DANGER AND OPPORTUNITY: THE ESSENCE OF RISK MANAGEMENT!

Aswath Damodaran

Risk is ubiquitous… and has always been around

- Risk has always been part of human existence. In our earliest days, the primary risks were physical and were correlated with material reward.
- With the advent of shipping and trade, we began to see a separation between physical risk and economic rewards. While seamen still saw their rewards linked to exposure to physical risk – scurvy, pirates and storms – wealthy merchants bet their money on ships returning home with bounty.
- With the advent of financial markets and the growth of the leisure business, we have seen an even bigger separation between physical and economic risks.

Agenda

- What is risk?
- Why do we care about risk?
- How do we measure risk?
- How do we deal with risk in analysis?
- How should we manage risk?

I. WHAT IS RISK?

Risk semantics…

- Risk versus Probability: While some definitions of risk focus only on the probability of an event occurring, more comprehensive definitions incorporate both the probability of the event occurring and the consequences of the event.
- Risk versus Threat: A threat is a low probability event with very large negative consequences, where analysts may be unable to assess the probability. A risk, on the other hand, is defined to be a higher probability event, where there is enough information to make assessments of both the probability and the consequences.
- All outcomes versus Negative outcomes: Some definitions of risk tend to focus only on the downside scenarios, whereas others are more expansive and consider all variability as risk.

Here is a good definition of risk…

- Risk, in traditional terms, is viewed as a ‘negative’. Webster’s dictionary, for instance, defines risk as “exposing to danger or hazard”. The Chinese symbols for crisis, reproduced below, give a much better description of risk.

- The first symbol is the symbol for “danger”, while the second is the symbol for “opportunity”, making risk a mix of danger and opportunity.

Risk management ≠ Risk hedging/avoidance

- For too long, we have ceded the definition and terms of risk management to risk hedgers, who see the purpose of risk management as removing or reducing risk exposures. This has happened because
  - the bulk of risk management product, which are revenue generators, are risk hedging products, be they insurance, derivatives or swaps.
  - it is human nature to remember losses (the downside of risk) more than profits (the upside of risk); we are easy prey, especially after disasters, calamities and market meltdowns for purveyors of risk hedging products.
  - the separation of management from ownership in most publicly traded firms creates a potential conflict of interest between what is good for the business (and its stockholders) and for the managers. Managers may want to protect their jobs by insuring against risks, even though stockholders may gain little from the hedging.
- Risk management, defined correctly, has to look at both the downside of risk and the upside. It cannot just be about hedging risk.

WHY DO WE CARE ABOUT RISK AND HOW DOES IT AFFECT US?

Measuring Risk Aversion

a. Certainty Equivalents: In technical terms, the price that an individual is willing to pay for a bet where there is uncertainty and an expected value is called the certainty equivalent value. The difference between the expected value and your certainty equivalent is a measure of risk aversion.

b. Risk Aversion coefficients: If we can specify the relationship between utility and wealth in a function, the risk aversion coefficient measures how much utility we gain (or lose) as we add (or subtract) from our wealth.

Evidence on risk aversion

I. Experimental studies: Controlled experiments, offering subjects choices between gambles.
II. Surveys: Actual behavior (on risk managing activities) across large samples.
III. Pricing of risky assets: Watch what people pay, not what they say.
IV. Game shows, Race tracks and Gambling: All offer a sense of how people deal with risk.

We are risk averse, but there are differences across people

- Male versus Female: Women, in general, are more risk averse than men. However, while men may be less risk averse than women with small bets, they are as risk averse, if not more, for larger, more consequential bets.
- Naïve versus Experienced: A study compared bids from naïve students and construction industry experts for an asset and found that while the winner's curse was prevalent with both, students were more risk averse than the experts.
- Young versus Old: Risk aversion increases as we age. In experiments, older people tend to be more risk averse than younger subjects, though the increase in risk aversion is greater among women than men. In a related finding, single individuals were less risk averse than married individuals, though having more children did not seem to increase risk aversion.
- Racial and Cultural Differences: The experiments that we have reported on have spanned the globe from rural farmers in India to college students in the United States. The conclusion, though, is that human beings have a lot more in common when it comes to risk aversion than they have as differences

With some strange quirks…

I. Framing: Would you rather save 200 out of 600 people or accept a one-third probability that everyone will be saved? While the two statements may be mathematically equivalent, most people choose the first.

II. Loss Aversion: Would you rather take $ 750 or a 75% chance of winning $1000? Would you rather lose $750 guaranteed or a 75% chance of losing $ 1000?

III. Myopic loss aversion: Getting more frequent feedback on where they stand makes individuals more risk averse.

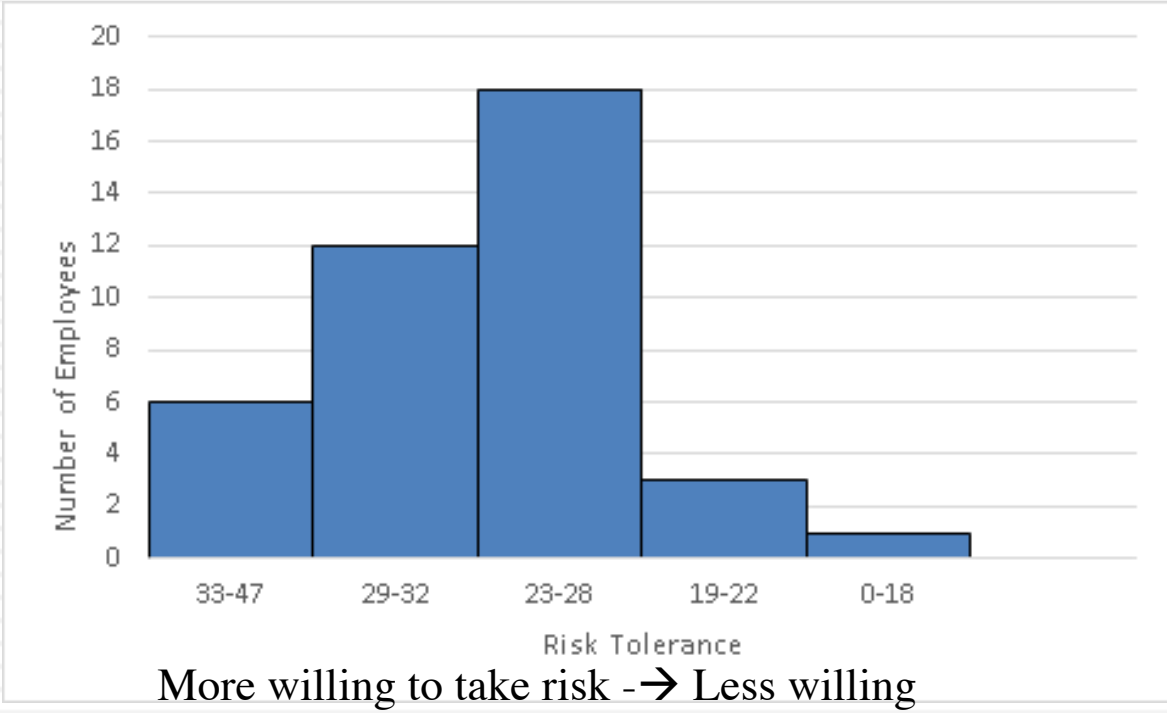
IV. House Money Effect: Individuals are more willing to takes risk with found money (i.e. money obtained easily) than with earned money.

V. The Breakeven Effect: Subjects in experiments who have lost money seem willing to gamble on lotteries (that standing alone would be viewed as unattractive) that offer them a chance to break even.

Task 1: How risk averse are you?

- How risk averse are you?
  a) More risk averse than my colleagues
  b) About as risk averse as my colleagues
  c) Less risk averse than my colleagues

Rutgers Risk Tolerance test on PATH staff



More willing to take risk -→ Less willing

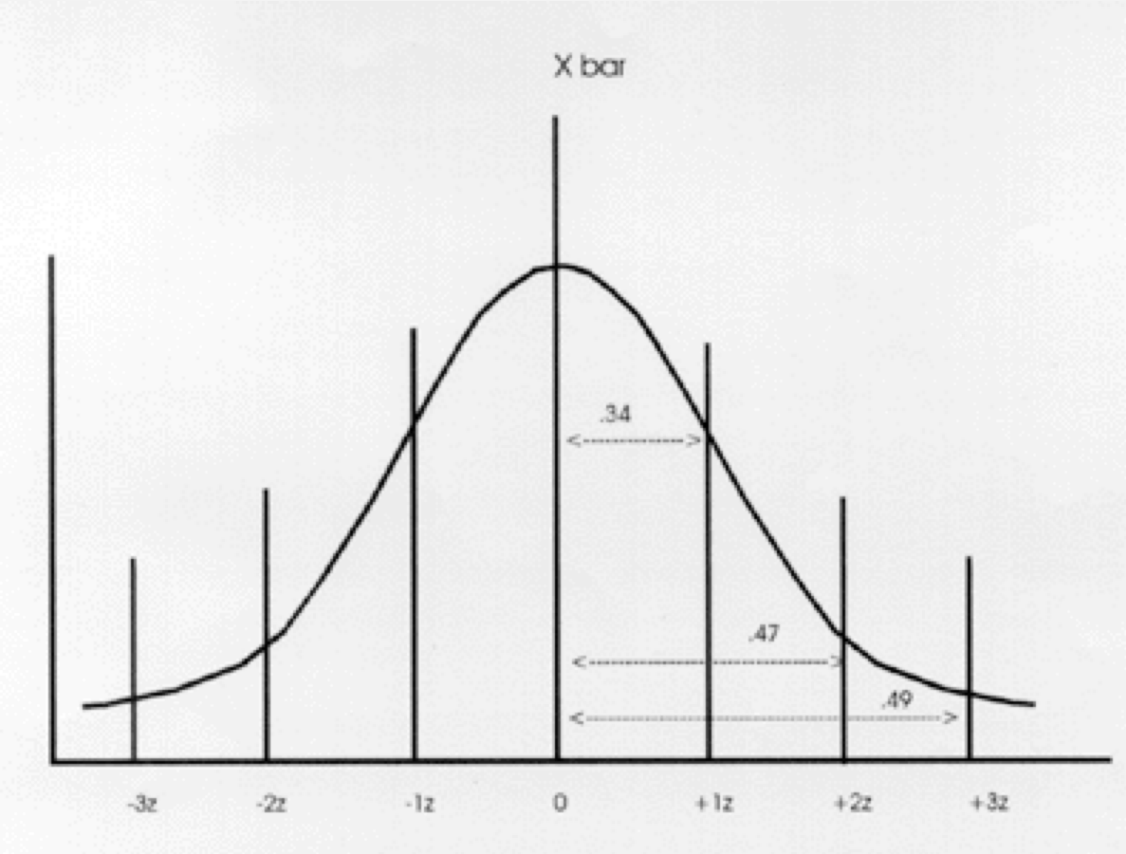
HOW DO WE MEASURE RISK?

I. Probabilities…

- The Pacioli Puzzle: In 1394, Luca Pacioli, a Franciscan monk, posed this question: Assume that two gamblers are playing an even odds, best of five dice game and are interrupted after three games, with one gambler leading two to one.
  - What is the fairest way to split the pot between the two gamblers, assuming that the game cannot be resumed but taking into account the state of the game when it was interrupted?
- It was not until 1654 that the Pacioli puzzle was fully solved when Blaise Pascal and Pierre de Fermat exchanged a series of five letters on the puzzle. That was where probability assessments were born.

II. To Statistical Distributions..

- Abraham de Moivre, an English mathematician of French extraction, introduced the normal distribution as an approximation as sample sizes became large.



III. To Actuarial Tables and the Birth of Insurance..

- In 1662, John Graunt created one of the first mortality tables by counting for every one hundred children born in London, each year from 1603 to 1661, how many were still living. He estimated that while 64 out of every 100 made it age 6 alive, only 1 in 100 survived to be 76.
- The advances in assessing probabilities and the subsequent development of statistical measures of risk laid the basis for the modern insurance business.
- In the aftermath of the great fire of London in 1666, Nicholas Barbon opened "The Fire Office", the first fire insurance company to insure brick homes. Lloyd's of London became the first the first large company to offer insurance to ship owners.

HOW DO WE DEAL WITH RISK IN DECISION MAKING?

Tools and Techniques for risk assessment

Ways of dealing with risk in analysis

- Risk Adjusted Value
  - Estimate expected cash flows and adjust the discount rate for risk
  - Use certainty equivalent cash flows and use the riskfree rate as the discount rate
  - Hybrid approaches
- Probabilistic Approaches
  - Sensitivity Analysis
  - Decision Trees
  - Simulations
- Value at Risk (VAR) and variants

I. Risk Adjusted Value

- The value of a risky asset can be estimated by discounting the expected cash flows on the asset over its life at a risk-adjusted discount rate:

$$\text{Value of asset} = \frac{E(CF_1)}{(1+r)} + \frac{E(CF_2)}{(1+r)^2} + \frac{E(CF_3)}{(1+r)^3} \ldots\ldots + \frac{E(CF_n)}{(1+r)^n}$$

where the asset has a n-year life, $E(CF_t)$ is the expected cash flow in period t and r is a discount rate that reflects the risk of the cash flows.

- Alternatively, we can replace the expected cash flows with the guaranteed cash flows we would have accepted as an alternative (certainty equivalents) and discount these at the riskfree rate:

$$\text{Value of asset} = \frac{CE(CF_1)}{(1+r_f)} + \frac{CE(CF_2)}{(1+r_f)^2} + \frac{CE(CF_3)}{(1+r_f)^3} \ldots\ldots + \frac{CE(CF_n)}{(1+r_f)^n}$$

where $CE(CF_t)$ is the certainty equivalent of $E(CF_t)$ and r_f is the riskfree rate.

II. Probabilistic Approaches

- The essence of risk that you are unclear about what the outcomes will be from an investment. In the risk adjusted cash flow approach, we make the adjustment by either raising discount rates or lowering cash flows.
- In probabilistic approaches, we deal with uncertainty more explicitly by
  - Asking what if questions about key inputs and looking at the impact on outcome (Sensitivity Analysis)
  - Looking at the outcomes under different scenarios for the future (Scenario Analysis)
  - Using probability distributions for key inputs, rather than expected values, and computing value as a distribution as well (Simulations)

a. Sensitivity Analysis and What-if Questions…

- The NPV, IRR and accounting returns for an investment will change as we change the values that we use for different variables.
- One way of analyzing uncertainty is to check to see how sensitive the decision measure (NPV, IRR..) is to changes in key assumptions. While this has become easier and easier to do over time, there are caveats that we would offer.

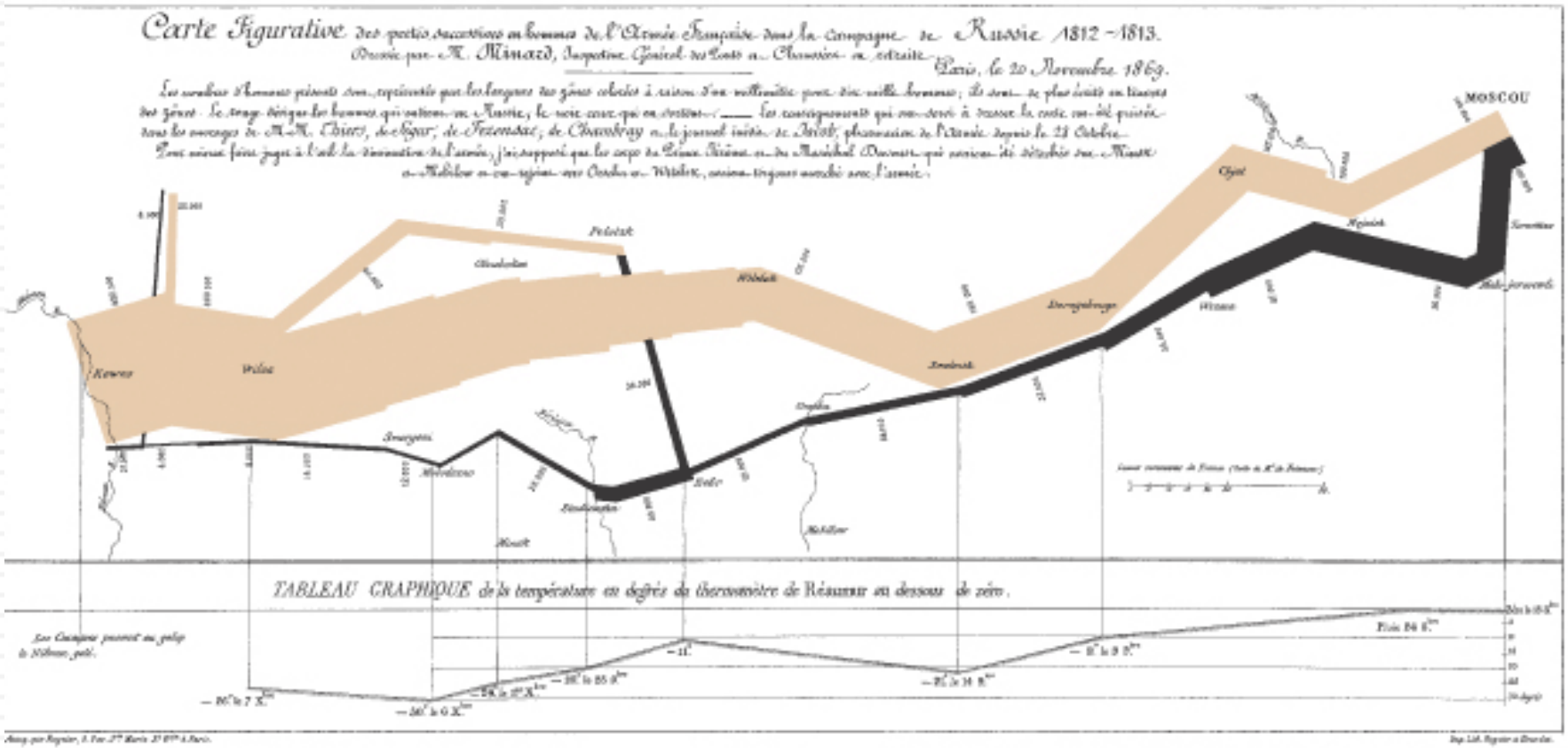
Caveat 1: When analyzing the effects of changing a variable, we often hold all else constant. In the real world, variables move together.

Caveat 2: The objective in sensitivity analysis is that we make better decisions, not churn out more tables and numbers.

Corollary 1: Less is more. Not everything is worth varying…

Corollary 2: A picture is worth a thousand numbers (and tables).

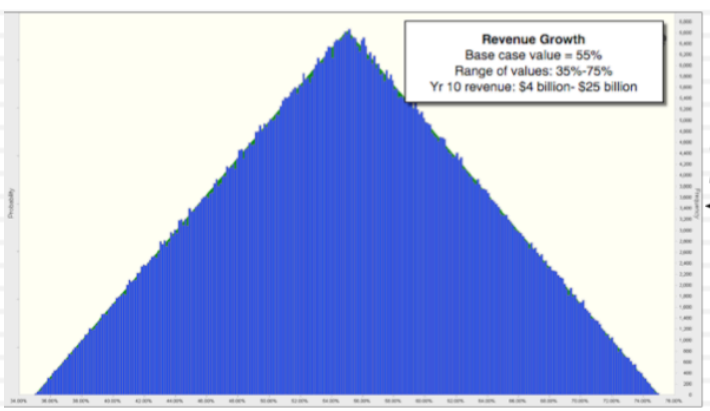
And here is a really good picture…



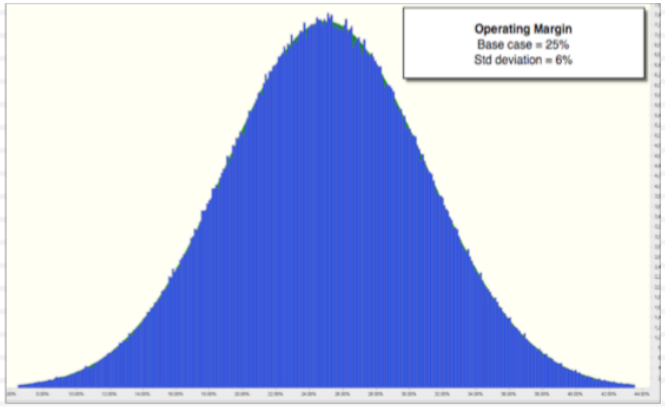
b. Scenario Analysis

- Scenario analysis is best employed when the outcomes of a project are a function of the macro economic environment and/or competitive responses.
- As an example, assume that Boeing is considering the introduction of a new large capacity airplane, capable of carrying 650 passengers, called the *Super Jumbo*, to replace the Boeing 747. The cash flows will depend upon two major "uncontrollable" factors:
  - The growth in the long-haul, international market, relative to the domestic market. Arguably, a strong Asian economy will play a significant role in fueling this growth, since a large proportion of it will have to come from an increase in flights from Europe and North America to Asia.
  - The likelihood that Airbus, Boeing's primary competitor, will come out with a larger version of its largest capacity airplane, the A-300, over the period of the analysis.

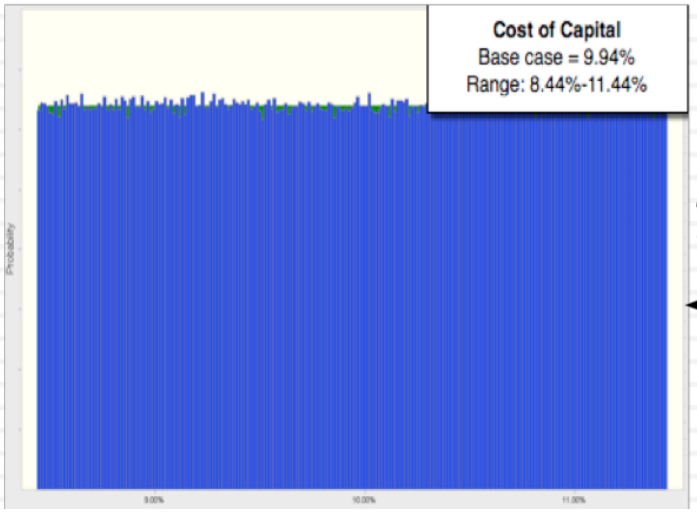
c. Simulations



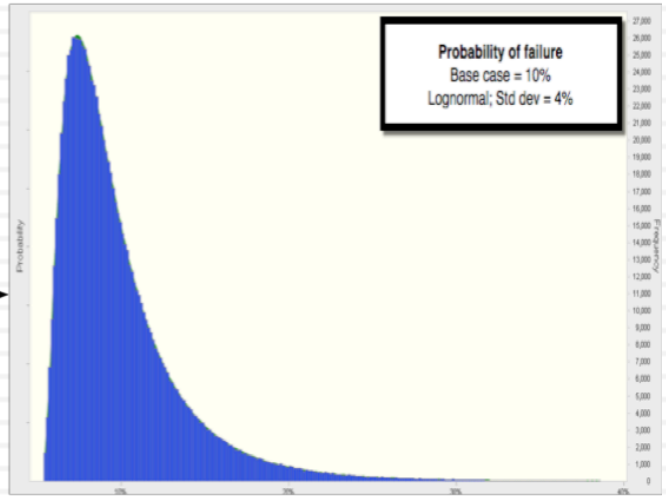
Correlation between margin & growth = 0.50



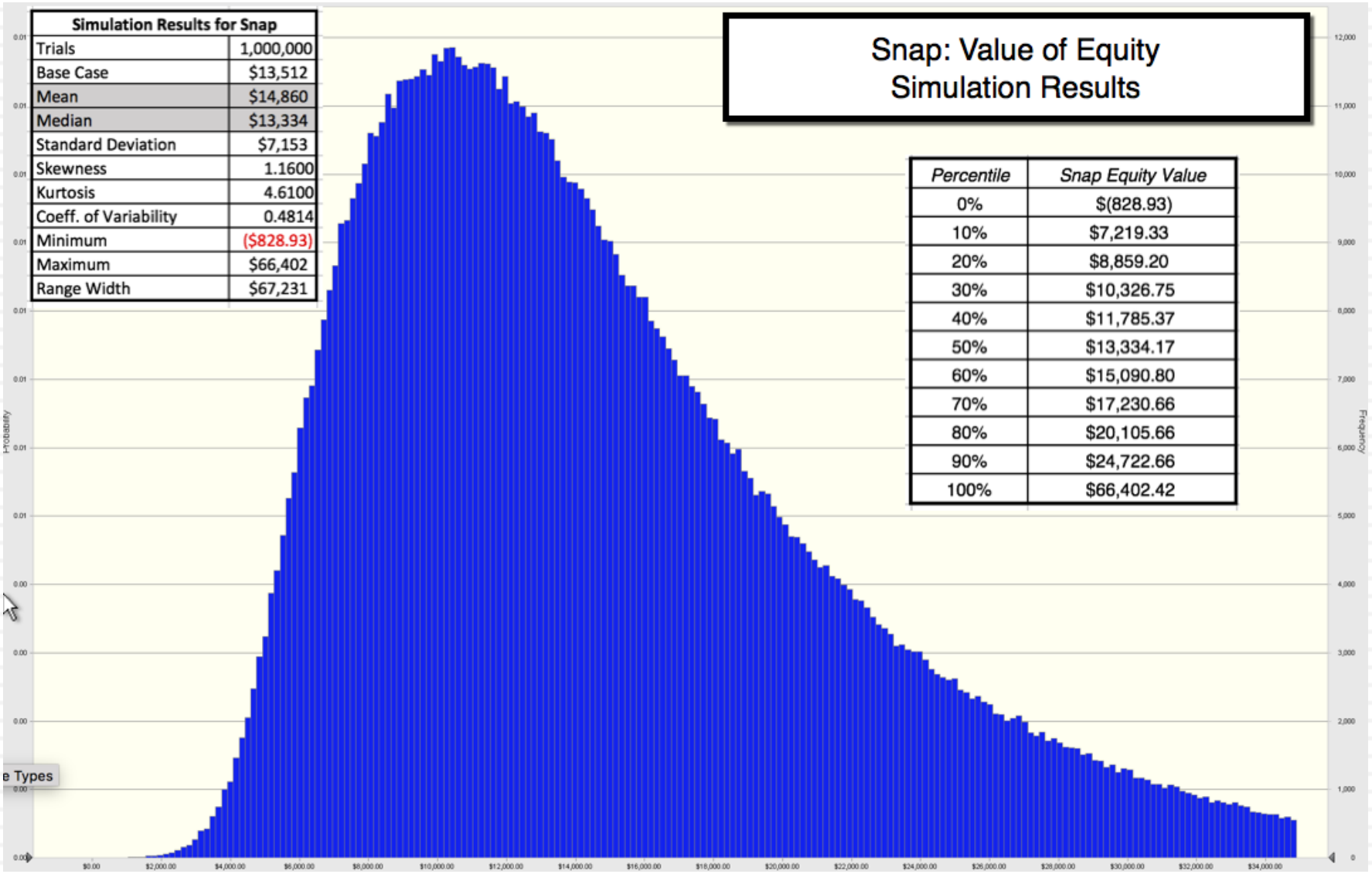
Snap: The Key Valuation Inputs



Correlation between cost of capital & failure= 0.25



The resulting outcome…



Simulation Results for Snap	
Trials	1,000,000
Base Case	$13,512
Mean	$14,860
Median	$13,334
Standard Deviation	$7,153
Skewness	1.1600
Kurtosis	4.6100
Coeff. of Variability	0.4814
Minimum	($828.93)
Maximum	$66,402
Range Width	$67,231

Percentile	*Snap Equity Value*
0%	$(828.93)
10%	$7,219.33
20%	$8,859.20
30%	$10,326.75
40%	$11,785.37
50%	$13,334.17
60%	$15,090.80
70%	$17,230.66
80%	$20,105.66
90%	$24,722.66
100%	$66,402.42

Task 2: Risk Assessment at your organization

- What risk assessment approaches do you use in your organization? (You can pick more than one)
  a) Risk adjusted Value
  b) Sensitivity Analysis
  c) Decision Trees
  d) Simulation
  e) All of the above
  f) None of the above

If you picked none of the above, what do you do about assessing risk in decision making?

HOW DO WE MANAGE RISK?

Step 1: Developing a risk profile

1. List the risks you are exposed to as a business, from the risk of a supplier failing to deliver supplies to environmental/social risk.
2. Categorize the risk into groups: Not all risks are made equal and it makes sense to break risks down into:
    a) Economic versus non-Economic risks
    b) Market versus Firm-specific risks
    c) Operating versus Financial risk
    d) Continuous versus Discrete risk
    e) Catastrophic versus smaller risks
3. Measure exposure to each risk (if possible): Use historical data and subjective judgments to make your best estimates.

Task 1: Risk in your organization

- List the five biggest risks that you see your firm (organization) facing, and then categorize them.

Risk	Micro or Macro	Discrete or Continuous	Catastrophic or Small
1.			
2.			
3.			
4.			
5.			

Step 2: Decide on what risks to take, which ones to avoid and which ones to pass through

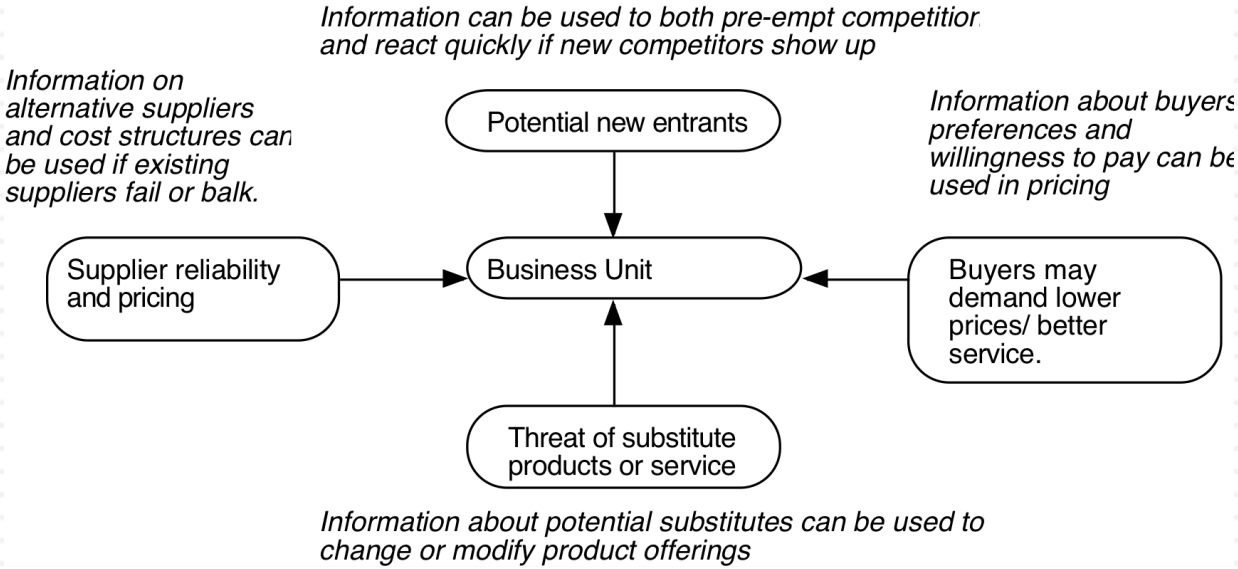
- Every business (individual) is faced with a laundry list of risks. The key to success is to not avoid every risk, or take every one but to classify these risks into
  - Risks to pass through to the investors in the business.
  - Risks to avoid or hedge.
  - Risks to seek out
- In practice, firms often hedge risk that they should be passing through, seek out some risks that they should not be seeking out and avoid risks that they should be taking.

How do you exploit risk?

- To exploit risk better than your competitors, you need to bring something to the table. In particular, there are five possible advantages that successful risk taking firms exploit:
  a. Information Advantage: In a crisis, getting better information (and getting it early) can allow be a huge benefit.
  b. Speed Advantage: Being able to act quickly (and appropriately) can allow a firm to exploit opportunities that open up in the midst of risk.
  c. Experience/Knowledge Advantage: Firms (and managers) who have been through similar crises in the past can use what they have learned.
  d. Resource Advantage: Having superior resources can allow a firm to withstand a crisis that devastates its competition.
  e. Flexibility: Building in the capacity to change course quickly can be an advantage when faced with risk.

a. The Information Advantage

- Invest in information networks. Businesses can use their own employees and the entities that they deal with – suppliers, creditors and joint venture partners – as sources of information.
- Test the reliability of the intelligence network well before the crisis hits with the intent of removing weak links and augmenting strengths.
- Protect the network from the prying eyes of competitors who may be tempted to raid it rather than design their own.



b. The Speed Advantage

- Improve the quality of the information that you receive about the nature of the threat and its consequences. Knowing what is happening is often a key part of reacting quickly.
- Recognize both the potential short term and long-term consequences of the threat. All too often, entities under threat respond to the near term effects by going into a defensive posture and either downplaying the costs or denying the risks when they would be better served by being open about the dangers and what they are doing to protect against them.
- Understand the audience and constituencies that you are providing the response for. A response tailored to the wrong audience will fail.

c. The Experience/Knowledge Advantage

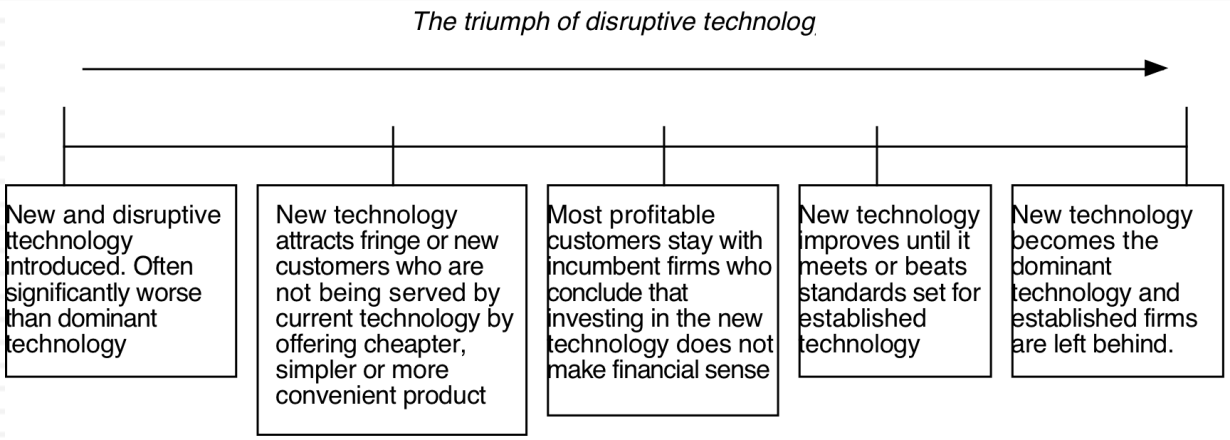
- Expose the firm to new risks and learn from mistakes. The process can be painful and take decades but experience gained internally is often not only cost effective but more engrained in the organization.
- Acquire firms in unfamiliar markets and use their personnel and expertise, albeit at a premium.. The perils of this strategy, though, are numerous, beginning with the fact that you have to pay a premium in acquisitions and continuing with the post-merger struggle of trying to integrate firms with two very different cultures. Studies of cross border acquisitions find that the record of failure is high.
- Try to hire away managers of firms or share (joint ventures) in the experience of firms that have lived through specific risks.
- Find a way to build on and share the existing knowledge/experience within the firm.

d. The Resource Advantage

- Capital Access: Being able to access capital markets allows firms to raise funds in the midst of a crisis. Thus, firms that operate in more accessible capital markets should have an advantage over firms that operate in less accessible capital markets.
- Debt capacity: One advantage of preserving debt capacity is that you can use it to meet a crisis. Firms that operate in risky businesses should therefore hold less debt than they can afford. In some cases, this debt capacity can be made explicit by arranging lines of credit in advance of a crisis.

e. The Flexibility Advantage

- Being able to modify production, operating and marketing processes quickly in the face of uncertainty and changing markets is key to being able to take advantage of risk. Consequently, this may require having more adaptable operating models (with less fixed costs), even if that requires you to settle for lower revenues.
- In the 1990s, corporate strategists argued that as firms become more successful, it becomes more difficult for them to adapt and change.



Task 2: Risk actions

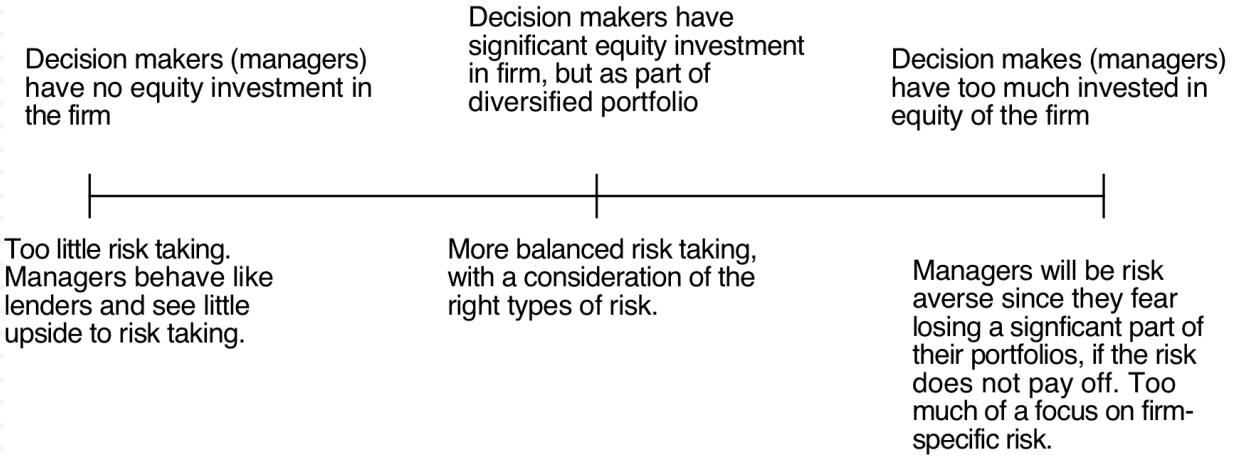
- Take the five risks that you listed in task 1 and consider for each one, whether you will pass the risk through to your investors, hedge the risk or seek out and exploit the risk.

Risk	Action (Hedge, Pass through or exploit)	Why?

Step 3: Build a successful risk taking organization..

- While firms sometimes get lucky, consistently successful risk taking cannot happen by accident.
- In particular, firms have to start preparing when times are good (and stable) for bad and risky times.

3.1: Align interests…

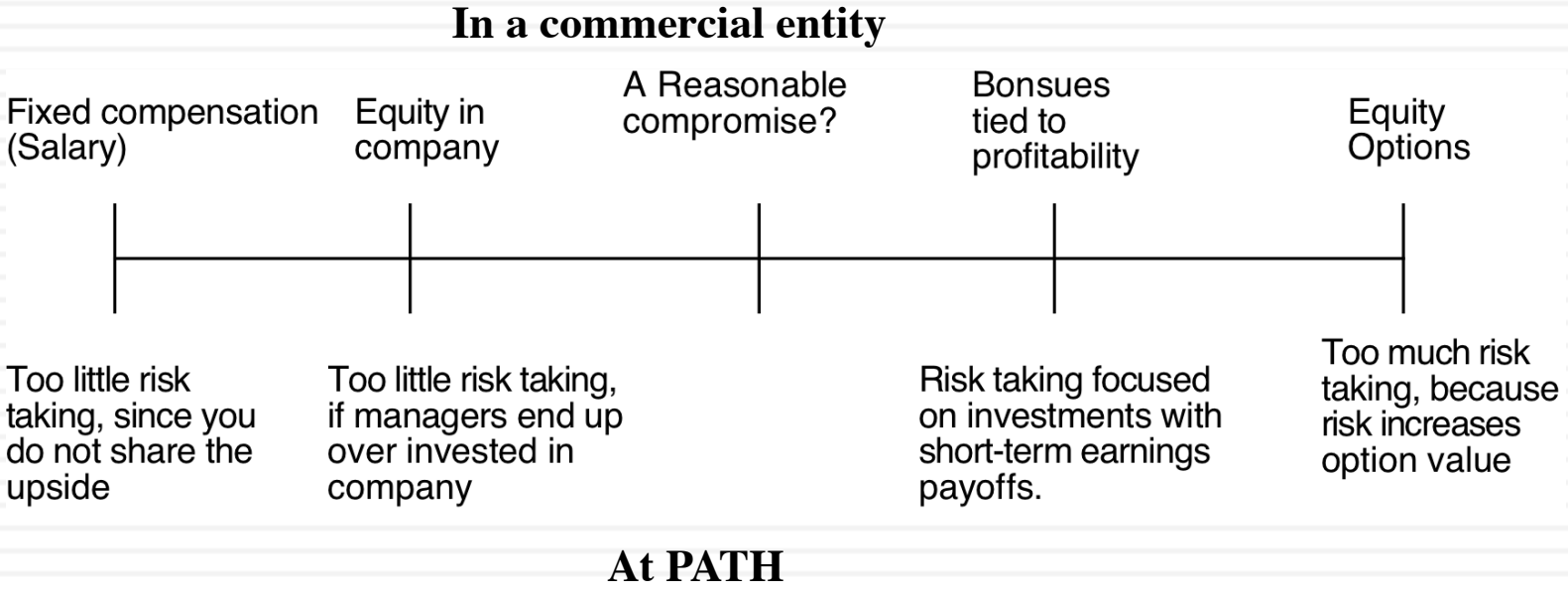


3.2: Pick the right people

- Good risk takers
  - Are realists who still manage to be upbeat.
  - Allow for the possibility of losses but are not overwhelmed or scared by its prospects.
  - Keep their perspective and see the big picture.
  - Make decisions with limited and often incomplete information
- To hire and retain good risk takers
  - Have a hiring process that looks past technical skills at crisis skills
  - Accept that good risk takers will not be model employees in stable environments.
  - Keep them challenged, interested and involved. Boredom will drive them away.
  - Surround them with kindred spirits.

3.3: Make sure that the incentives for risk taking are set correctly…

- You should reward good risk taking behavior, not good outcomes and punish bad risk taking behavior, even if it succeeds.



Given your reward/punishment mechanisms, how would you encourage good risk taking?

3.4: Make sure the organizational size and culture are in tune..

- Organizations can encourage or discourage risk based upon how big they are and how they are structured. Large, layered organizations tend to be better at avoiding risk whereas smaller, flatter organizations tend to be better at risk taking. Each has to be kept from its own excesses.
- The culture of a firm can also act as an engine for or as a brake on sensible risk taking. Some firms are clearly much more open to risk taking and its consequences, positive as well as negative. One key factor in risk taking is how the firm deals with failure rather than success; after all, risk takers are seldom punished for succeeding.

3.5. Preserve your options..

- Even if you are a sensible risk taker and measure risks well, you will be wrong a substantial portion of the time. Sometimes, you will be wrong on the upside (you under estimate the potential for profit) and sometimes, you will be wrong on the downside.
- Successful firms preserve their options to take advantage of both scenarios:
  - The option to expand an investment, if faced with the potential for more upside than expected.
  - The option to abandon an investment, if faced with more downside than expected.

Task 3: Assess the "risk taking" capacity of your organization

Dimension	Your organization's standing
1. Are the interests of managers aligned with the interests of capital providers?	❑Aligned with stockholders ❑Aligned with bondholders ❑Aligned with their own interests
2. Do you have the right people in place to deal with risk?	❑Too many risk takers ❑Too many risk avoiders ❑Right balance
3. Is the incentive process designed to encourage good risk taking?	❑Discourages all risk taking ❑Encourages too much risk taking ❑Right balance
4. What is the risk culture in your organization?	❑Risk seeking ❑Risk avoiding ❑No risk culture
5. Have much flexibility is there in terms of exploiting upside risk and protecting against downside risk?	❑Good on exploiting upside risk ❑Good in protecting against downside ❑Good on both

And here is the most important ingredient in risk management: Be lucky…

- There is so much noise in this process that the dominant variable explaining success in any given period is luck and not skill.

  Proposition 1: Today's hero will be tomorrow's goat (and vice verse) There are no experts. Let your common sense guide you.

  Proposition 2: Don't mistake luck for skill: Do not over react either to success or to failure. Chill.

  Proposition 3: Life is not fair: You can do everything right and go bankrupt. You can do everything wrong and make millions.

Propositions about risk

1. Risk is everywhere
2. Risk is threat and opportunity
3. We (as human beings) are ambivalent about risk and not always rational in the way we deal with it.
4. Not all risk is created equal: Small versus Large, symmetric versus asymmetric, continuous vs discrete, macro vs micro.
5. Risk can be measured
6. Risk measurement/assessment should lead to better decisions
7. The key to risk management is deciding what risks to hedge, what risks to pass through and what risks to take.