitudes towards entrepreneurship

- % of respondents saying yes to the question “Do you have the knowledge, skill, and experience to start a new business?”

- What do the cross-country differences imply about doing VC in these countries?

- Surveys done in 18 countries only.

Time to start a Business, in Days
Cost of capital for international VC

- What cost of capital should (big, diversified) investors expect to earn from investing in international VC?
  - Again, not entrepreneurs
  - Not venture capitalists

International Portfolio Diversification

- Because foreign stocks are not perfectly correlated with domestic returns, combining foreign and domestic assets significantly reduce risk.

- Standard deviation of portfolio returns can be reduced with international diversification
Cost of equity with integrated markets

- For globally-diversified U.S. investors making investments in company $i$ in country $X$,
  \[ r^S_i = r^S_f + \beta_{Gi} \left( r^S_G - r^S_f \right) \] where

  - $r^S_f$ = risk-free rate in U.S. dollars
  - $r^S_G$ = expected global market return
    - Sometimes proxied by the Morgan-Stanley International Index MSCI
    - Premium estimates range 7-8%
  - $\beta_{Gi}$ = beta of the company’s stock $i$ against global equity market

Estimating beta with data limitations

- For companies in many countries, data needed to obtain good estimates of their global beta are unavailable.
- Analysts often decompose the beta to two components, one that captures the industry’s correlation with a national stock market, and another that captures the nation’s correlation with the global stock market.
  - $\beta_{G,i(software)} = \beta_{G, India} \times \beta_{India, software}$
  - For example, for a software company $i$ in India, $\beta_{India, software}$ is how software industry companies are correlated with the Indian stock market, and $\beta_{G, India}$ represents how Indian stock market is correlated with the global stock market (G)
- What if $\beta_{India, software}$ is not available?
- Then $\beta_{G, i} = \beta_{G, X} \times \beta_{X, i} \approx \beta_{G, X} \times \beta_{US, i}$ where
  - $\beta_{US, i}$ = estimate of beta for U.S. companies in the software industry with respect to the U.S. stock market, used as a proxy
  - $\beta_{G,X}$ = estimate of country beta for country X with respect to the global market
COUNTRY BETAS, SELECTED COUNTRIES

<table>
<thead>
<tr>
<th>Country</th>
<th>Country Beta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>1.46</td>
</tr>
<tr>
<td>Finland</td>
<td>1.29</td>
</tr>
<tr>
<td>Mexico</td>
<td>1.23</td>
</tr>
<tr>
<td>Sweden</td>
<td>1.21</td>
</tr>
<tr>
<td>South Africa</td>
<td>0.91</td>
</tr>
<tr>
<td>Poland</td>
<td>0.84</td>
</tr>
<tr>
<td>Israel</td>
<td>0.78</td>
</tr>
<tr>
<td>China</td>
<td>0.68</td>
</tr>
<tr>
<td>India</td>
<td>0.57</td>
</tr>
<tr>
<td>Thailand</td>
<td>0.50</td>
</tr>
<tr>
<td>Japan</td>
<td>0.46</td>
</tr>
<tr>
<td>Egypt</td>
<td>0.16</td>
</tr>
</tbody>
</table>

Note: calculated based on daily index stock returns from 1998 to 2008.

Problem

Bankco, a multinational financial services company based in the United States, is considering a consumer-banking investment in Thailand.

Problems

(a) Use the betas.xls file to estimate the beta for this investment.

(b) With a risk-free rate of 4 percent and a global risk premium of 7 percent, what is the estimated cost of capital for this investment?
Solution

(a) In the industry worksheet of betas, we can look up the beta for the banking industry in the United States as 0.71. In the countries worksheet, we can look up the country beta for Thailand as 0.50. Thus, the estimated beta for Bankco’s investment in Thailand is

\[ 0.71 \times 0.50 = 0.36. \]

(b) By substituting a global beta of 0.36, a risk-free rate of 4 percent, and a global risk premium of 7 percent into the global CAPM of Equation, we obtain a cost of capital of

\[ R_i = 0.04 + 0.36 \times 0.07 = 6.5\% \]