Risk Management:

A Corporate Governance Manual

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Abstract

As we sift through the debris of the last economic crisis, we are reminded again that most business disasters can be traced back to bad risk taking. In particular, when managers over reach and expose their businesses to the wrong type of risks or too much risk, investors in these firms (stockholders and lenders) bear the immediate cost, but employees, customers and taxpayers all suffer collateral damage. Of all the tasks that make up corporate governance, none is more critical than oversight of risk: Are the decision makers in the firm taking the right risks and the right amount of these risks, hedging the appropriate risks and allowing the correct risks to pass through to investors? In this manual, we aim to lay out the scope of risk management, by first defining risk and looking at how human beings react to risk in the first three chapters. We then look at measuring and dealing with risk in the next few chapters, by examining how risk measures have evolved over time and the different tools that we use to incorporate risk into decision making. We close the manual by arguing for a much broader view of risk management and its impact on the value of a business and by developing a template for building a good risk taking organization.

Each chapter begins by stating a theme for that chapter, followed by a brief examination of the key issues relating to that theme. At the end of each chapter is a set of tasks that can be used to convert the abstractions and propositions in that chapter to real world corporate governance tests/measures for any organization.

Chapter 1: What is risk?

Theme

To manage risk, we first have to define risk. In this introductory chapter, we look at how risk has been defined in both theory and practice and why traditional definitions of risk fall short. We also look at the consequences of poor or narrow risk definitions for risk management.

Word Games: Uncertainty versus Risk

ln 1921, Frank Knight distinguished between risk and uncertainty by arguing if uncertainty could be quantified, it should be treated as risk. If not, it should be considered uncertainty. As an illustration, he contrasted two individuals drawing from an urn of red and black balls; the first individual is ignorant of the numbers of each color whereas the second individual is aware that there are three red balls for each black ball. The first one, he argued, is faced with uncertainty, whereas the second one is faced with risk. The emphasis on whether uncertainty is subjective or objective seems to us misplaced. It is true that risk that is measurable is easier to insure but we do care about all uncertainty, whether measurable or not.

In fact, there are other distinctions that are drawn that also make no sense:

- ➔ 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.

While these word games around risk may seem to be trivial, they can have significant consequences for risk. Thus, defining risk as only negative outcomes will essentially narrow risk management down to just risk hedging. Similarly, arguing that only measurable uncertainty comprises risk will lead managers to ignore new or unusual risks that they are unable to attach a number to.

Hiding behind numbers

As the data that we have access to increases, we have also become adept at measuring and quantifying risk. Many firms have risk models that deliver "measures of risk" (volatility estimates, betas, value at risk) in real time to decision makers and investors. While this can be viewed as a "good thing", it has also allowed analysts and managers to hide behind numbers, using either of the following excuses:

- ➔ We are better at measuring risk today than we were in the past: It is true that we have more powerful models for measuring risk and that we have the data and computations ability to put these models to use. However, as a result of globalization and technology, we are faced with more complex risks than ever before. Consequently, it is not clear that we are measuring risk more precisely today than we were a few decades ago.
- ➔ Measuring risk means that we are managing risks: Measuring risk is not managing risk. In other words, even if risk is measured well, decision makers have to make the right decisions with the information that they are obtaining about risk exposures. It is not clear that having access to more and better information leads to superior decisions.

As we noted in the last section, becoming too dependent on numerical risk measures can also lead managers to ignore risks that they cannot attach a number to. In fact, as sophisticated risk measures proliferate, we are still beset by crises at regular intervals.

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 symbol for crisis, reproduced here, 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. By linking the two, the definition emphasizes that you cannot have one (opportunity) without the other and that offers that look too good to be true (offering opportunity with little or no risk) are generally not true. By emphasizing the upside potential as well as the downside dangers, this definition also serves the useful purpose of reminding us of two truths about risk.

1. Where there is upside, there is a downside (and vice versa)

It should come as no surprise that managers become interested in risk management during or just after a crisis and pay it little heed in good times. The Chinese definition of risk/crisis points to the fact that good risk taking organizations not only approach risk with equanimity, but also manage risk actively in both good times and bad. Thus, they plan for coming crises (which are inevitable) in good times and look for opportunities during bad times.

2. Risk management ≠ Risk hedging

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 products, which are revenue generators, are risk hedging products, be they insurance, derivatives or swaps. Not surprisingly, the vendors of these products have a vested interest in emphasizing risk hedging.

- ➔ 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.

Implications for Risk Management

To manage risk correctly, we first have to take the right perspective of risk, which is recognition of both its positive and negative effects. Risk management, defined correctly, has to look at both the downside of risk and the potential upside. In other words, risk management is not just about minimizing exposure to the wrong risks but should also incorporate increasing exposure to good risks.

CHAPTER TASK: DEFINE RISK

1. How would you define risk?
2. Given your definition of risk, how would you measure risk?
3. Given your definition and measure of risk, what do you see as the objective of risk management?
   - Reduce exposure to all risk
   - Reduce exposure to "bad" risk
   - Increase exposure to "good" risk
   - Reduce exposure to bad risk and increase exposure to good risk
4. In your firm, how is risk management defined and organized? Does it match up to the objective you chose in the last question?

Chapter 2: Risk Aversion: The Theory

Theme

The ways in which we measure and deal with risk are colored by the basic presumption that investors, managers and decision makers are risk averse. But are they? And if so, are there differences in risk aversion across individuals? In this chapter, we begin by looking at the original experiment that established that investors are risk averse and how economic thought on measuring risk aversion has evolved over time.

The Bernoulli Experiment

Assume that I invite you to play a game. I will flip a coin once and will pay you a dollar if the coin came up tails on the first flip; the experiment will stop if it came up heads. If you win the dollar on the first flip, though, you will be offered a second flip where you could double your winnings if the coin came up tails again. The game will thus continue, with the prize doubling at each stage, until you come up heads. How much would you be willing to pay to partake in this gamble?

a. Nothing
b. <$2
c. $2-$4
d. $4-$6
e. >$6

This was the experiment run by Nicholas Bernoulli in the 1700s. While the expected value of this series of outcomes is infinite, he found that individuals paid, on average, about $2 to play the game. He also noticed two other phenomena:

➔ He noted that the value attached to this gamble would vary across individuals, with some individuals willing to pay more than others, with the difference a function of their risk aversion.

➔ His second was that wealthier individuals were willing to pay more to play his game than poorer individuals, a phenomenon he attributed to the utility from

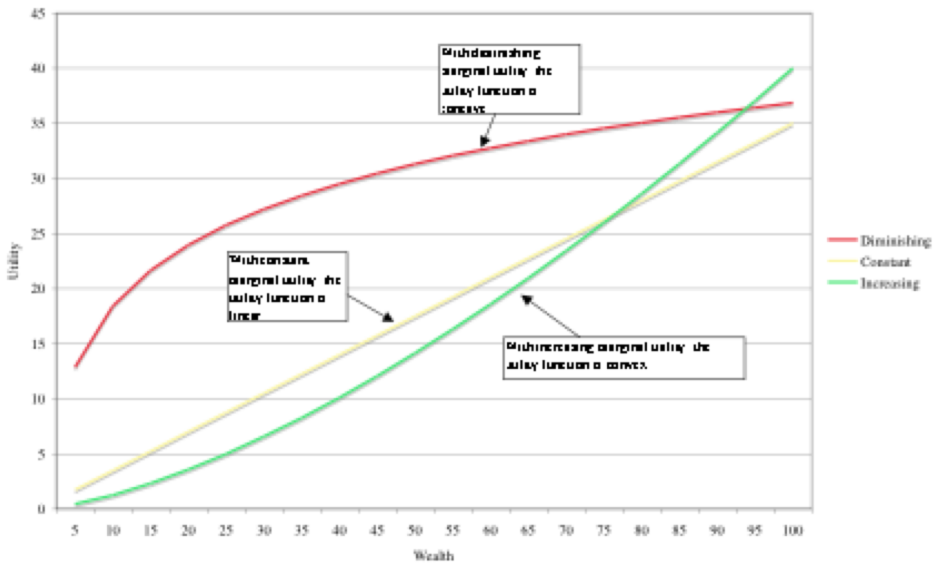
gaining an additional dollar decreasing with wealth; he argued that "one thousand ducats is more significant to a pauper than to a rich man though both gain the same amount".

Bernoulli's experiment may seem trivial in hindsight but it established the foundations for how we think about risk in economics and business.

Marginal Utility and Risk Aversion

Bernoulli's experiments suggested that the utility from adding an extra dollar of income decreases as wealth increases. The "diminishing marginal utility" of wealth can be illustrated simply in the graph below.

Figure 2.1: Utility and Wealth



While the experimental evidence backs the notion of diminishing marginal utility, it is entirely possible that a subset of individuals have marginal utility that remains unchanged as wealth changes (constant marginal utility) or even see their marginal utility increase as wealth increases (think of it as the Scrooge effect or increasing marginal utility).

Why should we care? While assumptions about marginal utility may not come into play directly in any of our decisions, they implicitly affect us because most risk models and measures make implicit assumptions about how the utility of

wealth changes as wealth changes, i.e., whether investors have diminishing, increasing or constant marginal utility of wealth.

Von Neumann and Morgenstern to the rescue

The Bernoulli experiment established risk aversion for individual gambles but did not provide a framework for comparing across gambles. Thus, there was little in the theory that allowed us to compare the utility gained from different risky gambles and to choose between them. Von Neumann and Morgenstern looked at how an individual faced with multiple gambles or lotteries chooses between them, and based their arguments on what they termed the five axioms of choice:

1. Comparability or completeness, Alternative gambles are comparable and individuals are able to specify their preferences for each one.
2. Transitivity: If you prefer gamble A to gamble B and gamble B to gamble C, you must prefer gamble A to gamble C.
3. Independence*:* Outcomes in each lottery or gamble are independent of each other.
4. Measurability: The probability of different outcomes within each gamble be measurable with a number.
5. Ranking axiom, If an individual ranks outcomes B and C between A and D, the probabilities that would yield gambles on which he would indifferent have to be consistent with the rankings.

What these axioms allowed Von Neumann and Morgenstern to do was to derive expected utility functions for gambles that were linear functions of the probabilities of the expected utility of the individual outcomes. In short, the expected utility of a gamble with outcomes of $ 10 and $ 100 with equal probabilities can be written as follows:

$$E(U) = 0.5\ U(10) + 0.5\ U(100)$$

Extending this approach, we can estimate the expected utility of any gamble, as long as we can specify the potential outcomes and the probabilities of each one. Once we are able to compute the expected utilities of risky gambles, the gamble that offers

higher expected utility is preferable to one that offers lower expected utility. Much of we do in conventional economics/finance follows the Von Neumann-Morgenstern construct.

Measuring Risk Aversion

If we accept the proposition that individuals are risk averse, but to different degrees, we have to follow up with measures of risk aversion. There are two broad measures of risk aversion in use by economists:

1. 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. As a simple example, assume that you are facing a gamble where you could make $ 100 with 80% probability and nothing with 20% probability; the expected value of this gamble is $ 80. An individual who is willing to pay only $ 70 to take this gamble is risk averse, but less so than one who is willing to pay only $ 60 for the same gamble.
2. 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. As an example, Bernoulli posited after his experiment that individuals had log-utility functions:

   $U(W) = \ln(W)$

   If this were the case, not only will individuals be risk averse, but their risk aversion coefficients can be extracted from the utility function.

While decision makers need to get a sense of how risk averse they are, relative to their colleagues and co-workers, neither certainty equivalents nor risk aversion coefficients are easy to extract. However, researchers have developed survey approaches that they can use to measure risk aversion, at least on a relative basis.

Implications for Risk Management

Assuming that investors are risk averse is easy to do and there is significant evidence backing up the proposition. Estimating exactly how risk averse they are and how that risk aversion varies across time and across individuals is much more difficult to do. Risk management systems have to attuned to the risk aversion of the decision makers in the systems, but change with them, as their risk aversion shifts over time.

CHAPTER TASK: ASSESSING YOUR RISK AVERSION

Try this online test to measure your risk aversion:

http://hec.osu.edu/people/shanna/risk/invrisk.htm

It leads you through a series of simple choices to make a judgment of your risk aversion.

Reference notes for survey

The risk measure was developed by Rui Yao and Sherman Hanna at Ohio State University and is described in the papers listed below.

References

1. Hanna, S. D., Gutter, M. S.& Fan, J. X.(2001). A measure of risk tolerance based on economic theory. Financial Counseling and Planning, 12(2), 53-60.
2. Hanna, S.D. and S. Lindamood (2004), An improved measure of Risk Aversion, Financial Counseling and Planning, Volume 15(2), 27-38.

Chapter 3: Evidence on how we deal with risk

Theme

While the theory on risk aversion is elegant, how individuals react to risk is ultimately an empirical question. In this chapter, we examine some of the evidence that has been collected over time on how human beings deal with risk.

Ways of measuring risk aversion

Broadly speaking, there are four avenues that researchers have used to learn more about how human beings react, when confronted with risk and uncertainty.

1. Experimental studies: In controlled experiments, subjects are offered choices between gambles and the resulting data is parsed to draw conclusions about their views on risk.
2. Surveys: In contrast to experiments, where relatively few subjects are observed in a controlled environment, survey approaches look at actual behavior – portfolio choices and insurance decisions, for instance- across large samples.
3. Pricing of risky assets: The financial markets represent experiments in progress, with millions of subjects expressing their risk preferences by how they price risky assets.
4. Game shows, Race tracks and Gambling: Over the last few decades, the data from gambling events has been examined closely by economists, trying to understand how individuals behave when confronted with risky choices.

A. Experimental Studies

Bernoulli's experiments, described in the last chapter, provide us with a sense of how experimental economists conduct tests. In that case, subjects were offered the specific gamble with the coin toss and asked how much they would pay to play the game.

How experiments are run

The objective, in experimental economics, is to try to isolate the effect of a factor (risk, in this case) and see how subjects react to variations in that factor. There are two ways in which experiments can be run:

1. Planned experiments: In this approach, which borrows from the physical sciences, subjects are divided randomly into two groups, with one group being the control group and the other the test group. The latter group is exposed to a higher dose of the factor (risk, in this case) and differences in response across the two groups are then attributed to that factor.
2. Independent trials: In this approach, the same experiment is run multiple times on different groups and the results are aggregated, analyzed and reported. The Bernoulli experiment, for instance, falls into this category.

The biggest problem with experimental economics is that researcher bias can influence how tests are designed and run and results analyzed.

What experiments have uncovered about risk aversion

Notwithstanding concerns about the objectivity of researchers, the results from experimental tests can be summarized as follows:

1. 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.
2. 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.
3. 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.

4. 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.

While these differences in risk aversion may seem distant from the more pragmatic concerns that we face in corporate governance, they do have relevance, especially when it comes to the personnel making decisions on risk. Thus, if you operate a firm where all or most of your employees are young men, you should expect to see far more risk taking in the organization than if you operate a business where all or most of your employees are older women. It should come as no surprise, then, that trading rooms at investment banks, which are generally filled with young males, have been the incubators for some of our biggest risk taking blunders.

With some strange quirks

While investors in these experiments reveal themselves to be risk averse, there are some interesting quirks that also seem to come through:

- Framing: Consider the following questions: "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, given a choice, choose to save 200 out of 600 people. Put another way, the decision maker who rejects a risky investment one moment may accept the same investment a moment later, if it is framed differently.
- Loss Aversion: Here is another question: 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? While almost every individual given the choice preferred $ 750 to a 75% chance of winning $ 1000 (which is what you would expect with risk aversion), the same individual almost invariably chose a 75% chance of losing over a guaranteed loss. In other words, how decision makers approach risk will depend upon whether they see the risk predominantly as a source of loss or a potential profit.

- ➔ Myopic loss aversion: In sequential or continuous games, getting more frequent feedback on where they stand in terms of making or losing money, makes individuals more risk averse. As technology delivers larger amounts of real time data to decision makers on the consequences of their risky actions, it may also be altering how investors react to new risks.
- ➔ House Money Effect: In a finding that should not surprise cynics, individuals are more willing to takes risk with found money (i.e. money obtained easily) than with earned money. In the modern corporation, where decision makers are almost always taking risks with other people's money, the key to good risk taking is ensuring that these decisions makers feel like it is their own money at play.
- ➔ 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. In effect, even risk averse decision makers become risk gamblers, if they have lost money and feel the urge to get back to break even.

Given these well-established irrationalities in the way human beings deal with risk, we are faced with a choice. We can either build risk management models for human beings as we wish they were (rational economic agents) or human beings as they really are (risk averse but irrational in specific ways and cases). The former will almost always fail whereas the latter have a better shot of succeeding.

II. Surveys

Experimental economics provides interesting evidence on risk aversion but critics point to the fact that the experiments are still games that people are asked to play. The choices they make in these games may bear little resemblance to how they behave with real money in real life. This is where surveys of actual risk taking or hedging behavior come into play. In effect, observing where you invest your savings and how much insurance you buy is more revealing about your views on risk than any small experimental gamble.

The tools

There are two major sets of decisions that are affected by an individual's risk aversion. The first is the decision on where to invest your savings/portfolio; risk averse investors will put more of their wealth in safer asset classes. The second is in your insurance decisions: what risks you choose to insure against, how much insurance you buy and how much you pay for that insurance are all revealing indicators of risk aversion.

- ➔ Investment Choices: By looking at the proportion of wealth invested in risky assets and relating this to other observable characteristics including level of wealth, researchers have attempted to back out the risk aversion of individuals. Studies using this approach find evidence that wealthier people invest smaller proportions of their wealth in risky assets (declining relative risk aversion) than poorer people.
- ➔ lnsurance Decisions: Individuals buy insurance coverage because they are risk averse. A few studies have focused on insurance premia and coverage purchased by individuals to get a sense of how risk averse they are.

And the findings

Reviewing the findings from many of these surveys, we find that the conclusions largely match up with what we have uncovered in experimental studies

- ➔ Individuals are risk averse, though the studies differ on what they find about relative risk aversion as wealth increases.
- ➔ Women are more risk averse than men, even after controlling for differences in age, income and education.
- ➔ The lifecycle risk aversion hypothesis posits that risk aversion should increase with age, but surveys cannot directly test this proposition, since it would require testing the same person at different ages. In weak support of this hypothesis, surveys find that older people are, in fact, more risk averse than younger people because they tend to invest less of their wealth in riskier assets and buy more insurance.

III. The Pricing of Risky Assets

Extending the argument that the best way to evaluate the risk aversion of individuals is by looking at the actual choices that they make every day (rather than the artificial, small gambles that comprise experiments), the best laboratories to observe risk attitudes are the financial markets. The prices that individuals pay for risky assets reveals not only how risk averse they are but how much they charge for that risk.

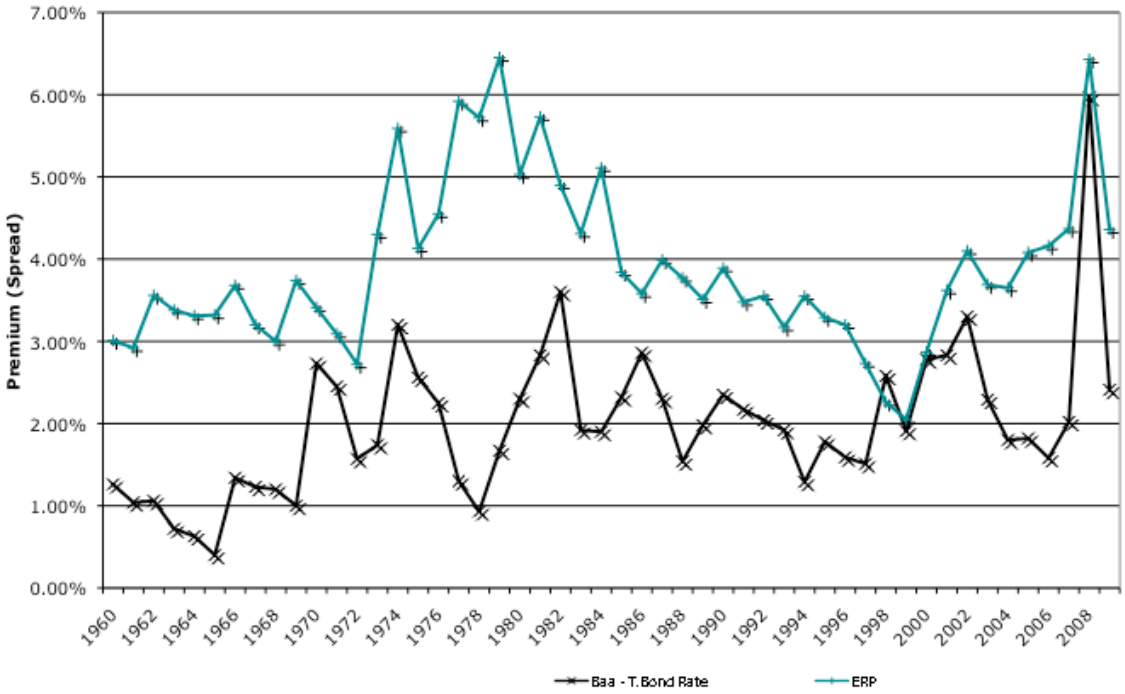
Teasing out risk premiums from prices

Consider a simple proposition. Assume that an asset can be expected to generate $ 10 a year every year in perpetuity. How much would you pay for this asset, if the cash flow is guaranteed? Now assume that the expected cash flow remains $ 10 a year but is now uncertain. How much would you pay for this asset? Most of us would be willing to pay more for the guaranteed cash flow than for the uncertain cash flow of the same magnitude, and the extent of our risk aversion is revealed by how much we discount the value (from the guaranteed value) for the uncertain cash flow.

Equity Risk Premiums and Default Spreads

This is the insight that we use to extract risk premiums from prices. In the bond market, the premium is easy to observe and takes the form of higher interest rates on riskier bonds. Thus, if we would settle for 3% on a default-free government bond and require 5% for a bond issued by a corporation with default risk, we are in effect charging 2% for the additional risk we bear in the latter bond. This difference between the risky bond rate and the risk free rate is called the default spread and should increase with the default risk in the bond. In the equity market, it is a little more complicated to extract the risk premium but it can be done. The dynamics remain the same. As investors become more risk averse or see more risk in equities, they will demand higher expected returns to compensate (and lower the prices they pay up front). The difference between the expected return on equities and the risk free rate is called the equity risk premium. In figure 3.1, we graph out the default

spread on a "Baa" rated corporate bond[1] and the equity risk premium for the United States, from 1960 to 2009:



Looking at this graph, it should be quite clear that while investors have stayed risk averse through history (the premiums would be zero, if that were not the case), both assessments of risk and the price of risk have changed over time. Investors were charging far higher prices for risk in 1978 than they were in 1999, and again in 2008, after the banking crisis, than in 2007.

IV. Game Shows and Gambling

The very act of gambling seems inconsistent with risk aversion, but gambling can be justified by arguing that individuals either enjoy gambling or that they derive substantial utility from the potential for a large payoff, even if the

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[1] Companies that issue bonds generally are rated for default risk by ratings agencies such as S&P and Moody's. Baa is a Moody's rating and reflects a company with intermediate default risk but not at either extreme (Aaa is a company with the least default risk and C rated companies have very high default risk).

likelihood of that happening is low. Gambling and game shows may be more entertainment and leisure than investing, but we can still learn a great deal about views on risk from how gamblers and game show contestants behave.

The key finding is what is termed as the long shot bias, which refers to the fact that people pay too much for long shots and too little for favorites. While this may take the form of putting your money on the horse with the longest odds on the racetrack, it may also manifest itself when investors buy stock in small, high growth companies or pharmaceutical firms invest R&D in a potential blockbuster drug, with little chance of success. This long shot bias has been explained by noting that:

- ➔ Individuals underestimate large probabilities and overestimate small probabilities.
- ➔ Betting on long shots is more exciting and that excitement itself generates utility for individuals.
- ➔ There is a preference for very large positive payoffs, i.e. individuals attach additional utility to very large payoffs, even when the probabilities of receiving them are very small.

There is no reason to believe that these factors are isolated to gambling and game shows. In fact, it is prudent to build risk management systems on the presumption that these same factors spill over into businesses and day-to-day decision making in those businesses.

In summary

Looking across experiments, surveys, risky asset prices and gambling studies, the following findings seem to represent the consensus:

- ➔ Individuals are generally risk averse, and are more so when the stakes are large than when they are small. There are big differences in risk aversion across the population and significant differences across sub-groups.
- ➔ There are quirks in risk taking behavior
    - Individuals are far more affected by losses than equivalent gains (loss aversion), and this behavior is made worse by frequent monitoring.

- The choices that people when presented with risky choices or gambles can depend upon how the choice is presented (framing).
- Individuals tend to be much more willing to take risks with what they consider "found money" than with earned money (house money effect).
- There are two scenarios where risk aversion seems to be replaced by risk seeking. One is when you have the chance of making an large sum with a very small probability of success (long shot bias). The other is when you have lost money are presented with choices that allow them to make their money back (break even effect).

Behavioral Finance

For hundreds of years, economists have designed systems for rational human beings, with rational being defined in economic terms, and have branded any behavior that does not fit the conventional economic model as irrational. In the last three decades, we have seen the advent of behavioral economics/finance, built on the reality that human beings behave in strange ways and that this behavior rather than being aberrant is the rule.

The foundations

The foundations of behavioral economics are in the quirks that we noted earlier that experimental economics have uncovered.

- ➔ Framing: Decisions are affected by how choices are framed, rather than the choices themselves. Thus, if we buy more of a product when it is sold at 20% off a list price of $2.50 than when it sold for a list price of $2.00, we are susceptible to framing.
- ➔ Nonlinear preferences: If an individual prefers A to B, B to C, and then C to A, he or she is violating a key axiom of standard preference theory (transitivity). In the real world, there is evidence that this type of behavior is not uncommon. As a consequence, decision rules based upon the Von Neumann Morgenstern view of the world may break down.

- ➔ Risk aversion and risk seeking: Individuals often simultaneously exhibit risk aversion in some actions while seeking out risk in others.
- ➔ Source: The mechanism through which information is delivered may matter, even if the product or service is identical. For instance, people will pay more for a good, based upon how it is packaged, than for an identical good, even though they plan to discard the packaging instantly after the purchase.
- ➔ Loss Aversion: Individuals seem to fell more pain from losses than from equivalent gains. Individuals will often be willing to accept a gamble with uncertainty and an expected loss than a guaranteed loss of the same amount.

Implications for risk management

Risky decisions are made by human beings, risk is measured by human beings and risk is managed for the most part by human beings. Consequently, we have to design systems that reflect the way in which human beings behave, rather than how we wished they behaved. One interesting aspect of behavioral economics is that it uncovers when people are most likely to make irrational or bad risk taking decisions: when they are trying to break even on a loss-making investment, for example. Taking decisions at that point out of the hands of humans and automating them (computerization, automated rules) can improve risk management systems.

CHAPTER TASK: RELATIVE RISK AVERSION

Based on your assessment of how risk averse you are and how risk averse your co-workers are, which of the following do you think describes your relative risk aversion?

a. I am more risk averse than my colleagues
b. I am about as risk averse as my colleagues
c. I am less risk averse than my colleagues

If you are more or less risk averse than your colleagues, how does this difference manifest itself in your decision-making and discussions?

a. It does not affect either decisions or discussions
b. I am usually the cautious one, pushing every one else to slow down or to stop risky actions.
c. I am usually the aggressive one, trying to get every one else to move quicker and take more risky actions.

Chapter 4: Measuring Risk

Theme

The way that we measure risk has advanced in steps over the centuries. In this chapter, we trace the evolution of risk measures over time, from the earliest and "primitive" measures of risk used prior to the Middle Ages to the sophisticated risk measures of today.

Risk as Fate or Divine Providence

For much of human existence, the outcomes of risk have been attributed to higher powers. The earliest risk management systems therefore required that these supreme powers be kept happy, through prayer, entreaties or even human sacrifice. It also followed that no attempt was made to measure risk, since it could not be controlled in the first place.

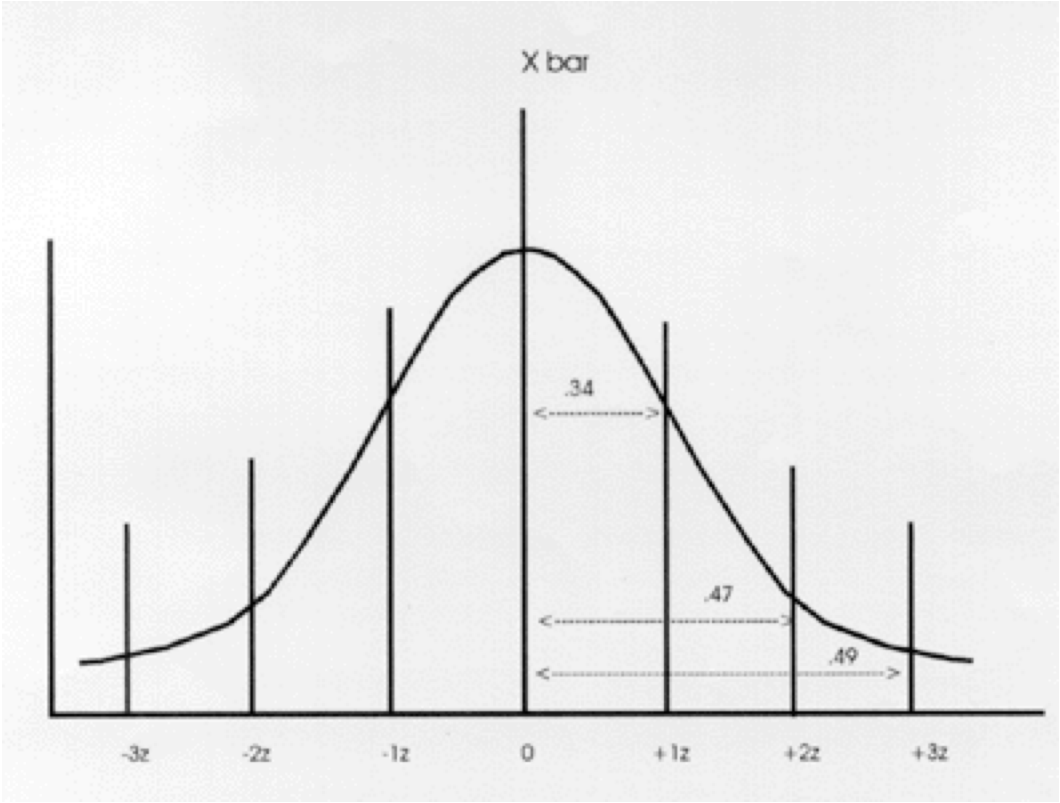
The first step in measuring risk: Pacioli and Probabilities

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. In these letters, Pascal and Fermat considered all the possible outcomes to the Pacioli puzzle and noted that with a fair dice, the gambler who was ahead two games to one in a best-of-five dice game would prevail three times out of four, if the game were completed, and was thus entitled to three quarters of the pot. In the process, they established the foundations of probabilities and modern statistics.

Making probabilities tractable: The advent of statistical distributions

The advent of probabilities was a huge step forward in measuring risk but it was cumbersome, especially in investments where dozens or even hundreds of possible outcomes were feasible. Assessing a probability for each of the outcomes would have required substantial time and resources. Thus, it was a welcome development for risk measurement, when Abraham de Moivre, an English mathematician of French extraction, introduced the normal distribution as an approximation as sample sizes became large.



The normal distribution, by assuming that events were distributed in symmetry around an expected value, made it easy to compute probabilities of events occurring, using the mean and the standard deviation.

In the years following, statisticians have developed other distributions, some symmetric like the normal distribution and others not, but the advantage of distributions remains the fact that it takes less work and inputs to describe a distribution than it does to estimate probabilities of all possible outcomes in a risky investment.

The advent of data: Actuarial Tables and the Birth of Insurance

While probabilities were easy to estimate for dice and other games of chance, they were much more difficult to come by for the real economic risks faced at that time: What is the chance that a ship leaving London for spice trading in India will not make it back? What is the likelihood that a house in London will burn down? To answer these questions and to assess their probabilities, we needed data. 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.

Researchers used Graunt's approach to collecting and chronicling data to address other risky questions and in the process 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.

In summary, the developments in statistics (probability and statistical distributions) in conjunction with real data on events allowed insurance companies to estimate how exposed they were to risks and to charge appropriate premiums to cover their costs.

Financial Assets: New Measures of Risk

When stocks were first traded in the 16th and 17th century, there was little access to information and few ways of processing even that limited information. Only the very wealthy invested in stocks, and even they were lead down the proverbial garden path. The resulting scams and scandals of that day are well described by Charles Mackey in his book on bubbles titled, "The Extraordinary Popular Delusions and the Madness of Crowds".

As new investors entered into the financial markets at the start of the twentieth century, the demand for risk measures also surged. In response, services were already starting to collect return and price data on individual securities and

computing basic statistics such as the expected return and standard deviation in returns. By 1915, services including the Standard Statistics Bureau (the precursor to Standard and Poor's), Fitch and Moody's were processing accounting information to provide bond ratings as measures of credit risk in companies. Concurrently, there were other services that provided risk measures for individual stocks that used a combination of accounting data, market data (stock price volatility) and qualitative information on the company (products, management etc.) to form assessments of risk.

The Markowitz Revolution: Diversification and Risk

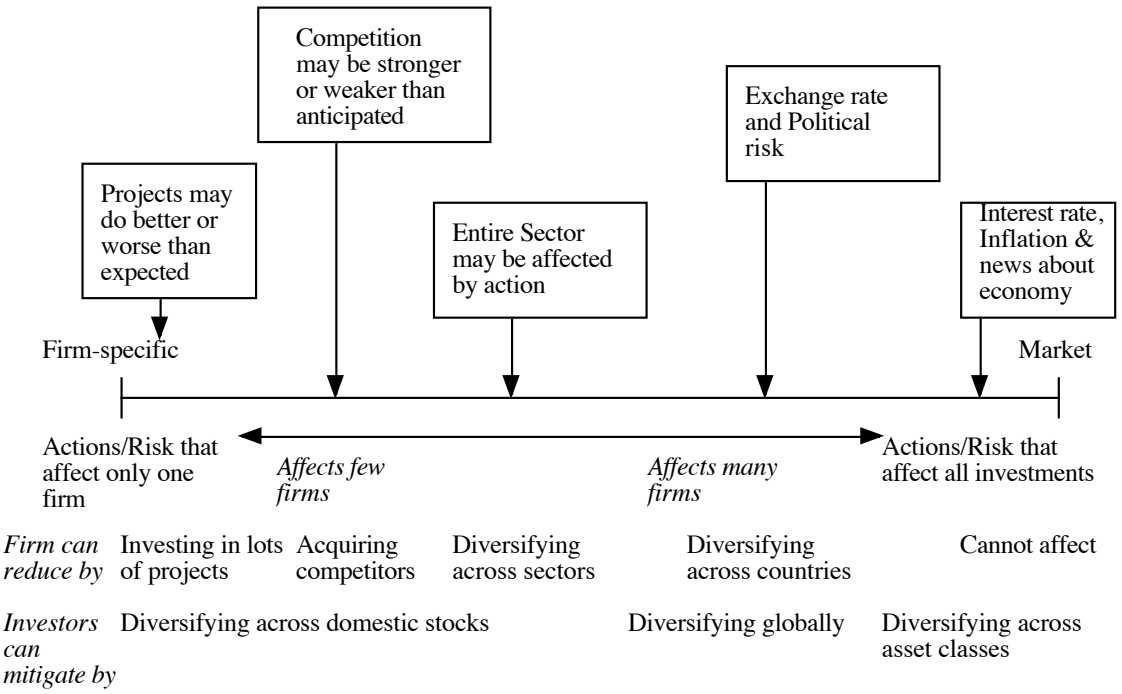
Harry Markowitz revolutionized both how we think about risk and how we measure that risk in the early 1950s by wrestling with a conundrum as a doctoral student in the University of Chicago. Markowitz noted that if the value of a stock is the present value of its expected dividends and an investor were intent on only maximizing returns, he or she would invest in the one stock that had the highest expected dividends, a practice that was clearly at odds with both practice and theory at that time, which recommended investing in diversified portfolios. So, what were we missing?

Markowitz reasoned that investors must diversify because they care about risk, and the risk of a diversified portfolio must therefore be lower than the risk of the individual securities that went into it. His key insight was that the variance of a portfolio could be written as a function not only of how much was invested in each security and the variances of the individual securities but also of the correlation between the securities.

Markowitz then went one step further. If we accept the proposition that investors are diversified, the risk in any individual investment (stock, bond or real asset) has to be the risk added to the diversified portfolio. Consequently, risks that are specific to a firm (and thus affect only that firm) will be averaged out in the portfolio.

To illustrate this concept, consider the variety of risks that any modern business is exposed to in the figure below:

A Break Down of Risk



At one extreme, there are some risks that affect only the firm whereas at the other, there are risks that affect all or most firms at the same time. When you invest all your money in one stock, you are exposed to all of these risks. When you spread your money out across many stocks, the risks that affect one or a few firms will get averaged out in your portfolio: for every company, where something worse than expected happens on a project, there will be another company, where something better than expected will happen. Risk that affects many or most firms cannot be diversified away. In the Markowitz world, this is the only risk that you should be considered as a publicly traded company.

Finance enters the mix: Risk and Return Models

If we accept the Markowtiz proposition that the only risk that we care about in an investment is the risk that you cannot diversify away, the question then becomes one of measurement. How do you measure this non-diversifiable risk? This is where different models part ways. Let us look at some of the alternatives:

1. The Capital Asset Pricing Model (CAPM): In the last section, we noted the benefits of diversification. Add another investment to your portfolio always

delivers a benefit, though the marginal benefit gets smaller as the portfolio gets larger. Given that the benefit is positive, why do most investors (including those who buy into the diversification arguments) stop diversifying? Two reasons. The first is cost, since adding another investment to a portfolio comes with transaction and monitoring costs. The second is that most investors believe that they can differentiate between investments and want to hold only the best ones. The capital asset pricing model by assuming that there are no transactions costs and no private information (not way of differentiating across investments) removes the impediments to diversification. As a consequence, every investor ends up holding a supremely diversified portfolio, composed of every traded asset in the market, and thus called the market portfolio. Differences in risk are then manifested in the proportions of their wealth that investors invest in the market portfolio; more risk averse investors will invest smaller proportions in the market portfolio and larger portions in the riskless asset.

Bottom line: If all investors hold the market portfolio, the risk of an individual asset becomes the risk it adds to this portfolio. Statistically, the beta of an investment measures how it co-varies with the market portfolio and thus the risk added to that portfolio.

Beta's features: Betas are standardized around one; an investment with a beta above (below) one is an above average (below average) risk investment.

2. The Arbitrage Pricing Model: Since market risk can arise from a variety of macro economic sources (factors), the beta in the CAPM bears the daunting burden of capturing exposure to risk from all of these sources in one number. In the arbitrage pricing model, the risk of an investment is measured relative to each market factor separately (with betas against each factor). To figure out how many market factors there are and what the betas of an investment relative to each factor are, we rely on past data on stock prices and a statistical approach called Factor Analysis. In a factor analysis, past data is scoured for common patterns (factors) and the number of factors and the factor betas are outputs.

Bottom line: The risk of an investment is captured in the betas of the investment to unspecified market risk factors.

Features: Since the factors are derived from a statistical, rather than an economic model, they are unnamed. Thus, we can say that a company is very sensitive (has a high beta) to factor 2 but we cannot specify what factor 2 is.

3. Multifactor Model: In a multi factor model, we try to attach macro economic names to the unspecified factors in the arbitrage pricing model, and measure the risk of the investment by computing betas against each of these factors. To identify the macro economic factors, we again start with past stock price data but correlate this data with past data on macro economic variables such as inflation, interest rates, exchange rates and economic growth. In the process, we identify the macro economic variables that seem to most drive stock returns and the betas of individual stocks against these variables.

   Bottom line: The risk of an investment is captured in the betas of the investment to macro economic risk factors.

   Features: Multi factor models are only as good as the macro economic variables that are thrown into the mix. The biggest problem that users face is that the identity and the relationship of macro economic variables shifts over time, making it difficult to use the model in forecasting.

4. Proxy Models: In a proxy model, we look for variables that are highly correlated with risk, though they may not directly measure risk themselves. In a well cited study, Fama and French (1991, 1992) looked at stock returns in the United States over three decades and concluded that differences in returns across companies were best explained, not by difference in betas, but by differences in market capitalization and price to book ratios. Finding that small companies (low price to book companies) earned significantly higher returns than large companies (high price to book companies), they concluded that these two factors were good proxies for risk.

   Bottom line: A company's risk exposure is determined by its characteristics. Thus, a small market capitalization firm that trades at a low market value of equity (relative to its book value of equity) is a risky firm, just as a large

market capitalization firms that trades at a high market value of equity (relative to its book value of equity) is a safe firm.

Features; Proxy models tend to do well at explaining past returns (which should be no surprise, since the proxies were picked because they worked well) and are thus widely used in performance evaluation in portfolio management. They have been less utilized in corporate finance and valuation, where we are seeking to estimate expected future returns.

After fifty years of experimentation and data analysis, it is disheartening that risk and return models in finance have not shown more improvement in explaining differences in returns across investments. As data expands and models improve, perhaps this will change.

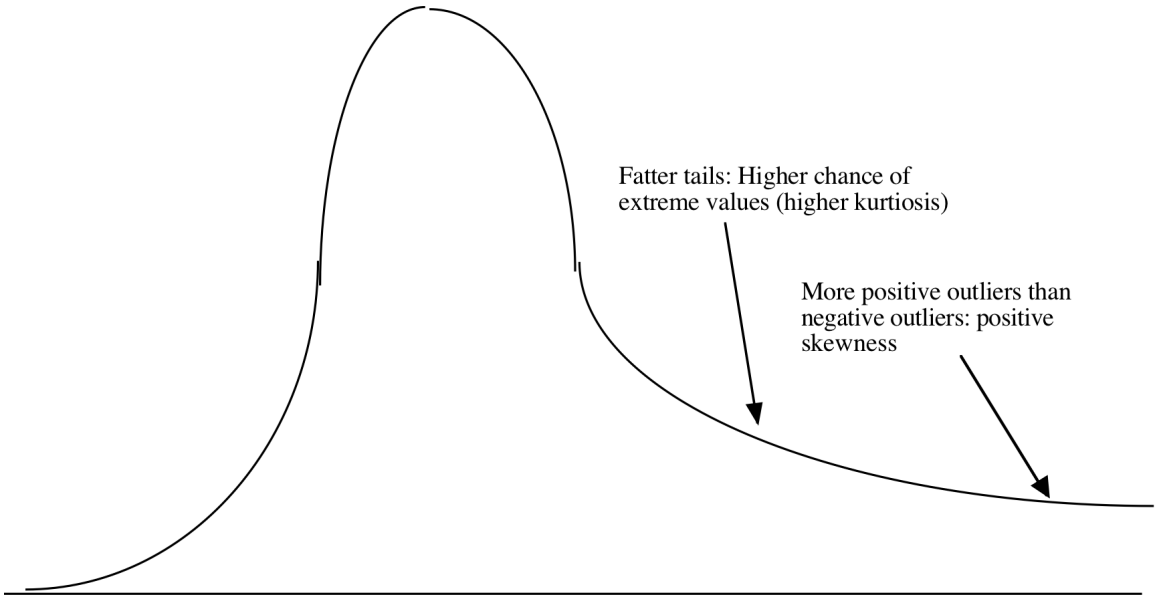
The curse of the Normal Distribution

All risk and return models trace their roots back to Harry Markowitz's initial work in portfolio theory. However, Markowitz's reliance on the normal distribution to simplify computations and make models tractable has also been passed through the decades into current risk and return models and measures. The normal distribution is an elegant distribution, minimalist in its informational requirements (an expected return and a standard deviation) and powerful in its implications. Put simply, if outcomes are normally distributed, we can estimate the likelihood of events occurring with precise probabilities and plan accordingly.

A normal distribution, however, does require symmetry in outcomes (between positive and negative outcomes) and a low probability of extreme events. In fact, the likelihood of the outcomes will have to be close to the following:

	Normal Distribution
0 Sigmas	1 in 2 times
1 Sigma	1 in 6.3 times
2 Sigmas	1 in 44 times
3 Sigma	1 in 740 times
4 Sigma	1 in 32,000 times
5 Sigma	1 in 3.5 million times
6 Sigma	1 in billion times

Financial and economic risks do not seem to possess these properties. Using stock returns as an example, the distribution that we observe looks more like the asymmetric distribution below than the symmetric, normal distribution.



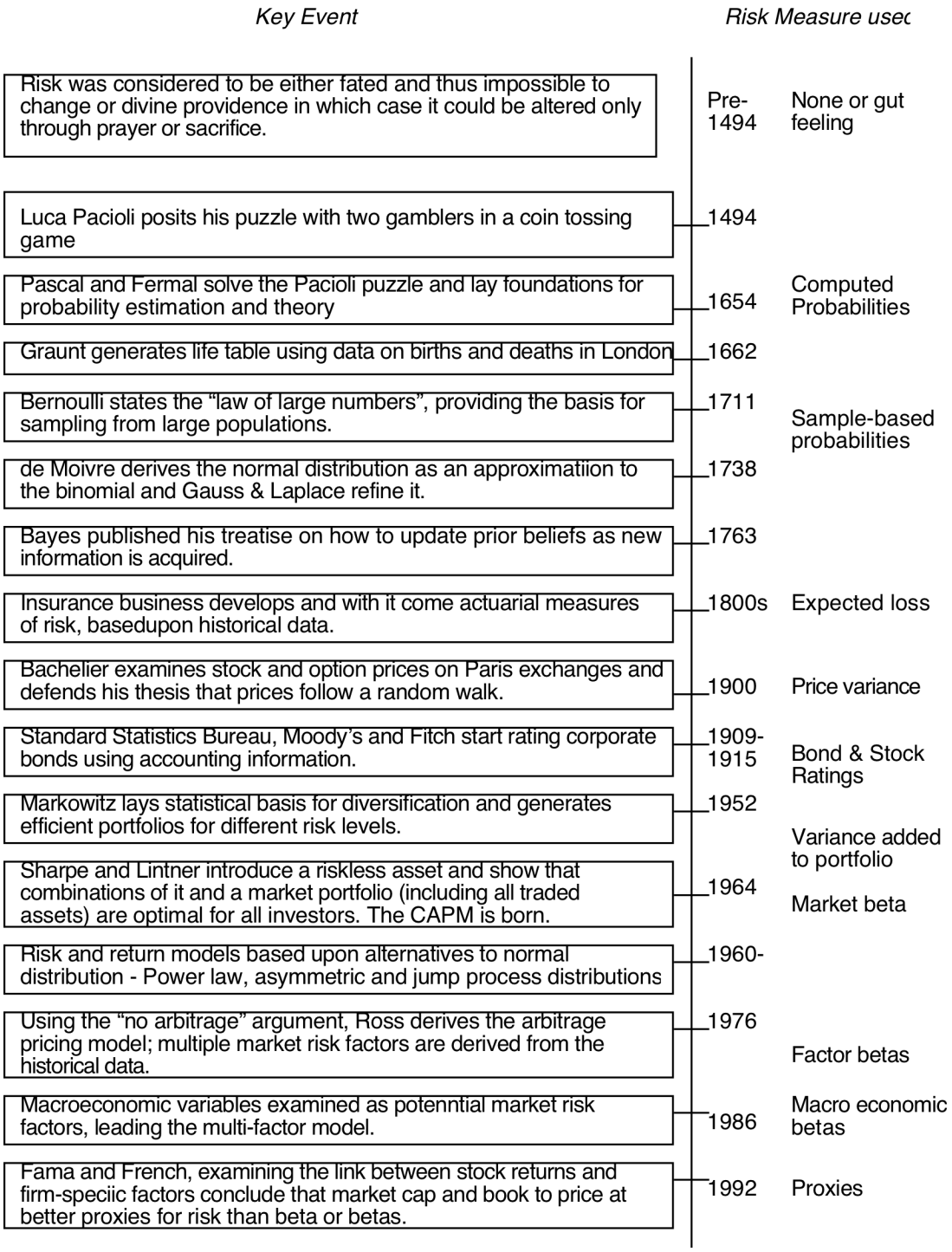
Continuing to use risk models/ measures based upon a normal distribution, when outcomes are not only asymmetric but prone to far more (and larger) jumps than is typical of a normal distribution can lead to disaster in risk management. We will constantly be surprised by unexpected events and risk management systems designed to reduce or eliminate risk (based on normal distribution models) will do neither.

In the aftermath of the banking crisis, there are some who have argued for a revamping of risk measures and models to reflect more realistic statistical distributions. One group of these dissidents traces its lineage back almost five decades to work done on power distributions by Benoit Mandelbrot; power distributions allow for more extreme outcomes than the normal distribution. Another group is more nihilistic and argues that risk management itself is a pointless exercise; Nassim Taleb makes this argument more persuasively than I can in his books, "Fooled by Randomness" and "The Black Swan".

Implications for Risk Management

The way we measure risk will affect the way we manage risk. As our risk measures have evolved over time, from a fatalistic "the Gods did it" to stock market betas, our risk management systems have also changed from keeping the gods happy to the enterprise risk management. While we should celebrate how far we have come in risk measurement/management, we should also be clear about how far we still have to go. Our understanding of risks, especially catastrophic ones, is still in its nascent stages and every risk measure in use has significant shortcomings. Thus, the old saying, "trust but verify", should characterize risk management systems.

In summary: A history of risk measures



CHAPTER TASK: RISK MEASURES FOR YOUR FIRM

This may require some research on your part.

If your firm is publicly traded:

1. Is your equity (stock) viewed as a safe, average or risky stock? (Find some measures of risk on your stock that are publicly accessible, such as beta and standard deviation).
2. Is your debt (bonds) viewed as safe, average or risky? (Again, see if you can find a measure of bond risk; this can take the form of a bond rating if you are a larger, multinational firm but it can be also extracted by looking at interest rates that banks charge you for lending you money)
3. Is this consistent with how you view your firm's risk? If not, why do you think there is a difference?
4. Has the riskiness of your firm changed over time? Do you think that the market measures of risk reflect these changes?

If your organization is not publicly traded:

1. Is your firm a safe, average or risky firm? What measure of risk are you using to come this conclusion?
   - Subjective
   - Objective (Earnings volatility etc.)

   Has the riskiness of your firm changed over time?
2. Do you think your firm is less or more exposed to risk because it is not publicly traded (as opposed to publicly traded firms in the same business)?

Chapter 5: Dealing with Risk: Risk Adjusted Value

Theme

If investors are risk averse, an asset with "risky" cash flows should be worth more than an asset with guaranteed cash flows of equal magnitude. In this chapter, we go from this intuitive statement to two practical ways of adjusting risky asset values for risk. In the first, we adjust the discount rates upwards for risky assets and reduce the present value of expected cash flows. In the second, we replace the expected cash flows with " certainty equivalent" cash flows, which when discounted back at the risk free rate, yields a risk adjusted value.

Approaches for adjusting value for risk

The value of an asset that generates cash flows can be written as the present value of the expected cash flows from that asset, discounted back at a discount rate that reflects the risk. 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. In this approach, the numerator is the expected cash flow, with no adjustment paid for risk, whereas the discount rate bears the burden of risk adjustments.

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. Note that the key set of inputs are the certainty equivalent cash flows, which bear the burden of risk adjustment. The discount rate is the riskfree rate.

With both approaches, the present value of the cash flows will be the risk adjusted value for the asset.

Risk Adjusted Discount Rate

To adjust discount rates for risk, we have to use one of the risk and return models developed in the last chapter. In this section, we will examine how best to estimate the inputs for the simplest of these models – the CAPM – but much of what we say about these inputs can be replicated for more complex risk and return models.

Steps

There are three steps in estimating value, using risk adjusted discount rates and they are described below:

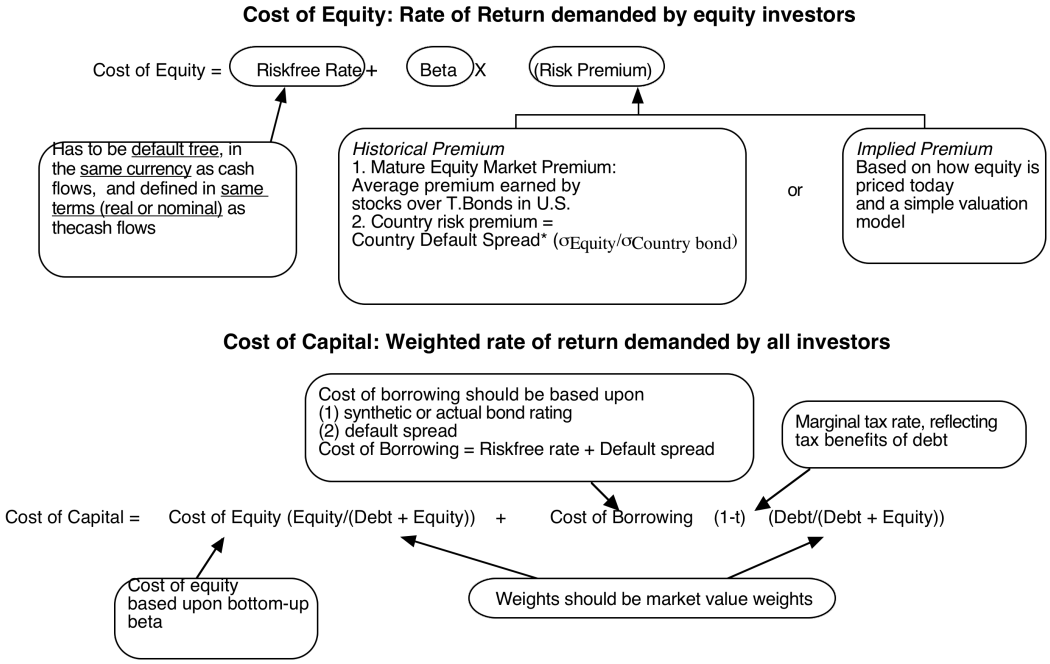
1. Estimate the expected cash flows from a project/asset/business. If there is risk in the asset, this will require use to consider/estimate cash flows under different scenarios, attach probabilities to these scenarios and estimate an expected value across scenarios. In most cases, though, it takes the form of a base case set of estimates that capture the range of possible outcomes.
2. Estimate a risk-adjusted discount rate. While there are a number of details that go into this estimate, you can think of a risk-adjusted discount rate as composed of two components

   Risk adjusted rate = Riskfree Rate + Risk Premium
3. Take the present value of the cash flows at the risk-adjusted discount rate. The resulting value will be risk adjusted.

In the sections that follow, we will focus on step 2, and then use an example to illustrate all three steps.

Adjusting discount rates for risk

If we start with the presumption that a business can raise funds for investments from one of two sources – borrowed money (debt) or owners' money (equity), we can boil down the process for adjusting discount rates for risk into the following inputs:



With cost of equity, we need three inputs to estimate the risk adjusted rate: a risk free rate, an equity risk premium and a beta. With the cost of debt, we need three inputs as well: the risk free rate, a default spread for the debt and a tax rate to use in adjusting the cost of debt for its tax advantages.

Input 1: The Risk free rate

On a riskfree asset, the actual return is equal to the expected return. Therefore, there is no variance around the expected return. For an investment to be riskfree, then, it has to have

- ➔ No default risk: Since there can be no uncertainty about the return on the investment, the entity promising the cash flows can have no default risk.
- ➔ No reinvestment risk: A six-month treasury bill rate is not riskfree for an investor looking at a 10-year time horizon, even if we assume that there is no default risk in the U.S. government. That is because the returns are guaranteed for only six months and there is uncertainty about the rate at which you can invest beyond that period.

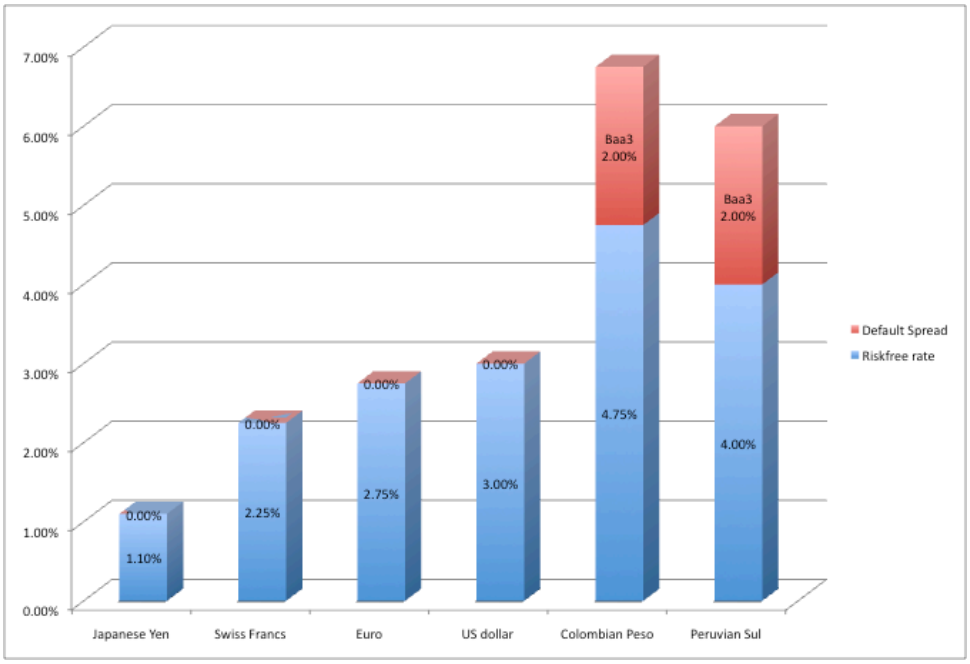
With these two criteria in place, two propositions follow about risk free rates.

Proposition 1: Time horizon matters: The riskfree rates in valuation will depend upon when the cash flow is expected to occur and will vary across

time. Thus, a six-month riskfree rate can be very different from a 10-year risk free rate in the same currency at the same point in time.

Proposition 2: Not all government securities are riskfree: Most practitioners use government security rates as riskfree rates, making the implicit assumption that governments do not default on local currency bonds. Some governments face default risk and the rates on bonds issued by them will not be riskfree.

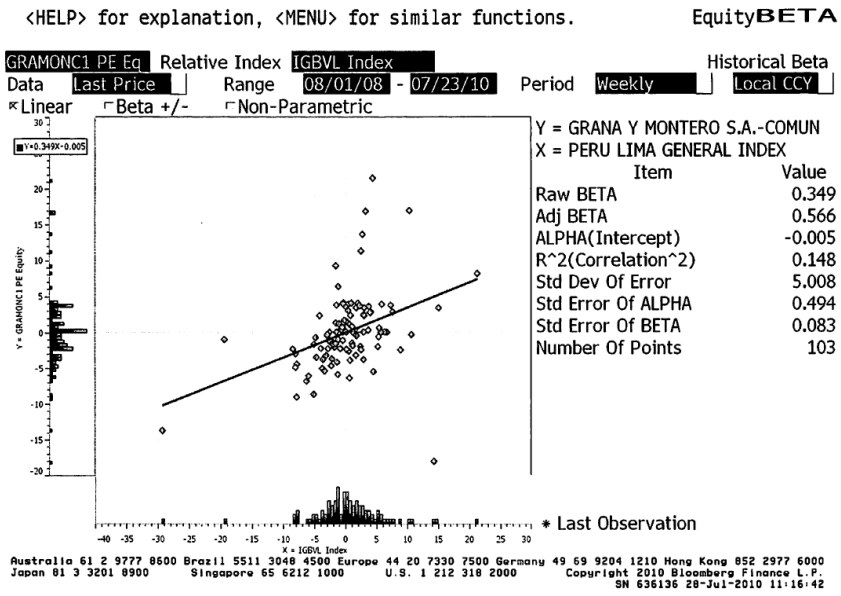
In the figure below, we illustrate this principle by estimating riskfree rates in different currencies. While we assume that the government bond rates in Japan, Switzerland and the United States are the riskfree rates in the currencies for those countries (the Japanese yen, the Swiss franc and the US dollar), we adjust the government bond rates in Colombia and Peru for the default risk embedded in them. With the Euro, we use the German Euro bond rate as the risk free rate, since it is the lowest of the ten-year Euro denominated government bond rates.



It is also worth noting that risk free rates vary across currencies because of differences in expected inflation; currencies with high expected inflation will exhibit high risk free rates.

Input 2: Beta (s)

Given that beta is a measure of relative risk, what is the best way to estimate it? In conventional corporate finance and valuation, the answer is that you run a regression of returns on the stock of the company in question against the market index. The slope of the regression is the beta. This is illustrated for a Peruvian construction company, Grana Montero, in the figure below:



Regressing weekly returns on Grana Montero from August 2008 to July 2010, against the Peruvialn Lima General Index, the beta for the company is 0.349. There are three reasons why we would be skeptical about this number.

a. <u>It is backward looking</u>: Since a regression is based on returns earned by owning the stock, it has to be historical or backward looking and does not reflect the current business mix and financial leverage of the company. Thus, the regression above, run in August 2010, uses data from 2008 to 2010 to estimate the beta for the company. Even if it is accurate, it gives you a beta for that period rather than for the future.
b. <u>It is estimated with error:</u> The standard error of the beta is 0.083, suggesting that the true beta for Grana Montero can be much higher or lower than the

reported value; the range on the beta from this regression, with 99% confidence, would be 0.09 – 0.60.[2]

c. It is dependent on how the regression is structured and whether the stock is publicly traded in the first place. The beta we would obtain for Grana Montero would be very different if we used a different time period (five years instead of two), a different return interval (daily instead of weekly) or a different market index (a different Peruvian Index or a broader Latin American or Global index).

As an alternative, it is worth thinking about the determinants of betas, i.e., the fundamental factors that cause some companies to have high betas and others to have low betas. The beta for a company measures its exposure to macro economic risk and should reflect:

- The products and services it provides (and how discretionary they are): Firms that produce products or services that customers can live without or defer buying should have higher betas than firms that produce products and services that are necessities.
- The fixed cost structure: Firms that have high fixed costs (high operating leverage) should have more volatile income and higher betas than firms with low fixed costs.
- The financial leverage: As firms borrow money, they create fixed costs (interest expenses) that make their equity earnings more volatile and their equity betas higher. In fact, the beta for equity in a firm can be written as a function of the beta of the businesses that the firm operates in and the debt to equity ratio for the firm:
  Levered (Equity) Beta = Unlevered Beta (1 + (1- tax rate) (Debt/Equity))

A better estimate of beta for a firm can be obtained by looking at the average betas for the businesses that the firm operates in, corrected for financial leverage.

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[2] Coefficients on regressions are normally distributed. A 99% confidence interval is plus or minus three standard errors.

Example: Grana Y Montero, the Peruvian company, is in three businesses, software, construction, oil extraction and software consulting. Using betas we estimated for each of these businesses and the revenues that Grana Montero get from each as weights, we obtain the unlevered beta for the firm:

	Revenues	% of Firm	Unlevered Beta for business
Consruction	1453	77.58%	0.75
Oil Extraction	225	12.01%	0.90
Software Consulting	195	10.41%	1.20
	1873		0.81

In August 2008, the firm had debt outstanding of 433 million Peruvian Soles and a market value of equity of 2.4 billion Peruvian Soles. Using Peru's corporate tax rate of 30%, we can estimate the beta for the equity in the company:

$$\text{Levered Beta} = 0.81\ (1+ (1-.30)\ (433/2400)) = 0.92$$

Proposition: When a firm is in multiple businesses with differing risk profiles, it should hold each business up to a different standard (hurdle rate). In the case of Grana Montero, for instance, the hurdle rates for investments will be much higher in software consulting than in construction.

Input 3: Equity Risk Premiums

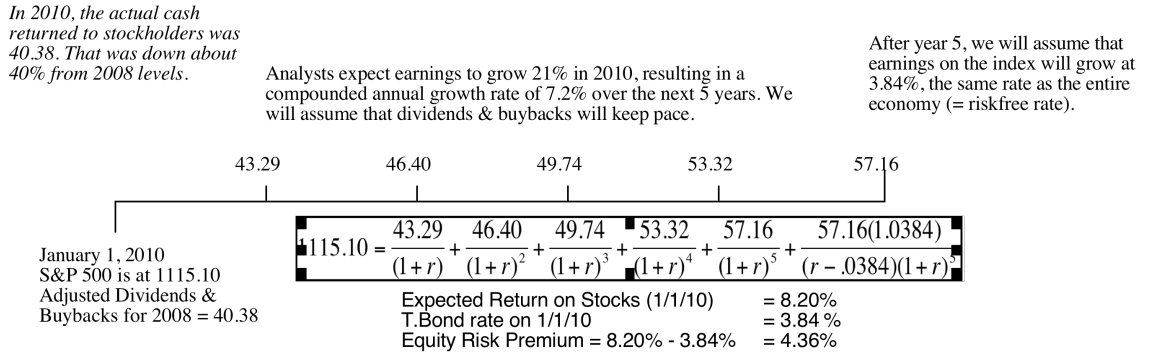
The equity risk premium is the additional premium that investors demand for investing in equities (or risky assets) collectively. There are two approaches used to estimate the number. One is to look at the past and estimate how much of a premium you would have earned investing in stocks as opposed to treasury bonds or bills over long time periods. We estimate the premiums for premiums ranging from ten to eighty years in the table below

	Arithmetic Average		*Geometric Average*	
	Stocks – T. Bills	Stocks – T. Bonds	Stocks – T. Bills	Stocks – T. Bonds
1928-2009	7.53% (2.28%)	6.03% (2.40%)	5.56%	4.29%
1960-2009	5.48%	3.78%	4.09%	2.74%

			4.09%	2.74%
	(2.42%)	(2.71%)		
2000-2009	-1.59%	-5.47%	-3.68%	-7.22%
	(6.73%)	(9.22%)		

The problem with using historical risk premiums is illustrated in the numbers in brackets in the table; these are standard errors in the risk premium estimates. Thus, even with 80 years of day (1928-2009), the estimated risk premium for stocks over treasury bonds comes with a standard error of 2.40%. With ten years of data, the standard errors drown out the estimates.

An alternative is to estimate a forward looking premium, using current stock prices and expected future cash flows. In the figure below, for instance, we estimate an implied equity risk premium for the S&P 500 on January 1, 2010:



The equity risk premium for the United States, and by extension other mature equity markets, in January 2010 was 4.36%. That number has been volatile and especially so in the last 3 years, going from 4.37% at the start of 2008 to 6.43% in January 2009, back to 4.36% in 2010. Based on the last number, it seems reasonable to use a 4.5% equity risk premium for mature markets, at least for 2010. That number may very well change in 2011.

With an adjustment for country risk

When a company operates in an emerging market, it is exposed to significantly more economic risk, arising from both political instability and the nature of the underlying economy. Even if we accept the proposition that an equity

risk premium of about 4.5% is reasonable for a mature market, you would expect a larger risk premium when investing in an emerging market.

One simple way to adjust for this additional risk is to add on the default spread for the country in question to the mature market premium. Thus, the total equity risk premium for Peru, which has a sovereign rating of Baa3 and a default spread of 2%, would be 6.5%. A slightly more involved way of adjusting for country risk is to start with the default spread and adjust this default spread for the higher risk borne by equities in that market. Using Peru as the example again, the standard deviation in weekly returns over the last 2 years for Peruvian equities is 26% and the standard deviation in the bond is 13%.

Additional risk premium for Peru = 2% (26/13) = 3%

Total equity risk premium for Peru = 4.5%+3%=7.5%

While neither of these measures is perfect, they do offer simple solutions to the country risk issue.

Input 4: Default Spreads

To get to the cost of borrowing for a firm, we need to assess how much banks will charge over and above the riskfree rate to lend to that firm. This "default spread" can be assessed in one of the following ways:

- ➔ For the relative few companies that have their bonds rated by a ratings agency, we can use the bond rating as a measure of default risk and estimate the spread based upon the rating. Disney, the large US entertainment company, for instance, has a rating of A from Standard and Poors. The default spread based on this rating in September 2010 was roughly 0.85%, which when added to the ten year bond rate at the time of 2.5% would have yielded a pre-tax cost of borrowing of 3.35%.
- ➔ For those firms that have no bonds and no ratings available, you can try to estimate the interest rate that they would have to pay on a long term bank loan today. That rate would be your pre-tax cost of debt.

➔ In some cases, you can estimate a synthetic bond rating for a company, based upon its financial ratios. That rating can then be used to estimate a pre-tax cost of borrowing.

Default spreads do change over time and reflect both economic uncertainty and investor risk aversion. In September 2010, the default spreads for bonds is different ratings classes were as follows:

Rating Moody's/S&P	Default spread on 10-year bond
Aaa/AAA	0.45%
Aa1/AA+	0.50%
Aa2/AA	0.55%
Aa3/AA-	0.60%
A1/A+	0.75%
A2/A	0.85%
A3/A-	1.05%
Baa1/BBB+	1.50%
Baa2/BBB	1.75%
Baa3/BBB-	2.25%
Ba1/BB+	3.50%
Ba2/BB	4.50%
Ba3/BB-	4.75%
B1/B+	5.00%
B2/B	5.75%
B3/B-	6.25%
Caa/CCC+	7.75%

Since default spreads can and often do change over time, this table has to be updated to reflect current levels.

Input 5: Tax rates and Weights for Debt and Equity

There are two final inputs we need for the cost of capital. The first is a tax rate to use in computing the after-tax cost of borrowing:

After-tax cost of borrowing = Pre-tax cost of debt (1- tax rate)

Since interest expenses save you taxes on your last dollars of income, the tax rate that should be used is a marginal tax rate and the best source for this rate is the tax code (and not the financial statements of the firm). To illustrate, the marginal tax rate in the United States is a cumulated value, based upon a 35% federal corporate

tax rate as well as sundry state and local taxes; that cumulated number was estimated to be about 40% in 2010.

The weights for computing the risk-adjusted cost of capital should be market value weights, since the business has to raise debt and equity in the market to fund its projects and at market values. It is also worth noting that risk adjusted discount rate for an individual project may be based upon target weights for the entire business rather than be reflective of the actual funding mix for the project.

An example: A Disney Theme Park in Rio

In this example, we will analyze a hypothetical theme park that Disney is planning for Rio De Janeiro, Brazil in early 2009. The first table provides our estimates of the expected cash flows from the theme park to Disney, based upon projections of revenues, operating expenses and taxes:

	0	1	2	3	4	5	6	7	8	9	10
Operating Income		-$50	-$150	-$84	$106	$315	$389	$467	$551	$641	$658
Taxes		-$19	-$57	-$32	$40	$120	$148	$178	$209	$244	$250
Operating Income after Taxes		-$31	-$93	-$52	$66	$196	$241	$290	$341	$397	$408
+ Depreciation & Amortization		$50	$425	$469	$444	$372	$367	$364	$364	$366	$368
- Capital Expenditures	$2,500	$1,000	$1,188	$752	$276	$258	$285	$314	$330	$347	$350
- Change in Working Capital	$0	$0	$63	$25	$38	$31	$16	$17	$19	$21	$5
Cash flow to Firm	-$2,500	-$981	-$918	-$360	$196	$279	$307	$323	$357	$395	$422
+ Pre-Project Investment	500										
- Pre-project Deprecn * t		$19	$19	$19	$19	$19	$19	$19	$19	$19	$19
+ Fixed G&A (1-t)		$0	$78	$109	$155	$194	$213	$234	$258	$284	$289
Incremental Cash flow to Firm	-$2,000	-$1,000	-$859	-$270	$332	$454	$501	$538	$596	$660	$692

To get the risk adjusted discount rates, we built up through the following steps:

1. Since the cash flows were estimated in US dollars, the riskfree rate is the US treasury bond rate of 3.5% (at the time of the analysis)
2. The beta for the theme park business is 0.7829. This was estimated by looking at publicly traded theme park companies.

3. The risk premium wass composed of two parts, a mature market premium of 6% (the premium used in 2009) and an additional risk premium of 3.95% for Brazil.

   Country risk premium for Brazil = 3.95%

   Cost of Equity in US$= 3.5% + 0.7829 (6%+3.95%) = 11.29%

4. Disney had a pre-tax cost of debt of 6% in early 2009, based on its rating of A and a default spread of 2.5% for that rating, and the marginal tax rate was 38%:

   After-tax cost of Debt = (3.5% + 2.5%) (1-.38) = 3.72%

5. Disney uses a mix of 35.32% debt and 64.68% equity to fund its existing theme parks. Using these inputs, we can estimate the cost of capital for the Rio Disney project:

   Cost of Capital in US$ = 11.29% (0.6468) + 3.72% (0.3532) = 8.62%

As a final step, we discount the expected cash flows back at the risk-adjusted discount rate of 8.62% to arrive at a value for the theme park, net of costs.

Year	Annual Cashflow	Terminal Value	Present Value
0	-$2,000		-$2,000
1	-$1,000		-$921
2	-$860		-$729
3	-$270		-$211
4	$332		$239
5	$453		$300
6	$502		$305
7	$538		$302
8	$596		$307
9	$660		$313
10	$692	$10,669	$4,970
Net Present Value =			$2,877

The risk-adjusted value for the Rio Disney theme park is $2.877 billion.

Certainty Equivalents

In the certainty equivalent approach, we adjust the expected cash flows for risk, rather than the discount rate, and use the riskfree rate as the discount rate. The biggest step in this approach is risk adjusting the expected cash flows and here there are three ways you can do this:

a. Compute certainty equivalents, using utility functions. This is very difficult to do and not worth exploring in most cases.

b. Subjectively estimate a haircut (or a decrease) to the expected cash flows. This is arbitrary and can lead to different analysts making different judgments of value, based upon their risk aversion.

c. Convert your expected cash flow to a certainty equivalent

This approach is the most straightforward but it does require use to estimate the risk adjusted discount rate first.

Once you have the risk-adjusted cash flows, you can discount them at the riskfree rate.

Certainty Equivalent value: Rio Disney

To estimate the certainty equivalent cash flows, we used the risk-adjusted discount rate of 8.62% that we obtained for Disney in conjunction with the riskfree rate of 3.5% to adjust each cash flow. To illustrate, the certainty equivalent for the expected cash flow of $332 million in year 4 can be computed as follows:

$$\text{Certainty Equivalent for year 4} = \$332 \left[\frac{1.035^4}{1.0862}\right] = \$274$$

Repeating this process with each cash flow yields the certainty equivalent cash flows for each year. Discounting all of the cash flows back at the risk free rate of 3.5% yields a risk-adjusted value for the theme park.

Year	Annual Cashflow	Terminal Value	Certainty Equivalent	Present Valiue
0	-$2,000		-$2,000	-$2,000
1	-$1,000		-$953	-$921
2	-$860		-$780	-$729
3	-$270		-$234	-$211
4	$332		$274	$239
5	$453		$356	$300
6	$502		$375	$305
7	$538		$384	$302
8	$596		$405	$307
9	$660		$427	$313
10	$692	$10,669	$7,011	$4,970
				$2,877

The risk-adjusted value for the theme park is $2,877 million, identical to the value that we obtained with the risk adjusted discount rate approach.

Implications for risk management

Any firm that is involved in risky activities has to make a good faith effort to estimate not only how much risk each part of the business is exposed to but also what that risk exposure translates into in terms of a risk adjusted discount rate. Thus, different components of the same business, with different risk exposures, can have different risk adjusted rates. These rates can then be used in risk adjusting value, either as discount rates for expected cash flows, or as adjustment factors in deriving certainty equivalents.

While managers may feel that risk and return models are flawed or that the estimates used in the models are incorrect, this skepticism cannot be viewed as a reason for not estimating risk adjusted discount rates or using arbitrary numbers.

CHAPTER TASK: RISK ADJUSTED VALUE

Risk Adjusted Discount Rates

1. Does your firm have a hurdle rate that it uses when assessing investments? If so, do you know (roughly) what it is right now?
2. Has this hurdle rate changed over time? Why
3. Is there only one hurdle rate for all investments or do you have different hurdle rates for different investments? If the latter, why do you use different hurdle rates for different investments?

Risk Adjusted Cash Flows

Do you risk adjust your cash flows?

If yes, how do cash flows get risk adjusted?

- Hair cut cash flows on risky investments
- No established approach but it gets done by individual decision makers
- It happens and I have no idea how it happens
- Other (Please describe):

Chapter 6: Dealing with Risk – Probabilistic Approaches

Theme

One problem with risk adjusted value approaches is that analysts are required to condense their uncertainty about future outcomes into a set of expected cash flows. In probabilistic approaches, we take a richer and more data intensive view of uncertainty, allowing for extreme outcomes – good and bad. In the process, we not only get a better sense of how risk can impact a venture but ways to manage that risk.

Probabilistic approaches

There are many ways in which uncertainty can be made explicit in an analysis. The simplest is to ask 'what if?' questions about key inputs and looking at the impact on value. This is called sensitivity analysis and allows analysts to examine at least extreme outcomes, as well as evaluate how sensitive the outcome is to changes in individual assumptions. The second approach is to estimate the outcomes and value under viable scenarios in the future, again ranging from very good scenarios to very bad ones. You can then follow up by attaching probabilities to these scenarios and arrive at a conclusion. The third and richest approach is to use probability distributions for key inputs, rather than expected values, and run simulations, where you choose one outcome from each distribution and compute the value. This process, called "simulation", is repeated many times and the resulting outcomes for the investment are presented to decision makers.

Sensitivity Analysis

The value of an investment and its outcome 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 is to changes in key assumptions. While this has become easier and easier to do over time, with the advent of more powerful tools and richer data, there are two caveats that we would offer. The first is that

when analyzing the effects of changing a variable, we often hold all else constant. Thus, we look at the impact of changing operating margins on cash flows, while keeping revenues constant. In the real world, variables move together; when you raise margins, your revenues drop. The second caveat is that the objective in sensitivity analysis is that we make better decisions, and not to churn out more tables and numbers.

As a consequence, we would suggest that analysts doing sensitivity analysis be bound by two rules. The first is that is less is more and not everything is worth varying; focus on the the two or three variables that matter the most and build the analysis around them. The second is that the output from sensitivity analysis be presented in innovative and succint ways that help decision makers; dozens of tables of numbers don't accomplish this objective.

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.

In the table below, we look at three possible outcomes for each of these factors and the number of planes that we would expect Boeing to sell under each outcome.

	Airbus Large Jet	Airbus A-300	Airbus abandons large capacity airplane
High Growth in Asia	120 (12.5%)	150 (12.5%)	200 (0%)
Average Growth in Asia	100 (15%)	135 (25%)	160 (10%)
Low Growth in Asia	75 (5%)	110 (10%)	120 (10%)

The probabilities of each scenario are in brackets below the number of planes. To illustrate, the best scenario for Boeing is if there is high growth in Asia and Airbus abandons the large capacity aircraft market. Boeing can then expect to sell 200 planes a year but the probability of this scenario. The worst scenario is if Asian growth slows and Airbus introduces its own version of the Super Jumbo; Boeing will sell only 75 aircraft a year and there is a 5% chance that this scenario will unfold.

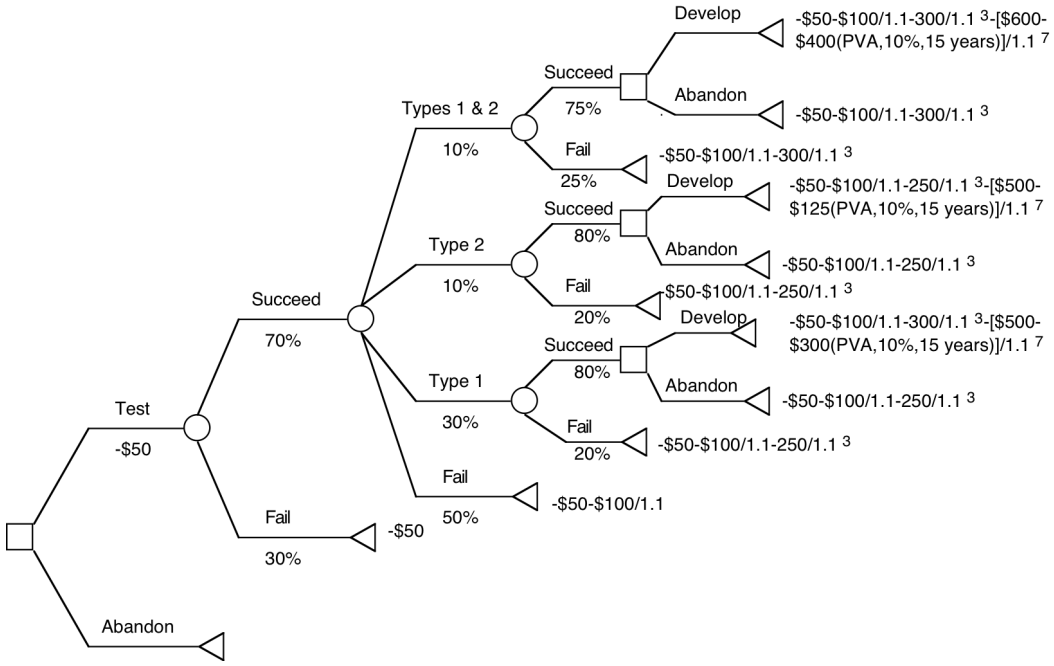
This table can be carried to its next logical level. The expected value of going ahead with the Super Jumbo can be assessed under each scenario and the consolidated expected value can be computed across the scenarios, using the probabilities.

Decision Trees

Some firms face sequential risks, where passing through one stage successfully is required to get to the next one. Decision trees are useful for that type of risk. A classic example would be developing a pharmaceutical drug in the United States. That drug has to be developed, tested and then has to pass through various stages in the Federal Drug Administration (FDA) approval process before it can be produced. At each stage, not only can the drug be rejected but the information can help refine estimates of what will happen in subsequent periods.

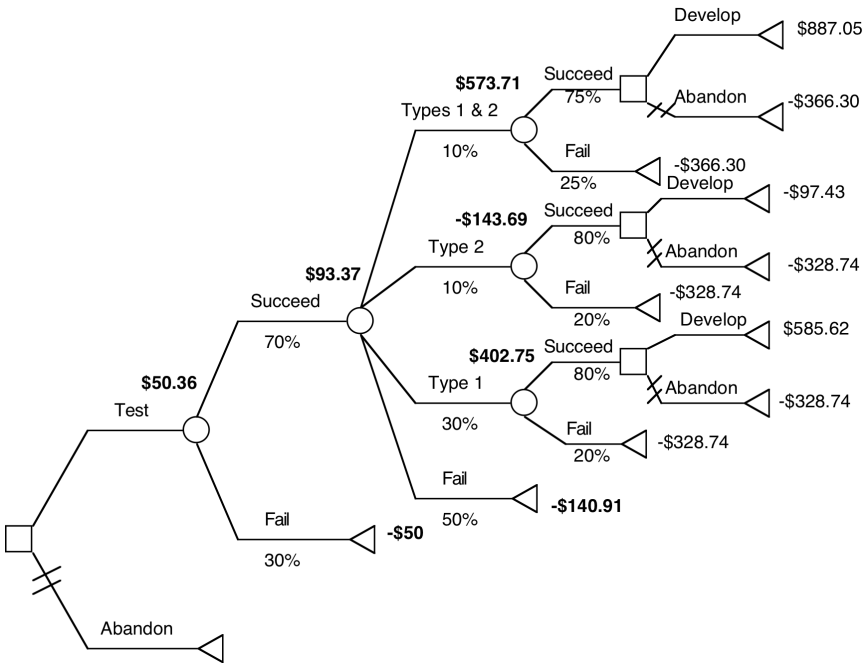
In the figure below, we use a decision tree to examine whether a diabetes drug should be tested by a firm; the firm is unsure about whether the drug will work

and, if it does, whether it will work only on type 1 diabetes, only on type 2 diabetes or both.



Thus, the firm will have to spend $ 50 million to test the drug. If the initial drug test is successful (estimated to be likely 70% of the time), there will be more intensive tests which will help determine what type of diabetes it will treat (with probabilities estimated for each: 10% chance that it will treat both type 1 and 2, 10% chance that it will treat only type 2, 30% chance that it will treat only type 1 and a 50% chance that it will not work at all). We then follow up on each likelihood with estimates of how much value the firm will extract from the drug.

Using this information, we can work backwards through the tree to determine what to do today:



The end result of this analysis is that notwithstanding the high probabilities of failure along the way, the firm should proceed with the drug test, because the expected value is positive.

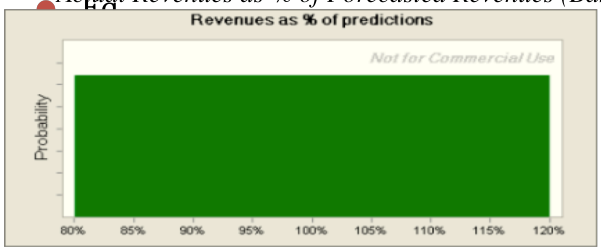
Simulations

A simulation allows for the deepest assessment of uncertainty because it allows analysts to specify distributions (rather than a single expected value) for each input that they feel uncertain about. Thus, if you are uncertain about operating margins, you can allow the margins to be normally distributed with an expected value of 8% and a standard deviation of 2%. Once you have specified distributions and parameters for the inputs, an outcome is picked from each distribution and the value is computed; this represents a single simulation and it is repeated over and over. The final values are then plotted on a distribution.

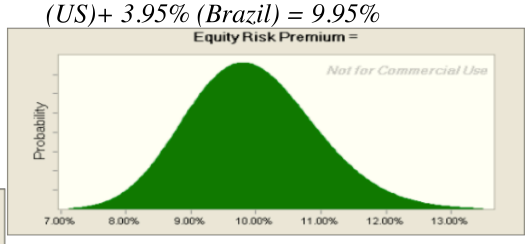
Consider the Rio Disney theme park we analyzed in the last chapter and found to have a risk adjusted value of $2,877 million. There is substantial uncertainty about expected revenues, operating expenses and risk premiums, all of which can change the theme park's value. We replaced the base case inputs for revenues, operating expenses and risk premiums with distributions. In the case of revenues, we assumed that the actual revenues could range anywhere from 80% of

the forecasted value to 120% of the forecasted value with equal probability (uniform distribution). With operating expenses, we replaced the assumption that these expenses were 60% of revenues with the assumption that expenses as a percent of revenues would be normally distributed with an average of 60% and a standard deviation of approximately 12%. With equity risk premiums, we assume that the country risk premium for Brazil is highly volatile, with an expected value of 3.95% but a standard error of 1%. The resulting distributions are below:

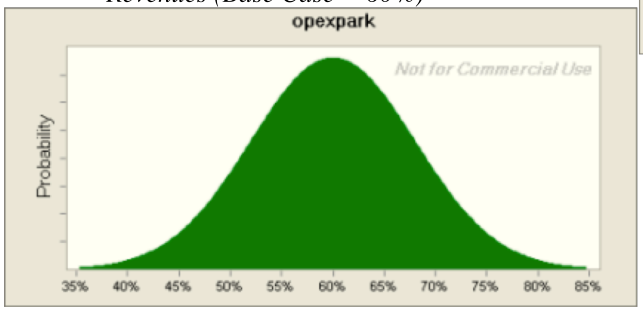
Actual Revenues as % of Forecasted Revenues (Base case = 100%)



Equity Risk Premium (Base Case = 6% (US)+ 3.95% (Brazil) = 9.95%

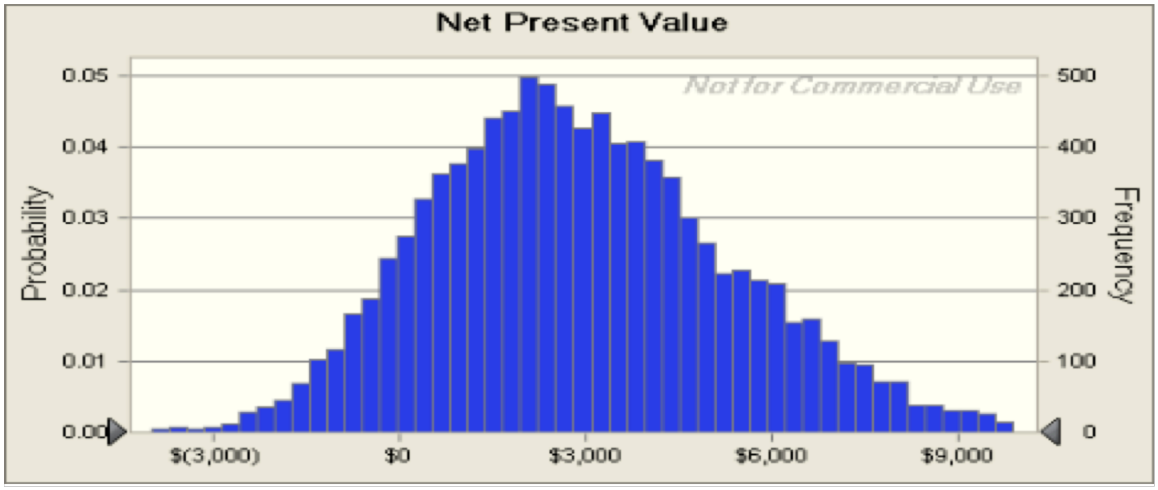


Operating Expenses at Parks as % of Revenues (Base Case = 60%)



With these distributions in place, we ran 10,000 simulations, with each simulation yielding a value. The values that we estimated for the theme park, across all the simulations, is shown in the figure below:

Average = $2.95 billion
Median = $2.73 billion



NPV ranges from -$4 billion to +$14 billion. NPV is negative 12% of the time.

The net present value for theme park ranges from very negative (- $ 3 billion) to extremely positive (in excess of $ 9 billion). The average value, across the simulations, is $2.95 billion and the median number is slightly lower at $2.73 billion. While these values are close to those that we derived using the conventional model, there is additional information in the chart that can be used to fine tune the decision. Using the chart above, we can estimate the probability that the project will be a bad investment – there is a 14% chance that project will be a bad project, as well as the values under best case scenarios – the theme park could add more than $ 9 billion in value.

While a simulation does provide for a richer assessment of the effects of uncertainty, it does require both more information on the part of the analysts and an understanding of statistical distributions. The old adage, "Garbage in, garbage out" applies. If analysts pick distributions randomly and estimate parameters carelessly, there is little value added in simulations. If, in contrast, they do their homework and choose the right distributions and estimate parameters with as much information as they can assess, simulations allow us to deal with uncertainty in more detail than any of the alternate approaches.

Picking the Right Probabilistic Approach

Asking what if questions in sensitivity analysis, examining values under different scenarios, assessing uncertainty in decision trees and running simulations are all probabilistic approaches to dealing with risk, but which one is best suited for your organization? To answer that question, we have to look at the nature of the uncertainty faced and answer the following questions:

➔ Is the uncertainty discrete or continuous?

Some risks are continuous, i.e., they affect your value through time. Thus, a firm that is exposed to interest rate or exchange rate risk will find its value changing on a minute-by-minute basis, as these variables change. In contrast, an oil firm that worries about a terrorist attack on its operations or nationalization by the government is exposed to discrete risk; you either have a terrorist attack or you do not.

➔ Are the risks that you face correlated with each other or independent?

While projects are exposed to a multitude of risks, some of these risks are correlated with each other. A cyclical firm that is exposed to interest rate risk may be worried about both real economic growth and interest rates changing, but the two generally move together; in good economic times, interest rates increase and in bad times, they go down. In contrast, a natural resource company that is exposed to commodity price risk as well as political risk may find the two are largely independent of each other.

➔ Are the risks sequential or concurrent?

Risks are sometimes sequential, as is the case with a pharmaceutical firm testing a drug: you have to get through stage 1 of the approval process to face the risks in stage 2. Most risks, though, are concurrent. You cannot put your inflation risk exposure on hold while you worry about the risk that the economy will go into a recession.

The table below lists the probabilistic risk approach that makes the most sense, given the nature of the risk faced by an organization:

Discrete/Continuous	*Correlated/Independent*	*Sequential/Concurrent*	*Risk Approach*
Discrete	Independent	Sequential	Decision Tree
Discrete	Correlated	Concurrent	Scenario Analysis
Continuous	Either	Either	Simulations

While it may not always be possible to use the favored risk approach, due to an absence of information or resources, it is worth still identifying it.

Implications for risk management

As organizations find themselves exposed to more complex risks, it is worth considering confronting concerns about uncertainty more directly in analysis. That is what probabilistic approaches do. While they will not make the uncertainty go away or even reduce it, they can let firms see the effect of uncertainty on their value and decisions and modify their behavior accordingly.

CHAPTER TASK: PROBABILISTIC APPROACHES

1. Do you use probabilistic approaches in your firm?
2. If yes, which approach do you use?
    a. What if analysis
    b. Scenario Analysis
    c. Decision Trees
    d. Simulation
3. If no, do you think that there is potential for a probabilistic approach? If you think there is, which one would best fit, given the type of risks you are exposed to (discrete or continuous, sequential or contemporaneous…)?

Chapter 7: Dealing with Risk: Value at Risk (VAR)

Theme

Risk adjusted value, scenario analysis and simulations all try to measure risk and bring it into the analysis, thus helping us make more reasoned investment decisions. Value at Risk represents an attempt to focus on not just downside risk but extreme manifestations of downside risk, where a catastrophic event can put a firm's survival at risk.

What is Value at Risk?

Value at Risk measures the potential loss in value of a risky asset or portfolio over a defined period for a given confidence interval. Thus, if the VaR on an asset is $ 100 million at a one-week, 95% confidence level, there is a only a 5% chance that the value of the asset will drop more than $ 100 million over any given week.

There are three key elements of VaR – a specified level of loss in value, a fixed time period over which risk is assessed and a confidence interval. The VaR can be specified for an individual asset, a portfolio of assets or for an entire firm. For an individual asset, the Value at Risk is a simple extension of the probabilistic approaches that we described in the last chapter. Once we have a distribution of possible returns on a specific asset, we can also specify the likelihood that losses will exceed a certain amount.

To estimate the probability of the loss for a business, with a confidence interval, we need to

a. Define the probability distributions of individual risks taken by the business. Each investment that a business takes exposes it to the risk of loss, and the probability distribution of these losses has to be estimated.

b. Since businesses take multiple risks that may be correlated with each other, we have to estimate the correlation across these risks to estimate the probability distribution of payoffs for the entire firm.

The focus in Value at Risk is clearly on downside risk and potential losses. Its use by firms reflects their fear of a liquidity crisis, where a low-probability catastrophic occurrence creates a loss that wipes out the capital and creates a client exodus. .

Who uses it and why?

VaR has been used most widely at financial service firms, where the risk profile is constantly shifting and a big loss over a short period can be catastrophic (partly because the firms have relatively small equity, relative to the bets that they make, and partly because of regulatory constraints). Thus, an investment bank will compute the VaR at the end of each trading period, by aggregating the risks of all of the open positions, long or short, where the bank has capital at risk.

To manage its risks and keep it at levels that do not imperil its survival, the investment bank will set a limit on the VaR. That limit is usually set by looking at how much capital the investment bank has in the first place and how close to regulatory limits the bank is operating. Other things remaining equal, the more capital a bank has to work with and the greater its capital buffer (over the regulatory limit), the higher the VaR will be. If the VaR limit is exceeded, trading positions will be closed or modified to bring the VaR back within specified limits.

How is it measured?

The key to using VaR as a risk management device is to measure it correctly in the first place. There are three approaches that are used to compute VaR, and each has its pluses and minuses.

I. Variance Covariance Matrix

If we can estimate how each asset (investment) owned by a firm moves over time (variance) and how it moves with every other asset (covariance), we can mathematically estimate the VaR. The dataset that contains these movements and co-movements is called the variance-covariance matrix. One estimation issue that we face in estimating the matrix is the number of covariances increases dramatically as the number of assets that we track rises.

Number of covariances = n (n-1)/2, where n = number of assets in matrix

With 100 assets, for instance, the number of covariances we have to estimate is 4950, and with 1000 assets, the number rises to 499,500. Over the last two decades, as data on price movements in different asset classes has become more accessible, analysts have also become more adept at using this data to arrive at the variance matrix.

While the variances and covariances can be estimated using historical data, the estiamates are notoriously unstable and change from period to period. Put another way, the variance-covariance matrix estimated using past data is a poor predictor of the future variances and covariances. Consequently, a VaR computed using the historical variance-covariance matrix may be very different from the actual VaR.

As investors search for bargains across markets, ranging across asset classes and geographical areas, the number of assets that you have to track in the matrix get larger and the correlations across asset classes becomes more difficult to estimate. In the race between data and complexity, complexity seems to be winning.

II. Historical data simulation

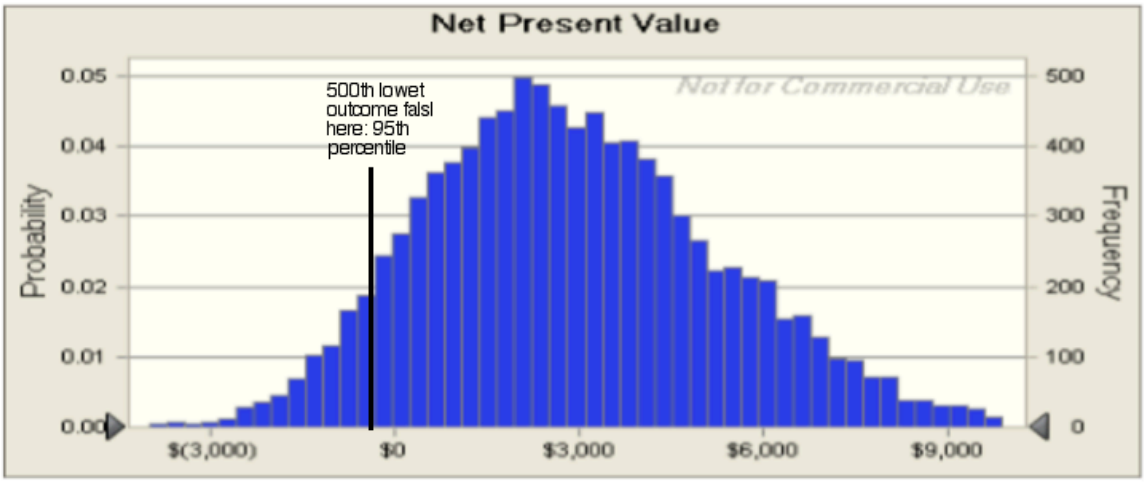
In an attempt to get around the difficulties of estimating reliable variances and covariances, some analysts have chosen a different path. They use all of the historical data on each asset in the computation of VaR. Thus, if a firm is invested in small market stocks and treasury bonds, the analyst uses the data from long time periods (say 1928- today) on each of these asset classes and uses simulations to arrive at the possible return outcomes from the entire portfolio.

While this approach avoids the problem of estimating and using historical covariances, it is bedeviled by the same underlying estimation issues. It is based on the presumption that the past is a good predictor of the future. Thus, we assume that returns on small cap stocks in the future will resemble returns that they earned in the past. To the extent that the this is not the case, the estimates of VaR from this approach will be flawed.

III. Monte Carlo Simulation

In the last chapter, we looked at simulations as one way of getting a handle on risk. If you can run a full-fledged simulation of possible outcomes, extracting a VaR from the distribution becomes simple to do. In fact, consider the simulation of the Rio Disney theme park in the last chapter. The VaR, over the life of the theme park, with 95% confidence is about $0.5 billion, estimated by looking at where the 500th lowest outcome (out of 10,000) falls in the distribution.

Average = $2.95 billion
Median = $2.73 billion



NPV ranges from -$4 billion to +$14 billion. NPV is negative 12% of the time.

Note, however, that a Monte Carlo simulation differs from a historical simulation in only one respect: rather than use the historical data in the simulation, we use statistical distributions for the variables. In the example of the company with investments in small cap stocks and treasury bonds, we specify return distributions and parameter for each of these asset classes. To the extent that we rely entirely on historical data to make these judgments, the problems that we noted with historical simulations will carry over into Monte Carlo simulations, with the added error created by misidentifying the distributions and misestimating parameters.

There is, however, the possibility that Monte Carlo simulations can be more informative than historical simulations. To bring this possibility to fruition, we have to use more than just historical data on the asset class to arrive at distributions; we

could use data from other markets in other time periods, as well as forward looking data from existing markets to enrich and make more realistic assumptions about return distributions.

Limitations of VaR

The collapse of Bear Stearns and Lehman in 2008, as well as the near-death experiences of many other investment banks, is clear evidence that VaR, at least as practiced today, does not do an adequate job in measuring risk in crisis periods. In fact, there are several limitations with focusing on VaR as the central risk measure in a firm:

- Focus is too narrow: The focus on VaR is very narrow. For instance, consider a firm that wants to ensure that the probability of losing more more than $ 100 million in a month is kept at below 5%, and uses VaR to ensure that this happens. Even if the VaR is estimated correctly, the ensuing decisions may not be optimal or even sensible. Too see why, consider two alternative investment strategies. The first one meets the VaR criteria of keeping the probability of losing more than $ 100 million below 5%, but when it does lose more than $ 100 million (one time out of 20), the potential losses can be in the billions. The second strategy fails the VaR criteria, because there is a 10% chance that the firm can lose more than $ 100 million, but when it does lose more than $ 100 million, the most that it can lose is $ 200 million. The second strategy is a more prudent one than the first, but the fixation of a dollar loss value leads it to be ignored.
- The VaR can be wrong: No matter which approach you use to estimate VaR, it remains an estimate and can be wrong. Put another way, there is a standard error in the VaR estimate that is large. Thus, a firm that thinks that it has only a 5% chance of losing more than $ 100 million may be basing that estimate on historical data or return assumptions that are unreasonable; the real likelihood may be 15%.
- The Black Swan: VaR approaches, no matter how you frame them, have their roots in the past. As long as markets are mean reverting and stay close to

historical norms, VaR will work. If there is a structural break, VaR may provide little or no protection against calamity. This is the "black swan" event that Nassim Taleb popularized on his book on the topic. More generally, Taleb argued that the focus on normal distributions and historical data leave firms exposed to new risks that can potentially wipe them out.

Implications for Risk Management

Any risk management system that is focused on a specific number and probability is likely to gamed by decision makers, who learn quickly how to take immense amounts of risk, while still looking safe of the measure. Sensible risk management requires multiple risk measures that can be used to cross check risk taking, and more importantly, a common sense, big picture perspective on the part of those who oversee risk taking.

CHAPTER TASK: VALUE AT RISK

1. Do you use Value at Risk (VaR) in your firm?
2. How is it used?
3. If it is used, do you know how often it is computed?
4. How is it computed?
    a. Variance Covariance Matrix
    b. Historical simulation
    c. Monte Carlo simulation
5. If your firm uses VaR, does it also use other risk measures? Which ones?

Chapter 8: Dealing with Risk: Real Options

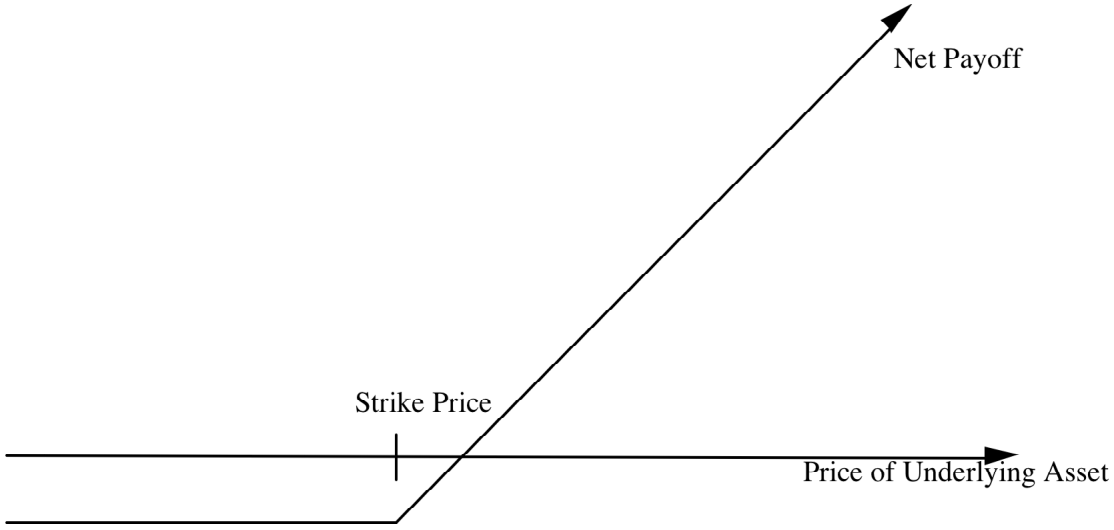
Theme

Risk adjusted value, probabilistic approaches and Value at Risk (VaR) are all focused on the downside of risk and how best to penalize investments that are exposed to too much of it. As we noted in chapter 1, though, risk is both upside and downside and a good risk management system will incorporate both components. In particular, good risk takers seem to find a way to build on upside risk, when it occurs, and limits their losses, when faced with downside risk. Real options provide us with a way to bring in these aspects of risk taking into our analysis.

What is an option?

A conventional option provides its holder with the right to buy or sell an asset at a fixed price (exercise price) sometime before the expiration of the option; the right to buy is called a call option and the right to sell is termed a put option. The key to understanding options is recognizing that its holder has a right and not an obligation to act. Hence, the owner of a call option will exercise his right to buy only if the exercise price is lower than the current price of the asset. As a consequence, the payoff from a call option at expiration looks as follows:

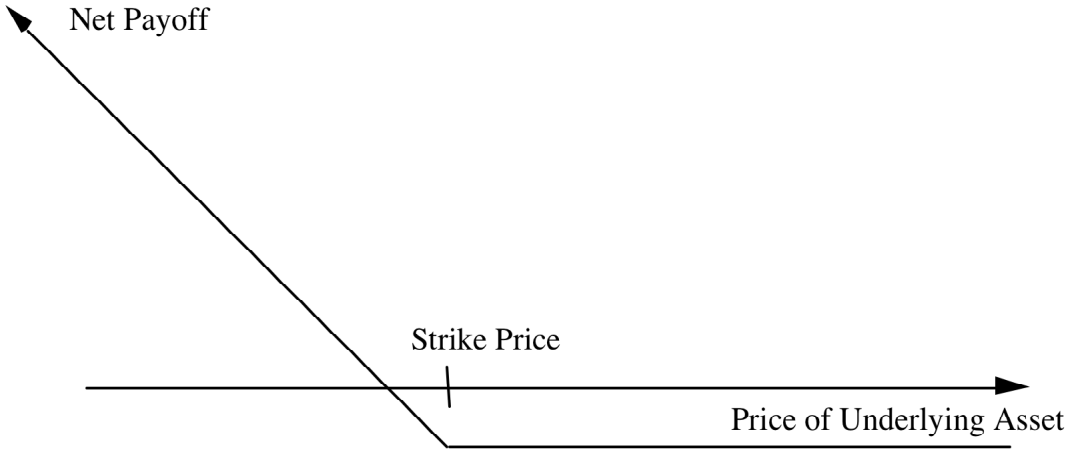
Figure 8.1: Payoff on Call Option



Note that the holder has limited his loss to what he paid to acquire the option, if the asset price drops below the exercise price and potentially unlimited profits, if the asset price rises.

The holder of a put option will exercise the right to sell at a fixed price, only if that price exceeds the current price of the asset. The payoff on a put option looks as follows:

Figure 8.2: Payoff on Put Option

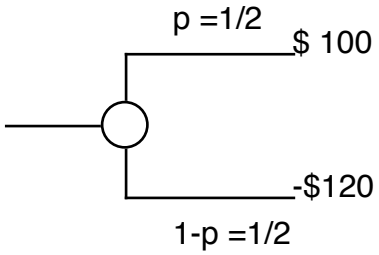


Again, the holder faces limited losses, if she is wrong, and rising profits, if she is right.

What does this have to do with risk management? If risk has both an upside and a downside, and it is the latter that we view with disfavor, options represent the best of risk management, where the downside is limited but the upside is not. One way to think about good risk management is that businesses that can build in call or put option components into their risk taking will emerge as winners.

The Essence of Real Options

To understand the basis of the real options argument and the reasons for its allure, it is easiest to go back to risk assessment tool that we unveiled in chapter 6 – decision trees. Consider a very simple example of a decision tree the figure below:

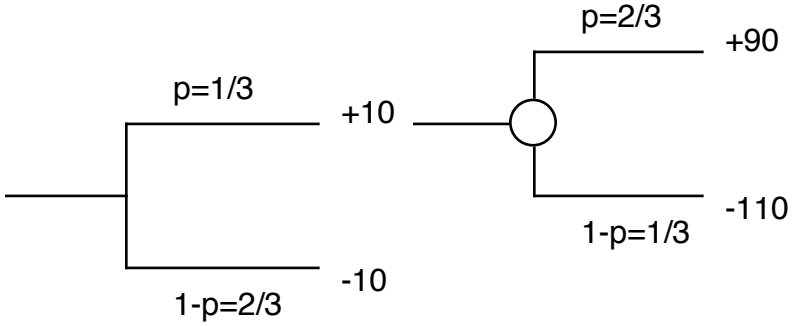


Given the equal probabilities of up and down movements, and the larger potential loss, the expected value for this investment is negative.

Expected Value = 0.50 (100) + 0.5 (-120) = -$10

Now contrast this will the slightly more complicated two-phase decision tree below:

Two-phase Decision Tree



Note that the total potential profits and losses over the two phases in the tree are identical to the profit and loss of the simple tree in figure 8.1; your total gain is $ 100 and your total loss is $120. Note also that the cumulative probabilities of success and failure remain at the 50% that we used in the simple tree. When we compute the expected value of this tree, though, the outcome changes:

Expected Value = (2/3) (-10) + 1/3 [10+(2/3)(90) + (1/3)(-110)] = $4.44

What is it about the second decision tree that makes a potentially bad investment (in the first tree) into a good investment (in the second)? We would attribute the change to two factors. First, by allowing for an initial phase where you get to observe the cashflows on a first and relatively small try at the investment, we allow for learning. Thus, getting a bad outcome in the first phase (-10 instead of +10) is an indicator that the overall investment is more likely to be money losing than money making. Second, you act on the learning by abandoning the investment, if the outcome from the first phase is negative; we will call this adaptive behavior.

In essence, the value of real options stems from the fact that when investing in risky assets, we can learn from observing what happens in the real world and adapting our behavior to increase our potential upside from the investment and to decrease the possible downside. Consider again the Chinese symbol for risk, as a combination of danger and opportunity that we used in chapter 1. In the real options framework, we use updated knowledge or information to expand opportunities while reducing danger. In the context of a risky investment, there are three potential actions that can be taken based upon this updated knowledge. The first is that you build on good fortune to increase your possible profits; this is the option to expand. For instance, a market test that suggests that consumers are far more receptive to a new product than you expected them to be could be used as a basis for expanding the scale of the project and speeding its delivery to the market. The second is to scale down or even abandon an investment when the information you receive contains bad news; this is the option to abandon and can allow you to cut your losses. The third is to hold off on making further investments, if the information you receive suggests ambivalence about future prospects; this is the option to delay or wait. You are, in a sense, buying time for the investment, hoping that product and market developments will make it attractive in the future.

We would add one final piece to the mix that is often forgotten but is just as important as the learning and adaptive behavior components in terms of contributing to the real options arguments. The value of learning is greatest, when you and only you have access to that learning and can act on it. After all, the expected value of knowledge that is public, where anyone can act on that knowledge, will be close to zero. We will term this third condition "exclusivity" and use it to scrutinize when real options have the most value.

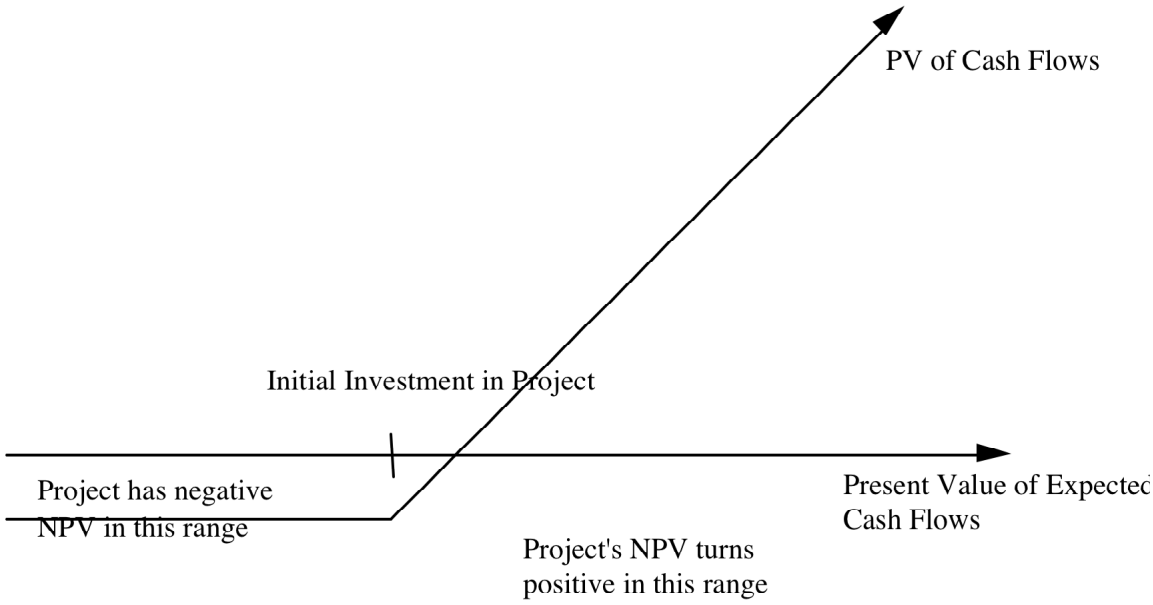
The option to delay

In the chapter on risk adjusted value, we examined how a firm should assess a risky investment; it can either adjust discount rates or cash flows for risk and arrive at a risk adjusted value. If that risk adjusted value is negative, the investment is a bad investment, at least in economic terms. But would you pay for the exclusive

rights to this bad investment? (Remember this bad investment could be a non-viable technology or a patent that will not generate commercial profits today)

The answer lies in thinking of this investment as an option. You have the exclusive rights to this investment, which you can take at any time over your rights period. While the investment makes no sense today (because the value of the expected cash flows is less than the cost of taking the investment), that may change in the future. In payoff terms, this is what the payoffs on this option are:

Figure 8.3: The Option to Delay an Investment



The right to this bad investment take on the characteristics of a call option, with the investment's cash flows representing the underlying asset.

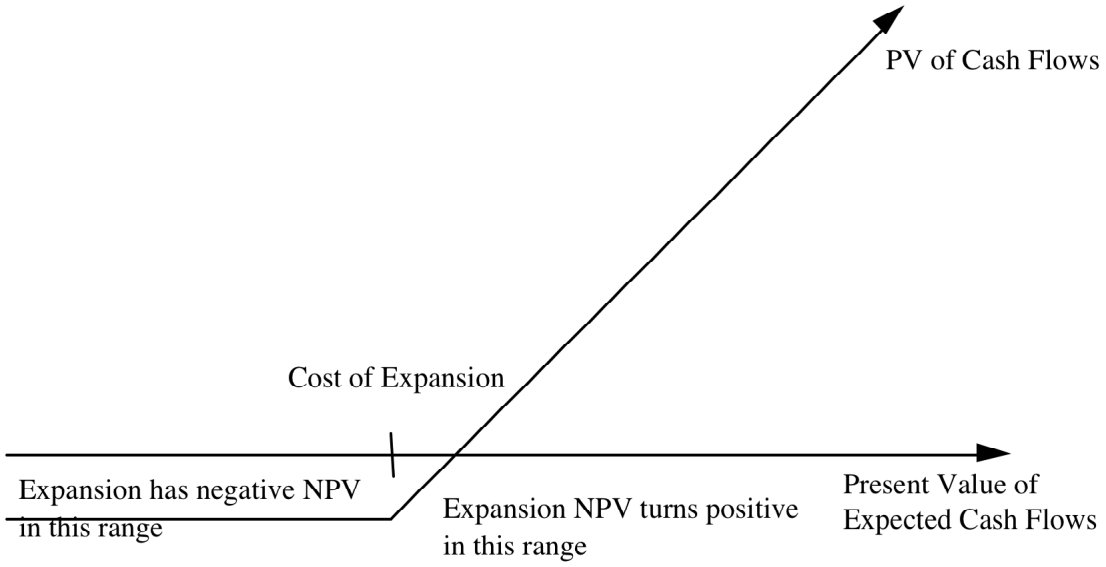
The option to delay provides an interesting perspective on why firms like IBM and Sony choose to accumulate portfolios of non-viable proprietary technologies. While the technologies would not generate value for these firms today, a few of them may payoff as the blockbuster technologies of the future. In the same vein, it may make sense for natural resource companies to accumulate reserves of the natural resource, even if these reserves are unlikely to be profitable at today's commodity prices. If commodity prices improve, these options will become valuable.

The option to expand

When making a risky investment, we emphasized the importance of value added in the risk adjusted value chapter. Put simply, we argued that firms should invest in risky investments or assets, only if they added value. While this holds true as a general proposition, there is one important exception. If the risky, negative value investment gives the firm a proprietary chance to expand into new markets and customers in the future, it may very well make sense for it to take that investment, negative value added notwithstanding.

Again, the best way to illustrate this argument is to draw the payoff diagram. In this case, the option is on the investment to expand into new markets and the exercise cost of the option is the expansion cost. As with any call option, you will exercise this option only if you believe that the cumulated value of the cash flows from expansion exceeds the cost of expansion.

Figure 8.4: The Option to Expand a Project



As with any option, it is entirely possible that the initial investment proves disappointing and that expansion never occurs. In this case, the value destroyed by the initial investment becomes the cost of the option to expand.

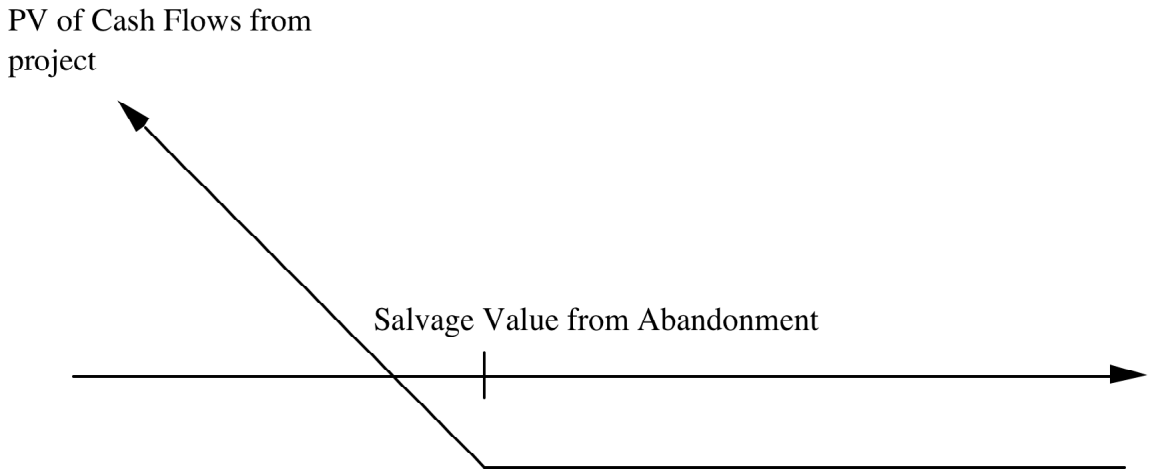
The implications for risk taking are significant. Taking small risks in big markets may make sense, even if those risk don't meet the value added criterion,

because these small risks, if they pay off, can allow the firm to expand into a much bigger market. It is for this reason that developed market firms entering markets like India and China may decide to enter these markets, even though the initial financial analysis may not be promising. In the same vein, good risk taking firms will find ways to leverage successes in initial investments to reap much larger profits.

The option to abandon

When investing in projects, firms are often called upon to assess market conditions and expected cash flows over the life of the project. The nature of risk is that conditions change and projects that looked good at the time of the assessment may become poor investments. Rather than sticking with these investments for the remaining lives, it may make more sense for the firm to abandon these investments, even if that requires selling the assets at well below the original investment value. This option to abandon represents a put option, where the salvage value from abandonment becomes the strike price.

Figure 8.5: The Option to Abandon a Project



If the value of the cash flows over the remaining life of the investment falls below the salvage value, the firm will gain by abandoning the investment.

The implications for risk management are straightforward. When entering investments, especially those requiring large outlays (relative to the size of the firm) and long lives, building in escape clauses that allow for limiting losses can reduce

the risk and increase the value of the investment substantially. This "flexibility" can take several forms including:

- ➔ Investing in large projects in stages, allowing for assessment and abandonment at each stage.
- ➔ Entering into joint ventures with partners with deep pockets, with the option to sell your share of the venture to the partner.
- ➔ Settling for short term renewable agreements with both buyers and sellers, rather than locking in long term agreements.

Each of these actions has costs, but the net effect of adding flexibility can be lower risks and higher value.

Implications for risk management

When taking risks, we want unlimited exposure to upside or good outcomes and protection against bad outcomes. Real options allow us to not only visualize this ideal scenario but also to plan for it. In particular, the options to delay, expand and abandon provide insight into how firms can exploit opportunities for gain, while limiting potential downside. If the lessons from this chapter are heeded, the right to a non-viable investment or technology can still have value, investments that provide the potential to enter new markets or expand should be assessed more favorably and the capacity to limit losses in investments is valuable.

CHAPTER TASK: REAL OPTIONS IN YOUR ORGANIZATION

1. Does your firm own any patents or proprietary technologies that are not viable right now?
    a. If yes, are they valued? If so, how are they valued? If not, why not?
    b. If no, are there processes or products that can be patented (and protected from competition)?
2. If you are a natural resource company, do you have undeveloped reserves of the resource? If yes, how are they valued?
3. Do you make investments that you know will not pass financial hurdles but that you feel offer your strategic opportunities (to enter new markets or acquire new customers)? What justification do you offer when you make these investments?
4. Do you invest in long term project with significant outlays? If yes, do you try to build in escape hatches, in case the project does not work out? If so, what form do these "escape hatches" take?

Chapter 9: Managing Risk: Risk and Value

Theme

Ultimately, the objective when managing risk in a firm is to make the firm more valuable. Thus, it is important that we link up how risk management can affect the value of a firm. The most straightforward way to do this is to start with the conventional drivers of firm value and look at how individual risk management actions affect these drivers.

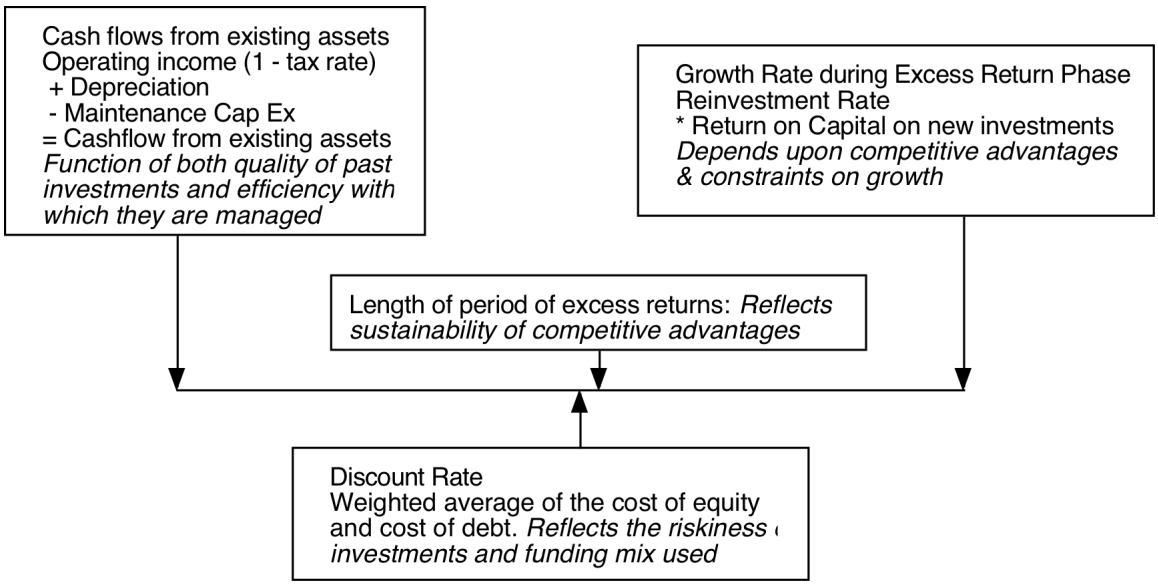
The Determinants of Value

Without exploring the details of valuation models, we can still highlight the four sets of inputs that determine the value of a business.

a. Cash flow from assets in place or investments already made. To the extent that these assets are managed efficiently, higher cash flows will be generated, leading to higher value.
b. Expected growth rate in the cash flows during what we can term a period of both high growth and excess returns (where the firm earns more than its cost of capital on its investments). Firms that can reinvest more, while preserving high excess returns, should be worth more than firms that cannot sustain this balancing act. Note that growth, by itself, has no value, since it is possible for a firm to growth and not add value (if it earns its cost of capital on new investments) or even destroy value (if it earns less than its cost of capital on new investments).
c. Length of time before the firm becomes a stable growth firm, which given out highlighting of excess returns can be viewed as the period that we expect the firm to maintain whatever competitive advantages it has. Firms with stronger and more sustainable competitive advantages should be worth more than firms with weaker and less sustainable advantages.
d. Discount rate. reflecting both the risk of the investments made by the firm and the financing mix used to fund them. Holding the first three factors

constant, firms with lower costs of capital should be worth more than otherwise similar firms that have higher costs of capital.

The factors are illustrated in the figure below:



How risk management affects value

Given that the value of the firm is a function of the cash flows from existing assets, the growth rates (accompanied by excess returns), the length of the competitive advantage period and the cost of capital, an action can affect the value of the firm only if it alters one or more of these inputs. In the context of risk management, the same principle applies. Since our definition of risk encompasses both the upside and downside, we can categorize risk management actions into those that are designed primarily to reduce exposure to downside risk (risk hedging actions) and those that are more generally focused on increasing exposure to upside risk (risk taking actions). Thus, buying insurance or entering into forward or options contracts to cover foreign exchange exposure in the future would be classified as risk hedging actions whereas introducing a new product or service or entering a new market would be categorized as risk taking action.

i. Cash flows from existing assets: Risk hedging actions are designed to reduce the risk in existing cash flows, but the cost of hedging risk will generally

reduce these cash flows. In effect, by hedging risk, you are trading off, at least on average, higher expected cash flows with more uncertainty for more stable, lower cash flows. Thus, buying insurance will reduce the cash flow by the amount of the insurance payment, while making that cash flow more predictable. Risk taking actions can increase your cash flows from existing assets, but only at the margin, and often at the expense of making them more volatile. Easing the terms of credit sales to your customers can increase your revenues but also expose you to a much greater risk of bad debt and defaults in the future.

ii. Growth rate: If the value of growth comes from both how high the growth rate is and what excess returns you generate while delivering that growth, it should be clear that the effects of risk taking are most likely to be seen here. Good risk taking will increase "good growth", through higher reinvestment and excess returns. Bad risk taking can generate value destructive growth, where the firm grows but only by taking investments that generate returns less than the cost of capital. Risk hedging can affect growth rates only indirectly. To the extent that conservative managers may hold back on taking good investments (which earn more than their cost of capital) because of their real and imagined fears, hedging that risk may allow them to overcome those concerns. Thus, the management of a firm that has historically avoided value-adding investments in foreign markets because of the fears of adverse movements in exchange rates may be more willing to make the leap, if exchange rate risk is hedged.

iii. Length of growth period: If the length of the growth period is really about competitive advantages and barriers to entry, the capacity to pick and take the right risks, by itself, is an important contributing factor to creating and augmenting these advantages. As we will argue in the chapter on risk taking, good risk taking firms are able to exploit certain risks better than their competitors because of some advantage they bring to the table – they have more resources or better information and can move faster than other firms in response to a crisis. Risk hedging generally cannot provide an advantage,

unless the hedging technique used in unique or a firm faces much lower hedging costs than competitors.

iv. Discount rate: The biggest argument provided for risk hedging is that it makes for more predictable, stable cash flows and that this stability should lead to lower discount rates. While that may be the case, the connection is neither as direct, nor is it as obvious, as proponents of risk hedging would lead you to believe. First, as we will see, the effect on the cost of equity for a publicly traded firm from hedging risk is ambiguous. Since the only risk that is incorporated into this cost of equity is risk that cannot be diversified away, hedging firm-specific risks will not lead to a lower cost of equity. Second, it is possible that lenders may see less default risk in the hedged firm, if its cash flows are more stable, and charge it a lower interest rate, leading to a lower cost of debt. It is also possible that lenders can look past the instability of an unhedged firm's cash flows and at its long term capacity to generate cash flows and base interest rates on that, in which case hedging will not lower your cost of debt. Risk taking has unpredictable effects on the discount rate, depending on which risks are taken and how they compare to the firm's current risk profile. Thus, a firm that seeks out new businesses that are riskier than its current ones will see its cost of capital rise as a consequence.

The effects of both risk taking and risk management on the inputs to value are summarized in the table below:

Valuation Component	*Effect of Risk Hedging*	*Effect of Risk Management*
Discount rate	Reduce cost of equity for private and closely held firms. Reduce cost of debt for heavily levered firms with significant distress risk	May increase costs of equity and capital, if a firm increases its exposure to risks where it feels it has a differential advantage.
Cash flow to the Firm	Cost of risk hedging will reduce earnings. over time. Trade off lower, more stable cash flows for higher, riskier cash flows.	More effective risk management may increase operating margins and increase cash flows.
Expected Growth rate during high growth period	Reducing risk exposure may make managers more	Risk taking will affect both how much you invest

	comfortable taking risky (and good) investments. Increase in investments in good risky projects will increase growth.	(reinvestment rate) and how well you invest (return on capital). While all risk taking generally will push up how much you invest, good risk taking will come with high returns on capital whereas bad risk taking will weigh down the firm with low returns on capital (relative to the cost of capital).
Length of high growth period	Minimal effect. Only possible competitive advantages come from either a unique hedging strategy (which others cannot match) or a cheaper way to hedge risks.	Being able to isolate and take the "right" risks is itself a significant competitive advantage. In face, the essence of strategic analysis is finding those risks that a firm can take more effectively than its competition.

Steps in risk management

There are five steps in building a good risk management system and they are outlined below:

Step 1: Make an inventory of possible risks: The process has to begin with an inventory of all of the potential risks that a firm is exposed to. This will include risk that are specific to the firm, risks that affect the entire sector and macroeconomic risks that have an influence on the value.

Step 2: Decide whether to hedge or not to hedge individual risk: We have argued through this paper that risk hedging is not always optimal and will reduce value in many cases. Having made an inventory of risks, the firm has to decide which risks it will attempt to hedge and which ones it will allow to flow through to its investors. The size of the firm, the type of stockholders that it has and its financial leverage (exposure to distress) will all play a role in making this decision. In addition, the

firm has to consider whether investors can buy protection against the risks in the market on their own.

Step 3: Choose risk hedging products for the risks that you choose to hedge: If a firm decides to hedge risk, it has a number of choices. Some of these choices are market traded (currency and interest rate derivatives, for example), some are customized solutions (prepared by investment banks to hedge against risk that may be unique to the firm) and some are insurance products. The firm has to consider both the effectiveness of each of the choices and the costs.

Step 4: Determine the risk or risks that you understand better or deal with better than your competitors: This is the step where the firm moves from risk hedging to risk management and from viewing risk as a threat to risk as a potential opportunity. Why would one firm be better at dealing with certain kinds of risk than its competitors? It may have to do with past experience. A firm that has operated in emerging markets for decades clearly will have a much better sense of both what to expect in a market meltdown but also how to deal with it. It may also come from the control of a resource – physical or human – that provides the company an advantage when exposed to the risk. Having access to low cost oil reserves may give an oil company an advantage in the event of a drop in oil prices and having a top notch legal staff may give a tobacco company a competitive advantage when it comes to litigation risk.

*Step 5: Devise strategies to take advantage of your differential advantage in the long te*rm. In the final step in the process, firms build on their competitive edge and lay out what they will do to create the maximum benefit. The oil company with low cost reserves may decide that it will use its cost advantage the next time oil prices drop to acquire oil companies with higher cost reserves and high leverage.

The table below summarizes the five steps and also looks at both where the responsibility lies in most organizations in devising these steps and actions that we can take to make the process better.

Table 9.8: Steps in Developing a Risk Strategy: Potential Problems and Possible Opportunities

	What is it?	*Who does it now?*	*Limitations/ Problems*	*Possible Improvements*
Step	Make an inventory	Internal. Managers	Managers may be	A team with sector

1	of all of the risks that the firm is faced with – firm specific, sector and market.	of firms do this now, but often haphazardly and in reaction to events.	good at identifying firm-specific problems but may not be very good at assessing sector or market risks. They may miss some risks and over inflate others.	expertise and experience can do a much more comprehensive job.
Step 2	Decide what risks should be hedged and should not.	Managers of the firm with significant input (and sales pitches) from investment banker and insurance companies.	Conflict of interest. Not surprisingly, the investment banker or insurance company will want managers to over hedge risk and find that their products are the best ones.	Offer unbiased advice on both components; in effect, offer to evaluate the products of others to find cheapest and best alternative. To do this, you have to take your products off the table.
Step 3	For the risks to be hedged, pick the risk hedging products which can be derivatives or insurance products			
Step 4	Determine the risk dimensions where you have an advantage over your competitors either because you understand the risk better or you control a resource.	If it occurs, it is usually part of strategic management and consultants and is packaged with other strategic objectives.	Risk gets short shrift since the focus is on rewards. In other words, strategies that offer higher growth will win out over ones which emphasize risk advantages.	Develop a team that focuses only on strategic risk consulting. You can offer your services as an adjunct to existing consulting services.
Step 5	Take strategic steps to ensure that you can use this risk advantage to gain over your competition.			

We will explore the process of creating a risk profile in the next chapter, move on to examine risk hedging steps (steps 2&3) in the chapter following and discuss the last two steps in chapter 12.

Implications for risk management

The objective in risk management is to increase the value of a business. To accomplish that objective, though, we have to think through how any given risk management action will translate into one of the four inputs in value – the cash flows from existing assets, value adding growth, the length of the competitive advantage period and the cost of capital. Actions that do not affect any of these

inputs are value neutral and any time spent on them is time waster. Actions that reduce value are perverse and should be eliminated from the risk management list.

CHAPTER TASK: VALUE AND RISK AT YOUR FIRM

- Do you have a risk manager or someone responsible for risk management at your firm?
    - If yes, what is their job description? (Is it to measure risk and report to top management, monitor risk taking, hedge risks or something else?
    - If no, how is risk managed in your organization?
- What is the objective of risk management in your firm?
    - If the objective is to increase value, is there a conscious effort made to see how risk management actions affect value?
    - If the objective is something else, what is it? How is "it" linked up to value (if at all)? Can you see potential conflicts between this objective and value creation?

Chapter 10: Risk Profiling and Hedging

Theme

The first step in risk management is listing out all of the risks that a firm is potentially exposed to and categorizing these risks into groups; this list is called a risk profile. The next step is breaking this risk down into three groups – risk that should be allowed to pass through the firm to its owners, risk that should be hedged and risk that should be exploited.

What is a risk profile?

Every business faces risks and it should make an inventory of the risks and get a measure of the exposure to each risk. There are four steps involved in this process – the listing of risks is the first step, categorizing these risks into broad groups is the second step, measuring risk exposure to each risk is the third and analyzing what to do with this risk is the final one.

I. A listing of risks

The process of managing risk starts with a laundry list of every risk that a firm is faced with. Some of these risks are small and some large, some may occur all through time and some on rare occasions. Do most firms have risk profiles? Not necessarily. In many firms, it is taken for granted that everyone within the firm, especially with experience, already is aware of the risks that the firm faces. This can be a mistake, and more so with risks that are uncommon, since some or even many managers may never have experienced that risk.

Rather than have an implicit risk profile that you assume that everyone is aware off, it is best to make it explicit. While the initial input for this list has to come from within the firm, there is no reason why external input should not be sought. Finding out, for instance, what equity research analysts who track your firm think are the biggest risks that your firm faces may give you insights into sector wide risk that you might not have had otherwise.

II. Categorizing Risks

A risk profile lists every risk that a firm is exposed but not all risks are made equal and it makes sense to break risks down into broad categories. This categorization not only makes the list more manageable but will allow us to decide how to deal with them in the following steps:

- Market versus Firm-specific risk: In keeping with our earlier characterization of risk in risk and return models, we can categorize risk into risk that affects one or a few companies (firm-specific risk) and risk that affects many or all companies (market risk). The formed can be diversified away in a portfolio but the latter will persist; in conventional risk and return models, the former have no effect on expected returns (and discount rates) whereas the latter do.
- Operating versus Financial Risk: Risk can also be categorized as coming from a firm's financial choices (its mix of debt and equity and the types of financing that it uses) or from its operations. An increase in interest rates or risk premiums would be an example of the former whereas an increase in the price of raw materials used in production would be an example of the latter.
- Continuous Risks versus Event Risk: Some risks are dormant for long periods and manifest themselves as unpleasant events whereas other risks create continuous exposure. Consider a coffee bean company's risk exposure in Columbia. A political revolution or nationalization of coffee estates in Columbia would be an example of event risk whereas the changes in exchange rates would be an illustration of continuous risk.
- Catastrophic risk versus Smaller risks: Some risks are small and have a relatively small effect on a firm's earnings and value, whereas others have a much larger impact, with the definition of small and large varying from firm to firm. Political turmoil in its Indian software operations will have a small impact on Microsoft, with is large market cap and cash reserves allowing it to find alternative sites, but will have a large impact on a small software company.

Some risks may not be easily categorized and the same risk can switch categories over time, but it still pays to do the categorization

III. Measuring Risk Exposure

A logical follow up to categorizing risk is to measure exposure to risk. To make this measurement, though, we have to first decide what it is that risk affects. At its simplest level, we could measure the effect of risk on the earnings of a company. At its broadest level, we can capture the risk exposure by examining how the value of a firm changes as a consequence.

It is easier to measure earnings risk exposure than value risk exposure. There are numerous accounting rules governing how companies should record and report exchange rate and interest rate movements. Consider, for instance, how we deal with exchange rate movements. From an accounting standpoint, the risk of changing exchange rates is captured in what is called **translation exposure**, which is the effect of these changes on the current income statement and the balance sheet. Translation exposure matters from the narrow standpoint of reported earnings and balance sheet values. The more important question, however, is whether investors view these translation changes as important in determining firm value, or whether they view them as risk that will average out across companies and across time, and the answers to this question are mixed. In fact, several studies suggest that earnings changes caused by exchange rate changes do not affect the stock prices of firms.

While translation exposure is focused on the effects of exchange rate changes on financial statements, **economic exposure** attempts to look more deeply at the effects of such changes on firm value. These changes, in turn, can be broken down into two types. **Transactions exposure** looks at the effects of exchange rate changes on transactions and projects that have already been entered into and denominated in a foreign currency. **Operating exposure** measures the effects of exchange rate changes on expected future cash flows and discount rates, and, thus, on total value.

IV. Analyzing Risk

Once you have categorized and measured risk exposure, the last step in the process requires us to consider the choices we can make in dealing with each type of risk. While we will defer the full discussion of which risks should be hedged and

which should not to the next chapter, we will prepare for that discussion by first outlining the three broad choices we have when it comes to what to do about any specific risk item.

i. Risks to pass through to the investors in the business: We can pass the risk through to the investors in the business. After all, an investor in an oil company invests in that company to be exposed to oil price risk. Passing the risk through to the investor seems to be the logical thing to do.
ii. Risks to avoid or hedge: There are some risks that investors may want a firm to hedge, either because they cannot gauge the risk exposure or because the firm can hedge the risk more inexpensively.
iii. Risks to seek out: Finally, firms should decide which risks they can exploit more effectively than their competition (and why).

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.

Implications for risk management

If the key step in risk management is understanding which risks to take, which ones to hedge and which ones to pass through, we have to spend more time in risk management looking at the big picture of risks and thinking about why we hedge (or do not) and which risks we exploit (and which one we should be exploiting).

CHAPTER TASK: DEVELOPING A RISK PROFILE

1. List the risks you are exposed to as a business. Try to include all risks, small and large, internal or external on this list.
2. Categorize the risks that you face into broad groups, based upon whether it is

   Macro risk or micro risk: Macro risks related to risks coming from macro economic factors such as interest rates, inflation or overall economic growth and micro risks refer to risks that come from within the firm.

   Discrete risk or continuous risk: Discrete risks are risks that occur at points in time whereas continuous risks are those that you are exposed to all of the time.

   Catastrophic risk or small risk: Catastrophic risks are risk that have large consequences for a firm. In effect, they can put a firm's future in doubt, if they come to fruition.

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

Chapter 11: To hedge or not to hedge?

Theme

It is undeniable that most firms hedge at least some risk and that some firms hedge a great deal. But what is the rationale for hedging? How does it increase the value of a business? In this chapter, we will look at the costs and benefits of hedging and follow up by examining whether the firm should hedge, even if the benefits exceed the costs. We will also look at the choices when it comes to hedging risk and which choice makes the most sense, for a given firm on a given risk.

Potential benefits from hedging

Tax Benefits

Hedging may reduce taxes paid over time by a firm in one of two ways. One flows from the smoothing of earnings that is a consequence of effective risk hedging; with risk hedging, earnings will be lower than they would have been without hedging, during periods where the risk does not manifest itself and higher in periods where there is risk exposure. To the extent that the income at higher levels gets taxed at higher rates, there will be tax savings over time to a firm with more level earnings. The other potential tax benefit arises from the tax treatment of hedging expenses and benefits. At the risk of over simplification, there will be a tax benefit to hedging if the cost of hedging is fully tax deductible but the benefits from insurance are not fully taxed.

Better investment decisions

In a perfect world, the managers of a firm would consider each investment opportunity based upon its expected cash flows and the risk that that investment adds to the investors in the firm. They will not be swayed by risks that can be diversified away by these investors, substantial though these risks may be, and capital markets will stand ready to supply the funds needed to make these

investments. There are two reasons why risk hedging may still make sense in the real world.

1. Managers are risk averse and often will reject even good investments because of their fear of the unforeseen – a catastrophic risk or exchange rate risk. Protecting against these risks may allow them to focus better on business decisions and make these investments.
2. To the extent that firms have to raise money from imperfect capital markets that may be swayed by the same irrational fears that hold back managers, removing or hedging against these fears may make it easier to raise funds and take good investments.

Reduce distress costs

Every business, no matter how large and healthy, faces the possibility of distress under sufficiently adverse circumstances. While bankruptcy can be the final cost of distress, the intermediate costs of being perceived to be in trouble are substantial as well. Given the large costs of bankruptcy, it is prudent for firms to protect themselves against risks that may cause distress by hedging against them. In general, these will be risks that are large relative to the size of the firm and its financial commitments.

Fine tuning Capital Structure

Firms that perceive themselves as facing less distress costs are more likely to borrow more. As long as borrowing creates a tax benefit, this implies that a firm that hedges away large risks will borrow more money and have a lower cost of capital. As we noted in chapter 9, holding all else constant, lowering the cost of capital will increase the value of the business.

Informational benefits

Hedging away risks that are unrelated to the core business of a firm can also make financial statements more informative and investors may reward the firm with a higher value. Thus, the changes in earnings for a multinational that hedges

exchange rate risk will reflect the operating performance of the firm rather than the luck of the draw when it comes to exchange rates.

The Costs of Hedging

The benefits of hedging have to be weighed off against the costs and these costs can range from small to large, depending upon both the type of risk being hedged and the product used to hedge the risk. In general, the costs of hedging can be broken down into explicit costs (which show up as expenses in the financial statements) and implicit costs (which may not show up as expenses but can affect earnings in dramatic ways.

- ➔ Explicit costs: When companies hedge risk against risk by either buying insurance or put options, the cost of hedging is the cost of buying the protection against risk. It increases costs and reduces income.
- ➔ Implicit costs: When you buy/sell futures or forward contracts, you have no upfront explicit cost but you have an implicit cost. You give up upside to get downside protection. Thus, a gold mining company that buys futures contracts that lock in the price of gold may face no explicit costs at the time it enters into these agreements, but will report sharply lower earnings in future periods, if gold prices go up above the futures price.

Evidence on Hedging

Since hedging is so integrated into many businesses, it is worth examining first how much firms do hedge and what types of risks they hedge. It is also worth following up by asking a bigger and more important question: what is the payoff, if any, to hedging?

How much and what do firms hedge?

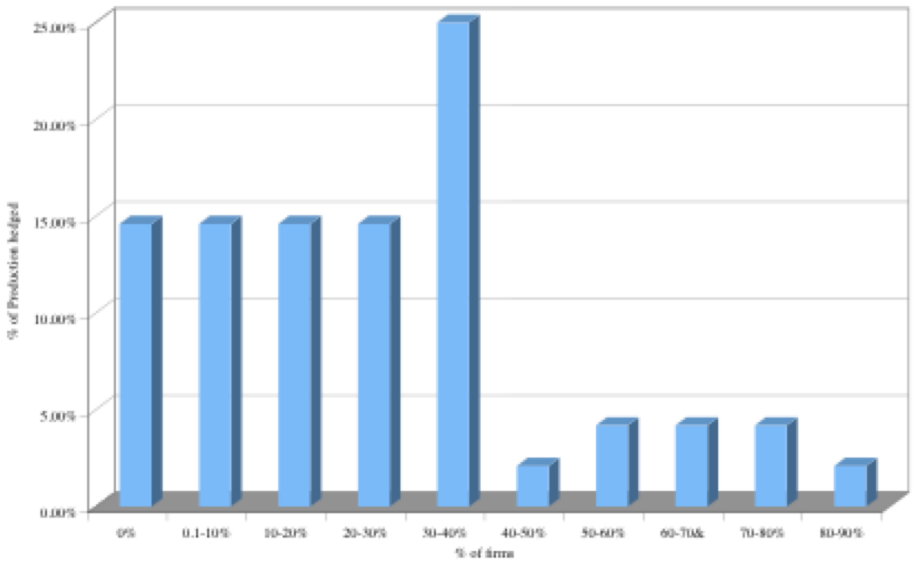
Studies that have looked at the hedging behavior of firms has uncovered the following data about hedging behavior:

- ➔ Hedging is common: In 1999, Mian studied the annual reports of 3,022 companies in 1992 and found that 771 of these firms did some risk hedging during the course of the year.

➔ Large firms hedge more: Looking across companies, he concluded that larger firms were more likely to hedge than smaller firms, indicating that economies of scale allow larger firms to hedge at lower costs.

➔ Some risks are hedged more frequently: Exchange rate risk is the most commonly hedged risk because it is easy and relatively cheap to hedge and also because it affects accounting earnings (through translation exposure). Commodity risk is the next most hedged risk by both suppliers of the commodity and users.

Figure 10.1: Production Hedging at Gold Mining Companies: 1990-93



Does hedging affect value?

Studies that examine whether hedging increase value range from finding marginal gains to mild losses.

➔ Smithson presents evidence that he argues is consistent with the notion that risk management increases value, but the increase in value at firms that hedge is small and not statistically significant.

➔ Mian finds only weak or mixed evidence of the potential hedging benefits– lower taxes and distress costs or better investment decisions. In fact, the evidence in inconsistent with a distress cost model, since the companies with the greatest distress costs hedge the least.

➔ Tufano's study of gold mining companies finds little support for the proposition that hedging is driven by the value enhancement

In summary, the benefits of hedging are hazy at best and non-existent at worst, when we look at publicly traded firms. A reasonable case can be made that most hedging can be attributed to managerial interests being served rather than increasing stockholder value.

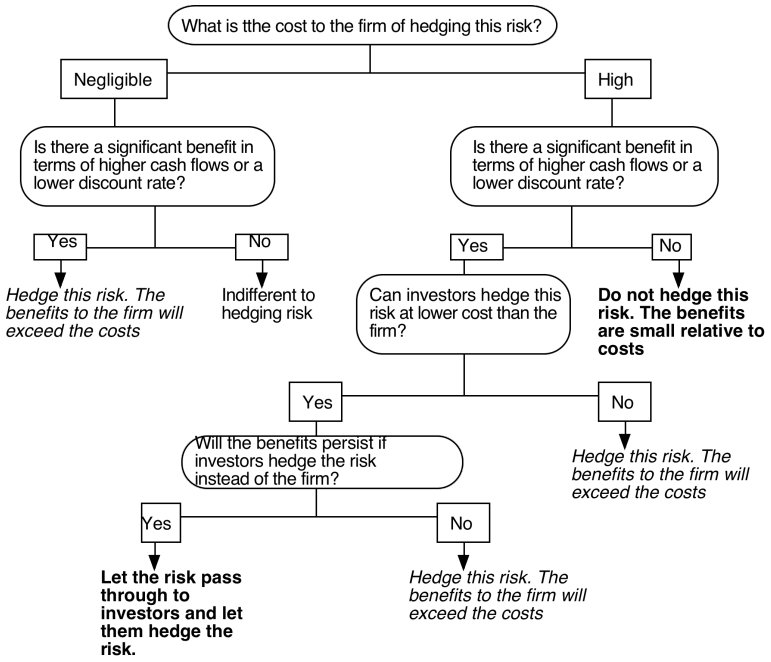
A framework for risk hedging

Given the mixed evidence on whether hedging helps or hurts firms, it behooves us to return to basics when it comes to whether a firm should hedge a risk. Fundamentally, it makes sense for firms to hedge a risk if both of the following conditions hold:

d. The benefits of hedging the risk exceed the costs: Bringing together the tax benefits, the reduced distress costs and improved investment decisions all into the picture, do the benefits exceed the costs? If the answer is no, the firm should not hedge that risk.

e. Even if the benefits exceed the costs, the firm has to follow up by examining whether it is cheaper for the firm to hedge this risk or whether it is cheaper for investors to hedge it on their own. As an example, consider exchange rate risk. Each firm, facing this risk, can choose to hedge it. However, the institutional investor who holds dozens of these firms in his or her portfolio may face a lower cost hedging the same risk, since some or a large portion of the risk may be eliminated in the portfolio.

The figure below provides a flow chart for determining when it makes sense to hedge risk and when it does not.



The choices on hedging

Assuming that a firm has reached the conclusion that hedging risk makes sense, there are several ways in which it can reduce or eliminate its exposure to a specific risk.

- ➔ Investment Choices: By investing in many projects, across geographical regions or businesses, a firm may be able to get at least partial hedging against some types of risk.
- ➔ Financing Choices: Matching the cash flows on financing to the cash flows on assets can also mitigate exposure to risk. Thus, using peso debt to fund peso assets can reduce peso risk exposure.
- ➔ Insurance: Buying insurance can provide protection against some types of risk. In effect, the firm shifts the risk to the insurance company in return for a payment.
- ➔ Derivatives: In the last few decades, options, futures, forward contracts and swaps have all been used to good effect to reduce risk exposure.

So which of these choices is the best one? The answer will depend both upon what type of risk is being hedged but also upon what the firm wants to accomplish through the hedge.

- ➔ If you want complete, customized risk exposure, *forward contracts* can be designed to a firm's specific needs, but only if the firm knows these needs. The costs are likely to be higher and you can be exposed to credit risk (in the other party to the contract).
- ➔ *Futures contracts* provide a cheaper alternative to forward contracts, since they are traded on the exchanges and not customized and there is no credit risk. However, they may not provide complete protection against risk.
- ➔ *Option contracts* provide protection against only downside risk while preserving upside potential. This benefit has to be weighed against the cost of buying the options, which will vary with the amount of protection desired.
- ➔ ln combating event risk, a firm can either *self-insure* or use a *third party insurance* product. Self insurance makes sense if the firm can achieve the benefits of risk pooling on its own, does not need the services or support offered by insurance companies and can provide the insurance more economically than the third party.

Implications for risk management

Hedging decisions should not be based upon inertia (we have always hedged that risk) or upon fear. They have to be based upon an assessment of the risks faced by a firm and whether it makes economic sense to hedge some or all of those risks. Hedging risks may create more stable earnings and cash flows but reduce the value of the firm at the same time, because the costs exceed the benefits.

CHAPTER TASK: A RISK HEDGING CHECK LIST

Do you hedge risks at your firm?

a. Yes
b. No
c. Not sure

Who makes these risk hedging decisions?

a. Managers on individual investments
b. Corporate treasury
c. Ad hoc

If you hedge risk, what types of risks do you hedge?

a. Input cost risk (Cost of raw materials that you use for operations)
b. Output price risk (Price of products that you sell)
c. Exchange Rate risk
d. Political risk
e. Other

Why do you hedge risk?

a. To increase earnings stability
b. To ensure survival
c. To increase value
d. Because every one else does it

If you hedge risk, how do you hedge risk

a. Internal investment decisions
b. Financing decisions
c. Insurance
d. Options
e. Futures and forwards

Chapter 12: Exploiting Risk

Theme

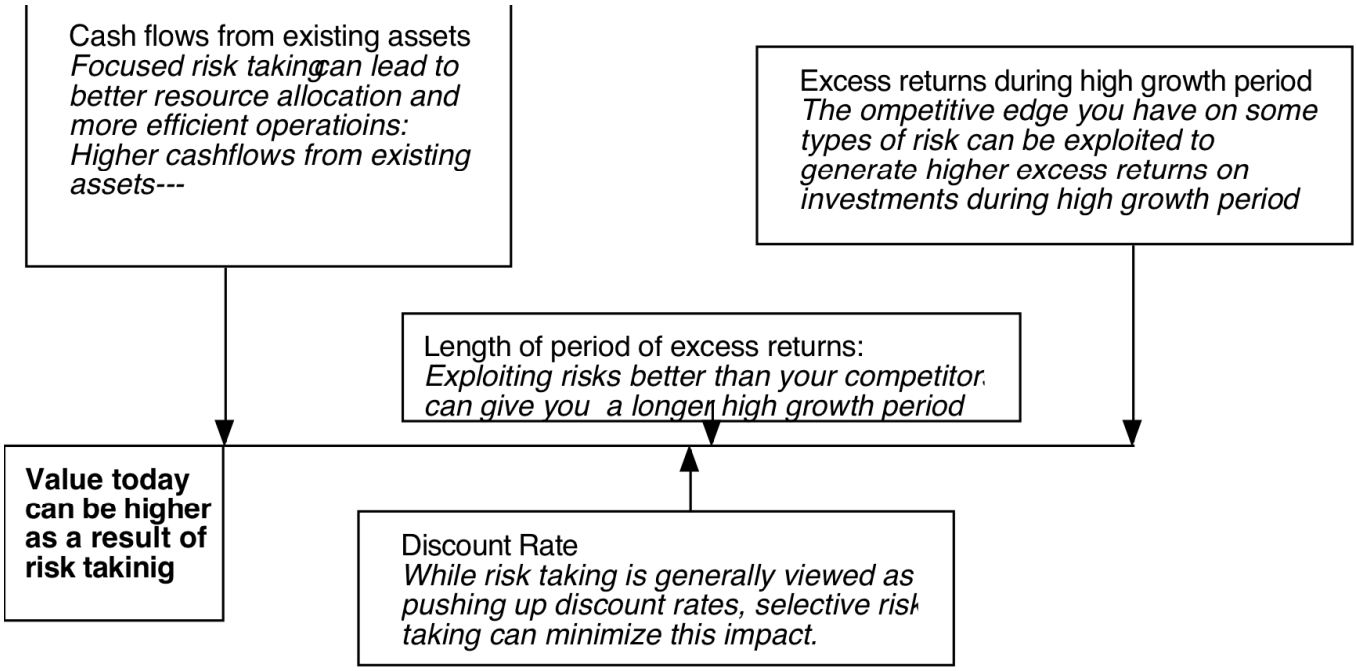
Risk management is more than just risk hedging. In fact, successful firms, over time, can attribute their successes not to avoiding risk but to seeking out and taking the "right risks". In this chapter, we will examine which risks to exploit and how to convert this to value increases.

Risk Taking and Value

Returning to the framework that related value to fundamental inputs in chapter 9, there are four basic inputs that drive value – cash flows from existing assets, the expected growth rate during the high growth period, the length of the competitive advantage period and the cost of capital. Exploiting risk well can affect each of these inputs:

- ➔ Cash flows from existing assets: Better risk taking can lead to more efficient operations and higher cash flows from existing assets.
- ➔ Higher expected growth rate: More efficient risk taking can lead to more reinvestment and higher returns on capital, both of which can translate into higher value-adding growth.
- ➔ Length of competitive advantage growth period: Good risk taking can be a significant competitive advantage by itself, but exploiting risks better than the rest of your competitors requires bringing something to the table that is unique and different.
- ➔ Discount rate: Risk taking that increases potential upside, while minimizing or reducing downside risk, can provide the best of both worlds: higher cash flows and lower discount rates.

The effect of risk taking on each of the valuation inputs is captured in the figure below:



Does risk taking affect value?

As with risk hedging, the question of whether risk taking adds or detracts from value is ultimately an empirical question. The evidence on this question is murky. First, the good news! The most successful companies in any economy got there by seeking out and exploiting risks and uncertainties and not by avoiding these risks. Across time, on average, risk taking has paid off for investors and companies. Now, the bad news! There is evidence that some firms and investors have been destroyed by either taking intemperate risks or worse, from the downside of taking prudent risks.

In conclusion, then, there is a positive payoff to risk taking but not if it is reckless. Firms that are selective about the risks they take can exploit those risks to advantage, but firms that take risks without sufficiently preparing for their consequences can be hurt badly.

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:

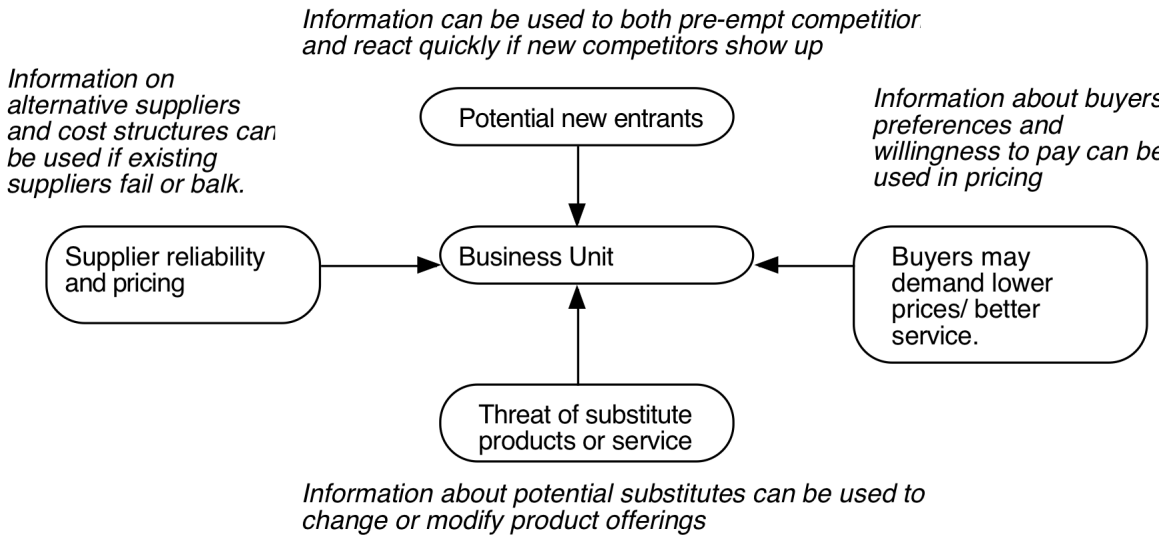
- ➔ Information Advantage: In a crisis, getting better information (and getting it early) can allow be a huge benefit.
- ➔ Speed Advantage: Being able to act quickly (and appropriately) can allow a firm to exploit opportunities that open up in the midst of risk.
- ➔ Experience/Knowledge Advantage: Firms (and managers) who have been through similar crises in the past can use what they have learned.
- ➔ Resource Advantage: Having superior resources can allow a firm to withstand a crisis that devastates its competition.
- ➔ Flexibility: Building in the capacity to change course quickly can be an advantage when faced with risk.

The information advantage

In a crisis, having better information about what is happening on the ground, than your competitors, gives a firm a significant advantage. That information can used not only to allow the firm to overcome the crisis but to get a step up on its competitors. While the importance of having better information is not contested, the question of how firms get this information is a more difficult one to answer. There are three ways in which it can be done, though each one has its associated costs:

- ➔ lnvest 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.

Another way to think about information is that it gives the firm an advantage with each of the parties it deals with. Using Michael Porter's competitive advantage framework, it can be argued that better information allows firms to deal better with suppliers, customers and competitors, as illustrated in the figure below:



Speed Advantage

When faced with a crisis, being able to act quickly can give a firm an advantage. Acting quickly, though, will provide an advantage only if the action is appropriate. Here are some of the factors that feed into the speed advantage:

- ➔ lmprove 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.

Experience/ Knowledge

When faced with a negative surprise, it is nice to have personnel or a process that as been tested by a similar surprise in the future. The knowledge acquired in dealing with similar crises in the past can help firms deal with new crises. But how does a firm acquire such experience?

- ➔ 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.

The Resource Advantage

Every crisis puts firms to the test, and while it is not fair, firms that have access to more resources (capital, personnel etc.) are better positioned to survive them than firms without these resources. There are are at least two ways in which firms can gain a resource advantage:

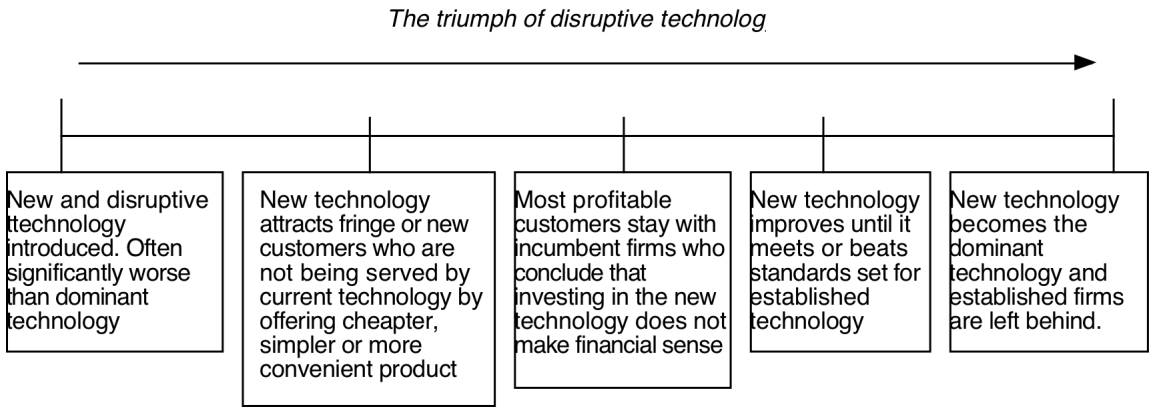
- ➔ Capital Access: Being able to access capital markets allows firms to raise funds in the midst of a crisis. Thus, firms that operate in more accessible capital markets should have an advantage over firms that operate in less accessible capital markets.
- ➔ Debt capacity: One advantage of preserving 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.

The Flexibility Advantage

When faced with adversity, successful firms improvise. The flexibility that some firms seem to possess, when faced with peril, gives them an advantage over their more rigid competitors. The flexibility can take different forms but 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.

As a related point, it is worth noting that successful firms often find it difficult to remain flexible, as they grow larger. As firms succeed, they become more unwilling to consider innovative strategies that may put their existing business at risk. Clayton Christensen used this insight to argue that disruptive technologies are far more likely to emerge from upstarts than from established businesses.



In Christensen's framework, new entrants in a business start by going after the low hanging fruit in a business, attracting customers who are unhappy with the existing offerings. They then go after new segments of the market, under the radar, getting a larger and larger share of the market. By the time the establishment reacts, it is too late.

Implications for risk management

To take risks better than the competition, a firm has to have competitive advantages. It has to act quicker than everyone else, with better information, and to better effect. To be able to do this consistently, the firm has to invest in information or response networks that will drain resources in good or stable times. In other words, good risk takers gain their status by design.

CHAPTER TASK: ASSESSING YOUR "STRATEGIC RISK TAKING" ADVANTAGES

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?

Chapter 13: Building a good risk taking organization

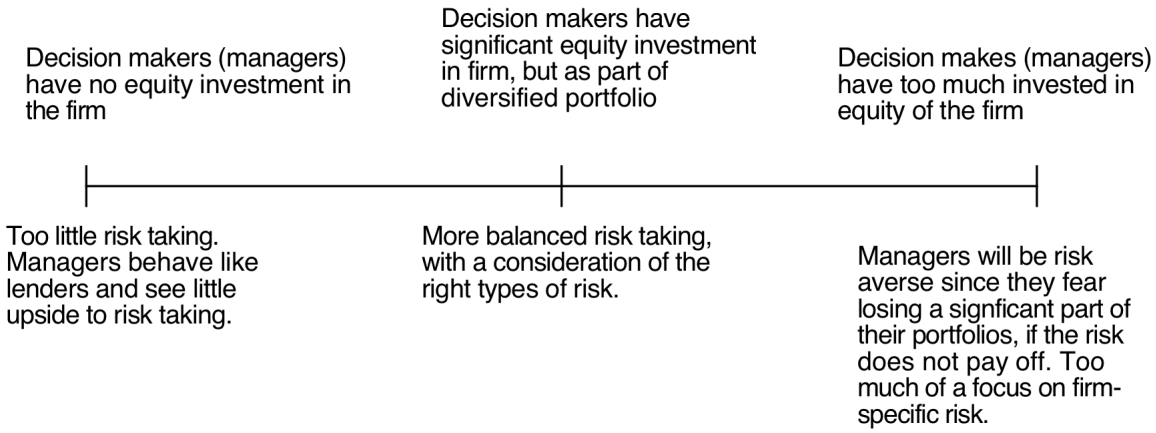
Theme

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. Success is risk taking is as much a result of design as it of luck.

Align interests

One of the by products of creating large publicly traded firms, where the owners are no longer the decision makers is that what is good

for decision makers may not longer be what is good for the owners of the business. In risk management firms, decision makers may be inclined to take far less risk than owners would want them to, if their interests point them in that direction.



At one extreme, when managers have no equity ownership stake in the firm, they will be inclined to take less risk than their owners would like them to, since their tenure in the firm is tied to stability. At the other extreme, decision makers who have their entire wealth tied up in a business can also have a skewed perception of risk, relative to the owners. Since these decision makers are over invested in the firm, they are likely to worry about all risk (and not just the risk that can be diversified away in a portfolio) and reject investments on that basis.

On balance, you would like decision makers to be invested sufficiently in the equity of a business to take risky investments, where they feel they get a share of the upside, but not invested to an extent that they hold back on risky investments.

Pick the right people

Good risk taking needs good risk taking personnel, but what are the characteristics of a good risk taker? Research in the last few decades suggests that good risk takers have the following characteristics:

- ➔ They are realists who still manage to be upbeat.
- ➔ They allow for the possibility of losses but are not overwhelmed or scared by its prospects.
- ➔ They keep their perspective and see the big picture, even in the midst of a crisis.
- ➔ They make decisions with limited and often incomplete information

So, how do you hire and retain good risk takers?

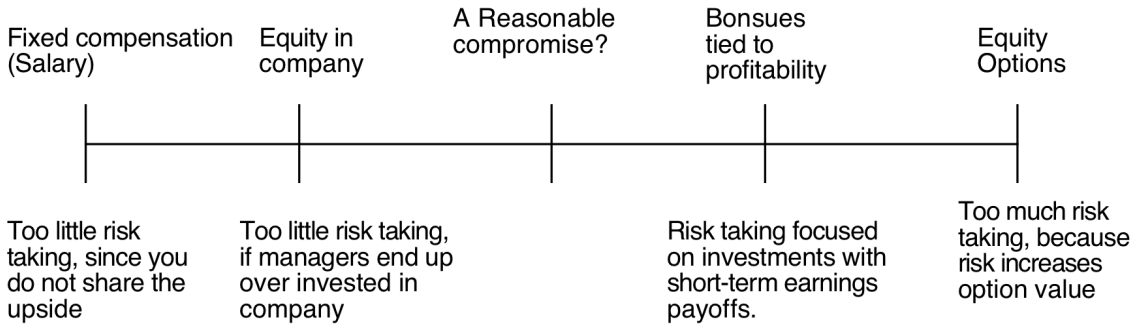
- ➔ Have a hiring process that looks past technical skills at crisis skills. In other words, the hiring process should look at how people react when exposed to the change and instability and not just at backgrounds and skills.
- ➔ Accept that good risk takers will not be model employees in stable environments. The people who seem to be most attuned to risk are generally also disruptive people to have around in more placid times.
- ➔ Keep these risk takers challenged, interested and involved. Boredom will drive them away.
- ➔ Surround them with kindred spirits.

Create incentives for good risk taking

Self interest is the strongest force driving how individuals make decisions. In risk management terms, the biggest factor determining risk taking and whether it is good or bad is the incentive system in place. In a perfect world, we would reward managers who expose the firm to the right risks and punish those who expose it to the wrong risks. In practice, though, we often reward or punish decision makers, based on outcome, rather than process. Thus, a trader who takes an imprudent risk

but succeeds can get millions of dollars in compensation, while one who takes a prudent risk and fails gets fired.

In recent decades, firms have increasing turned to offering their mangers equity options as compensation or instituted bonus systems or compensation based upon profits earned for the firm from decisions made. It can be argued that both these systems are asymmetric – they reward upside risk taking too much while punishing downside risk taking too little – and thus lead to too much risk taking.



While this search will not be easy, we are looking for balanced compensation systems that are more symmetric (punish downside about as much as they reward upside) and reward process as much as outcome.

Make sure the organizational size and culture are in tune with risk taking

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. Bureaucratic, multi-level organizations err on the side of too little risk and have a difficult time dealing with change and risk. Flatter organizations tend to be much more agile and flexible in the face of change, but the absence of checks and balances also makes them more susceptible to lone rangers undercutting their objectives.

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.

Implications for risk management

Building a successful, risk taking organization requires several components to come together. First, you have to find the right people; good risk takers are not always good organizational people. Second, you have to give them not only a stake in the outcome that makes them think like the "typical owner" but also create compensation systems that reward the right processes for dealing with risk, rather than outcomes. Third, you have to build a corporate structure and culture that is compatible with good risk taking.

CHAPTER TASK: ASSESS THE RISK TAKING CAPABILITIES IN YOUR ORGANIZATION/FIRM

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

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