Finance of Innovation
[ITMDI 703]

Introduction to finance of innovation and the concepts of venture capital finance

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3 major questions

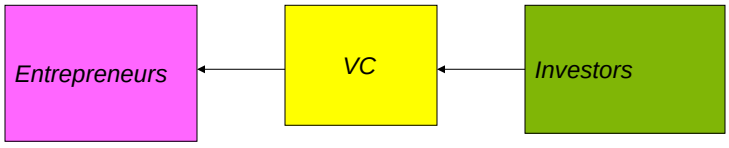
1. ***VCs as fund managers and an asset class***: How do VCs and investors split revenues and profits? What is the risk-adjusted return in VC?

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

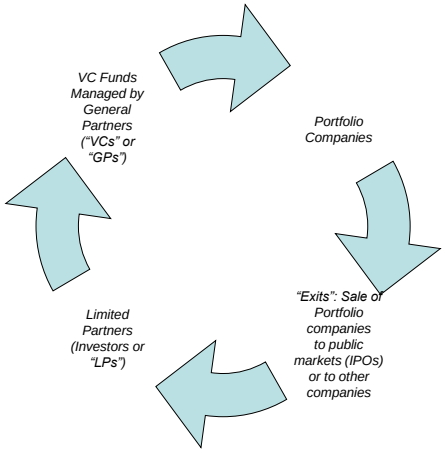
3. ***R&D projects with Uncertainty:*** How can we evaluate R&D investments, often with real option values?

What is a VC? (1)

(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



What is a VC? (2)

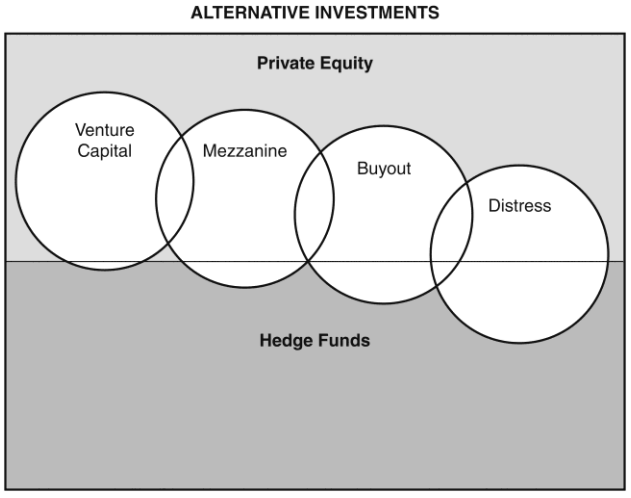
(2) A VC will only invest in private companies. This means that once the investments are made, the companies cannot be immediately traded on a public exchange.

- no simple mark to market
- no liquidity

What is a VC? (3)

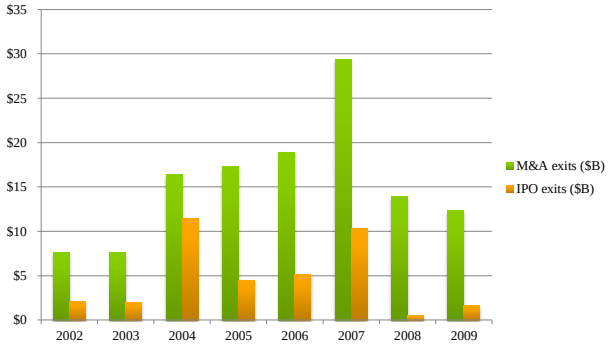
(3) A VC takes an active role in monitoring and helping the companies in his portfolio.

VC is a segment of Private Equity



What is a VC? (4)

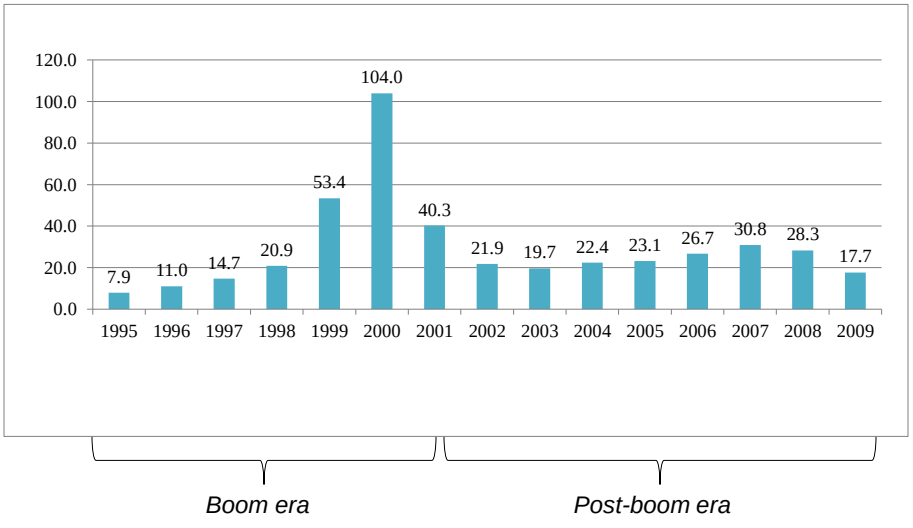
(4) A VC's primary goal is to maximize his financial return by **exiting** investments through a sale or an initial public offering (IPO).



What is a VC? (5)

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

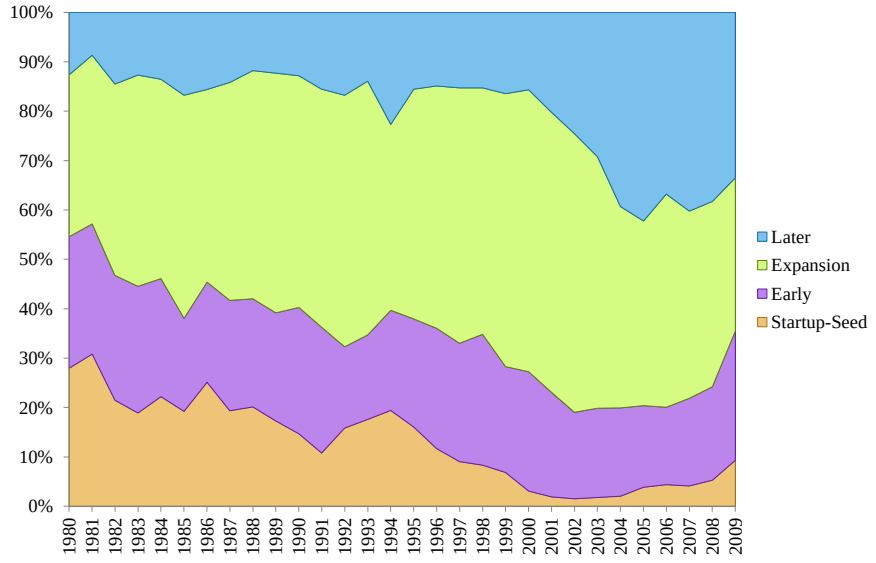
U.S. VC investment ($ billions)



Stages of Growth

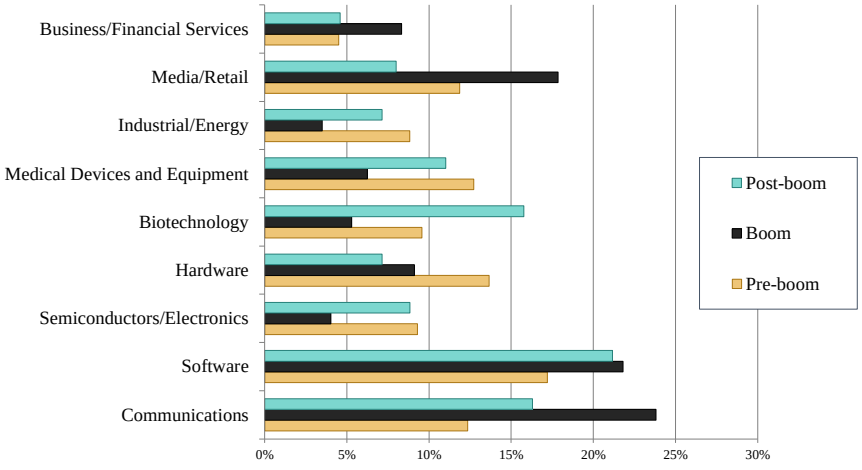
- Early-Stage
  - Seed/Startup
  - Early Stage
- Expansion Stage
- Later Stage

Investment by Stage



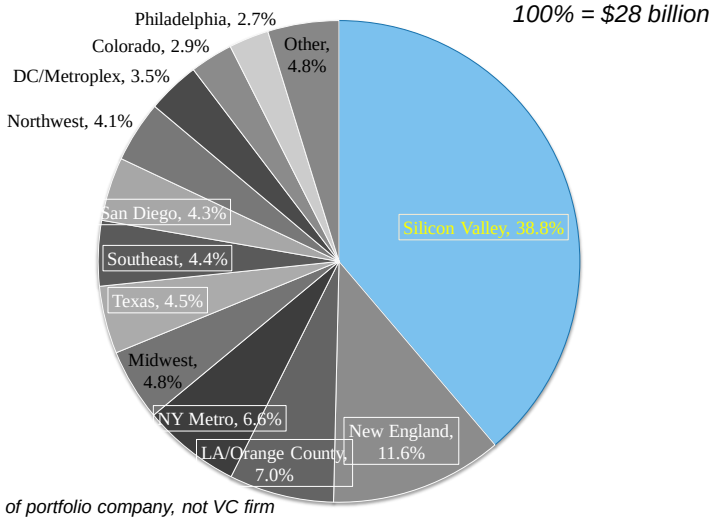
Investment by Industry

Percent of VC dollars invested



Pre-boom = 1980-1994, Boom = 1995-2000, Post-boom = 2001-2009

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



** By location of portfolio company, not VC firm*

Some Important Terms

- VC firm
- general partner (GP)
- VC fund
- limited partner (LP)

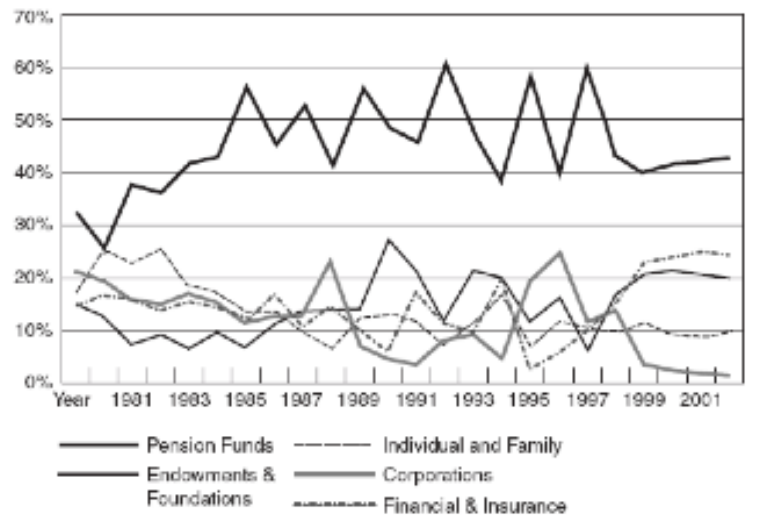
- committed capital
- early-stage, mid-stage, late-stage fund, multi-stage fund
- raised, closed

- 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.

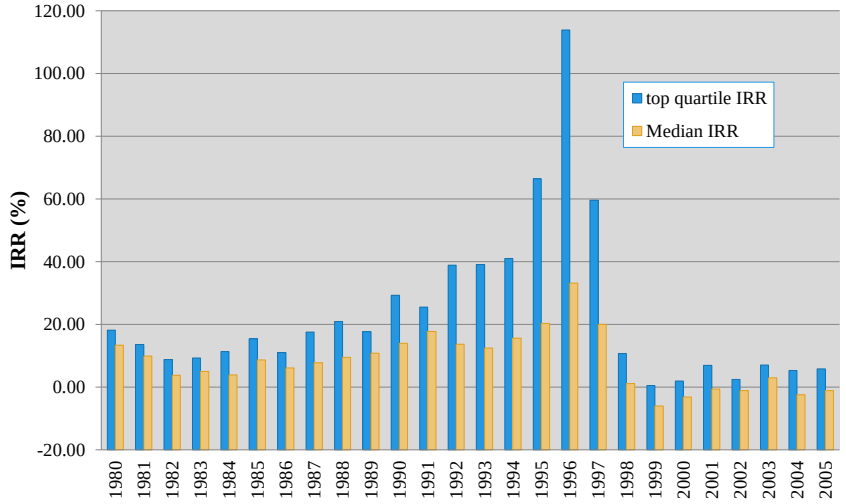
Committed Capital by LP Type



Example: Sierra Ventures

Fund Name	Vintage Year	Committed Capital
(previous funds information omitted)		
Sierra Ventures V	1995	$100M
Sierra Ventures VI	1997	$175M
Sierra Ventures VII	1999	$250M
Sierra Ventures VIII	2000	$500M
Sierra Ventures IX	2006	$400M

Performance varies greatly across vintage years



IRR= IRR from the lifetime (10 yrs.) of funds starting in year X

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?

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

- Contributed capital = invested capital + management fees that have been paid to date
  - For a fully-invested and completed fund, contributed capital = investment capital + lifetime fees = committed capital

- 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%)
  - Return only part of contributed/invested capital
    - Often distinguishes between realized and unrealized investments
    - Fair value test (14%)
  - Other (16% of sample)

Carried Interest (cont'd)

- 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
  - 45% of VC funds have a priority return
  - More common among late-stage funds than early-stage funds

- Catch-up: Once this threshold return is achieved, there is often a catch-up period during which GPs receive disproportionately high ratio of profit until the aggregate profit is split according to the carry rule (e.g., 20:80).
  - Priority with catch-up affects *timing* of cash flows, but not the eventual aggregate profit split if there are sufficient exits
    - This is much more common
  - Priority without the catch-up, on the other hand, permanently affects the eventual aggregate profit split

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

VC COMPENSATION (IN$ THOUSANDS)

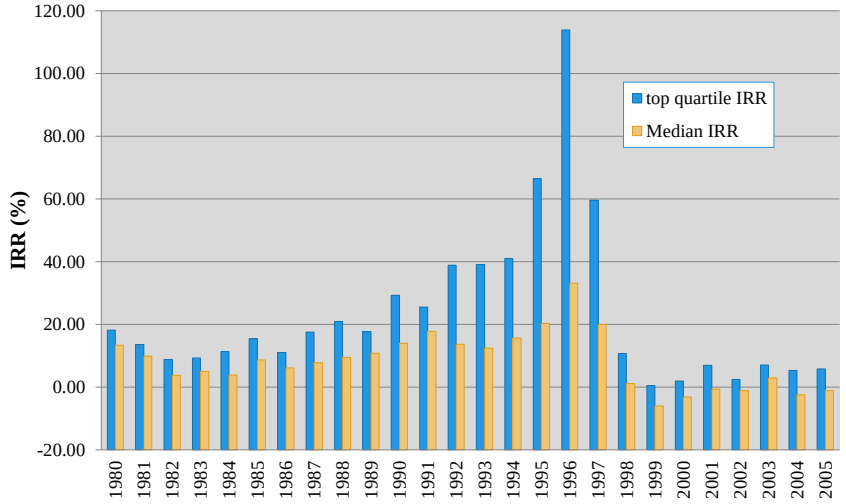
	2008				2009			
Title	Salary	Bonus	Carry	Total	Salary	Bonus	Carry	Total
Managing GP	688	633	192	1,513	700	350	101	1,151
Senior Partner	595	350	155	1,100	600	200	50	850
Partner	375	150	35	560	350	130	20	500
Principal/VP	240	78	2	320	206	75	6	287
Senior Associate	155	46	0	201	156	44	1	201
Associate	105	33	0	138	105	35	0	140
Analyst	101	15	0	116	100	10	0	110
Venture Partner	250	0	43	293	185	40	12	237

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



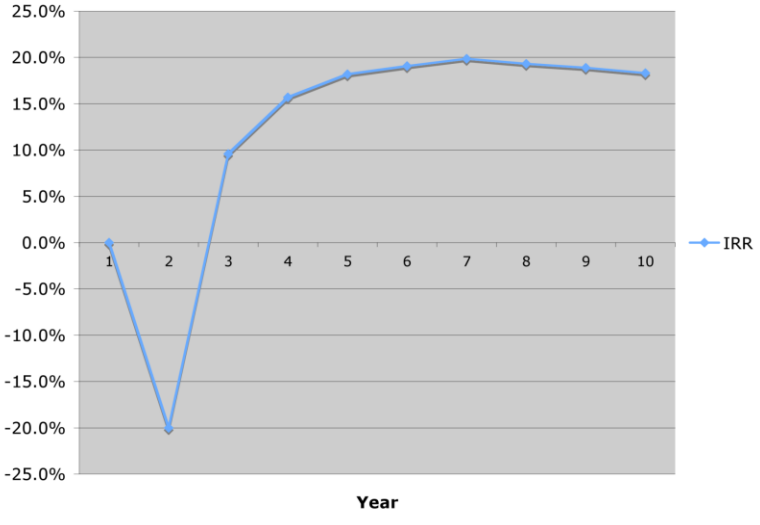
Return Definitions (1)

- 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

Example of a J-curve



GP Clawback

- Given the often complex formulas for distributions, GPs could end up with more than their share of profits (excess carry) at the end of the fund's life.
- Clawback ensures that LPs get back what is promised to them in the agreement by requiring GPs to return any excess carry.
  - Most funds have a clawback clause.
- Many top-quartile funds raised in the late 90's enjoyed early carry distributions during the boom years, but then had the clawback kick in in later years.

Clawback is not perfect

- Enforcing clawback is easier said than done.
  - Potential disagreements between LPs and GPs over what is owed
  - GPs are often not obligated to return taxed part of distributions
  - Some partners may have retired or died; need to have joint and several liability to go after the other remaining partners
    - Only 33% of funds make other partners liable
- Two remedies sought by GPs and LPs:
  - Escrows: keep early carry distributions in escrow accounts till the end
  - Annual true-ups: don't wait till the end, re-calculate the right amount owed each year, and seek speedy repayment.

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

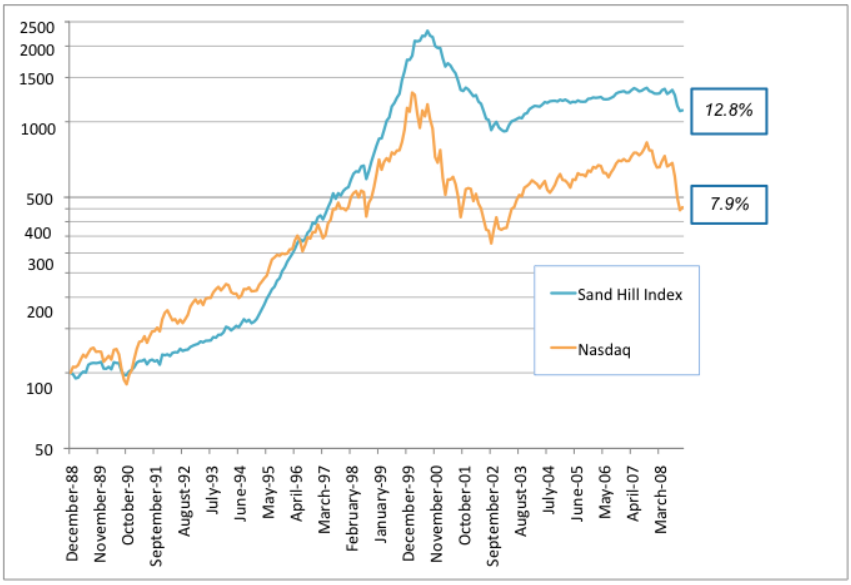
- 3 sources:
  - Sand Hill Econometrics (SHE): portfolio comp level
  - Cambridge Associates (CA): fund level
  - Venture Economics (VE)

Return Definitions

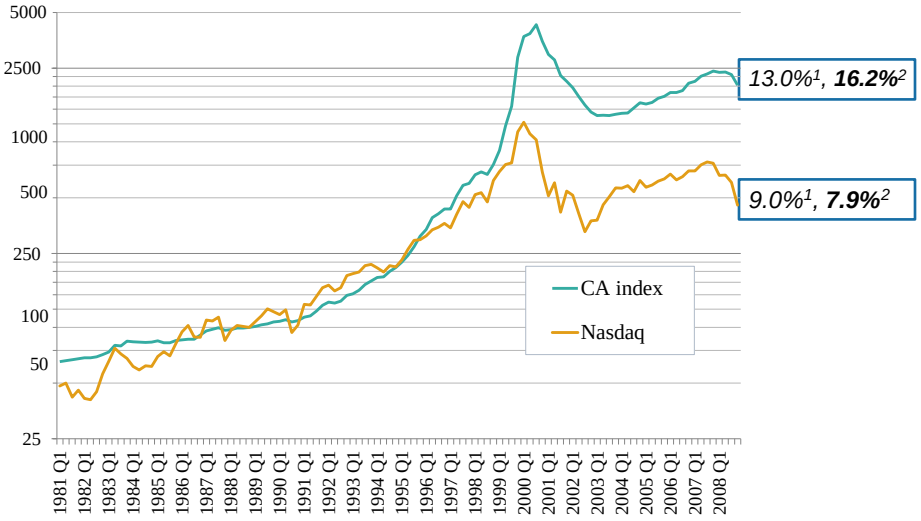
- Periodic returns = $R_t = \frac{(P_t + D_t)}{P_{t-1}} - 1$
- Compound returns = $(1+R_1)*(1+R_2)* \ldots *(1+R_T) - 1$
- Annualized return = $\bar{R}$ = (1+ compound return)$^{(1/T)}$ - 1
- Gross returns = returns before subtracting fees and carry
- Net returns = returns after subtracting fees and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

(To practice these definitions, try Exercise 3.1 in the textbook)

A Gross-Return Index



A Net-Return Index



Note: 1. 1981 Q1 to 2008 Q4. 2. 1988 Q4 to 2008 Q4.

Kleiner Perkins Returns

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

[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

$$r_i = R_i = R_f + \beta(R_m - R_f) \quad ,$$

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**,

β, or "**beta**", is the level of risk for asset *i*.

The difference $(R_m - R_f)$ is called the **market premium**.

Risk

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"

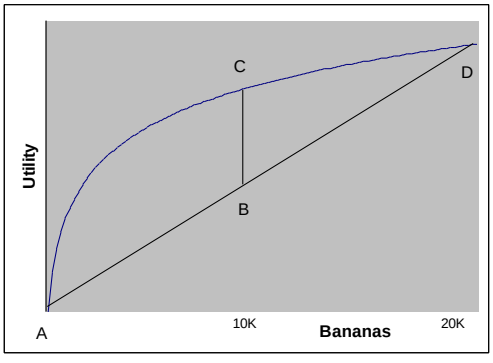
2. Idiosyncratic risk = diversifiable risk = firm-specific risk = residual risk = "variance"

- 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?

Risk (1): banana bird risk

- 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.

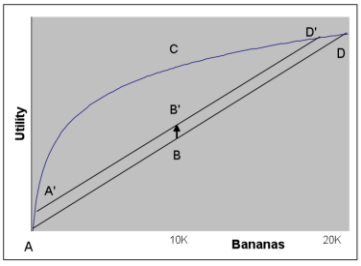
Utility with Bird Risk



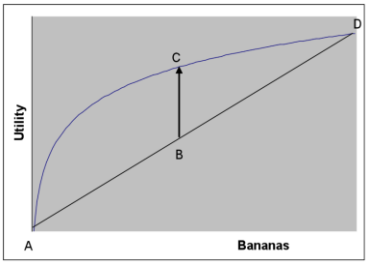
- With this serious banana bird risk, their expected utility is B, weighted average of A and D (50%*U(0) + 50%*U(20,000))
- B is worse than C (utility of getting 10,000 bananas with certainty)
- Can islanders do better?

Solution: diversification

Islander's utility after partial diversification

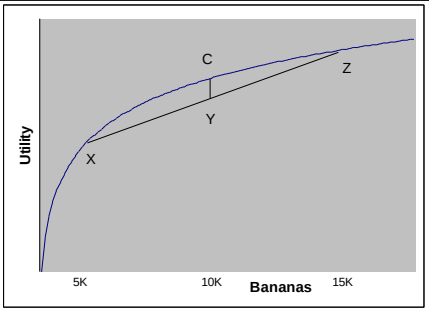


Islander's utility after complete diversification



- 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 β, $R_{vc,t}$, $R_{m,t}$, 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 α, 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

Coefficient	Monthly Data (SHE Index)	Quarterly Data (CA Index)
Alpha (in % per year)	5.73***	6.10
Market Beta	0.81***	0.56***
Sample Period	Jan. 1989 to Dec. 2008	1981:2q to 2008:q4
	(240 monthly observations)	(111 quarterly observations)

****, **, 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 3 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

$$R_{vc,\,t} - R_{ft} = \alpha + \beta * (R_{mt} - R_{ft}) + \beta^{size} * SIZE_t + \beta^{value} * VALUE_t + e_{vc,\,t}$$

where α, β, R_{mt}, R_{ft}, $e_{vc,\,t}$ 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 β^{size} and β^{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

$$R_{vc,\,t} - R_{ft} = \alpha + \beta * (R_{mt} - R_{ft}) + \beta^{size} * SIZE_t + \beta^{value} * VALUE_t + \beta^{liq} * LIQ_t + e_{vc,\,t}$$

where *LIQ* is the new liquidity factor, β^{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.

Adjustment (3): stale-prices

- The last issue is that aggregate VC industry price index is updated based on reported valuations of private portfolio companies.
- Often these are based on the most recent round of financing, which leads to stale prices.
- We include values from past periods in our regression.
- So our final equation incorporating all 3 adjustments is

$$R_{vc,t} - R_{ft} = \sum_{s=0}^{23} \beta_s * (R_{m,t-s} - R_{f,t-s}) + \sum_{s=0}^{11} \beta_s^{size} * SIZE_{t-s} + \sum_{s=0}^{11} \beta_s^{value} * VALUE_{t-s} + \sum_{s=0}^{11} \beta_s^{liq} * LIQ_{t-s} + e_{vc,\,t} \quad \textit{and}$$

$$\beta = \sum_{s=0}^{23} \beta_s$$

Final estimation results

Total Coefficient	Monthly Data (SHE Index)	Quarterly Data (CA Index)
Alpha (in % per year)	-2.11	0.13
Market Beta	1.63 ***	2.04***
Size beta	-0.09	1.04***
Value beta	-0.68***	-1.46***
Liquidity Beta	0.26**	0.15
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,

  r_{VC} = 15%
  - 0.04 (r_f) + 1.63 * 0.07 (Market) – 0.090 * 0.025 (size) – 0.68 * 0.035 (value) + 0.26 * 0.05 (liquidity) = 14.1% (SHE estimates)
  - 0.04 (r_f) + 2.04 * 0.07 (Market) +1.04* 0.025 (size) – 1.46 * 0.035 (value) + 0.15 * 0.05 (liquidity) = 16.6% (CA estimates)
- We use 15% as the cost of capital for VC in this course.

Firm age, capital inflow and performance

- If the asset class as a whole earns no alpha, what about the top VCs?
- Study of Venture Economics data shows that
  - For each VC firm, later funds do better, on average (IRR increases with fund sequence number)
    - Accumulated expertise
    - Improved deal flow
    - Better network
  - New fund flows are bad for overall VC returns ("money chasing deals"), but has **no impact on the most experienced VC**

Does VC performance persist?

- The study also find strong evidence that "winners stay winners".
- High returns in previous funds forecast high returns in future funds.
- This is completely different from the evidence found in mutual fund industry, where performance does not persist in the long run
- Implications for LPs: Access to the coveted, high-performers is key.

Kleiner Perkins Returns

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

[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.

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

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

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 (Sequoia/KP)
- 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

North America		World Rank
USA	35.49	(1)
Canada	1.18	(15)
NA Total	36.67	

Western Europe		World Rank
UK	10.5	(2)
France	3.11	(5)
Sweden	2.52	(7)
Germany	2.18	(8)
Spain	1.20	(14)
Netherlands	1.03	(17)
Switzerland	0.71	(18)
Denmark	0.64	(19)
Finland	0.59	(20)
W. Europe Total (top 20 only)	22.48	

Asia		
India	5.17	(3)
Korea	3.18	(4)
Singapore	2.89	(6)
New Zealand	2.13	(9)
Japan	1.93	(10)
China	1.41	(11)
Hong Kong	1.24	(12)
Australia	1.07	(16)
Asia Total (top 20 only)	19.02	

Middle East & Africa		
Israel	1.20	(13)

Source: PWC Global Private Equity Report 2008.

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…

1. 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)

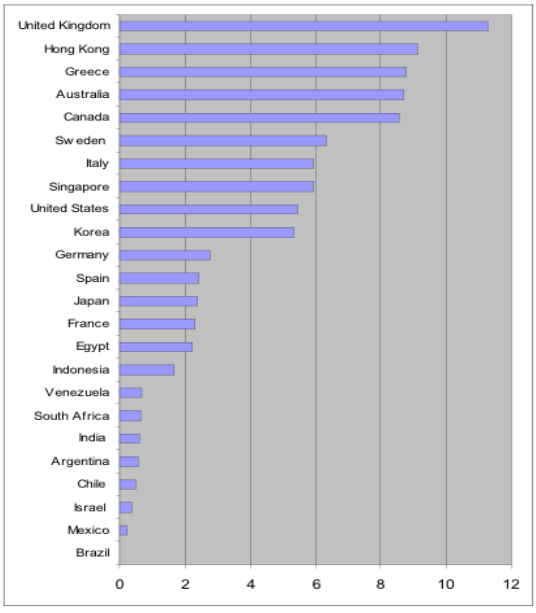
What are remaining challenges?

1. Exits

2. Legal / Country Risk

3. Entrepreneurial Ecosystem

Ratio of capital raised in IPOs (in $thousands) to GDP (in $millions), 1996 -2000

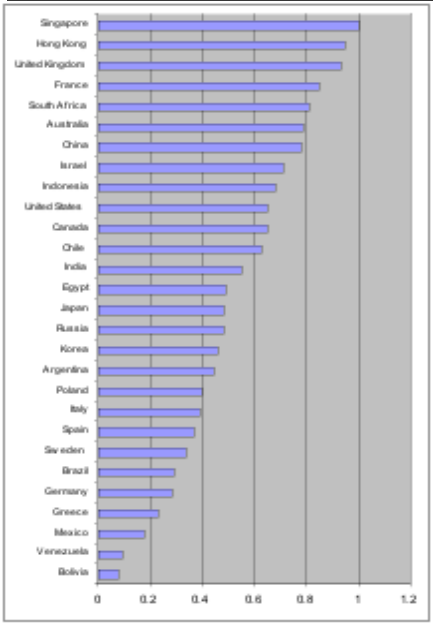


- Who has large capital markets?
- What do they have in common?

Exits

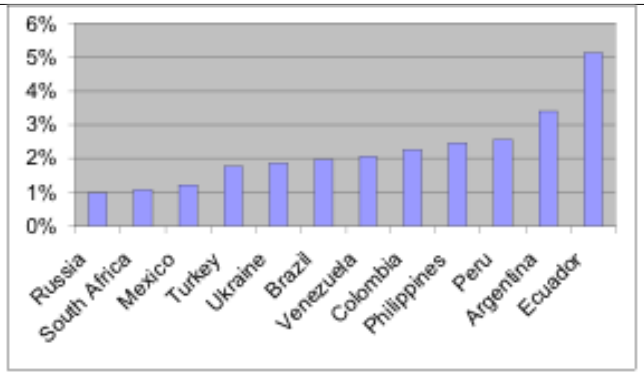
- IPO exits
  - IPOs have generated the most profitable exits for VCs
  - Success of non-U.S. VC-backed companies to exit via IPOs have been limited to a few:
    - Israel, China, India, other Asian countries
  - Success has been less sustainable elsewhere (e.g., Europe)
- M&A exits
  - More broadly available options and shorter time to exit, but average returns more muted

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



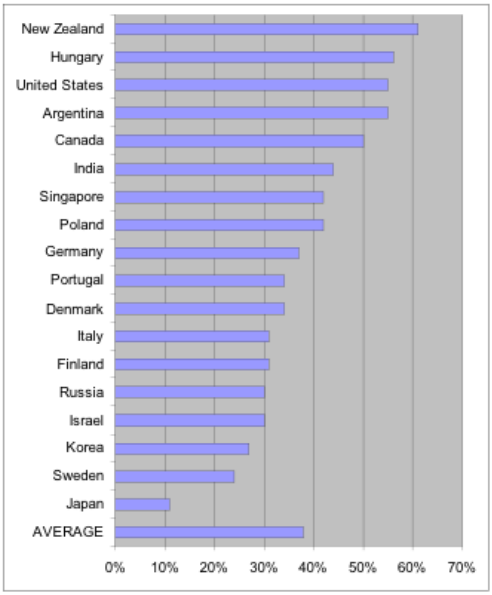
- Investor protections are again higher in UK law-based countries
- Lower in continental Europe & Latin America
- This index does not measure one's ability to enforce contracts
- Nor does it measure the state's power to override the rule of law

Sovereign Spread of Dollar-Denominated Bonds



- Sovereign spread is sometimes used as measure of "country risk".
- But: better job of measuring monetary / fiscal fragility of governments than purely political risk and/or corruption

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.

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,
  $r^{\$}_i = r^{\$}_f + \beta_{Gi} (r^{\$}_G - r^{\$}_f)$ where
  - $r^{\$}_f$ = risk-free rate in U.S. dollars
  - $r^{\$}_G$ = expected global market return
    - Sometimes proxied by the Morgan-Stanley International Index MSCI
    - Premium estimates range 7-8%
  - β_{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.
  - $\beta_{G,i(software)} = \beta_{G,\ India} * \beta_{India,\ software}$
  - 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 $\beta_{G,\ i} = \beta_{G,\ X} * \beta_{X,\ i} \approx \beta_{G,\ X} * \beta_{US,\ i}$ 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

Country	Country Beta
Brazil	1.46
Finland	1.29
Mexico	1.23
Sweden	1.21
South Africa	0.91
Poland	0.84
Israel	0.78
China	0.68
India	0.57
Thailand	0.50
Japan	0.46
Egypt	0.16

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

Cost of Capital for International VC

- We make model adjustments similar to those we made for calculating the cost of capital for *domestic* (U.S.) VC.
- From Class 2 (Chapter 4): We estimated U.S. VC cost of capital as:

$$r^{US}_{VC} = r_f + \beta_{market,\,VC} * (r_m - r_f) + \beta_{size,\,VC} * SIZE + \beta_{value,\,VC} * VALUE + \beta_{liq,\,VC} * LIQ,$$ where

r^{US}_{VC} = U.S. VC return, r_f = risk-free rate,

$r_m - r_f$ = market premium,

SIZE, *VALUE*, and *LIQ* are factor premia for the three factors, and

$\beta_{size,\,VC}$, $\beta_{value,\,VC}$, and $\beta_{liq,\,VC}$ are their betas.

Using estimates of **4%** (risk-free) 7% (market premium), 2.5% (size), 3.5% (value), and 5% (liquidity), and using beta estimates, we obtain

r^{US}_{VC} = **15%** (average of the two from Cambridge and Sand Hill data).

This gives us:

$B_{market}*(r_m - r_f) + \beta_{size}*SIZE + \beta_{value}*VALUE + \beta_{liq}*LIQ$ = **15%** − **4%** = **11%**.

A global multifactor model for VC

- Since we almost always lack data to do this exercise for non-U.S. countries, we use the same trick using beta decomposition into country beta (β_{GX}) and U.S. domestic (market, size, value, liquidity, instead of industry) beta.
- Keep everything in US$.
- G = global, X= country X, US = U.S.
- For VC investment in country X, its cost of capital, r^X_{VC}, is:

$$r^X_{VC} = r_f + \beta_{market(G),\,VC(X)} * (R^G_m - R^G_f) + \beta_{size(G),\,VC(X)} * SIZE^G + \beta_{value(G),\,VC(X)} * VALUE^G + \beta_{liq(G),\,VC(X)} * LIQ^G$$

$$= r_f + \beta_{GX} * \beta^X_{market,\,VC} * (R_m - R_f) + \beta_{GX} * \beta^X_{size,\,VC} * SIZE + \beta_{GX} * \beta^X_{value,\,VC} * VALUE + \beta_{GX} * \beta^X_{liq,\,VC} * LIQ$$

$$\approx r_f + \beta_{GX} * \beta^{US}_{market,\,VC} * (R_m - R_f) + \beta_{GX} * \beta^{US}_{size,\,VC} * SIZE + \beta_{GX} * \beta^{US}_{value,\,VC} * VALUE + \beta_{GX} * \beta^{US}_{liq,\,VC} * LIQ$$

$$= r_f + \beta_{GX} * [\beta^{US}_{market,\,VC} * (R_m - R_f) + \beta^{US}_{size,\,VC} * SIZE + \beta^{US}_{value,\,VC} * VALUE + \beta^{US}_{liq,\,VC} * LIQ]$$

$$= 4\% + \beta_{GX} * [15\% - 4\%].$$

Objections and extensions

- Style effects
- Currency risk
- Country risk
- Segmented markets