A man walks across the street and faces it: A car could spin out of control and accidentally run into him.

A woman sits down in first-class sleeper seat 1A to cross the ocean on Airline FlyByNight and confronts it: A flight delay could cause her to be late to the crucial meeting that prompted her to spend $10,000 on her ticket, or the plane could end up in the ocean and she could miss the meeting in a more permanent sense.

A child plays in its new crib and bears it: A design defect could cause the child to trap its head in the bars and get stuck, perhaps causing permanent harm.

Harrison Ford accepts it when he takes a role in a new movie where he plays a drug-dealer cheating on his wife: His wholesome image as Han Solo, Indiana Jones, and Jack Ryan might never be the same.

It of course is risk. Risk is everywhere. You do not have to look very hard to find risk. When you want to preoccupy yourself, it is easy to convince yourself that the world is so inherently unsafe that it is better to be the Boy in the Bubble. It is easy to worry about the risks in the food you eat, the machines you operate, the stocks you purchase, and the air you breathe.

Most of us do not opt for the Howard Hughes solution. Instead, we manage risks. The man crossing the street at risk from being hit by a car might manage that risk by never crossing the street. Or he might a bit more reasonably adopt intermediate solutions designed to reduce his risk without completely eliminating it, such as looking both ways. The woman on Airline FlyByNight can manage risk by checking the frequency of on-time arrivals of her air carrier, calling ahead to see if the flight is on time, and generally avoiding airlines whose planes have a tendency to fall from the sky. Concerned parents can investigate their child’s crib manufacturer and look for prior problems or complaints in places like Consumer Reports. And Harrison Ford can say no to bad scripts and stick to playing Jack Ryan.
Like it or not, the world is an unpredictable place. And as long as there is some uncertainty about the future that could result in an adverse outcome for individuals, the world is a place in which risk must be managed.

**IS THE WORLD A RISKIER PLACE?**

Many argue that the world has become “a riskier place.” This is certainly what the proponents of health and safety risk management like to argue. As a society, America has become obsessed with risk. Americans are among the healthiest, wealthiest people in history. And yet, we are among the most seemingly risk-averse. We worry about alar in apple juice, cholesterol in red meat, bovine somatotropin in milk, and more.

In finance, as well, many contend that the world has become more dangerous, both for individuals whose wealth is exposed to seemingly larger and larger swings in global equity markets and for corporations whose cash flows seem to depend more and more on unpredictable cross-border variables.

In fact, the evidence that risk is greater today than it was 10, 100, or even 1,000 years ago is hardly compelling—both in health and safety and in finance. How many more people are killed today by tainted pharmaceuticals than were killed 100 years ago when home remedies were the only thing available to combat disease? How many more people die from accidental electrocution than froze or starved to death before the advent of alternating current? How many more people threw themselves out of windows after the stock market crash of October 1987 compared to the crash of 1929? The answer to all these questions is not many, if any.

The tendency to claim that the world is a riskier place comes not from any real empirical evidence, but rather from the illusory temptation to pursue change without experiencing risk. But as Wildavsky (1988) argues, the effort to experience progress without risk is both paradoxical and futile. The evolution of financial products in a risk sense has closely paralleled the evolution of health and safety risks. The good old days when the only...
real financial instruments to understand were stocks and bonds have been replaced by the arrival of new and often more complex financial products like index amortizing swaps, exotic options, finite risk insurance products, and other fancy instruments. But just as society had to take a risk on the canning process in order to reduce the danger of botulism from home canning, financial society has had to risk financial innovation. And that financial innovation has, like canning, led to opportunities to further reduce risk.

True, change often creates new risks. In that, the advent of canning and derivatives are not so different. With the reduced risks of infection that accompanied canning came the increased risks of injury to workers during mechanized processing, lead poisoning, and so on. Likewise, the interest rate, currency, and commodity price risks that derivatives help firms eliminate also pose a greater threat when derivatives are abused or misused.

Progress without risk is not just paradoxical, but also futile. As Wildavsky (1988) says, “Playing it safe, doing nothing, means reducing possible opportunities to benefit from chances taken, and can hurt people.” The man who decides to stay at home rather than cross the street may appear to be reducing his risk, but what if staying at home stopped him from inventing penicillin? What if Henry Ford decided safer was better and never took what must have seemed like a huge risk of creating dangerous metal objects that roll around and threaten pedestrians? And what if the desire to play it safe had kept the Wright brothers from stepping off Kill Devil Hill in the wind that day in their terrifying artificial birdlike device that paved the way for modern commercial airline travel? How many other innovations would be lost without the mobility that air travel has brought us?

THREE COMMON FALLACIES ABOUT RISK

If we recognize that risky changes can be beneficial and choose not to sit idly by while the risky world evolves around us, how can we begin to develop a framework for managing risk responsibly? The answer to that question, in very broad terms, is that a healthy and responsible risk management framework that neither lends itself to over-caution nor to carelessness is a framework that avoids three basic fallacies. If risk management can be implemented without falling into these three traps, the groundwork for a healthy risk management program has been laid.

Fallacy 1: Risk Is Always Bad

The first important thing to realize about risk is that it can represent either a threat or an opportunity. The most common attitude toward risk is to
think of it as a four-letter word—for more reasons than because it is a four-letter word. In fact, risk is neither good nor bad. It simply is. To a homeowner in coastal South Carolina, the risk of a hurricane is a horrifying one. But to the seller of lumber, sand bags, and weather radios in coastal South Carolina, that very same risk of hurricanes is a livelihood.

A closely related fallacy to “risk is always bad” is a fallacy that labels those who turn risk into opportunity as being insensitive and socially undesirable. The construction materials retailer who profits from a hurricane is preying on the suffering of others. Yet, without that construction materials retailer, rebuilding the coastline would be an impossibility. And the retailer is taking risks of his own, moreover. If a hurricane does not occur, the developer may find himself with more lumber than he knows what to do with. In return for taking that risk, he charges an appropriately adjusted price when the disaster does occur and the demand for lumber rises. And despite victims’ opinions of those retailers at the time, better to have them than not. Despite seemingly high prices, it is those very prices that guide resources to their most highly valued and needed uses. How much better off would we have been, for example, had the price mechanism been allowed to allocate scarcity in the gas crisis of 1979? Examples of turning risk into opportunity abound.

Decrying the role of the construction materials retailer in posthurricane rebuilding for opportunism is to confuse the emotions associated with the risk itself—the hurricane—with those who help provide a buffer against that risk. Even more common will be the tirades and angry accusations of insensitivity leveled at insurance companies that try to limit their payouts on a disaster like a hurricane. But without the insurance company’s attention to its exposure, insurance would not be available for anyone.

Criticisms against those who appear to benefit from risk are nothing new. In his Wealth of Nations, Adam Smith reviewed eighteenth-century public attitudes toward forestalling and engrossing. Forestalling was an activity in which corn was purchased during times of plenty in hopes it could be resold when prices rose. Engrossing was a similar activity in which corn was purchased in one city and transported to another, hopefully to be sold at a profit greater than the transportation cost (Smith and Culp, 1989).³

The antitrade Corn Laws were intended in part to restrict forestalling and engrossing. Smith nonetheless noted the obvious benefits of those activities: “By making [people] feel the inconveniences of a dearth somewhat earlier than they might otherwise do, [forestallers and engrossers] prevent their feeling them afterwards so severely as they certainly would do, if the cheapness of price encouraged them to consume faster than suited the real scarcity of the season.”

Smith went on to call forestalling and engrossing a “most important operation of commerce.” He noted, “The popular fear of engrossing and
forestalling may be compared to the popular terrors and suspicions of
witchcraft. The unfortunate wretches accused of this latter crime were not
more innocent of the misfortunes imputed to them, than those who have
been accused of the former."

Engrossing and forestalling, too, were risky. If an engrosser guessed in-
correctly about the corn price difference between cities in England, the en-
grosser paid for that mistake. Surely when those losses were incurred, few
people were upset. But when some of England’s respectable draymen and
warehousers lost money engaging in forestalling and engrossing, the outcry
against those novel and nontraditional activities must have surged.

Smith’s view ultimately prevailed; the Corn Laws were repealed, and
England’s economy grew to be one of the largest in the world.

**Fallacy 2: Some Risks Are So Bad That They Must Be Eliminated at All Costs**

Contrary to the assertion of this fallacy, there is no risk so great that it must
be eliminated at all costs. To drive home the essential parts of the sentence
and avoid confusion, emphasis can be added to the key words and phrases:
There is no risk so great that it must be *eliminated at all costs*. In other
words, the issue is not whether or not bad risks should sometimes be re-
duced, but whether reduced means *completely eradicated* and whether the
cost of that risk reduction comes into play.

Consider the risk that a comet or asteroid could strike the earth and
wipe out humanity. As Hollywood has reminded us in *Deep Impact* and
*A rmageddon*, this is a real risk—there is some positive probability this event
will occur. But does that mean everyone is ready to commit all of their per-
sonal funds to building self-sustaining caves in the ground below their
homes? Hardly. Indeed, when faced with the choice between putting money
toward a comet shelter, or, say, keeping the local school open, concern
about the risk of an event that could well cause the extinction of humanity
becomes greatly reduced.

The first lesson here is that risk must be evaluated in a probabilistic
context and not merely in terms of consequences. If a comet hits the earth,
the actual loss likely would be the end of the world. But if the probability of
a comet hitting the earth is only 1 in 1 billion, then the actual loss must be
viewed in that context.

The second lesson this fallacy teaches us is that the management of risk
should somehow try to equate the benefit of risk reduction with the cost of
risk reduction at the margin. Consider the case of sulfur dioxide pollution,
which is a supposed source of such iniquities as ozone depletion and global
warming. A factory can install a sulfur dioxide scrubber and *greatly reduce*
its emissions. Up to a point, the benefit of reducing those emissions may
well exceed the cost of a scrubber. But as emissions are reduced further and further, the cost of further reductions rises and the benefits of further decreases become less pronounced. In the extreme, the cost of eliminating all sulfur dioxide emissions is virtually unlimited, whereas most of the benefits are achieved early on and not from the reduction of emissions from one to zero parts per million.

Risk management thus must consider not just the benefit of reducing risk—if risk is indeed a thing to be reduced—but also the cost. At the margin, the two should be roughly equal for an optimal level of risk. This leaves us in a politically incorrect position much of the time. We are forced to make statements like the following: The optimal quantity of pollution is not zero; the optimal amount of crime is positive; and the probability the airplane you board will crash should be slightly positive. These statements seem unthinkable. Nevertheless, strictly speaking, the statements are all true.

What these statements really mean is not that we like pollution, condone crime, or tolerate plane crashes, but rather that the marginal costs of achieving zero pollution, zero crime, and zero plane crashes are higher than the marginal benefits. It may be worth it to move from high risk to low risk, but rarely does it make sense to make the final step from low risk to zero risk.

In the end, risk cannot be completely eliminated at a reasonable cost. Instead of being eliminated, risk thus must be managed.

**Fallacy 3: Playing It Safe Is the Safest Thing to Do**

A risk-averse individual is a person who, other things equal, prefers certainty to uncertainty when the uncertainty includes a potential outcome worse than in the certainty case. In statistical terminology, a risk-averse individual will reject a fair bet.

A bet is considered fair if the price to place the bet is the same as the expected (i.e., probability weighted) winnings. Take the case of a lottery ticket that pays zero half of the time and $1,000 the other half of the time. The expected value of the lottery ticket is the probability weighted outcome, or $0.50(0) + 0.50(1000) = 500$. A risk-averse individual would not pay $500 for the ticket because the value of $500 for sure required to pay for the ticket is higher to that individual than the value of a bet whose expected value is $500 but whose worst-case is zero. The risk-averse individual prefers not to part with the $500 and risk the possibility of having nothing, even if that possibility occurs with an equal probability of doubling his or her money.

A traditional assumption made in microeconomics and financial economics is that investors and individuals are risk averse. This assumption is probably pretty accurate and is not the source of this third fallacy. Rather, the third fallacy that playing it safe is the safest thing to do has more to do with the definition of safe than with whether or not people are risk averse.
Especially when dealing with politically sensitive issues like environmental protection or health and safety, the trend toward conservatism in risk management has increased in recent years. The risk that the Food and Drug Administration (FDA) approves a deadly drug to come to market is considered unacceptable. Accordingly, the FDA has an extremely strict and conservative policy about new drug approvals. The FDA thus plays it safe.

But what about the other side of the coin? What happens if the FDA's effort to keep dangerous drugs off the market also keeps good drugs off the market? How many people might die from that? Is playing safe in this example really the outcome that leads to the fewest fatalities? Not necessarily. And at the extreme, probably/certainly not.

In statistics, this conundrum is known as the Type I/Type II error bias. The following matrix illustrates the problem for some null hypothesis that this drug is not harmful:

<table>
<thead>
<tr>
<th>Hypothesis Is</th>
<th>True</th>
<th>False</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypothesis Is</td>
<td>Accepted</td>
<td>Type II error</td>
</tr>
<tr>
<td></td>
<td>Correct decision</td>
<td>Type I error</td>
</tr>
<tr>
<td></td>
<td>Correct decision</td>
<td></td>
</tr>
</tbody>
</table>

A Type I error occurs when a true hypothesis is rejected, and a Type II error occurs when a false hypothesis is accepted. For the hypothesis “this drug is not harmful,” the FDA approval of another killer Thalidomide is a Type II error, whereas the FDA rejecting the approval of the next penicillin would be a Type I error.

Human beings have a natural bias toward avoiding Type II errors. Part of that is just human nature—most risk-averse people err on the side of what they perceive as caution, despite the fact that the consequences of caution can sometimes be worse than not. In fact, some studies suggest that more people have died from the FDA marooning drugs in the approval process than have ever died from an actual bad drug being released. This is not so unreasonable, given that drug companies have a strong desire to stay in business. Killing people is not usually conducive to future profits.

Apart from human nature, the bias toward Type II errors also results from the fact that the consequences of Type II errors are often more obvious than the consequences of Type I errors. Information about the consequences of the two types of errors is not always complete. If a bad drug is released, we can count the bodies. But who really knows how many people died from a good drug being withheld, or how many afflicted people the drug would have helped would have died anyway?
The impossibility of knowing the consequences of many Type I errors together with the vivid reality of Type II errors tends to drive people away from making the former in favor of the latter. Despite this tendency, it is important to recognize this might be the wrong decision. Playing it safe does not always yield the proper risk management solution, especially when the person making the risk management decision has incomplete information about what “safe” really means.

RISK MANAGEMENT AS A PROCESS FOR INDIVIDUALS AND ORGANIZATIONS

In general terms, risk management is the process by which an individual tries to ensure that the risks to which she is exposed are those risks to which she thinks she is and is willing to be exposed in order to lead the life she wants. This is not necessarily synonymous with risk reduction. As indicated, some risk is simply tolerated, whereas others may be calculatedly reduced. In still other instances, some individuals may conclude that their risk profile is not risky enough. A man who is extremely late to an important meeting and about to watch his bus pull away from the curb may not only willingly fail to look both ways at a cross walk, but he might—perhaps quite rationally—conclude that the risk of being late is so much higher than the risk of being hit by a car that bounding across the intersection when the light is green seems like the right judgment call.

The process of risk management can differ based on both the risk(s) being managed and the agent managing them. First and foremost, risk management is a problem faced by individuals. Although organizations, like companies, are just collections of individuals, organizations face a set of risks all their own.

Risk Management for Individuals

Risk management begins at the level of the acting human agent—homo economicus, or economic man. The decision to wake up is a type of risk management decision—or, more specifically, the deliberate decision not to wake up again represents the most extreme version of unwillingness to manage risk. Once the decision to live another day has been made, nearly each decision that follows has some risk management dimension to it. We manage the risk of not burning our fingers on the toast by using toasters that pop out the bread when it is done at the same time they turn off the heating elements. We manage the risk of not getting sick from spoiled eggs first by buying them from reputable establishments and then again by smelling and
cooking them before eating them. We manage the risks of electrocution from the coffee maker by putting covers around wires and over alternating current wall sockets, and so on.

All of these personal risk management issues concern health and safety. But risk of injury or damage to our physical self is certainly not the only risk we face as individuals. We also bear intangible risks that may affect the quality of our life, such as reputation risks. The one homeowner on the street who never mows his lawn runs the risk that the neighbors will ostracize him. Telling too many white lies subjects you to the risk of not being trusted. Blaming the dog for eating the homework once too often makes it harder to miss an assignment when the pooch really does get a paper craving.

Reputation risks can also affect individuals through their professional lives. An actor who does a bad job or takes a bad script runs the risk of attracting subsequently fewer fans and fewer high-quality scripts. A professor who systematically teaches his students incorrect information will quickly lose his audience. An executive who plays office politics too much rather than earn performance-based promotions will lose the respect of his peers. These sorts of reputation risks cannot only reduce an individual’s happiness, but also can reduce the person’s income.

In broad terms, we refer to any risk as financial if the consequences of that risk come to bear on the cash flows of an individual. Being disliked by your neighbors is a reputation risk that does not necessarily translate into financial trouble, whereas being a dentist known to regularly work on the wrong tooth has direct financial consequences.

Apart from reputation risk, individuals also are subject to a variety of other financial risks: the risk that an increase in interest rates will raise the costs of an adjustable rate mortgage, the risk that a decline in global equity markets adversely impacts the value of retirement assets, the risk that an increase in gasoline prices raises the costs of commuting, and so on.

**Risk Management for Organizations**

Organizations are collections of individuals. A church is a collection of members and clergy. A golf club is a collection of golfers and the staff that serve them. A financial exchange is a collection of traders and the personnel who manage the exchange’s trading infrastructure, and so on.

Fama and Jensen (1983a, 1983b, 1985) define four types of organizations, distinguished principally by the different relationships between stakeholders, managers, and users of the organization. The first type of organization is an **open corporation**, characterized by the almost complete specialization of decision management and residual risk bearing. In other words, management is typically a distinct group from those who have a
residual claim on the net cash flows of the company (i.e., what is left after the bills have been paid). The residual claims of open corporations are almost always in the form of unrestricted common stock which can be freely bought and sold in the capital market.

A second type of organization is a closed corporation or proprietorship. These are organizations in which management and ownership overlap significantly. In other words, the same people that have a residual claim on the value of the firm also do the work.

The third organizational classification is called the financial mutual. These types of organizations have residual claimants who are also the customers of the organization. When the owner and the customer of the organization are one and the same, the financial mutual can be viewed as a type of club or syndicate. Hedge funds are examples of financial mutuals. Typically set up as limited partnerships, the partners of the hedge fund act as the owners who delegate primary management responsibility to a managing partner and as residual claimants who can withdraw their proceeds from the fund at any time. Spotting a financial mutual is usually easy inasmuch as these organizations have the unique property that a liquidation of shares by all owners also shuts down the organization.

Finally, nonprofits are organizations whose major goals are not to maximize profits. Instead, the objective of a nonprofit may be to preach the Word of God (e.g., a church or synagogue), feed the poor (e.g., Oxfam), teach the principles of business administration to student customers (e.g., The University of Chicago's Graduate School of Business), and the like. Because generating cash flows is not the primary objective of such organizations, they have no residual claimants per se. The closest thing are the donors and supporters that provide operating cash flows.

Each of the four types of organizations has both stakeholders and customers. A stakeholder in an organization is any individual whose personal welfare is affected by the success of the organization. Primary stakeholders are usually the residual claimants—shareholders or owners—of the enterprise. Creditors can also be stakeholders in these organizations to the extent that the success of the organization determines its ability to pay its bills. Managers are often stakeholders even when they are not also shareholders or creditors. Their jobs, after all, depend on the ongoing viability of the enterprise.

The success of an organization also impacts its beneficiaries or customers. Whether a nonprofit producing education in the classroom or a for-profit corporation producing soda pop, the customers of the organization represent the demand side of the picture, without which the organization could not exist. Customers of an organization may be either other organizations or individuals.
As collections of stakeholders and customers, every organization can inevitably be characterized as a group of individuals held together by, as Jensen and Meckling (1976) call it, a *nexus of contracts*. Accordingly, organizations inherit many of the risks to which individual stakeholders and customers are subject. Airline FlyMe runs the risk that all the passengers on a flight purchase refundable tickets and then get caught in a traffic jam and fail to show up. The airline also runs the risk that a disreputable or dishonest employee wrongly but credibly accuses the firm of cutting corners on maintenance, thereby resulting in reduced customer demand and lower revenues.

Apart from the risks an organization inherits from its individual stakeholders and customers, the organization itself also bears certain risks arising from the nexus of contracts that keep the organization together. The stakeholders and customers of Airline FlyMe, for example, bear the risk that jet fuel prices increase and adversely impact the net operating margin of the company or result in higher ticket prices. Other risks the airline bears include the risk that sales to foreign customers denominated in a foreign currency change in value as exchange rates move, the risk that dividends paid to foreign investors change in value as exchange rates move, the risk that changes in interest rates alters the present value of future investment projects, the risk that changes in interest rates changes the cost of debt capital for the firm, and so on.

The last section argued that individuals are subject to basically two kinds of risk—physical (e.g., health and safety) and financial (e.g., professional reputation or declines in retirement funds). The same grouping of risks is true for organizations. The physical risks borne by a company range from the risks of fire, flood, and theft to the risks of exploding machines and chemical spills. The financial risks include vulnerabilities to changes in market prices, the creditworthiness of contract counterparties, the risk of cash imbalances, and the risk of operational failures. Not to mention risks like reputational risk that can be even *worse* for companies than for people—Tylenol after some tainted capsules were found, Perrier after benzene was discovered, and the epic failure of new Coke that necessitated a name change to Classic Coke.

Unlike individuals whose risk management objectives are clearly defined with respect to personal well being, however, organizations have a muddier risk management mandate. One factor that blurs the clarity of the problem is *whose risks an organization is managing*. Is shareholder welfare the primary issue? Or management welfare? Or creditor repayments? Or employee satisfaction? Or customer retention?

If the interests of all the participants in an organization were perfectly aligned, the risk management objective of an organization would not matter so much. But the interests of various stakeholders in an organization are not
only rarely aligned, but often in actual conflict. Managers, for example, might prefer to spend money on a new office coffee maker, whereas the owners of the company would rather see funds invested in a new production technology. Or shareholders of the firm might prefer to take on a risky project with potentially large losses and gains because they get to keep the gains and have losses limited on the downside by bankruptcy. The firm’s creditors might not like the same project, however, because the higher project risk increases the chances they will not receive their money back without offering them the chance to participate on the upside if the project is a success.

Risk management by organizations thus starts to get tricky. The following questions come to mind:

- What are the risks to which corporations are exposed?
- Should individual stakeholders of the corporation or corporations themselves manage risk?
- What risks should the company manage?
- Is risk management always about risk control and loss avoidance, or can risk be turned into opportunity by the corporation?
- If some risks are to be managed by the company, what are the right tools it needs to engage in risk management most effectively?
- How does a company choose a method of changing the risks to which it is exposed—futures versus forwards, financial instruments vs. insurance?
- How does a company implement its strategic risk management objectives tactically?

The remainder of this book answers these questions.

CLASSIFYING THE RISKS FACING BUSINESSES

Risk can be defined as any source of randomness that may have an adverse impact on a person or corporation. Accordingly, risk management is the reaction to risk by individuals or businesses as they attempt to ensure that the risks to which they are exposed are the risks to which they think they are exposed and want to be exposed.

This book deals with the management of risk as a business process—how risks are managed in the context of broader corporate strategies and financing considerations. Risk management cannot be discussed in isolation from corporate strategy and corporate finance.

Before tackling the strategic and tactical issues of designing a risk management process for a company, agreement must first be reached on what we mean when we say risk. What does the risk in risk management really mean?
The Nature of Risk

It is tempting to associate definitions of risk with measures of risk, such as the variance of returns on some asset. Although risk measurement will be addressed in some detail later, the goal at this stage is an entirely conceptual one. Consequently, this chapter makes use of mathematical formulas only when they make sense for illustrative purposes. Risk is a concept, not a particular statistical construct.

Developing a common understanding of what is meant by the term risk at the conceptual level is no trivial task. Some would say that one type of risk is interest rate risk, whereas others might break that down by maturity, currency, credit quality, and the like. Neither definition is actually wrong. Rather, it is merely a question of context—What do you plan to do with the definition? For a risk manager whose goal is quantifying the precise impact of changes in interest rates on a bond portfolio, the more finely portioned definition makes sense. For a CEO who is merely concerned with broad classifications of her company’s exposure, the more generic definition may be adequate.

To most corporate executives, risk is defined in the same manner that U.S. Justice Potter Stewart once defined pornography: “I don’t know how to define it, but I’ll know it when I see it.” Yet, for a risk management process to make sense, the definition of the risks to be managed cannot be left excessively vague. Defining risk in the Potter Stewart manner is a recipe for defining a risk only after it has gotten the best of you once.

In general, the conceptual definition of risk varies with the perspective. In this chapter, three different perspectives are offered for how to define risk. After presenting all three, the relations between these three mutually interdependent perspectives are explored.

Note that none of the perspectives of risk discussed next are unique to financial instruments. Whatever risk affects the value of a traded bond will also affect the value of a loan. And even apart from financial exposures, many of these risks affect nonfinancial exposures, as well. When discussing the thing that risk affects, the term exposure is used to reinforce the fact that any bundle of cash flows whose future value is uncertain is subject to risk.

EVENT-DRIVEN DEFINITIONS OF RISK

The first and probably most common perspective of defining risk is commonly found in risk management functions, corporate treasury functions, and at financial institutions. This perspective defines risk differently based on the type of event that can result in a loss. From this perspective, a potential loss arising from a flood is treated as a different risk than a possible loss tracing to changes in the yen/sterling exchange rate.
The level of detail into which we can go to characterize event-driven risks is practically limitless. Is information technology systems risk a risk, or a part of another, broader risk like operational risk? Is the risk of crop spoilage a risk on its own, or a subset of another? No correct answers to these questions exist. The purpose of classifying risk at all is partly pedagogical and partly analytical, so the level of detail in the classification should be commensurate with the level of detail required in the application.

For the purposes of this book, we will not get into particularly fine distinctions between specific events that give rise to risk. Instead, we use the relatively broader classification system proposed in the Global Derivatives Study Group (1993), often called the Group of Thirty Report after its sponsor.

**Market Risk**

Market risk arises from the event of a change in some market-determined asset price, reference rate (e.g., LIBOR), or index. The events that define market risk can be separated into two categories. The first type of event that generates market risk defines market risk based on the type of asset class whose price changes are impacting the exposure in question. A common form of asset class-based market risk is known as interest rate risk, or the risk that the balance sheet assets, liabilities, and off-balance sheet items of a firm—including its derivatives—will change in value as interest rates change. Other asset class-driven classifications of market risk include changes in the value of an exposure attributable to fluctuations in exchange rates, commodity prices, and equity values.

Any market-determined price, rate, or index value that impacts the cash flows of an exposure is called a *risk factor*. If we are interested in the present value of an asset, the discount rate also comes into play, although convention does not classify it as a risk factor. We also typically stop short of decomposing risk factors into the nontraded exposures that may underlie them. As will be explained in Chapter 3, Chapter 13, and elsewhere, for example, the common stock issued by a corporation can be viewed as a type of call option on the assets of the corporation. A contract to buy or sell a share of common stock thus has the common stock as its risk factor, which in turn has the assets of the firm determining its value. But we usually stop with the fact that common stock is the risk factor underlying a stock purchase or sale.

Apart from the risk factors that influence the value of an exposure, the market risk of an exposure can also be characterized based on how those risk factors impact its value. In this context, market risk generally is classified by using a colorful argot known as *fraternity row*. Trade practitioners and academics alike tend to refer to five types of market risk by using Greek or Greek-sounding letters.
**Delta** is the risk that the value of an exposure will deteriorate as the price or value of some underlying risk factor changes, all else equal. A bond is affected by changes in interest rates, so the interest rate is the risk factor. When interest rates rise, bond prices fall. Similarly, the value of a machine is the discounted NPV of the future cash flows generated by that machine. Because the discounting in the NPV involves interest rates, a rise in rates also puts downward pressure on the present value of the machine.

**Gamma** is the risk that delta will change when the value of an underlying risk factor changes. It is sometimes referred to as *convexity risk* or *rate of change risk*. Returning to the bond example, bond prices fall as interest rates rise, but the amount of the price change depends on the level of interest rates. Large interest rate increases may cause larger bond-price declines than small interest rate increases.

The risk that volatility changes in the underlying risk factor will cause a change in the value of an exposure goes by many names. *Vega*, *lambda*, *kappa*, and *tau* are among them. For purchased options (longs), *declines* in volatility pose the risk. Less volatility means there is a smaller chance that the option held will expire profitably. For options written (short), lower volatility increases the odds for profits by reducing the opportunities for unprofitable exercise against the short to occur.

**Theta** measures the risk to certain exposures due only to the passage of time. Insurance, for example, is an asset that decays or wastes over time. For every day that passes on an unused insurance policy, there is one less day for the insurance contract to become valuable.

Finally, **rho** is the risk that the interest rates, which are used to discount future cash flows in present value calculations, will change and impose unexpected losses on the firm. For many exposures, the discount rate is the borrowing or lending rate that corresponds to the maturity of the contract. For other contracts, such as swaps, a yield curve is used to discount cash flows, and hence any shifts in the level of any of several interest rates may affect cash flows.

Yet another market risk—correlation risk—is the risk of an unexpected change in the correlation of two factors affecting the value of a contract. We must be careful here to distinguish between *basis risk*, or correlation risk arising from the combination of a derivatives contract with another asset or portfolio, and correlation risk affecting a single asset held in isolation or in a portfolio.

The term *basis risk* comes from the term *basis*, which is usually defined as the difference in price between a derivatives contract and the current spot price. The oil futures basis, for example, is the difference between the current price of an oil futures contract and the current oil spot price. In equilibrium, a derivatives basis is equal to the marginal *cost of carrying* the asset underlying the derivatives contract to the maturity date of the derivatives.
transaction. In the oil example, the oil futures basis is thus the marginal expected cost of storing oil and the interest cost of oil storage less the marginal expected benefit of holding physical oil, which the holder of a futures contract foregoes. To take another example, the basis of a foreign exchange futures contract reflects the domestic interest rate less the foreign interest rate, because the former would be earned and the latter foregone if the spot currency were stored over time and then exchanged for the foreign currency.

**Liquidity Risk**

Liquidity risk occurs in the event that cash inflows and current balances are insufficient to cover cash outflow requirements, often necessitating costly asset liquidation to generate temporary cash inflows. Most firms, both financial and nonfinancial, have liquidity plans designed to manage funding risks. The well-publicized bankruptcy of Drexel Burnham Lambert Group, Inc., occurred due to a failure in funding risk management and has only increased corporations’ attention to this risk.

Liquidity risk also includes a type of risk called *market liquidity risk*, or the risk that volatile markets will inhibit the liquidation of losing transactions and/or the establishment of new transactions to hedge existing market risk exposures. Suppose a firm has a forward contract to purchase British pounds for Deutsche marks three months hence. If the British pound experiences a massive and rapid depreciation vis à vis the Dmark—as happened in September 1992 when the European Monetary System’s exchange rate mechanism collapsed—the forward contract will rapidly decline in value. If the forward contract is unhedged or the counterparty to an offsetting contract defaults, volatility may be so high that a new hedge cannot be initiated at a favorable price, even using liquid exchange-traded futures on pounds and Dmarks. The firm’s market risk is thus exacerbated by market liquidity risk.

The distinctions between pure funding risk and market risk are reasonably subtle, as the two are clearly related. Market risk can be viewed as the risk of changes in the value of a bundle of cash flows when adverse market events occur. But value is just defined as the discounted net present value (NPV) of future cash flows. Market risk is thus in some ways inseparable from liquidity risk.

Perhaps a more useful distinction between the two concepts is achieved by noting that liquidity risk is based on the risk of cash flows when they occur in time. For the purpose of comparing liquidity risk at one time to liquidity risk at another, discounting to an NPV serves no purpose. On the contrary, all that is relevant is cash balances per period. Market risk, by contrast, deals with cash flow risks in any period, because all future cash flows ultimately affect the current NPV of the asset or liability in question.
Credit Risk

Credit risk is the risk of the actual or possible nonperformance by a firm. Credit risk can be subdivided along a variety of different dimensions, two of which will be summarized briefly here: settlement versus presettlement credit risk, and direct versus indirect credit risk.

Settlement versus Presettlement Credit Risk

Presettlement credit exposure arises from the potential for a counterparty to default on a transaction prior to the initiation of the settlement of that transaction, whereas settlement risk is specifically associated with the failure of a firm during the settlement window, or the time period between the confirmation of a transaction and the final settlement of that transaction. The transaction may be anything—the initiation of a 10-year interest rate swap, the delivery of funds for securities, the exchange of funds denominated in one currency for funds denominated in another currency, or the transfer of funds in exchange for the acquisition of a real asset (e.g., a machine). All transactions take some time to settle.

Presettlement credit risk arises from the possibility that a party fails to make good on future settlements, or settlements that have not yet been initiated. This exposes counterparties to the risk that valuable assets will have to be unexpectedly replaced at then-current market prices. If Captain Piccard buys a toaster from Commander Riker and the two agree that Piccard will pay Riker $100 in a month at which time Riker will deliver the toaster, the declaration by Riker that he cannot deliver the toaster before the month is up constitutes a presettlement default. Assuming Piccard needs the toaster, he will have to find someone else—say, Commander Data—from whom to obtain the toaster. But by the time Riker notifies Piccard of his inability to make good on the deal, the price of toasters may have gone up. If Commander Data wants $110 for the toaster, Captain Piccard has incurred a $10 replacement cost loss (i.e., the difference between the price in the original, defaulted deal and the new price at which the defaulted deal must be replaced).

Now suppose Commander Riker is planning to buy the toaster directly from Counselor Troy for $90 to resell it to Piccard, but a month passes and Commander Riker cannot come up with the $90. This makes sense only if Riker must pay Troy before Piccard pays Riker, but assuming that is indeed the case, Riker will have no toaster for Piccard. As long as Riker informs Piccard of this before Piccard initiates his payment, the default is still considered a presettlement default.

To take a third case, suppose a month passes and Piccard pays Riker the $100 for the toaster. On the way back to his cabin to get the toaster, Riker is robbed by a Romulan, who steals both the money and the toaster. In this
case, Captain Piccard will be on the receiving end of a settlement default (i.e., a default on one leg of a transaction after settlement on the other leg has been initiated irrevocably). In the case of a presettlement default, Piccard was only out the replacement cost, or the difference between the old transaction price and the new one. But in a settlement default, Piccard loses his principal, or the whole $100—and no toaster.

Settlement risk is sometimes called Herstatt risk, so named from the failure of Bankhaus Herstatt in Germany in 1974. The convention in most foreign currency markets is for settlement two days after a spot transaction is consummated or a forward contract matures. A number of New York banks had initiated payments to Herstatt on their side of a bunch of spot and forward currency trades, and Herstatt failed after those payments were initiated from New York but before any reciprocal payments were initiated from Germany. The New York banks suffered considerable principal losses.

One means of mitigating settlement risk is by netting like cash flows in the same currency whenever possible. Instead of A owes B $10 and B owes A $12, the net payment of $2 from B to A is the only cash flow that occurs at settlement. Although bilateral netting of this sort greatly reduces the settlement risk of many financial transactions, contracts in which funds are exchanged in different currencies or in which funds are exchanged for assets cannot be net and thus are subject to full settlement risk. A toaster cannot be netted for cash.

**Direct versus Indirect Credit Risk** A second perspective from which credit risk can be viewed pertains not to the timing of the default as in the prior section, but instead to the source of the risk. Direct credit risk is the risk of a failure by a counterparty to deliver assets or funds when required to do so or an increase in the perceived probability that such a failure will occur in the future. The former is typically called default risk, and the latter downgrade risk. In either case, the direct credit risk borne by a company is limited to the counterparties and security issuers with which that company has direct contractual relations.

Indirect credit risk—sometimes called credit-dependent market risk or spread risk—is the risk that the value of an asset declines because of a change in the credit risk of some firm with which the enterprise has no direct dealings. For concreteness, consider a swap contract with a notional principal of $1 million in which nonbank Company Ludlum makes a semi-annual payment to nonbank Company LeCarré based on the realization of six-month LIBOR, in return for which Ludlum receives a semi-annual payment from LeCarré based on the six-month Treasury rate. Sometimes called the Treasury-Eurodollar or TED spread, the spread in this swap will be driven in large part by differences in liquidity and credit quality in the two markets.
The six-month Treasury rate is the rate on zero-coupon securities issued by the U.S. Treasury and backed by its full faith and credit. If market participants agree that the government has no default risk over the next six months, this rate is determined primarily by the classic equation postulated by Irving Fisher in 1930. According to the Fisher equation, the six-month Treasury rate is approximately equal to the six-month “real” rate of interest—or, as Fisher characterized it, the marginal “rate of time preference” consumers have for consumption today vis-à-vis consumption tomorrow—plus the rate of inflation expected to prevail over the next six months.

Now consider six-month LIBOR, which represents some average of rates at which commercial banks offer to lend money to other commercial banks in the Eurodeposit market. In the absence of any differential liquidity effects, six-month LIBOR is basically the same rate except for the important distinction that LIBOR is determined by commercial banks that can, in principle, default on their obligations. Yet, this distinction is enough not only to keep six-month LIBOR at a premium to six-month Treasury rates but also to ensure that premium fluctuates—sometimes quite a lot, as Figure 1.1 shows. Because liquidity effects are not the same in both markets and cannot be assumed away, some of these fluctuations may owe to liquidity and not credit considerations. But at least some component of the TED spread reflects changing perceptions of banks about the likelihood of default by their counterparties.

**FIGURE 1.1** The TED spread (month-end, Sept. 1989–May 2000).
*Sources:* FNMA (LIBOR) and Federal Reserve Board (Treasury).
A bank that borrows from another bank in the form of a six-month term Eurodeposit bears direct default risk and resale risk to the extent the deposit is marked to market. But both of these are clearly credit risks. Now return to our basis swap between Companies Ludlum and LeCarré. Because neither firm is a bank, neither firm participates in the determination of LIBOR nor bears any direct default or resale risk in LIBOR. The two companies do, however, bear market risk that is driven by changes in the TED spread, at least part of which is determined by the credit risk of banks that participate in the Eurodeposit market.

In simple terms, indirect credit risk or credit-dependent market risk is the risk that the present value of a bundle of cash flows can change when the credit quality of a third party (i.e., neither creditor nor debtor in the actual transaction in question) appears to change. Company Ludlum loses money when the banks that determine LIBOR experience an increase in perceived default risk, which places upward pressure on LIBOR relative to the default-free Treasury rate. For Ludlum, this is the market risk of the swap, but it is driven in part by the credit risk of the participants that determine the reference rate in the swap.

Note that Ludlum and LeCarré also bear direct credit risk in the swap, as well. As the swap moves into-the-money for LeCarré when the TED spread widens, LeCarré now bears the risk that Ludlum will default on its payments to LeCarré. Although the size of the loss to which LeCarré is exposed depends on LIBOR, the risk of a default actually occurring is the credit risk of Company Ludlum. So, the perceived default risk of Ludlum impacts the direct credit risk of the swap from LeCarré’s perspective, whereas the perceived default risk of participants in the Eurodeposit market impacts the indirect credit risk or credit-dependent market risk of the swap.

**Operational Risk**

Operational risk is the risk that failures in computer systems, internal supervision and control, or events such as natural disasters will impose unexpected losses on a firm’s derivatives positions. Consider a firm that enters into a variety of customized transactions—financial and commercial—governed by nonstandard contracts rather than master agreements. If the firm has a fire and its documentation is destroyed, its portfolio might literally become unidentifiable in a matter of minutes.

Other aspects of operational risk relate to personnel quality and internal controls. Fraud or irresponsible trading activities by employees is a type of operational risk. Alternatively, employing personnel whose skills are not adequate to carry out their tasks responsibly is also an operational risk, and can have consequences as significant as fraud.
In the case of operational risk, the problems tend to arise because inadequate attention was paid to some process or system or because personnel either fail to perform their duties or have ill-specified responsibilities. Counterintuitive as it sounds, people thus tend to be at the root of most operational risks, which inevitably arise from someone making a questionable decision—either by mistake or on purpose.

**Legal Risk**

Legal risk is the risk that a firm will incur a loss if a contract it thought was enforceable actually is not. The Global Derivatives Study Group (1993) identified several sources of legal risk for innovative financial instruments that are often associated with risk management, including conflicts between oral contract formation and the statutes of frauds in certain countries and jurisdictions, the capacity of certain entities (e.g., municipalities) to enter into certain types of transactions, the enforceability of close-out netting, and the legality of financial instruments. In addition, unexpected changes in laws and regulations can expose firms to potential losses, as well.

**Capacity** Some concern remains about the legal authority or capacity of certain entities—most prominently municipalities—to enter into privately negotiated derivatives transactions. In a well-publicized 1991 case before the U.K. House of Lords, it was determined that the Hammersmith borough of London did not have the statutory capacity to enter into the numerous swap transactions that it had been negotiating since 1981. The Law Lords held that “a local authority has no power to enter into a swap transaction,” thereby rendering the contracts *ultra vires*. That ruling of the House of Lords invalidated swap agreements between more than 130 councils and 75 major banks, and it reportedly resulted in over $1 billion in total losses to counterparties.6

Concern persists in the marketplace that counterparties to certain types of financial transactions, still including many swaps, may not have the legal capacity—or, more recently, the suitability—to enter those transactions, thereby giving rise to fears that the Hammersmith experience could be repeated in the future.

**Selective Enforceability** Selectively enforcing or “cherry-picking” only the favorable terms in a contract is another form of legal risk. For example, close-out netting allows two counterparties to net any payment obligations after an event of default by one of the counterparties triggers the early termination of contracts between the two counterparties. Suppose two U.S. nonfinancial corporations, Company Victoria and Company Jungfrau, enter into a simple
interest rate swap that stipulates close-out netting. One year before the last settlement date, Company Victoria owes Company Jungfrau $1 million, and Company Jungfrau owes Company Victoria $1.1 million—which means that Jungfrau owes $100,000 to Victoria in the event of default by either firm. But if the netting provision of the swap is unenforceable and Company Jungfrau defaults, it may insist on collecting the gross $1 million from Company Victoria even though it cannot pay the $1.1 million in return.

Legality The legality of certain transactions like derivatives occasionally is called into question because of broadly or improperly written laws. In the United States, for example, state anti-gambling laws have sometimes inadvertently included certain types of derivatives and rendered them illegal.

Regulatory risk is the related risk that actions taken by regulators constitute events that can unexpectedly raise costs and risks for market participants. Financial instruments can be highly specific, customized products. In contrast, statutory regulations are general and inflexible. Forcing the regulation of financial innovation into an inflexible statutory and administrative law infrastructure in which regulators must operate is rather like instructing a child to insert a square peg into a round hole. Despite the futility, an obedient child will try to make the peg fit, often with disastrous consequences for the peg.

Regulatory risk can take two forms. First, procedural regulatory risk is the risk that legal uncertainties and financial losses will result from ill-conceived and costly changes to statutory or administrative regulations. Congressional actions precipitate the first, and unilateral regulatory actions the latter.

The second type of regulatory risk is judgmental regulatory risk. This risk stems from inadequately informed examiners and regulatory auditors who attempt to review the derivatives activities of a firm based on incomplete information. Very complex, dynamic trading strategies can be difficult to explain to examiners in a short period of time. Examiners may be likely to draw conclusions based on conservatism, thereby resulting in actions taken to discourage the use of such complex programs. Similarly, examiners and regulatory auditors may not possess the quantitative skills necessary to evaluate the mathematical models used by firms for risk management.

Other Risks
The risks discussed above—market, liquidity, credit, operational, and legal—are the primary risks on which the Global Derivatives Study Group (1993) focused. These risks are called—somewhat misleadingly—financial risks. In addition, there are many other risks with which a firm may need to concern itself, sometimes merely on an ad hoc basis and sometimes through
its regular risk management process. These risks will differ in importance from one firm to the next, and the examples that follow are risks that fall outside the classic Group of Thirty taxonomy.

**Intellectual Risk**  Intellectual risk arises in the event that personnel with specialized knowledge leave a firm and make it difficult for the firm to continue managing the risks of its positions and portfolios. Suppose a firm keeps poor records of derivatives positions, payment schedules, and hedging policies. If key trading personnel leave the firm, the company could miss payments or incur losses on the portfolio as prices change due to a failure of understanding of any dynamic hedging strategies in place.

More realistic examples of intellectual risk occur in large firms with complex bureaucracies. Senior management may fail to realize how important one or two workers are for identifying records, reports, or risk exposures. If those people take ill or leave on vacation, not to mention switch jobs, losses may be incurred in a fast-moving market while important information is located and retrieved.

**Customer Loss Risk**  At the core of risks facing a business is the risk that the business loses its customers, either because a competitor attracts them away or because they no longer demand the products and services you are selling at the prices you are quoting. Customer loss risk thus encompasses pricing risk, or the risk that firms misestimate either the level or the structure of prices for their customers.

The importance of customer retention has been vividly illustrated by the recent boom in internet commerce. To a start-up Web company, its ability to accurately assess customer value is everything. Only when those values can be compared accurately to the cost of customer acquisition can the business truly be valued. For this reason, attention to customer loss risk and customer valuation has perhaps never been higher.

Nevertheless, customer loss risk is just as important—Perhaps the real core risk of operating a profitable business—for all types of firms. An airline must worry about customer loss just as much as an online bookstore. And a consulting firm must be as attentive as an airline. And so on. If either the demand curve shifts in for exogenous reasons or available substitutes for the good or service being sold become relatively more attractive, the business is in trouble.

**Supply Chain Risks**  Many nonfinancial firms also face risks from adverse events that may occur at any point along a physical supply chain, or the chain that connects inputs to the firm’s production process to its outputs. For a typical nonfinancial firm, the physical supply chain and examples of what occurs at each stage are shown in Figure 1.2.
Problems may arise at any juncture in this supply chain. Consider, for example, a firm that grows wheat, mills it into flour, and exports the flour to bread makers around the world. Problems could arise at origination from disease, bad weather, vandalism, or any number of other factors that prevent the crop from being grown and brought in according to schedule (both time and quantity). At the transformation stage, equipment breakdowns could occur, contamination of the grain is a possibility, and losses of product during transportation a consideration, and so on. In short, the firm faces some form of inventory or product risk at every stage here.

**Diversifiability**

The event-driven taxonomy of risk discussed previously differentiates types of risk based on the type of event that might trigger a loss. Whereas this nomenclature is popular with risk managers and treasurers, an alternative lens through which to view risk is more popular with academics, portfolio managers, and investors. This perspective on risk differentiates between only two types of risk—the risks that a firm can diversify or hedge away, and the risks that it cannot. Diversifiable or idiosyncratic risks in any bundle of cash flows are those risks particular to the bundle of cash flows in question, including the features of the firm holding the bundle of cash flows. Systematic risk, by contrast, refers to changes in the values of assets that are driven by movements in some risk factors that affect all bundles of cash flows.

To divide the total risk of an exposure into idiosyncratic and systematic components, some set of systematic risk factors must be defined. A systematic risk factor is any economic factor (e.g., aggregate consumption growth) whose changes drive all asset prices. The impact of a change in a risk factor on any particular asset price may be different depending on the asset, but if the risk factor is truly systematic, it affects all asset prices in some way.
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The Single-Factor CAPM

The most popular way to decompose risk into idiosyncratic and systematic components is using the single-factor capital asset pricing model (CAPM) of Sharpe, Lintner, Mossin, and Black. In the CAPM, the return on any asset \( j \) is related to a single risk factor, the return on the market portfolio. Specifically, the CAPM implies that the excess return on any asset \( j \) (i.e., return in excess of the risk-free rate) is proportional to the covariance of the return of that asset with returns on the market portfolio and to the excess return on the market portfolio. Although the model involves the true market portfolio of all invested wealth and the true risk-free rate, we usually measure these variables using a broad equity index (e.g., the S&P 500) and the U.S. Treasury bill rate, respectively.

Mathematically, the CAPM implies the following for any asset \( j \):

\[
E(R_j) - R_f = \beta_j [E(R_m) - R_f]
\]  

(1.1)

where \( E(R_j) \) is the expected return on asset \( j \); \( R_f \) is the risk-free rate (i.e., Treasury bill rate); \( E(R_m) \) is the expected return on the market; and:

\[
\beta_j = \frac{\text{cov}(R_m, R_j)}{\text{var}(R_m)}
\]

The parameter \( \beta_j \) measures the degree to which changes in the systematic risk factor—the market—impacts changes in expected asset returns. In other words, the expected excess return on the market portfolio is the risk factor, and \( \beta_j \) is the “price” of that risk factor in asset \( j \). The price of market risk may be different for different assets, because both \( \beta_j \) and \( E(R_j) \) differ for different assets and portfolios. Nevertheless, the characterization of expected excess returns on the market as a systematic risk factor means that the excess return on the market always affects excess returns on assets somehow.

The CAPM is called a single-factor model because excess returns on all assets are systematically affected by only one factor—the excess return on the market portfolio. In the CAPM, all systematic risk thus is reflected in the relation between expected asset returns and expected market returns, and the price of this systematic risk—the degree to which it affects returns on a particular asset—is reflected fully in beta.

Any particular asset also may be affected by idiosyncratic risk, or market risk that is specific to the asset in question. To see the impact of systematic
risk on the return on any asset \( j \), we can rewrite the CAPM relation in Equation 1.1 without using expected values as follows:

\[
R_j - R_f = \beta_j (R_m - R_f) + \epsilon_j
\]

(1.2)

where \( \epsilon \) is a term that reflects the idiosyncratic risk of the asset. Equation 1.2 essentially says that the actual return on asset \( j \) is equal to the risk-free rate plus the asset’s beta times the actual excess return on the market plus a shock that reflects risk specific to asset \( j \). If the expected value of \( \epsilon \) is zero, the above equation becomes the CAPM equation in expected value terms. If \( R_j \) is the actual return on some well-diversified portfolio \( j \) rather than a single asset, the assumption that \( E(\epsilon) = 0 \) is equivalent to presuming that the diversification effects of the portfolio cause all idiosyncratic risks to net out.

**Multifactor Asset Pricing Models**

The CAPM has been sharply criticized as an unrealistic representation of systematic risk. Specifically, significant academic work has shown that the excess return on the market is not the only factor that significantly affects all asset returns. Other systematic risk factors known to affect all stock returns, for example, include leverage, market capitalization, dividend yields, and the ratio of book to market equity.

Numerous alternatives to the CAPM have been proposed that presume excess returns on any asset are a function of multiple systematic risk factors. The particular factors differ depending on the particular model in question, but the basic form of the relation is usually the same:

\[
R_j - R_f = \delta_1 \gamma_1 + \delta_2 \gamma_2 + \cdots + \delta_k \gamma_k + \epsilon_j
\]

(1.3)

where \( \gamma_1 \) is the first systematic risk factor and \( \delta_i \) is the “price” of the first risk factor in asset \( j \). In other words, \( \delta_i \) measures the sensitivity of returns on asset or portfolio \( j \) to changes in the first systematic risk factor, and so on for the other risk factors through \( k \). The number of risk factors, \( k \), can be small or large depending on the particular model, all of which collectively reflect the systematic risk of asset \( j \)’s returns. Like the CAPM, the term \( \epsilon \) reflects the idiosyncratic risk of asset or portfolio \( j \) (i.e., that risk which is specific to asset or portfolio \( j \)).

Identifying systematic risk factors can be difficult, and the systematic risk factors usually need to have a few important characteristics. The idiosyncratic risk term should be uncorrelated with all the systematic risk factors—\( \text{cov}(\gamma_m, \epsilon) = 0 \) for all \( m \). In addition, the systematic risk factors should
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exhaustively span all of the possible sources of systematic risk impacting asset prices. Some factors that fall into these categories are macroeconomic, such as real consumption growth. Other factors cannot be identified directly, so factor-mimicking portfolios—portfolios whose returns are perfectly correlated with the underlying risk factor—must be chosen as substitutes.

FINANCIAL VERSUS BUSINESS RISK

Yet a third perspective on risk attempts to distinguish between financial and business risks.10 Put most simply, financial risks are those that a firm is not in the business of bearing and business risks are those that the firm must bear in order to operate its primary business.

The distinction between the concepts of business and financial risk was proposed by Frank Knight (1921). Knight defined financial risk as risk, or situations in which the randomness facing a firm can be expressed in terms of specific, numerical probabilities. These probabilities may be objective (as in a lottery) or subjective (as in a horse race), but they must be quantifiable. Because they can be quantified, they can be managed. Financial risk is thus a risk that firms can avoid.

Unlike risk, Knight defined uncertainty as situations when a firm faces some randomness that cannot be expressed in terms of the probabilities of alternative outcomes. This was business risk in Knight’s eyes, or the risks about which only the firm in question had some perceived special insight. To Knight, uncertainty was the source of all major profits and losses to businesses. Lord Keynes agreed, choosing the term animal spirits to describe essentially the same phenomenon.

In this context, the distinction between business and financial risk—Knightian uncertainty and risk—is driven purely by information. Those factors about which a firm perceives itself as having some comparative informational advantage will be those factors on which the business concentrates for its core business cash flows. Risks about which the firm has comparatively less information will be those risks more likely to be hedged, diversified away, or controlled in some other fashion.

The distinction between business and financial risk clearly rests on a slippery slope. Not only does it vary from one firm to the next, but it also depends not on the quality of information the firm actually has, but rather on the firm’s perceived comparative advantage in digesting that information. Perceptions, of course, can be wrong. Businesses fail, after all, with an almost comforting degree of regularity. Without business failures, one might tend to suspect the market is not working quite right. Accordingly, the preponderance of actual business failures clearly means that some firms thought they had a better handle on information than they did, whether
that information concerns market demand for their products, their competitors, or their costs.

Despite the vagaries of distinguishing between business and financial risk, the distinction is an important one conceptually and pedagogically for the rest of this book. As will become clearer later, successful business strategy is also in large part about exploiting perceived comparative informational advantages—loading up on the risks the firm is uniquely positioned to handle, and getting rid of the other ones.

**RELATIONS BETWEEN THE THREE PERSPECTIVES**

As noted at the beginning of this chapter, the three perspectives on risk are not independent. On the contrary, they are *equivalent* ways of looking at the same picture from different angles. Indeed, the primary reason that these three perspectives coexist is the disparity in audiences and in why risks are being examined at all.

The academic perspective of risk is the second one, which views risk as either systematic or idiosyncratic. As noted, the operationalization of this concept is hindered by the dependence of the concept on the “correct” asset pricing model. But as a concept, it is both a perfectly legitimate way to view risk *and* perfectly consistent with the other two. Whatever risk factors are used to characterize systematic risk, the basic principle of portfolio diversification means that *any* event-based risk types are idiosyncratic if they can be diversified away. Accordingly, *all* of the event-based risk types are firm-specific, idiosyncratic, and diversifiable.11

Market risk as defined in the event-based risk taxonomy may be either systematic or idiosyncratic from a diversifiability risk perspective. The risk of commodity price changes on a gold mine’s cash flows is clearly idiosyncratic, but the risk of marketwide changes in the value-weighted portfolio of world stocks and bonds is clearly systematic, even though both are sources of market risk for the gold mine. The particular perspective adopted depends on the business strategy of the firm in the context of its risk management initiatives.

Similarly, gold price fluctuations that represent market risk in the event-based risk nomenclature and idiosyncratic risk in the diversifiability definition of risk can be *either* a business *or* a financial risk. Whether gold price fluctuations represent a source of financial risk that the firm may wish to hedge or represent an opportunity that the firm may wish to exploit is unclear *ex ante*. Indeed, the fact that some gold mining firms hedge and others do not is a strong indication that the distinction between business and financial risk is far from obvious. (For an excellent analysis of hedging in the gold mining industry, see Tuffaro [1996].)