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FREE SOLO

A DISCOURSE ON ASSESING AND MANAGING INVESTMENT RISK

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BY ROB NICOSKI, CFA

Recently, I was scrolling through the limitless selection of movie titles offered by a prominent online video streaming service when my attention was drawn to a documentary titled, *Free Solo*. The cover art for the film beautifully captured an iconic vertical rock formation in Yosemite National Park called El Capitan. On the face of this 3,000-foot sheer granite wall, about halfway to the top, was a solitary climber. Amazingly he had no safety apparatus. He was completely untethered – no rope, no harness, nada.

At the time I was unaware of the fact that "free soloing" literally refers to the act of rock climbing unassisted by safety equipment. I'm not sure that knowledge would have changed my initial reaction, which was to question this young man's sanity. The thought of him plunging to his death was unnerving to say the least. Yet, I was drawn to the prospect of gaining a better understanding of why someone would consciously accept what appeared to be an intolerable level of risk.

As the documentary unfolded, my original knee-jerk assessment of the risk involved in his venture began to gradually shift. Yes, the prospect of this man plunging to his death was still a horrifying possibility; it's apparently not uncommon in this type of pursuit. However, contrary to my preliminary assessment, he is not some lunatic with a death wish screaming "Watch this!" as he scurries haphazardly up the side of the cliff. His name is Alex Honnold, and he is one of the most accomplished free solo climbers in the world.

The documentary outlines Mr. Honnold's attempt to be the first person to free solo El Capitan. It is difficult to imagine an endeavor more fraught with risk than climbing a vertical wall of granite three times the height of the tallest skyscrapers in the world with no tether. At times, I found it impossible not to recoil in fear for his safety. Yet, over the course of the film it became apparent that Mr. Honnold is not just an accomplished climber, he is also a master of risk management. I admit this assertion likely sounds ridiculous given he is intentionally accepting what most of us would consider a foolish level of life-threatening risk, but it is highly unlikely he could have survived more than one thousand free solo climbs without a serious and effective commitment to mitigating risk.

I began to appreciate that Mr. Honnold applies a surprisingly rational approach to an irrational activity. While the documentary seizes on the sensational quality of his quest, it also explores how Mr. Honnold integrates risk management into every aspect of his preparation. He carefully researches and maps out his preferred route up the face of the mountain — scrutinizing and documenting the nuances of each nook and cranny. Then he practices and memorizes the features of every foot and handhold he will use during his ascent. At one point, he abruptly abandons his climb because "it did not feel right" that day; honoring the intuition developed over years of successful climbs. An underactive amygdala may have influenced his choice of vocation, but it did not undermine his comprehension of the lethal risks involved.

> "THE ESSENCE OF INVESTMENT MANAGEMENT IS THE MANAGEMENT OF RISK AND NOT THE MANAGEMENT OF RETURNS."
>
> -BENJAMIN GRAHAM
>
> AUTHOR OF *THE INTELLIGENT INVESTOR* AND *SECURITY ANALYSIS*

Clearly, free solo climbing is not an activity I would consider even in my least sensible moments (of which my wife Mary would argue there are far too many). Yet, his tale underscores the notion that even in the most perilous and frankly mindboggling endeavors, applying sound risk management principles can greatly reduce the probability of a catastrophic outcome. This is the essence of risk management.

There are two notable differences between Mr. Honnold's risky adventure and those of the investor–time horizon and continuous choice. When climbing, Mr. Honnold receives immediate feedback on his decisions. Make the right move, keep on climbing; make the

wrong move, plunge to serious injury or death. Feedback for investors is measured in years and decades—a fundamentally different time horizon. Second, once Mr. Honnold scaled partway up the mountain, he could not reverse his decision. He had to keep climbing. Investors in publicly traded securities have the ongoing ability to change their decisions. This is one of the greatest inventions in the history of capital markets; it is also the most misapplied.

Mr. Honnold had extreme motivation that comes from no escape. He could focus solely on the next step. Investors in public markets possess, daily, the ability to escape the vicissitudes of the market. They misuse this gift, favoring the easy ability to exit an investment over the need to make thoughtful, fact-based long-term decisions. Proper risk management would suggest they should invest as if there were no escape, that they should purchase securities with the intention of never selling. They should only change their investments based on a careful assessment of the known facts. Mr. Honnold successfully managed extreme personal risk far beyond most investors. We all can learn from his example.

Like Mr. Honnold, investors are free to embrace strategies with varying degrees of risk. Ultimately, those investors who can effectively and continuously understand and mitigate risk have paved the way towards long-term investment success. Risk mitigation is not only fundamental to investing success, but also the only thing an investor totally controls. Benjamin Graham, the progenitor of modern security analysis, captured this oft misunderstood reality when he shrewdly observed, "The essence of investment management is the management of risk and not the management of returns."

UNIVERSAL PRINCIPLES OF RISK MANAGEMENT

It may seem odd in a paper advocating for prudent risk management to highlight an athlete that has dedicated his life to an unbelievably risky endeavor like free solo climbing. While we cannot answer the question of what drives Mr. Honnold to do what he does, we are in awe at what might be the single greatest athletic achievement of our lifetimes as well as a textbook example of how to mitigate risk when everything is on the line. Mr. Honnold demonstrated in dramatic fashion that a properly constructed risk management approach starts with a risk mitigation plan that carefully considers the specific risks associated with an activity or endeavor. This appreciation for the specific risks flows from a set of principles that clarify basic fundamental truths about risk and uncertainty.

Principle #1: Uncertainty is a fact of life

Voltaire once said, "Doubt is not a pleasant condition, but certainty is an absurd one." His was a brilliant observation on not just the folly and arrogance of professing certainty about future events, but also the immutable nature of uncertainty in human affairs in general. Uncertainty is a fact of life that we must all accept. It guarantees the consequences of our actions cannot be exactly known or fully defined in advance, because all practical endeavors have an element of unknowability or unpredictability.

Generally, the more complex the system, the greater the degree of uncertainty. This equates to a much broader range of possible outcomes. For instance, the spread of potential outcomes for the level of the stock market one-year out is quite wide based on historical experience. This is because the market is a highly complex system driven by the independent decisions of millions of participants – leading to a dizzying array of possible outcomes. This is why we waste no time trying to predict future stock market levels or highly complex systems in general.

In contrast, systems with more limited or concentrated possibilities are more amenable to prediction. However, uncertainty guarantees that even activities with narrowly constrained outcomes still have indeterminate results. Take flipping a coin for example. There are only two possible outcomes – heads or tails. We can assert with a high degree of confidence that if we flipped a coin thousands of times the collective results would converge on roughly half heads and half tails; yet, on any one flip the outcome is completely unknowable.

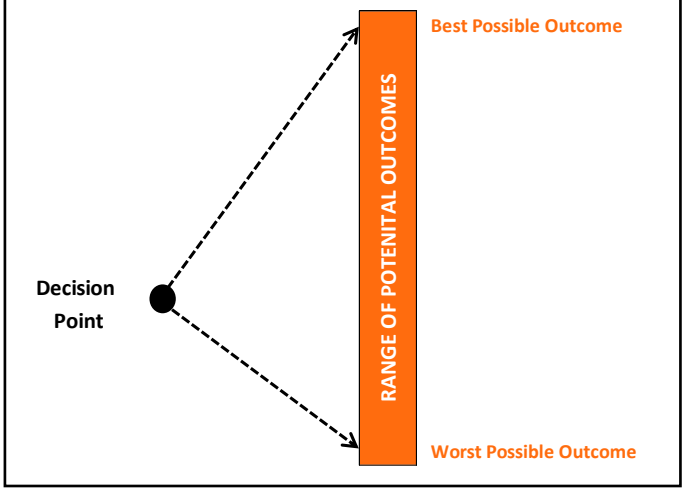
This element of unknowability does not mean we are helpless to make decisions in the face of uncertainty, but it does suggest we

Risk Management Versus Risk Mitigation

The terms risk "management" and risk "mitigation" are often used interchangeably. There are, however, subtle differences that are important to understand. Risk management is a comprehensive system for controlling exposure to and the impact of risk. It represents a strategic framework for addressing risk in any endeavor. Risk mitigation is part of the risk management process. Risk mitigation speaks to the diverse set of tools or tactical approaches one can employ to reduce the chance of a risky outcome as part of a systematic risk management process. In those circumstances where risk cannot be reduced to an acceptable level (aka, mitigated) the outright avoidance becomes the only sensible choice.

should have a plan. Since we are generally most concerned with the relative desirability of the consequences of our actions (i.e., Are the outcomes more likely to be good or bad?), this strikes us as a logical starting point for constructing a framework to deal with uncertainty. We capture this common normative view of uncertainty in Figure 1. The orange column represents the range of outcomes for a hypothetical decision sorted by the perceived utility. The best- and worst-case scenarios set the outer boundaries.

Figure 1: Orange shaded area represents all possible outcomes for a decision



Putting boundaries (even fuzzy ones) around the range of potential outcomes helps us understand the full scope of possibilities (good, bad and indifferent) that uncertainty represents. However, we humans are generally not concerned with the full spectrum of uncertain outcomes, for good reason our attention tends to fall disproportionately on those outcomes that have the capacity to cause harm – a concept that we have come to call risk.

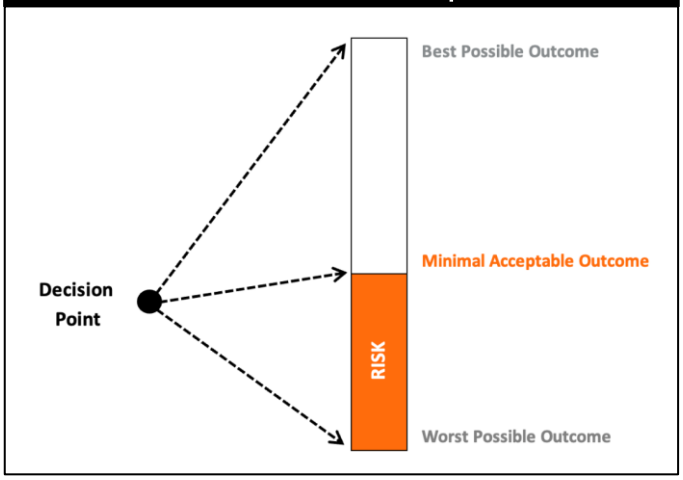
Principle #2: Risk is the element of uncertainty that carries the threat of harm or loss

Humans intuitively grasp the notion of risk. We recognize that even though our behavior may be geared to elicit a positive outcome, negative consequences are generally likely as well. We have come to associate the gamut of potential unfavorable outcomes with the concept of risk. The specifics of these adverse consequences may conjure varying images in each of our minds, but humans generally concur that *risk is the potential for harm or loss.*

As a first step in building an understanding of risk that can allow us to eventually more effectively manage it, we find it helpful to think of risk as any outcome that falls below a "minimal acceptable result." Think of this as the threshold at which an effect begins to represent risk. For an everyday activity like driving a car, the minimal acceptable outcome might be making it to the target destination without injury or damage to the vehicle. Any result that falls short of a safe arrival would constitute risk.

In Figure 2 we use the same graphic illustration as before to specify where risk falls within the full continuum of uncertain outcomes. In the case of our illustration, any outcome below the "Minimal Acceptable Outcome" constitutes risk (shaded orange). It is easy to see in Figure 2 how risk is actually a subset of uncertainty; that portion of uncertain outcomes that carry the potential to cause harm.

Figure 2: Risk is represented by all potential outcomes below the minimal accepted outcome



The minimal acceptable outcome is unique to the decision maker. In the case of free solo climbing, we probably can achieve broad agreement that the minimal acceptable outcome is "completing the climb without suffering a serious injury or worse." For investing, the minimal acceptable outcome may vary considerably based on each investor's particular goals, liquidity needs and risk tolerance.

Risk is also a highly dynamic variable, arguably more volatile than uncertainty. This can be seen in activities where even subtle changes in context have the potential to meaningfully alter risk exposure. Such a change can shift the range of potential outcomes

(e.g., shrink or expand it) and/or modify the likelihood of different outcomes occurring (e.g., skewing the probabilities toward more negative or positive outcomes). For instance, in 2021 valuation risk in the equity markets was excessive according to our work; by late 2022 valuation risk had been reduced and largely removed from most publicly traded companies. This rapid shift in investor perception precipitated a sharp decline in market prices over the course of 6-9 months and led to an entirely different risk profile for stocks.

An ability to assess shifts in context and the impact on risk is a function of expertise, self-awareness and a willingness to acknowledge changes in circumstances and adjust accordingly. We get a glimpse of this with Mr. Honnold. Over the course of his practice runs on El Capitan, he recognizes that he does not want to be on certain parts of the climb when the sun is at the wrong angle as it will sap his stamina and increase the odds of a fatal mistake. He chooses to start his climb before dawn to avoid this potentially risky change in circumstances.

Finally, it is crucial for an investor to have a clear understanding of the difference between risk and uncertainty. The natural linkage between risk and uncertainty (i.e., risk is a subset of uncertainty) has caused many investors to conflate the two. The investment issue is that uncertainty in its entirety can generally not be managed, but risk can. Those investors who lump the two together will likely make faulty risk management decisions, thereby creating opportunities for those who properly separate them.

Principle #3: Probabilistic thinking is the most effective way to contend with uncertainty

On the surface the immutable nature of uncertainty and the dynamic nature of risk seems problematic, particularly in endeavors that require a reasonably accurate forecast of the future like investing. The reality is we all have an imperfect and variable view of what the future holds. Fortunately, we possess a powerful cognitive tool to help us deal with uncertainty in any form – a sense of probabilities about future events.

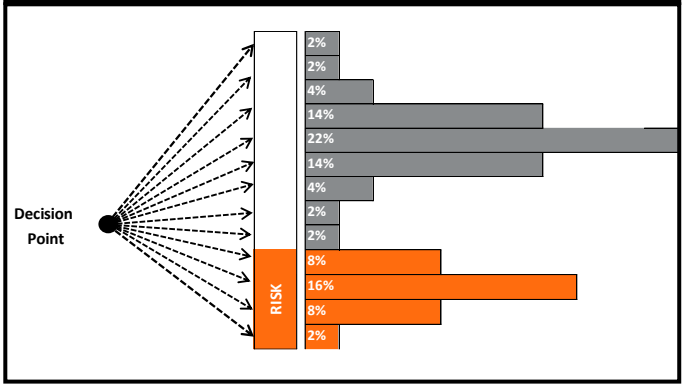
It is this ability to think probabilistically that allows us humans to make sense of an array of uncertain outcomes and move toward a decision. This is why even in the face of a puzzling and sometimes opaque set of possibilities humans tend to make most decisions with relative ease. Absent the ability to think probabilistically we would likely freeze up at the prospect of uncertainty or default entirely to emotional impulses. As we will discuss later, letting emotion drive our decision process will often push us toward suboptimal outcomes.

In practice, the probability-setting exercise generally involves assessing probabilities for the most likely as well as the most imaginably extreme outcomes. Much of this process is so embedded in repeated behavior patterns that we may no longer consciously recognize it as an exercise in probabilistic thinking. And of course, we rarely methodically assign numerical probabilities, instead we make general assessments like "highly likely" or "unlikely." Over time these assessments transform into cognitive shortcuts or heuristics that can be expanded to similar circumstances to promote decision-making efficiency.

In Figure 3, we demonstrate the probability setting process by overlaying a set of predicted probabilities on the continuum of possible outcomes from our previous examples. The bars on the right (both gray and orange) denote the estimated probability of occurrence for the various potential outcomes. The longer the bar, the higher the chance of realizing that specific outcome. The goal here is not to launch into some deeper treatise on probability theory, but to provide a visual representation of how one might mentally assess the consequences of a decision under uncertainty.

In this example, the likely consequences of the decision are centered around two outcomes, which are represented by the longest bars. What's worth noting is that a significant proportion of the possible outcomes (orange bars) lie beneath the minimum acceptable outcome and constitute risk as we have defined it. This should provide pause for our fictional decision maker.

Figure 3: Assigning probabilities to a range of possible outcomes



Of course, our inherent capacity for assessing probabilities does not mean our probabilistic conclusions are always accurate. It only suggests that even the least mathematically inclined among us routinely engage in a rudimentary form of probabilistic thinking to deal with uncertainty over the course of our typical day.

We expect some pushback at this point. We imagine it would take the following form, "You just asserted that uncertainty is unknowable. How can we possibly assess the unknowable?" This requires a point of clarification. The unknowable part of uncertainty refers to our inability to predict the ultimate outcome with 100% certainty. It does not mean that we cannot anticipate the most likely outcomes. Admittedly, we will never have absolute certainty, and there will always be situations that fall outside our ability to foresee–the proverbial "unknown, unknowns." The good news is that we can manage for these blind spots.

Managing blind spots starts with drawing more of the possibilities into our range of vision. This is accomplished through a combination of deep analysis, experience and deliberate practice that expands our scope of expertise and the associated ability to anticipate the future. The free solo ascents Mr. Honnold completed before El Capitan combined with his preparatory climbs to evaluate the face of the cliff undoubtedly allowed him to anticipate many of the possible pitfalls that would fall outside the purview of a less experienced climber. Our push to develop a comprehensive understanding of each company we look to invest in combined with a growing body of successes and failures serves a similar role in our investment process.

ABSENT THE ABILITY TO THINK PROBABILISTICALLY WE WOULD LIKELY FREEZE UP AT THE PROSPECT OF UNCERTAINTY OR DEFAULT ENTIRELY TO EMOTIONAL IMPULSES.

Second, the reality is that for most decisions some outcomes are far more likely than others. Rarely does life mirror a coin flip where all outcomes are equally possible; life is not a 50/50 proposition. This is important because it allows us to focus our attention on positive outcomes (opportunities) that are highly probable as well as the full range of potential adverse outcomes (risk). This allows a rational approach to uncertainty and risk without having to "know" every possible outcome for a considered action.

Third, there are proven strategies for improving our predictive accuracy. In his book, *Superforecasting*, prediction researcher Philip Tetlock provides compelling evidence that average people can become quite accomplished at making accurate long-term predictions under extreme uncertainty provided they are probabilistic, self-critical thinkers that ground their views in facts and make frequent updates to their forecasts based on the weight of the evidence. Mr. Tetlock's insights are derived from decades of research on prediction tournaments as well as his role as co-creator of the Good Judgement Project.*

Fourth, for those outcomes that will always lie outside our ability to anticipate we employ a strategy of prudent diversification. Diversification does not guarantee a positive outcome in the event an unknown unknown comes to fruition, but it does minimize the impact of one.

The point is even though uncertainty is an inescapable fact of life, intentional effort underpinned by relevant knowledge, experience and sound process allows us to replace blind uncertainty with informed probabilities. This empowers us to make sound predictions and provides insights that guide us toward risk mitigating actions where the odds of a positive outcome are tilted in our favor.

Principle #4: Human perception of risk is often distorted

There is another uniquely human attribute we need to consider if we are to develop an effective framework for assessing uncertainty and managing risk: humans are emotional creatures, not rational decision-making automatons, and emotion can skew behavior in ways that hinder optimal decision making. Pioneering psychologist and behavioral economist Daniel Kahneman aptly captured this all-too-human tendency when he observed that we are "guided by the immediate emotional impact of gains and losses, not by long-term prospects for wealth and global utility." In other words, emotional influences often override more strategic considerations in the average human's thought processes.

In his opus, *Thinking Fast and Slow*, Mr. Kahneman refers to the fast-acting, reflexive part of our cognitive processes as System 1 and the deliberate, logical part as System 2. He argues that "System 1 operates automatically and quickly with little or no effort and no sense of voluntary control." System 1 is essentially a pattern-recognition machine designed for efficiency of action. System 1 has a substantial unconscious influence on our decisions that leaves us prone to systematic cognitive errors, or biases.

These cognitive errors recur predictably under testing. For instance, whether we realize it or not, we homo sapiens are far more sensitive to the potential for loss than gain. A pioneering 1984 paper by Mr. Kahneman and Amos Tversky introduced a behavioral bias that is commonly referred to as loss aversion. Through their research, they established that when faced with an equivalent loss and gain the average individual perceives the "pain" of the loss to be roughly twice the "benefit" of the gain.

*The Good Judgement Project is a partnership with the Intelligence Advanced Research Projects Activity (IARPA), which is focused on improving the accuracy of probability judgements of high-stakes, real-world events.

This perceptual asymmetry between positive and negative expectations leads to overly risk-averse behavior. For instance, an exaggerated sense of risk may cause an investor to pass on intriguing investment opportunities. It also helps explain why investors commonly experience an intense urge to "cut their losses" during periods of market duress even though they may rationally comprehend that substantial market declines offer compelling long-term buying opportunities.

WHETHER WE REALIZE IT OR NOT, WE HOMO SAPIENS ARE FAR MORE SENSITIVE TO THE POTENTIAL FOR LOSS THAN GAIN.

A second well-documented cognitive error referred to as the endowment effect causes humans to underestimate financial risk in certain situations. The endowment effect describes a perceived value change based on a difference in reference points. The reference point is ownership. Humans tend to place a higher value on an object if they own it versus if they do not own it. The endowment effect can cause an investor to overestimate the value of an existing portfolio holding and, as a consequence, underestimate the associated risk.

Loss aversion and the endowment effect are just two of the cognitive errors in a long list that have demonstrated the ability to unwittingly skew decision-making in unhealthy directions. They are, however, two of the more impactful cognitive biases for investors – capable of severely distorting an investor's perception of value and risk.

Yet, investors need not let their reflexive System 1 and its cognitive perturbations derail efforts to prudently assess and manage risk. Once an investor is aware of these distortions, they can protect from suboptimal decision making with process discipline. Sound process allows the investor to defend against knee-jerk decision making and purposefully engage in logic-minded System 2 thinking.

This ability to forestall System 1 impulses (i.e., slow down the decision-making process) to allow for a sober analysis of the risks might be Mr. Honnold's greatest weapon for surviving and thriving in one of the world's most dangerous occupations. His athletic conditioning and climbing expertise are surely indispensable as a lack of either would undoubtedly have led to failure on his attempt to summit El Capitan; however, many fit and talented climbers have failed at less challenging climbs, just as many intelligent and talented investors have destroyed untold amounts of wealth. The difference lies in an ability to properly harness the unique skillset he possesses with minimal emotional influences.

The impact of autonomic cognitive processes on our decision-making calls to mind a quote by Nobel prize-winning physicist Richard Feynman. Mr. Feynman once quipped: "Imagine how much harder physics would be if electrons had feelings." Mr. Feynman was probably not directing his comments at the practice of investing specifically, but he very well could have been. Investing is an enterprise awash with emotions (especially fear and greed) and the decision-making distortions it leaves in its wake. Investors need to consider this reality to ensure it does not unwittingly undermine sound decision making.

Principle #5: Margin of safety is the only reliable way to manage risk

Since uncertainty guarantees the consequences of our actions cannot be exactly known or fully defined in advance, we must be prepared to accept a degree of unpredictability in each of our decisions. However, accepting the inescapable nature of uncertainty does not mean it is impossible to prepare for the potential risk it engenders. This is where we call upon the risk-mitigating power of margin of safety.

Margin of safety is the only reliable way to navigate risk in an uncertain world. Incorporating a margin of safety into our decisions does not eliminate risk (even multiple rolls of bubble wrap cannot do that), but it can *reduce the odds that an adverse event will become catastrophic*. In this context, catastrophic refers to a consequential and irrecoverable loss. Humans routinely use the concept of margin of safety to avoid disastrous outcomes. This is evident in everyday life such as when we choose to wear our seat belt when driving or set down the scissors before deciding to run.

We see this awareness of the importance of margin of safety in Mr. Honnold's preparation for his climb of El Capitan. He attempted a physical feat in which there was no room for error. Yet he survived. We think his entire training regimen and risk management approach was oriented around this inescapable fact. Perhaps the most memorable part of the documentary was his first attempt to scale the mountain. He climbed partway then decided this was not the right day. He likely felt humiliated abandoning his

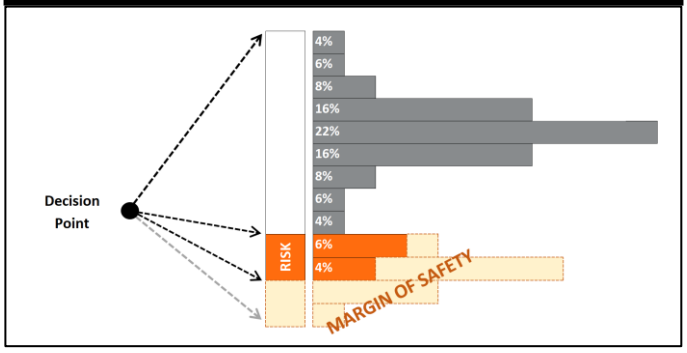
climb. We would guess he realized that on that particular day his personal margin of safety was not wide enough given the severe consequences of failure.

Admittedly, Mr. Honnold readily assumes extreme levels of risk; risks that the average person would not willingly accept. Yet, the fact that he has been able to complete hundreds of free solo climbs without a life-altering (or life-ending) injury only serves to reinforce the importance of margin of safety.

Properly applied, margin of safety reduces the odds of a risky outcome for any activity, even one as dangerous as free solo climbing. We illustrate this general principle in Figure 4. Figure 4 utilizes the same decision and probability framework from the previous illustrations. However, this time we assume that a margin of safety has been incorporated into the decision. The margin of safety (light yellow shading) has reduced the potential of a risky consequence by shifting the probabilities from the previous illustration to favor a more positive outcome. Now only a small fraction of the likely outcomes carries the potential for causing harm. Additionally, the likelihood of a catastrophic event has been greatly reduced.

This hypothetical example could represent the classic investing decision of waiting to purchase a stock until after the price declines to a level that skews the probabilities toward more favorable outcomes by reducing the valuation risk. It could also represent a climber deciding to use a rope and safety harness rather than free soloing their way up the mountain side. Both represent tangible ways to incorporate a larger margin of safety into the decision.

Figure 4: Margin of safety reduces the odds of an adverse event becoming catastrophic



The concept of margin of safety applies equally to all manner of risky activities. However, in practice we need to thoroughly understand the distinct nature of the risk involved if we are to properly build a margin of safety into our decision process. This means expertise and experience have a significant influence on one's ability to not only recognize the risk inherent in our chosen activities, but also to constitute a margin of safety that addresses the unique nature of the risk. We will have more to say on what this looks like for an equity investor when we discuss the particulars of our risk framework.

These five principles of risk management are more than philosophical rallying points. They are foundational assumptions that must be honored if a risk management framework is to be effective in protecting an investor's portfolio from long-term damage.

TWO COMPETING VIEWS OF INVESTMENT RISK

There is a view regarding risk and risk management that dominates the investment industry today; a view constructed in the ivory towers of academia We will refer to this notion of investment risk as the "Volatility View." We will spend some time dissecting this risk theory as its pervasive adoption argues for investors to be familiar with its basic precepts. We will argue that the Volatility View is fatally flawed. Even worse, it can lead investors into inappropriate types of risk mitigation plans. This is often the case because it violates the principles of risk management by misidentifying risk at a fundamental level. This mischaracterization of risk makes it impossible to properly apply the concept of margin of safety – a common and costly mistake for anyone adopting this risk management framework.

Fortunately, there is a second way – an alternative framework for measuring and mitigating risk that has been developed in the investment trenches by practitioners employing a combination of reason, evidence, and experiential feedback over many decades. This is the "Fundamental View" of managing investment risk. This framework may not offer the appealing theoretical sophistication of the Volatility View of risk, but it has been constructed to carefully incorporate the universal principles of risk management. Additionally, it has proven its risk-mitigating merits over decades of real-world application through every type of market cycle.

The Volatility View

The story of risk management in the modern investment industry begins with an academic theory conceived in the 1950s that ascended to industry dominance in the 1980s. This investment theory is known as Modern Portfolio Theory or MPT. A thorough examination of the benefits and drawbacks of MPT is beyond the scope of this paper. We will gear our comments toward the outsized influence of MPT on the investment industry's approach to measuring and managing risk.

MPT is an elegant theory. It has provided a useful framework for understanding some of the key variables that should be considered by any investor, the most notable of which is the concept of diversification. Diversification is a potent risk mitigation tool when properly applied (we will have more to say on this later) but many of the other conclusions, particularly as it relates to assessing and managing risk, do not hold up in practice.

Modern Portfolio Theory fails in practice because the entire underlying structure of MPT (and its sister theory, the Capital Asset Pricing Model) is based on one flawed overriding assumption. It assumes investors are always rational agents; that their decisions are based on optimizing portfolio returns. This is a serious and damaging assumption about the behavior of investors. We can imagine at least two primary ways investors deviate from this model.

First, investors are often more emotional than rational. Fear and greed are the two predominant emotions experienced by investors; many investment decisions are made to satisfy these emotions. Second, most investors have a process which can drive their decisions away from portfolio optimization. For example, average investment holding periods hover around six months. This time frame can drive decisions into the short term, away from long-term portfolio optimization. The bottom line is that reality clashes with the pivotal MPT assumption that investors routinely set aside emotion and bias to craft optimal decisions from the jumble of facts, rumors, and uncertainty common to the real world.

If investors are (mistakenly) believed to be rational actors, it naturally follows that financial markets will quickly and accurately incorporate all material information and investor insights into the price of a security. This putative rational behavior combined with the aggregating powers of the auction-based pricing mechanism leads MPT adherents to conclude that there is information content in the movement or *volatility* of security prices. Security price volatility becomes, theoretically speaking, a composite of investor sentiment that captures the collective doubt of all market participants regarding the value of the security.

The result of this line of reasoning is to make investment risk synonymous with volatility in the MPT framework. Volatility, or *beta*, refers specifically to the relative short-term volatility of the price of a security. What this means in practice is that if the price of Fred Corp. stock fluctuates more on average than the price of Rob Corp. stock, Fred Corp. stock is a "riskier" investment. (This is probably self-evident to those of you that know Fred well.)

FEAR AND GREED ARE THE TWO PREDOMINANT EMOTIONS EXPERIENCED BY INVESTORS; MANY INVESTMENT DECISIONS ARE MADE TO SATISFY THESE EMOTIONS.

This is admittedly a conceptually appealing explanation of how market price volatility can internalize the wisdom of the crowd and reflect risk; yet many of the assumptions upon which volatility depends deeply limit its applicability. A security price may vary because a well-informed crowd cannot conclusively decide on a company's worth despite deep deliberation; a price may also vary because investors are herding together based on the fear or euphoria of the moment, or because a periodic contribution to a pension plan is blindly driving share purchases at a given price based on nothing more than when the check hit the brokerage account. Additionally, individual investors are not the only actors in the drama: analysts, market makers, portfolio managers, economists and others are all exerting their influence.

In short, an individual investor cannot possibly know all the other actors contributing to current market pricing, let alone their motivations. To assume that short-term market pricing (or its volatility) accurately reflects the collective uncertainty of all investors is analogous to assuming a broken clock shows the correct time. It will be right twice per day but the information lacks context and therefore is of little use. We think it is a much sounder risk mitigation practice to assume that the information contained in daily volatility is of little use. It is actually a much safer practice to assume it is often wrong.

It is not just academic acceptance of MPT and the presumed "rational investor" that established volatility as the industry standard for measuring risk despite its obvious flaws. The popularity of volatility also benefits from the fact that it can be easily quantified. This allows for unconstrained comparisons across securities and

asset classes. It gives statistics of volatility an element of numerical precision not available in messier, more qualitative approaches to assessing risk.

The crisp mathematical conclusions volatility offers are a textbook example of a psychological bias called the "Streetlight Effect." The Streetlight Effect is captured by an apocryphal tale of an inebriated man crawling on the ground under a streetlight. A police officer walking his evening beat approaches the man who explains that he is looking for his car keys. The police officer joins him in the search with no success. Eventually the officer asks the man if he is sure that he lost his keys in this area. The man confesses he lost his keys in the park two blocks away. The confused officer asks the man why he is looking here if he is certain he lost his keys in the park. The drunken man answers, "Because the light is better here."

The Streetlight Effect captures our tendency to look where "the light is best" – to favor ease of measurability over relevance. Volatility embodies this phenomenon perfectly in that it can be measured and manipulated with exacting mathematical precision. However, its relevance and effectiveness in understanding and mitigating risk is not supported by evidence. In fact, it can just as easily obscure risk (e.g., see Bernie Madoff) as expose it. The moral of the story is that we jeopardize our ability to accurately assess risk if we choose ease of measurability over predictive relevance.

THE MORAL OF THE STORY IS THAT WE JEOPARDIZE OUR ABILITY TO ACCURATELY ASSESS RISK IF WE CHOOSE EASE OF MEASURABILITY OVER PREDICTIVE RELEVANCE.

There is one other curious aspect of volatility that investors who subscribe to MPT must consider. When a publicly traded company is taken private, it is magically transformed into a "less risky" investment under the precepts of the Volatility View of risk. This happens because there ceases to be a daily market price for the equity. Instead, the new owners of the business may perform a periodic assessment of value to determine the "price" of the equity. This value assessment most always displays far less variability than the previous public market pricing due to its grounding in the long-term fundamental outlook of the business. While we wholeheartedly agree that the real underlying business value rarely fluctuates to the same degree as trading-influenced market prices, we are hard-pressed to accept that the exact same investment is now less risky solely due to the discontinuation of active market quotes.

In fact, we think the idea that taking a company private reduces the riskiness of the investment is simply absurd. Throughout history the value of liquidity (i.e., I can get my money back quickly and at little cost) is one of the greatest features of capitalism. The markets routinely recognize the value of liquidity. Historically, investors have demanded a substantially higher return to be compensated for the risk of holding illiquid assets. Research by Barclays suggests that the excess return of illiquid private equity investments over liquid public equity investments was between 2% to 6% per annum over the 10-year period ended 12/31/2022. If we assume the same 10-year investment horizon and an expected return of 10% on public equities, Barclays research implies a publicly-traded stock would sell at a 20% to 70% premium to an equivalent private company. This 20% to 70% is consistent with the valuation step up we have seen when a company goes from private to publicly traded. Liquidity is valuable.

To recap: volatility has no proven efficacy in assessing prospective investment risk, and the numerical objectivity combined with the ease of comparison across securities has seduced a large proportion of investors into believing that it offers a reasonable assessment of the risk inherent in any investment. In our estimation, these intractable shortcomings make volatility the risk management equivalent of a psychic palm reading; meaning acceptance is largely a function of the skill of the psychic and the willingness of the subject to believe rather than robust evidence supporting previous predictive success. In other words, since risk is misidentified (as volatility) the putative application of margin of safety is misapplied in a way that provides a dangerous false sense of safety.

Yet, despite our objections and those of a small minority of like-minded investors, the idea of volatility is so embedded in the many layers of the investment ecosystem that it is unlikely to change in our lifetimes. Turn on CNBC or read the leading investment blogs and you will undoubtedly find a parade of brilliant pundits who equate price volatility with security or market risk. Additionally, the entirety of financial market education both within and outside of academia is built on the foundations of MPT and the Volatility View of risk.

While we can agree with the adherents of MPT regarding the centrality of risk and expected returns in all investment decisions, we clearly differ on the most effective means for assessing and managing that risk.

The Fundamental View

To develop an understanding of the fundamental structure of investment risk, we believe it helps to revisit why we invest in the first place. Investing is (by definition) an exercise focused on generating long-term profits on an investor's capital. Anything that threatens this profit-driven initiative represents investment risk. However, even though generating investment profits is the goal, those profits are a means to an end for the investor. They are a medium for expanding the range of future opportunities such as providing the flexibility to change jobs, improving the prospects of a timely retirement, or enabling the funding of favored charitable projects. Therefore, the real harm as it relates to investing is the narrowing of this opportunity set. Those opportunities just happen to be enabled by the profits earned on an investor's capital.

The typical investor intuitively understands that the most direct threat to future investment profits (and opportunity) is a permanent loss of capital on one or more portfolio holdings. By "permanent" loss, we mean an impairment in value that will never be fully recouped, at least not in a reasonable time frame or without embracing ill-advised levels of risk. Permanent losses of capital have the potential to seriously undermine an investor's portfolio returns. (At DGI we despise losing money to the point our significant others have speculated that we all may suffer from the same genetic defect.)

Preventing permanent losses of capital requires an investor to be skilled at avoiding two equally devastating events. The first is a substantial fundamental breakdown in the business of a portfolio holding. As investors, we cannot control this outcome, but we can assess the likelihood of such an event and adjust our portfolio holdings accordingly. The second event is paying too dear of a price for a security. Avoiding this error is entirely within the investor's control through the exercise of purchase price discipline. Yet, it still generally represents the most common loss of capital experienced by the average investor. This is a critical issue that we will revisit later when we detail our risk management framework. In both cases, the loss of value is irrecoverable.

It is also important for the investor to understand that not all stock price declines represent permanent losses. In fact, *most short-term price declines are temporary in nature; they are a common, reversible portfolio phenomenon*. (This is a big departure from the Volatility View of risk, which presumes that short-term price movements are the embodiment of risk.) Absent a need to fund short-term spending, the long-term investor need not fear such temporary or quotational price markdowns. Short-term stock price declines do not cause permanent portfolio damage (unless an investor panics and sells). They do, however, have the propensity to extract an emotional cost that investors must be prepared to bear.

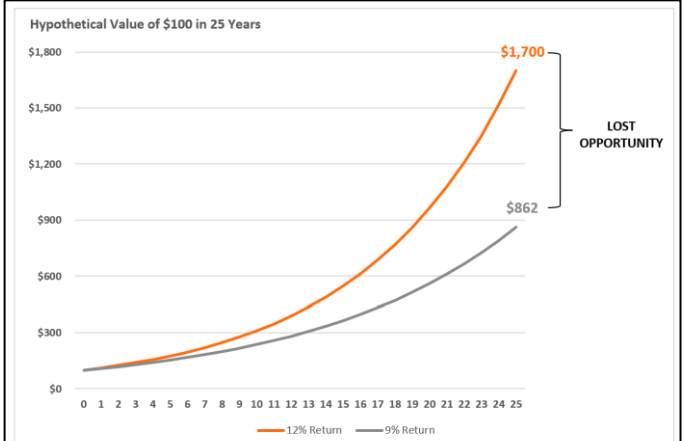
Intriguingly, an investor can virtually eliminate the risk of a permanent loss of capital and still suffer harm. Such a counterintuitive assertion may seem entirely implausible, so let us elaborate. An investor may employ strategies that are the equivalent of stuffing their money in a mattress (preferably a fireproof one). Over a long-term investment horizon that investor will not have experienced a loss of any of their original funds. Not a single cent. However, given the near certainty of inflation, the purchasing power of that capital will be greatly diminished over time – leaving the investor much worse off. While the Volatility View assigns no risk to this situation given the stability of cash (i.e., no price volatility), the Fundamental View of risk is not impressed by the lack of pricing volatility. In fact, the Fundamental View does not concern itself with short-term price fluctuations; rather, it is focused on the long-term "value" that the portfolio investments can be exchanged for over time. This strikes us as a key consideration in the risk equation for any investor.

THE FUNDAMENTAL VIEW DOES NOT CONCERN ITSELF WITH SHORT-TERM PRICE FLUCTUATIONS; RATHER, IT IS FOCUSED ON LONG-TERM "VALUE"

Time exposes the second major threat to profit potential – a substandard investment return. An inadequate long-term investment return results in forgone opportunities in the form of forced future spending concessions. Only the passage of time unveils the full extent of an inadequate investment return on an investor's future financial options. It is a particularly pernicious form of investment risk in the sense it often goes undetected by the individual investor until it is too late to respond in a prudent manner. This primarily stems from the fact that the average investor often does not have an appreciation for the substantial impact a few percentage points of annualized return have on their investment balance when compounded over a long-term investment horizon.

We illustrate the long-term value of excess return on future investment balances in Figure 5. The chart shows the impressive impact a three-percentage point annual difference in return has on future investment balances when compounded over a 25-year investment horizon.

Figure 5: This chart illustrates the long-term value of excess return



The long-term impact of returns on an investment portfolio reveals another critical investment insight – in investing, persistence wins. Persistence allows an investor to benefit from the magic of compounding. We can see in Figure 5 that compounding gains momentum the longer it is allowed to proceed without interruption. In fact, two-thirds of the value created in the "12% compound return" scenario occurs *after* year 15.

This mathematical certainty suggests an overriding goal of our risk management process should be to avoid (or at least survive) mistakes that disrupt the value-creating potential of compound returns. It also reinforces the importance of taking a long-term view when considering the nature of risk and risk management. A misplaced focus on short-term volatility can lead an investor to unwittingly sacrifice the benefits of long-term compounding for the false security of a more stable (less volatile) short-term portfolio balance.

To recap, the Fundamental View argues that investment risk is best viewed as a loss of future opportunities reflecting the possibility for either devastating permanent losses of capital and/or actual long-term investment returns falling short of expectations. The two forms of underlying risk are clearly deeply intertwined in that permanent losses of capital are often a primary cause of inadequate long-term returns. That said, we believe it is important for the investor to be aware of both threats to their investment profits, because strategies to avoid one can unwittingly increase the probability of the other as our mattress stuffing example illustrates.

To this point, we have offered a predominantly theoretical examination of investment risk. This has allowed us to highlight the stark contrast in the conception of risk between the two competing theories of risk management in the investment industry. The next step is to push deeper into the Fundamental View of risk and understand the specific sources of investment risk that compose the more abstract definition of risk discussed above.

SOURCES OF INVESTMENT RISK

The most dangerous decisions are those that fail to fully appreciate the real, and sometimes subtle, risks involved. Just like Mr. Honnold's scrutiny of the cliff face in preparation for his summit of El Capitan helped focus his attention on the most likely points of failure, breaking down the complex phenomenon of investment risk into its constituent parts helps bridge the gap from abstract concepts of "harm" and "lost opportunity" to concrete threats to portfolio returns that we can construct defenses against. By identifying risk at its source, we can unearth the web of interconnected elements contributing to each risk factor. This knowledge helps focus our attention on the actual underlying drivers of risk and reduces the likelihood we are distracted by irrelevant matters like short-term stock price movements.

The ability to assess the underlying structure of investment risk provides an amplified sensitivity to subtle changes in the risk profile. Early recognition of a shift in risk can provide a chance to act before the risk is fully realized and permanent value impairment occurs. Practical insights such as this are obscured in a metric like stock price volatility, which provides no link or practical look through to the root cause of the investment risk.

Such a foundational understanding of investment risk also allows an investor to take a more proactive stance toward enhancing portfolio returns. This knowledge empowers the investor to engage with higher-return potential investment opportunities, because a better understanding of the specific nature of risk means the investor can proactively prepare to manage it rather than being left to react after the fact. And as we illustrated in Figure 5, a seemingly small variance in annual returns can result in substantial differences in portfolio value over a typical investing lifetime.

When it comes to revealing risk at its source in investing, there is no magic shortcut like the Volatility View claims to offer. In our estimation, the best way to identify and assess the primary causes of investment risk is through reasoned judgement based on evidence and experience. We must become students of investment success and failure. Insights gained from this mode of inquiry cultivate a richer understanding of the common signs of

failure in any investment decision. We see this in Mr. Honnold's approach. His thorough preparations meant he was rarely surprised by what he found when he was halfway up the cliffside.

Our multidecade investigation into the origins of investment risk has culminated in the recognition of four primary investment-specific risk factors that are central to our risk management framework. They are *Forecast, Valuation, Allocation* and *Model* risk. We provide a brief introduction of each risk factor here. In the next section, we will discuss how each risk factor influences our investment process and our strategies for mitigating them.

Forecast Risk

Yankee Hall of Famer and satirist Yogi Berra once said, "It's tough to make predictions, especially about the future." Yogi has a point; making a reasonably accurate forecast in the face of uncertainty is a challenging, but not hopeless, venture. And for value-conscious investors, it is near impossible to have sustained investment success without an effective and repeatable effort on this front.

FORECAST RISK: RISK THAT OUR FORECAST OF INTRINSIC VALUE PROVES OVERLY OPTIMISTIC OR PESSIMISTIC

Developing credible financial projections is critical because they underwrite a reliable assessment of the true or intrinsic value of an investment, and this estimate of value lies at the core of our investment decision process. This means that material, unanticipated deviations from our long-term financial forecasts represent the biggest threat to our assessment of intrinsic value and our associated ability to make sound investment decisions. This is forecast risk.

Many elements of forecast risk fall outside our direct control as investors. This includes a myriad of company-specific fundamental risk factors such as execution risk, governance risk, cultural risk, financial risk, competitive risk, technological risk and regulatory risk. We have limited avenues to directly influence these and most other fundamental risk factors, but our research process is geared to identify and monitor these elements of forecast risk as well as gauge their potential influence on our company forecasts.

There is another element of forecast risk that does land solidly within our control – analytical error. Analytical error speaks to our efficacy at transforming information into forecasts, particularly those data points that have an outsized impact on our long-term financial projections and estimates of security value. Our ability on this front is influenced by analytical expertise as well as self-awareness and team candor that allow us to minimize the impact of any cognitive biases.

What is conspicuously absent from our discussion of forecast risk is the macroeconomic developments that tend to capture public attention. These events, while a component of forecast risk, generally have little impact on the long-term prospects of the individual businesses we own. So while we monitor and evaluate economic and geopolitical events for the slight chance that they may influence the long-term intrinsic value of our portfolio holdings, we carefully shepherd our analytical efforts by not wasting resources trying to predict such events.

Valuation Risk

Valuation risk is a function of the ratio of our long-term estimate of intrinsic value to the current market price. It is a mathematically straightforward exercise to convert this relationship into an expected return, which represents a projected 7-year annualized compound return of a portfolio holding based on our forecast of intrinsic value. We use a 7-year forecast period for estimating intrinsic value and expected return to both capture the prospects for long-term growth and escape the random short-term financial volatility associated with typical business cycles.

VALUATION RISK: RISK OF LOSS DUE TO OVERPAYING FOR, OR CHOOSING TO HOLD, A SECURITY THAT OFFERS AN INADEQUATE EXPECTED RETURN UNDER A REASONABLE SET OF ASSUMPTIONS

While the majority of our expected return projections reflect the underlying fundamental progress of the companies (aka, growth in intrinsic value), we should note that a meaningful portion of our expected return is derived from purchasing the securities at a discount to our current estimate of the intrinsic value of the

business. In other words, our expected return calculation incorporates both a business growth component and a purchase discount component. With regard to the purchase discount, we assume the market price of a holding converges with the underlying intrinsic value by the end of our 7-year forecast period. This phenomenon of convergence has persisted over the course of our investment careers. We continue to trust this bedrock assumption that, over the long-term, market prices will ultimately align with value.

Functionally, a high expected return suggests low valuation risk as it allows for more variability in company performance relative to our forecast, while still providing an acceptable long-term investment return. Conversely, a low expected return constitutes high valuation risk. If the expected return is too low, we run the risk that even modest levels of forecast error may lead to substandard returns or even losses on that particular holding.

Expected return is our preferred valuation metric because it enables us to easily compare the return implied in our forecast to our long-term target or hurdle rate return. The availability of a real-time expected return for each holding also allows us to calculate the position-weighted expected return for the overall portfolio. This helps us understand aggregate levels of valuation risk as well as facilitating return comparisons across asset classes such as the relative attractiveness of stocks versus bonds in our balanced portfolios.

By far the most common source of unappreciated valuation risk for the typical investor is the act of overpaying for a security, which means purchasing a security at a price that offers a low (or even negative) expected return. This generally happens when an investor either makes a poor value assessment or decides to purchase purely on the allure of attractive business prospects, giving no consideration as to whether the stock price is already fully incorporating the promising outlook. Of course, many market participants willfully ignore value altogether and instead rely on tactics such as technical or trend analysis to time their buy and sell decisions. Followers of this practice are numerous despite the lack of evidence supporting repeatable or sustainable success.

Regardless of preferred purchase methodology, investors must be aware of the increasing potential for financial catastrophe as investment decisions become increasingly untethered from fundamental value. The recent demise of FTX is a case in point as the company raised capital at an implied value of $32 billion just 10 months prior to filing for bankruptcy.

Even when an investor has carefully purchased a stock at attractive prices, valuation risk can develop. Typically, this occurs when the market price of a holding increases at a rate in excess of the progress in the underlying business fundamentals. Said differently, the market price of the stock is increasing faster than the underlying intrinsic value of the company. This was the case for many widely owned large cap stocks from 2018 through 2021. Valuation risk can also develop when a company's business fundamentals deteriorate to the point where the associated decrease in intrinsic value no longer supports an attractive future return.

Allocation Risk

At a fundamental level, allocation risk is a function of the size of the position in the portfolio (measured by market value). Typically, but not always, the larger the position size the greater the allocation risk and vice versa. Larger position sizes do not, however, automatically lead to increased overall allocation risk levels. They only become a concern when they lead to potentially excessive concentration in holdings that carry uncomfortable levels of valuation and/or forecast risk. In other words, allocation risk is correlated with position size, but the relationship is not entirely linear.

ALLOCATION RISK: RISK DERIVED FROM MISALIGNMENT OF A PORTFOLIO POSITION SIZE WITH THE COMPANY-SPECIFIC LEVEL OF FORECAST AND VALUATION RISK

In addition to oversized positions in individual portfolio positions with elevated levels of fundamental risk, allocation risk can result from a concentration in securities that have the potential for substantial correlation in business risk and therefore security price correlation. For example, a portfolio that has a high percentage of its market value in bank stocks, where movements in interest rates and/or deteriorating credit trends may have a more uniform impact, could see the price of those securities move in unison at times.

Model Risk

Model risk refers to an undetected systemic flaw in our investment process or business approach that undermines our attempts to make quality investment decisions. Failure to uncover and address this type of risk subverts our investment process. For instance, using a flawed or unproven methodology for generating our intrinsic value estimates would qualify as a serious model risk because it pervades every investment decision.

MODEL RISK: POTENTIAL FOR A SYSTEMIC FLAW TO UNDERMINE THE INTEGRITY OF OUR INVESTMENT EFFORT.

Model risk is also unique in our risk framework because it is not constrained to the investment effort itself like the first three sources of investment risk. It can manifest in the form of unsound business practices of the sort that force adverse changes in investment decision making. An example of this would be prioritizing asset growth over the investment mission; something we are careful to avoid at DGI.

In the age of sophisticated MPT-driven allocation schemes designed to diversify away risk in any particular asset category, our emphasis on pinpointing the underlying drivers of risk at the individual security level may be viewed by some practitioners as unnecessary or even counterproductive in the elusive search for excess return. We respectfully disagree. In our experience, the farther the risk focus drifts from the root of the risk the more likely it is to evade discovery as it grows and metastasizes within an investor's portfolio.

Now that we have developed a more thorough understanding of the elemental risks that threaten long-term portfolio returns, we can begin to construct a risk management framework that expressly addresses each of the specific risks.

MANAGING INVESTMENT RISK, FINALLY

For a risk management framework to be effective, we believe an investor must first be clear regarding the desired results. To this end, we believe the overriding goal of an investment risk management process should be to protect the wealth generating magic of compound returns. More specifically, our risk management process is geared to mitigate the type of risks that would be likely to upend our ability to generate our targeted rate of return over an investment cycle (e.g., 12% compound returns for our mid cap portfolios).

To achieve this goal, our risk framework needs to honor a few essential principles:

First, we need to accept the truisms regarding risk and uncertainty discussed in the risk management principles above. In particular, we need to remember that effective risk management is *always* about the sound application of margin of safety. Investing without a margin of safety is not really investing at all; it is speculation. To maximize our odds of success, we must develop a clear understanding of the risks we face and how to most effectively build a margin of safety; a margin of safety that is thoughtfully structured to mitigate the unique investment risks.

Second, we need to understand the direct, if not imperfect relationship between risk and return – meaning accepting more risk, *ceteris paribus*, generally brings the potential for higher returns. This is broadly accepted industry doctrine. What is less appreciated is that the goal of achieving high returns becomes heavily dependent upon the ability of the investor to properly mitigate risk. Let us state it differently, average returns from the stock market are generally available to everybody. Superior returns are also available to everybody but only a few investors will be able to earn those returns. And those investors will thoroughly understand uncertainty, risk, and risk mitigation. We would guess every rock climber would like to duplicate Mr. Honnold's feat. Only a tiny few would even have the skill to attempt it and fewer still could manage the risks as Mr. Honnold did. Likewise, most investors would like to be as good as Buffett, but lack the clarity and discipline to effectively manage investment risk.

Finally, our risk framework needs to be aligned with our investment philosophy in a way that maximizes our capacity to assess, monitor, and manage risk without hampering our ability to invest in outsized opportunities that drive the long-term compounding of investment returns.

Figure 6 provides an overview of our risk management framework. It highlights how each risk factor parallels a primary investment goal as well as our strategies for managing each risk.

Figure 6: Summary of DGI Risk Management Framework

Investment Goal	Associated Investment Risk	Assessing Risk	Monitoring Risk	Managing Risk/Margin of Safety
"Develop a reasonable assessment of value"	Forecast risk	Develop a comprehensive understanding of the business	▪ Milestone achievement ▪ Emerging threats to our forecast	▪ Achievable forecasts ▪ Probability-weighted intrinsic value estimates ▪ Bayesian updating ▪ Diversification
"Pay a fair price"	Valuation risk	Estimate intrinsic value and expected return	▪ Changes in expected return	▪ Challenging hurdle rate return ▪ Avoidance
"Align portfolio weightings with investment insights"	Allocation risk	Evaluate position size in the context of security specific Valuation & Forecast risk	▪ Material changes in Forecast and/or Valuation risk	▪ "Managed Darwinism" ▪ Diversification ▪ Avoiding extreme concentration or diversification
"Strive for continuous process improvement"	Model risk	Challenge prior assumptions	▪ Deviation from expectations	▪ Process evaluation & improvement ▪ Prioritize investment mission over business goals

Over the balance of this section, we delve deeper into each primary investment goal, the associated investment risk, and how we assess, monitor, and manage each risk in the context of our investment process with the explicit goal of maximizing our chances of reaching our long-term return objectives.

Develop a reasonable assessment of value

It is impossible to make an informed decision on what price to pay for something without an appreciation of its value. This is true for stocks, bonds, bicycles, deodorant or any other good or service obtained in exchange for value. I doubt anyone reading this paper would walk onto a car lot, hand the nearest salesperson a blank check and say, "I really like the aqua blue SUV, so just fill in whatever number works for you." Yet, many investors do exactly this when purchasing stocks and other financial assets; they make no discernable effort to assess value.

Lacking insight as to the value of an asset when we transact strikes us as a dangerous approach. If we wish to protect our financial interests, we need to be informed buyers (or sellers), which requires an understanding and appreciation of value. In the case of investable assets, value is a function of the long-term profit-generating power of the business. This means our investment success or failure is dependent on the reliability of the financial forecasts underlying our value judgments and, therefore, forecast error is a primary threat to this effort.

So how then can we reduce forecast risk and improve the veracity of our financial forecasts when we are predicting an uncertain future?

Predicting the future can be especially challenging, but there are steps we can take to reduce the level of uncertainty, particularly as it relates to forecast error. Drawing from decades of research on the foundations of superior forecasting abilities, Philip Tetlock concludes that foresight is not a divine gift, but rather a skillset that can be developed through a process of organized thinking and information gathering. We concur. In our experience certain behaviors and operating habits consistently applied have significantly improved the reliability of our forecasts over time and, as a consequence, reduced the impact of forecast risk on our estimates of intrinsic value.

The most powerful tool for mitigating forecast risk is relevant knowledge. Developing deep company-specific knowledge improves the odds of forming a credible view of the future and effectively capturing it in our financial forecasts. It is our primary weapon for minimizing the potential of unanticipated business variability to undermine our forecast. This is why we spend the bulk of our research effort building an intimate understanding of each business. It allows us to more fully assess the range of likely outcomes. Our long-holding periods have proven highly beneficial for augmenting this knowledge base.

IF WE WISH TO PROTECT OUR FINANCIAL INTERESTS, WE NEED TO BE INFORMED BUYERS (OR SELLERS), WHICH REQUIRES AN UNDERSTANDING AND APPRECIATION OF VALUE.

Second, we utilize a proven financial model to estimate intrinsic value. Statistician George Box is credited with the observation that all models are wrong, but some models are useful. The usefulness of a model hinges on its effectiveness in not only helping the practitioner develop a reasonable approximation of reality, but also promoting effective decision making. We believe the financial model we have cultivated has demonstratively improved our capacity on both fronts by balancing the inevitable tradeoff between a useful representation of reality and precision. It also helps to understand that in most attempts at predicting an uncertain future typically a few factors dominate. Therefore, focusing our efforts on building a more comprehensive understanding of those factors can improve our efforts to drive toward a more accurate (if not entirely precise) assessment of reality.

Third, our process incorporates regular updates to our forecasts. As incremental evidence emerges, we update our forecasts accordingly. This process is facilitated by establishing rigorous fundamental milestones—incorporating the critical factors our research process has identified—to measure each company's progress toward achieving our long-term forecast. Milestones are a powerful tool for titrating our projections and improving the accuracy of our intrinsic value estimates. Our confidence in our forecast and the probability of the company achieving it then evolves based on a dynamic view of the company's ongoing progress, which feeds directly into our decision-making process.

Fourth, we look to leverage the collective insights of the team. Our research environment is a free-flowing, collaborative effort that encourages candid intellectual discourse. This part of our effort aligns with another key finding from Philip Tetlock's research. Mr. Tetlock discovered that when people who had already demonstrated superior forecasting abilities as solo prognosticators were placed in the right team environment, their accuracy increased by another 50% – besting projections based on alternative forecasting methods including the "wisdom of the crowd", prediction markets and individual industry experts.

Fifth, we are committed to considering the evidence on its face without interpreting it through a filter of existing beliefs or biases. In other words, we work diligently to prevent the cognitive distortions inherent to System 1 thinking from hijacking our decision processes. Addressing this part of forecast risk requires introspection and self-awareness on the part of the analyst. The team plays an important role here as well by offering candid feedback and acting as a crosscheck on each analyst's work.

Unfortunately, even the most well-conceived and impartial financial projections do not guarantee a company will perform in line with our forecast. This is why we further address forecast uncertainty by building a suitable margin of safety into our projections. We accomplish this by using only reasonable assumptions in our model; assumptions that favor achievability over exacting precision. Reasonable assumptions raise the odds that a company meets our expectations even in the event our forecast proves overly optimistic. It shifts the odds in favor of a positive outcome.

Reasonable assumptions may seem at odds with our previous comments stressing the importance of accurate intrinsic value estimates (which implies precise forecasts). We always strive for accuracy in our forecasts, but that does not preclude us from building a margin of safety into our intrinsic value estimates to allow for uncertainty. This is especially true for companies that we perceive to have a wider range of potential outcomes and/or more extreme downside scenarios.

Diversification also plays a key role in protecting the portfolio from forecast risk. The heterogeneous nature of forecast risk allows for it to be effectively diversified. We can also diversify the internal component of forecast risk (aka, analytical risk) with cognitive diversity among the team members and a process geared to surface disconfirming evidence.

Pay a Fair Price

Once we are comfortable with our forecast and the resultant assessment of intrinsic value for a company, the next step is to determine what constitutes a fair purchase price for the stock. We define a fair price as one that will result in an acceptable expected return based on our probability-weighted intrinsic value forecast. Our expected return estimates are a direct reflection of the level of valuation risk, e.g., a low expected return means higher valuation risk and vice versa. So the primary factor in assessing what constitutes a fair price is the level of valuation risk in a security. We utilize several strategies to assure that valuation risk is kept at a tolerable level.

Our primary mechanism for combating valuation risk is the adoption of challenging return targets. Our long-term return target is 12% annualized returns for our mid cap strategy and 15% for our small cap strategy. These return levels compare favorably to long-term historical returns for both the market and the respective categories of stocks. Demanding hurdle rates such as these are natural regulators of valuation risk. They introduce a margin of safety into our purchase price by pushing down the price we are willing to pay. This effectively prevents us from "intentionally" overpaying for a security and shifts the odds of success in our favor even should our forecasts prove overly optimistic.

THE PRIMARY FACTOR IN ASSESSING WHAT CONSTITUTES A FAIR PRICE IS THE LEVEL OF VALUATION RISK IN A SECURITY.

Second, we capitalize on the fact that valuation risk is always completely under the investor's control. We set the margin of safety and corresponding level of valuation risk via our buy and sell decisions. So, we can (and do) refuse to purchase if a security does not offer an expected return at or above our target rates of return. It is not uncommon for us to wait years before a security trades at a price level where the valuation risk is acceptable and we are comfortable purchasing it. Additionally, since valuation risk is simple to measure and uniform in nature it is easy to compare risk levels across holdings, which facilitates portfolio level decisions.

Third, we always honor our valuation discipline. Restraint with respect to valuation is absolutely critical because valuation risk is immune to the risk-mitigating powers of diversification. This is due to the uniform nature of the risk across holdings. This means as valuation risk increases, we need to proactively reduce it. Ignoring valuation risk and experiencing the costly price correction after drastically overpaying for a security is akin to Alex Honnold getting sloppy on a routine handhold and plunging down the cliff. In such a scenario, informed onlookers would be perplexed as to how the talented and experienced climber could have overlooked such an obvious and avoidable risk.

Similarly, we are puzzled by the tendency of many investors to routinely ignore the most quantifiable and avoidable element of risk. We suspect this inclination to disregard valuation risk might be

in part attributable to the challenges involved in making an accurate assessment of intrinsic value and in part due to an interesting psychological phenomenon regarding human propensity to openly accept more common risks regardless of the potential severity of the consequences. Since valuation risk is a market reality, particularly for the popular "story" stocks of the day, many investors seem to have discounted its importance in their risk calculations. This may work for a short period of time, but eventually the laws of financial gravity set in and overpriced stocks decline (usually violently) and converge with the underlying intrinsic value of the business.

The aftermath of ignoring valuation risk is brutal. We have seen a failure to address rising valuation risk in broadly rising markets (like 1998-2000 and 2019-2021) devastate many investment portfolios over the years. It can take years (or decades) to recover.

Align weightings with investment insights

Beyond a minimum number of holdings that capture the majority of the benefits of diversification, the level of concentration in any particular security should be dictated by the quality of one's investment insights with the overriding goal of structuring the weightings in a way that maximizes the long-term probability-weighted return potential of the portfolio. This requires an allocation process that is geared to strike the optimal balance between the long-term potential of each business with the attendant company-specific risks. This process requires a fair amount of considered judgement as tilting too far in either direction increases allocation risk.

Any allocation decision ultimately triggers a survival-of-the-fittest process that we refer to as "Managed Darwinism." This is when companies that are attractively valued and achieving our fundamental milestones "capture share" within the portfolio and, in some cases, completely force out their "weaker" or less attractive counterparts. This capital reallocation process is the primary tool we use to adjust the level of forecast and valuation risk within the portfolio.

In the end, portfolio allocation is more art than science. There is no mathematical formula precise or reliable enough for determining the "right" size for a portfolio holding. Leveraging the insights gained through experience and continual process improvement, we shape each position so that it is large enough to generate a material contribution to performance when it works, but not so large as to put the portfolio at risk of a catastrophic permanent loss of capital by accepting too much forecast and/or valuation risk.

Strive for continuous process improvement

Though our investment philosophy and process has proven effective over the course of multiple decades and market cycles, we are vigilant for changes or discontinuities that may expose deficiencies in the model. We marry our attention for irregularities with an active commitment to ongoing process improvement that manifests in a number of ways.

First, we challenge our existing assumptions. As the common disclaimer goes, "Past success does not guarantee future results." However, it can provide a springboard for ongoing investment excellence provided we remain committed to challenging our prior methods in the spirit of improvement. We regularly examine all parts of our investment process to better understand the inherent strengths and weaknesses. For instance, in recent years we have adapted our portfolio weighting methodology to better align with the quality of our investment insights. The previous weighting framework served us well for decades, but upon deeper examination we were able to identify a considerable opportunity for improving long-term returns by modifying the tight and somewhat arbitrary restrictions we had previously imposed on ourselves. Additionally, the deeper our understanding of the core assumptions underlying our process, the more prepared we will be to adapt to unexpected developments.

THE DEEPER OUR UNDERSTANDING OF THE CORE ASSUMPTIONS UNDERLYING OUR PROCESS, THE MORE PREPARED WE WILL BE TO ADAPT TO UNEXPECTED DEVELOPMENTS

Second, we regularly evaluate the quality of each investment decision including decisions not to act. These decision post-mortems allow us to analyze any deviations from expectations. While the vast majority of decisions that lead to poor outcomes are a function of human error in forecasting and/or the forces of uncertainty working against us, we are searching for those that provide potential insight for improvement or contrarily might expose some deeper flaw in our strategy or process. This process has led to demonstrable process improvements not the least of which is a commitment to more definitive fundamental milestones for each of our portfolio holdings.

Third, we pay extra attention to outliers. Outliers represent outcomes that lie far outside a reasonable band of expectations. They can be positive or negative, but in either case they generally have much to teach us. The goal here is to achieve early recognition of outlier performance, both positive and negative. Further, we seek to make timely changes to our forecasts based on outlier performance. Finally, we believe outliers have much to teach us given the magnitude of the deviation between a reasonable set of expectations and the end result.

Fourth, we work to identify our own biases and look for ways they might be adversely influencing our process. As we discussed earlier, all humans suffer from some degree of cognitive bias. The question is whether we acknowledge those biases and account for them in our investment framework. Legitimate truth seeking is the antidote for cognitive bias. Truth seeking requires a fundamental commitment to accuracy, viewpoint diversity and intellectual curiosity. Our process honors this truth-seeking charter with an upfront commitment to robust information gathering. We are individually and collectively accountable to make sure all the key facts have been surfaced and vigorously vetted. Additionally, we actively seek out diverse viewpoints to both fill the gaps in our knowledge base as well as uncover potential blind spots. Finally, none of this works without a true growth mindset that values genuine learning more than "winning the argument." Of course, we are human and far from perfect regarding these attributes, but this emphasis on analytical rigor, viewpoint diversity and an open, curious mindset are cultural imperatives that are reinforced through accountability to each other and our clients.

While investment philosophy and process delineate the frontline for model risk, it is not uncommon in the investment industry for it to materialize at the firm level. To defend against this, we manage the business in a way that always prioritizes our ability to deliver quality investment management. For instance, we acknowledge that there is a limit to the amount of assets we can effectively manage. We honored this commitment more than 10 years ago when we closed our small cap strategy at $500M in assets, and we will do the same for our mid cap strategy before it reaches levels that would adversely influence how we invest the portfolios.

Hopefully, it is evident by this point that our efforts to decompose and understand the complex nature of investment risk have heavily informed our approach to risk management. This exploration has yielded invaluable insights that have advanced our ability to identify subtle changes in a company's risk profile. We simply cannot emphasize enough how helpful it is to have a nuanced view of risk at its source when it comes to assessing and managing the long-term impact of incremental change.

Diversification

No paper on managing risk in investing is complete without a discussion of diversification. *Diversification is the process of investing money in a variety of different securities and/or asset classes to limit exposure to any one investment.* Properly applied against the right type of risk, it offers an effective risk management protocol.

The risk-reducing benefits of diversification are largely a function of the impact it has on two factors that can raise the probability of a risky outcome – concentration and correlation.

IN ESSENCE, DIVERSIFICATION FREES A MANAGER TO FOCUS ON INVESTMENT STRATEGIES THAT HAVE THE POTENTIAL TO GENERATE SUPERIOR RETURNS.

Concentration is an element of allocation risk that comes from committing too much capital to a limited number of holdings. The potential risk posed by an overly concentrated portfolio is straightforward: the more concentrated a portfolio's investments (aka, the larger the position sizes), the greater the chance one poor investment can undermine future returns. For instance, in the extreme an investor could choose to allocate their entire investment portfolio to one security. If that security suffers a large, permanent loss of capital, the impact on the portfolio is catastrophic; there are no other securities to potentially cushion the loss. By owning more than one security, an investor reduces the risk of concentration (or allocation risk), thereby limiting the potential portfolio damage caused by an adverse outcome in any singular holding.

Diversification can also be utilized to mitigate the risk associated with high levels of correlation between security prices. Correlation is the likelihood that the price of the securities in an investment portfolio rise and fall in unison. This is an alarming situation for an investor that is depending on their portfolio to fund short-term liquidity needs. It can also be problematic in a severe down market as it can initiate the type of emotional response that leads to poor decision making, e.g., selling at the bottom to preserve one's sanity. Efforts to manage price correlation spawned the practice of

diversifying one's holdings across different asset classes such as stocks, bonds, real estate, commodities, etc. The basic theory is that the pricing of certain asset classes, or more specifically the underlying securities within those asset classes, typically does not move in unity with the market pricing of other asset classes. In some cases, they may even move in opposite directions, which buffers the impact of price declines in any one asset class.

From the perspective of investing in portfolios of publicly traded securities, there is a significant potential benefit from diversification. The skill and discipline of the investment manager can be applied across enough individual securities so that the portfolio can achieve acceptable (or superior) rates of return free from a bad outcome from one security. In essence, diversification frees a manager to focus on investment strategies that have the potential to generate superior returns. As noted below, the investment manager must fully apply risk mitigation at the individual stock level and must be careful not to overdiversify.

While diversification provides vital benefits, investors must be aware that not all investment risks can be washed away in a prodigious sea of diversification. Investors must be aware of the risks that are immune to diversification's protections. We discuss a few of the critical limitations below:

- Diversification is advantageous only up to a point. The mindless diversification inherent in portfolios of hundreds or thousands of securities provides rapidly diminishing benefits while simultaneously introducing other risks. For instance, the more securities an investor holds the more challenging it will be to develop specific knowledge on each holding. This expanding knowledge deficit raises the associated forecast risk both at the individual security level and in the aggregate. It is also virtually impossible to make a reasonable assessment of value across hundreds or thousands of securities – effectively undermining one's ability to manage valuation risk. Additionally, the more holdings in a portfolio the higher the odds of mediocre investment returns. This is because the smaller average position size limits the impact any one big winning stock will have on overall returns.

- While a thoughtfully diversified portfolio can help buffer the impact of a price decline in any one security or asset class, it is important to understand that in practice the pricing of most classes of investable assets are far more correlated than often believed. This is particularly true during periods of extreme economic and market duress. For instance, during the steep 2008 stock market selloff nearly every major asset class (except investment-grade bonds) experienced substantial losses. So just when investors are counting on the non-correlation of returns, returns tend to move together. The one notable exception to this tendency of asset prices to move in unison is stocks versus investment grade bonds. Since 1941 there have been only two years when both stocks and bonds have generated materially negative returns in the same calendar year. Stocks and bonds have been the only reliably non-correlated assets to own.

- Diversification offers little protection from uniform risks. For instance, diversification can be effective for mitigating highly heterogenous risks like forecast risk, but it does little to mitigate homogenous risks like valuation risk. We saw the limits of diversification as it related to valuation risk play out over the last few years. In the latter part of 2020 and throughout 2021, the S&P 500 experienced significant stock price appreciation led by the seven largest stocks by market value. Much of this appreciation was driven by valuation expansion that was not supported by accompanying levels of fundamental progress. By any reasonable assessment, these companies reached extreme valuation levels in 2021. From 12/31/2021 through 3/31/2023, these businesses collectively lost $2.8 trillion in market value. For the millions of investors that owned these stocks through investment strategies mirroring the S&P 500 Index, the purported diversification of 500 "blue-chip" holdings did little to protect their capital from the obvious overvaluation risk that plagued many of the S&P 500 index constituents.

> "DIVERSIFICATION IS PROTECTION AGAINST IGNORANCE. IT MAKES LITTLE SENSE IF YOU KNOW WHAT YOU ARE DOING."
>
> –WARREN BUFFET

Intelligent diversification then is all about finding the optimal number of securities to provide most of the risk-reducing benefits without compromising security-specific knowledge and long-term return potential. In our opinion, the majority of the benefits of diversification can generally be achieved in a portfolio of 10 to 40 stocks. The right number depends on the discipline and expertise of the investor.

Despite these truths, the prevailing view regarding diversification today is that "broad" diversification frees an investor from the cumbersome practice of developing an understanding of security specific risk and the divergence between fundamental value and market prices. We cringe when we hear this argument. In our

opinion, it offers an all-too-convenient excuse for investment managers and other professionals acting in an advisory capacity to abdicate their fiduciary duty with respect to instituting a robust risk management framework tethered to the real sources of underlying investment risk. Warren Buffet has been even more direct in his criticism saying that "Diversification is protection against ignorance. It makes little sense if you know what you are doing."

Passive index funds and ETFs are a prime example of the growing acceptance of mindless diversification. The central theory behind index funds and other passive investments is that it is a rare investor that can consistently outperform the market; therefore, the odds are that the average investor generates mediocre investment returns through attempts to select outperforming securities. Add in the meaningful fee savings that passive funds often offer compared to other investment vehicles, and the value proposition looks even better.

It is true that passive strategies can offer a low-fee alternative to active funds with index-like returns and that most investment managers are unable to outperform their chosen benchmarks over a longer-term investment horizon. But the risks of these passive strategies are rarely acknowledged. This list includes:

- lack of security specific knowledge,
- no assessment of value (which leaves the investor particularly vulnerable to losses in generally overvalued markets),
- the potential for unanticipated concentration,
- the unprecedented level of investor usage of these asset strategies and the commensurate risk of unpredicted market-wide phenomena, and
- a high likelihood of pedestrian long-term investment returns (please revisit Figure 5 to see what a few percentage points of excess return can mean to an investor with a long-term time horizon).

Any investment strategy that fails to acknowledge the risks inherent in its portfolio construction process is highly likely to suffer the consequences.

We suspect we will receive a fair amount of pushback on our assertions regarding the limits and common misapplication of diversification and passive investment strategies. The arguments will likely contend that the prevailing diversification practices have served investors well. Again, if the investor's goal is to reduce fees and receive "benchmark-like" returns, then in many cases this approach has worked. If the goal is to acknowledge and carefully manage all forms of investment risk while also preserving the potential for superior long-term investment returns, then we have serious reservations regarding its efficacy.

PARTING THOUGHTS

Our goal at DGI has always been to develop a risk management model that offers an approximation of investing reality that will guide sound long-term decision making. While the evidence suggests our approach has performed quite well in practice through numerous market cycles, we are not foolish enough to think that we have fully solved the riddle of risk management.

In fact, as I enter my fourth decade as a "professional" investor I readily acknowledge that I have been humbled on more than one occasion by my failure to comprehend basic truths about investing and risk that seem so obvious in hindsight. For this reason, our risk management framework is a perpetual work in process. We continue to routinely examine new and/or disconfirming evidence and, when appropriate, update our thoughts.

If my indefatigable colleague Fred Martin has taught me anything, it is that we are never too old to learn and improve. Fred demonstrated as much through our free-flowing discussions that were instrumental in shaping and improving the insights in this paper. So in the spirit of the internal debate that forged this paper, we invite your intellectual challenge and constructive feedback.