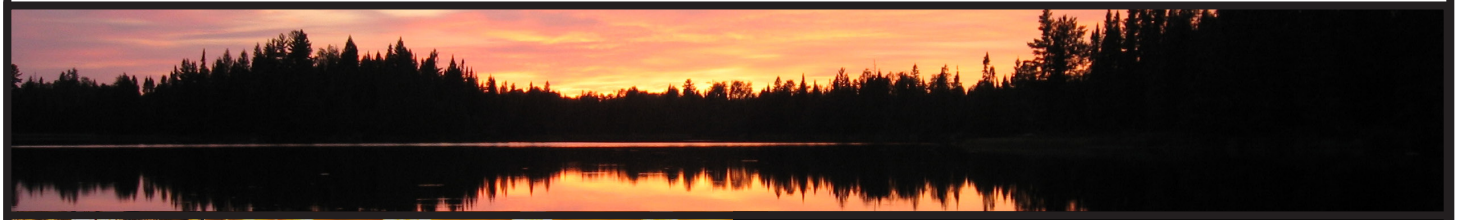
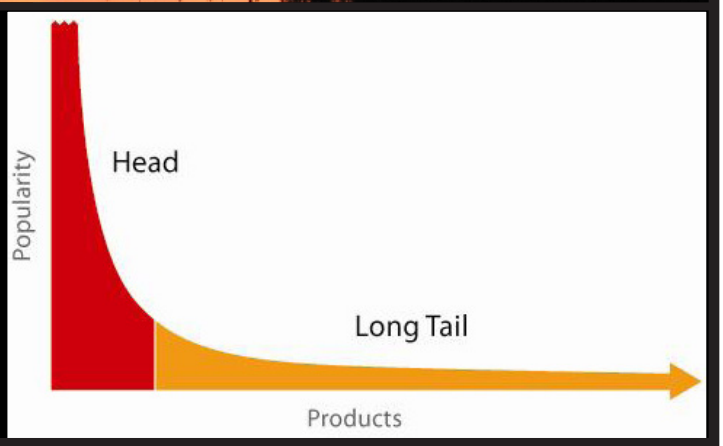
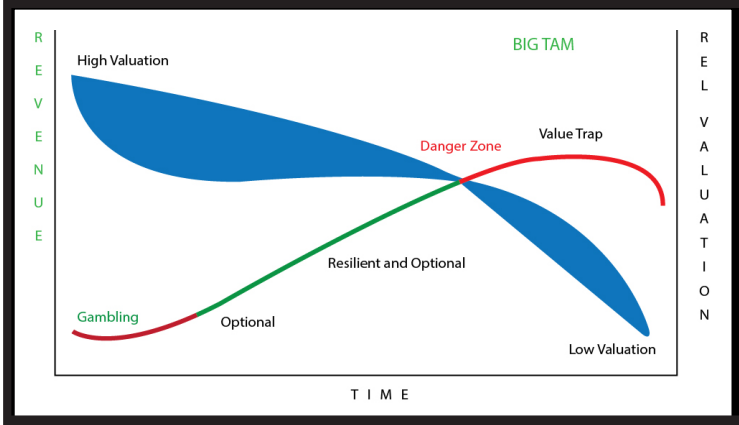
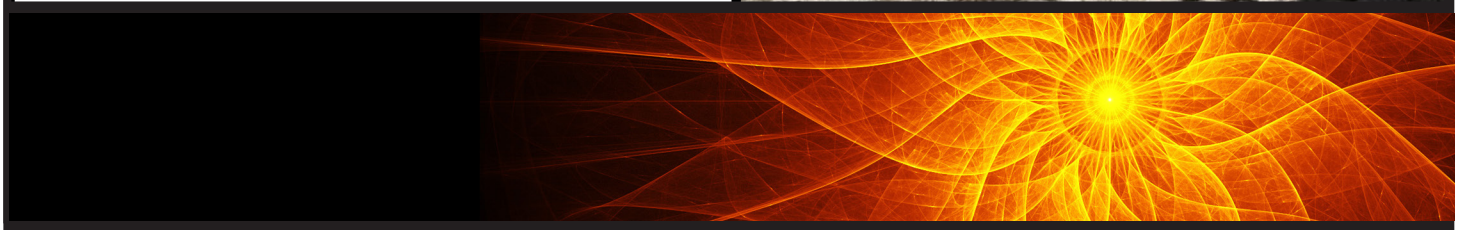
# Complexity Investing

An investment philosophy working paper by
Brad Slingerlend and Brinton Johns





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# Abstract

Investors and corporate management are in the same fundamental business: capital allocation – applying scarce resources toward the best long term outcomes. Historically, stock market investing and corporate strategy have optimized around normally distributed future outcomes. However, we believe financial markets and companies operate in complex, adaptive systems, and as such are better explained by the phenomena of power laws and "fat tail" events. Investing and corporate strategy are often based on narrow predictions of the future, but complex systems dictate such predictions will ultimately prove very dangerous and loss making. We propose a new framework for capital allocation at companies and in portfolios that emphasizes adaptability, innovation, network effects (positive and negative feedback loops), management vigilance, long term thinking, and duration of growth. Combining these elements creates a new type of capital allocation model, which balances Resilience and Optionality. This framework helps avoid and protect against the common mistakes that come from the false belief in a normally-distributed world. In order to apply a disciplined framework for optimizing capital allocation between Resilience and Optionality, we must be awake – paying attention to the world around us to recognize when the right situation arises to re-allocate capital. In other words, we must be present to see when luck finds us. While focusing on Resilience and Optionality we must also cut out the unproductive middle – investments or resources, which are neither Resilient nor Optional.

This paper begins with a brief overview of normal distributions compared to a power law or complexity framework. We then outline the key aspects of Resilience and Optionality that we look for in companies and investments. This new framework leads to a new understanding of competitive advantage in the information age and a better way to construct investment portfolios for superior long-term risk adjusted returns.

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# Chapter 1:
# We're All Above Average...

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When it comes to confidence in our views of the future, most of us live in Garrison Keillor's mythical Lake Wobegon – we're all above average. Behavioral

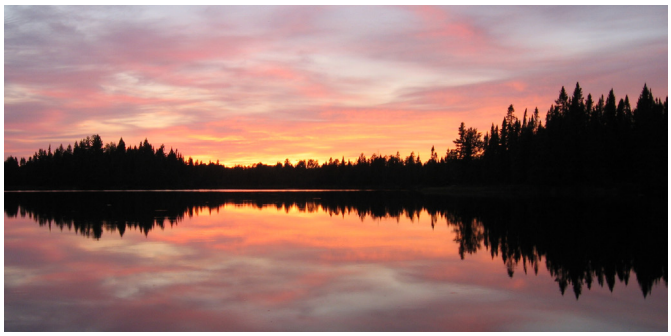

Figure 1: Are we all living in Lake Wobegon?

scientists and numerous scientific studies, however, love to show us that facts paint a different picture.[1] They reveal **we're actually quite bad at predicting the future**. Perhaps worse, our past track records seem to have no bearing on our serial overconfidence about being right the next time. So while we're bad at correctly predicting future events, **we're quite good at being overconfident.**

To find evidence of this phenomenon in financial markets, look no further than track records of economists' forecasts (Figure 2).

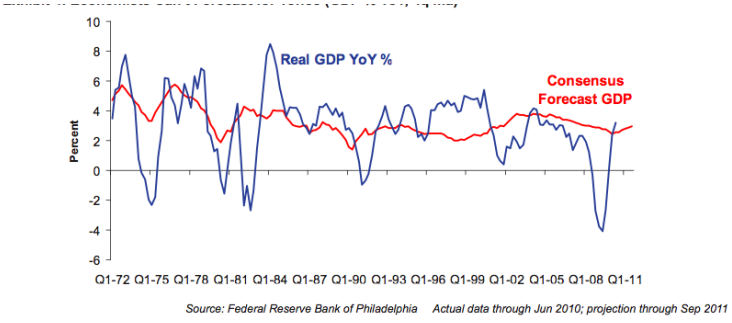


Figure 2: Economist forecasts compared to reality.

A quick scan of consensus GDP estimates over the past 30 years illustrates that the 'professionals' are only good at telling us what just happened. Of note, they are particularly bad at catching more extreme events.[2] We tend to think about the future in terms of a bell curve. Bell curves, or normal distributions, correctly explain many things – especially things that occur under relatively mild conditions, such as the distribution of people's height, or particles in a room, etc. . . . After all, 99.7% of all phenomena in a normally distributed curve happen within three standard deviations of the mean. **Bell curves are great for equilibriums – situations**

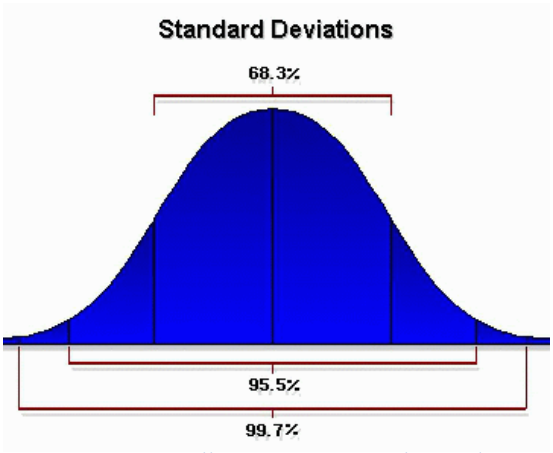


Figure 3: A Bell Curve, or Normal Distribution

**that do not evolve or adapt. Normal distribution curves are really bad at explaining phenomena in more dynamic conditions such as those found in complex systems (like the world we live in).** For example, under a normal distribution, the odds of the 1987 stock market crash, otherwise known as Black Monday are $10^{-148}$ or essentially impossible in the lifetime of the universe![3]

1 Both Kahneman and Montier detail numerous experiments where participants consistently engage in overconfident behavior. Some of our favorites are Keynes Beauty Contest, pp 90-92, *Behavioural Investing*, and Kahneman's detailed work around the planning fallacy and optimistic bias, pp 249-265,*Thinking, Fast and Slow*.

2 Montier compiled a similar chart in his rant against the Efficient Market Hypothesis on p 11, *Value Investing* (2009).

3 Beinhocker offers a good overview of power laws on pp. 179-181, *The Origin of Wealth*. In particular, he delves into the findings of first Pareto and later Mandlebrot that evolved into an understanding of the "scale free" or fractal nature of power laws.

And here's the catch, most of the math we use in economics has, at its foundations, the assumption that risk is normally distributed.

## Financial markets are complex systems

**Scientists define complex systems as those in which large networks of components with no central control exhibit complex behavior, sophisticated information processing and adaptive learning.**[4] Further, complex systems experience emergent properties and are incredibly sensitive to relatively small changes. Because they are sensitive to small changes, i.e., nonlinear, complex systems are poorly explained by bell curves and best explained by power laws. [5]


Figure 4: Power Law.

**Unlike bell curves, power laws (heavily tailed, non-normal distributions) tell us that extreme events are massively more likely than we care to predict – sounds an awful lot like financial markets to us!** In other words, we see numerous data points in the 'tails' of the distribution, giving power laws 'fat tails' compared with a normal distribution or bell curve.

Put simply, a power law is a mathematical relationship where the frequency of some event varies as a power, or exponent, of some characteristic of that event. For example, the number of earthquakes is inversely proportional to some power of their size.

In other words, if we have several relatively small earthquakes, we know that a certain amount of the time we're going to experience some REALLY big ones – we just never know when and where the next one will hit or at what magnitude. Power laws tend to be

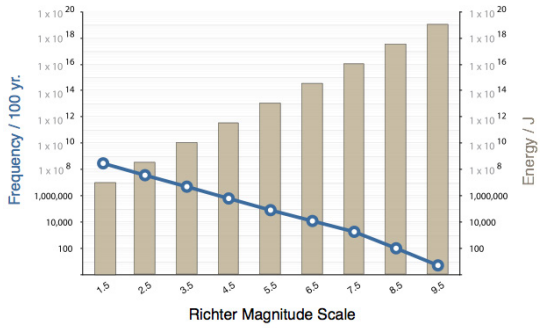


Figure 5: Earthquake frequency and size, log scale.

very common in nature and they also tend to be very common in networks. For example, in a city, creative output, wages, crime and poverty all tend to scale at a rate of 1.15 with population (we get more of both the good and the bad). However, scaling at an exponential rate is not possible forever no matter what the system.[6]

4 Melanie Mitchell attempts to arrive at a common definition of complex systems by pooling the characteristics together on pp 12-13, *Complexity: A Guided Tour*.

5 This may be a bit of a contentious conclusion as some believe complex systems don't always fit power law behavior in the strictest sense of the definition. Particularly Clausset, Shalizi and Newman conclude much of the data for complex systems seem to suggest 'heavily tailed' distributions rather than absolute power laws ("Power Law Distributions in Empirical Data" SIAM Review 51(4), 2009.) However, several others including Beinhocker, Mitchell, and Bettencourt make a case that power laws are more norm than exception when it comes to complex systems. Everyone agrees that complex systems are best explained by 'fat tails' and least explained by Normaldistributions.

6 Bettencourt, Lobo, Helbing, Kuhnert and West brilliantly illustrate the scaling effects of cities and their characteristics. Geoffrey West detailed their thoughts in the following TED talk: http://www.ted.com/talks/geoffrey_west_the_surprising_math_of_cities_and_corporations.html

**Which is why complex systems don't tend to exhibit points of equilibrium, instead they go through large shifts (or phase transitions) when growth hits a ceiling and adaptation or innovation is required – they do NOT exist in long term equilibriums.** This adaptation takes the form of emergent behavior, which is virtually impossible to predict. These are periods of 'punctuated equilibrium'.

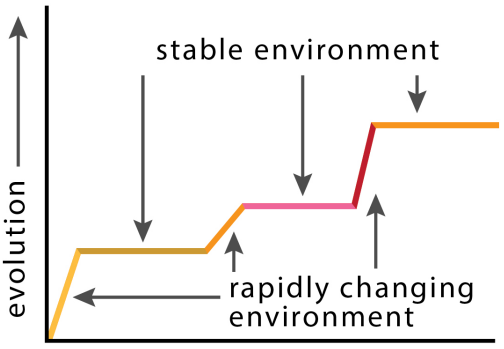


Figure 6: Punctuated equilibrium.

Power laws also teach us that instead of the rule of diminishing returns most of us learned in Economics 101, complex systems tend to reward the strongest and punish the weakest. This results not in diminishing returns, but in increasing returns for the winners.[7] In companies we see this phenomenon with some regularity, for example, Coke with about half of global cola market or Google with their dominant market share in search.

Skipping past the math, the key insight we gain from power law modeling is: **large changes/events are far more likely to occur than what 'normal' distribution curves would lead us to believe. In fact, they're not that uncommon.** Which is why, for those of us who wonder why we live through so many three standard deviation events, power laws make intuitive sense (**i.e., we've been trying to fit the wrong 'normal' paradigm onto a complex system).** For example, the probability of Black Monday under a power law distribution is more like $10^{-5}$, or a decent chance we'll experience that type of event every 100 years or so.[8] **Extreme events are not only common, they should be anticipated as the norm.**

## Flaws in Traditional Economics

Conventional market models and modern portfolio theory assumes[9] that events cluster around a mean (bell curves), but in reality financial markets follow the 80/20 rule (power laws) a few seemingly improbable events effect the system in a nonlinear fashion. **Therefore applying "normal" math to complex systems leaves us surprised and vulnerable. Applying power law math, however, prepares us for the common nature of extreme events. When we try to squeeze power laws into normal bell curves, we expose ourselves to overly narrow predictions.**

Unfortunately, the investment industry has an ingrained tradition of using "broken" math and cognitive shortcuts to convince ourselves that we are great at predicting the future under a narrow range of normally distributed outcomes. However, as we've explored, returns in complex systems are distributed in a fashion much closer to power laws than normal or normal. Ole Peters has done fascinating research concerning the origin of these distributions, he's uncovered a flaw.

7 Waldrop goes into detail about increasing returns pp 34-36 of his book, *Complexity*. In particular, he details the departure of economist Brian Arthur from the traditional path of decreasing returns. Beinhocker also delves into agent based modeling programs such as "Sugarscape", which illustrates the evolution and nature of increasing returns on pp 80-96, *The Origin of Wealth*.

8 Beinhocker, p 181, *The Origin of Wealth*.

9 Wikipedia on Modern Portfolio Theory offers this explanation: "MPT modes and asset's return as a normally distributed function, defines risk as the standard deviation of return, and models a portfolio as a weighted combination of assets, so that the return of a portfolio is the weighted combination of the assets' returns. By combining different assets whose returns are not perfectly positively correlated, MPT seeks to reduce the total variance of the portfolio return. MPT also assumes that investors are rational and markets are efficient."

Modern Portfolio Theory utilizes ensemble or average returns to calculate a portfolio's expected return. However, an individual portfolio manager is not interested in the ensemble return but in the individual portfolio's return through time (i.e., the path-dependent return). The catch is that ensemble and time average returns are NOT equal because the distribution of returns is not normal. This is referred to as non-ergodic.

Peters imagines a coin toss game[10] in which a winning toss generates a 50% gain while a losing toss yields a 40% loss. Intuitively, this seems like a favorable game, and on average, it is. However, we see that for an individual through time, the game actually results in losses for the majority. To understand this disparity, we need to look closer at what is happening inside the average. Here's where we see a classic heavily tailed or power law relationship emerge.

The surprising reality is most people experience losing streaks while playing this game through time, but a very few people emerge as fantastic winners. It's the very few that drive the ensemble average higher, e*ven though the typical experience of an individual participant is that of loss*. This is classic non-ergodicity – the individual experience is not the same as the average or ensemble experience. In fact, path dependency, or one's experience through time is what really matters to that individual, not the ensemble of all possible experiences he or she might experience.

**To put this another way, the average of 1000 different people tossing a coin can be different than the path of one person tossing a coin 1000 times.**

**Because financial systems are non-ergodic, the very foundations of traditional economic theory are based on false assumptions. False assumptions in turn yield false predictions and a false sentence of security. Unfortunately, this false sense of security underlies almost all commonly accepted measures of risk management and portfolio theory.**

Andrew Lo builds on this thought by asserting that physicists define "risk" as randomness fully captured by probability and statistics. Indeed this is exactly how risk management practically defines risk in financial models. However, human behavior is not nearly as stable and predictable as physical phenomena.

Richard Feynman once quipped, "Imagine how much harder physics would be if electrons had feelings!"[11] **As subjective beings, it is very difficult for us to accurately quantify risk in complex systems in which we are centrally involved.** In temporarily limited systems, "risk" is better characterized as "uncertainty," or other types of randomness which cannot be fully captured by probability and statistics.[12]

**Risk and uncertainty are not the same thing. In markets, there's a limit to which we can reduce our uncertainty through the use of math, and we're certainly not able to accurately define risk.**

When we look at the effectiveness of risk models to help us avoid the manic ups and downs of the market over the past 100 years or so, this perspective makes intuitive sense. Risk models and portfolios built on normally distributed outcomes might be just tamping down volatility rather than actual risk.

10 Peters has done a fantastic job of catching a simple math mistake, made by Menger in his widely cited 1934 paper. This paper, built upon by Ken Arrow and Harry Markowitz in the 50's, helped send the world down an errant path which Peters has proven (with the agreement of Arrow) to be empirically false. One can watch a Peters present his findings at Gresham college in November of 2012, here: http://www.gresham.ac.uk/lectures-and-events/time-for-a-change-introducing-irreversible-time-in-economics.

11 Richard Feynman, speaking at a Caltech graduation ceremony.

12 Andrew Lo correctly distinguishes the nuance between "risk" and "uncertainty" in his paper "Warning: Physics envy may be hazardous to your wealth".

Further, we question the assumed equivalence of volatility and risk. In complex systems, volatility leads to emergent behavior which improves the nature of the system over time. Imagine a river, it needs the sharp bends and narrow straights to vary the flow of water and carve out depths to support various ecosystems. If a river ran in a straight line with a constant flow and at a constant depth, it could not support near the diversity enabled through volatility. Complex systems embrace volatility. Through this lens, volatility is not risk, in fact lack of volatility would imply higher risk.

One might even argue that current risk models have made things worse, which takes us back to the future: because we can't accurately predict the future, risk often turns out to be more random and extreme than our models.

Perhaps we should spend less time trying to build a portfolio that attempts to pin down the future within a narrow range of outcomes and neatly quantified risk (which is really tough unless you have access to a tricked-out Delorean and bit of plutonium). Instead, perhaps we should think more about allocating capital in a way that companies and portfolios thrive in a complex environment, which brings us "Resilience and Optionality."

Figure 7: We need one of these to predict the future.

# Chapter 2: Resilience and Optionality

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**Resilience:** When it comes to Resilience, we have a lot to learn from ants – masters of Resilience. When we think about ants most of us would describe them as industrious. We'd certainly not think them lazy. Stanford University professor Deborah Gordon offers a different take. She's been studying the same group of ants for the past 30 years and may know more about the behavior of ants than anyone. What she found is surprising: Most of the time about half the colony is just sitting around doing absolutely nothing.[13] Why? Certainly they could gather much more food if they all pitched in, right? Going back to complex systems, in nature, we see extreme events happen with some regularity. What if a flash flood destroys part of the colony out harvesting or destroys the nest? Inversely, what if someone sets up a picnic nearby? No problem, call out the reserves! **Ants have adapted**

Figure 8: Ants are masters of resilience.

**to be resilient to extreme events, even though most days it costs them from a productivity optimization perspective.** Ants have survived millions of years precisely because they DO NOT optimize around productivity – that type of behavior would have knocked them out long ago. **Ants are built for Resilience. In the world of business and investing, resilient companies are less optimized for maximizing immediate returns and more focused on the ability to adapt and evolve to changing conditions, able to quickly recover from or capitalize on extreme events.**

**Optionality**: In addition to focusing on Resilience, we also focus on a second characteristic we call Optionality, i.e., a large potential payoff resulting from a relatively small investment. Power laws are no secret to venture capitalists. They know that the majority of their investments are going to amount to nothing, but they also know that a few are going to make up for all of their disappointment and then some. The best management, the most sophisticated plans or ample funding don't guarantee success. Instead, often times the least plausible startups are the ones that break through. For example, who knew that Facebook would become such a massive success when MySpace seemed to dominate the market? To hedge against the risk of uncertainty, venture capital firms fund a number of companies. Further, VC's are not afraid to pull the plug on a company that just isn't working. Although it may be a bit counterintuitive, **it's because of extreme volatility and unpredictability that it's possible for a VC to lose more often than they win but still come out ahead in the game.**

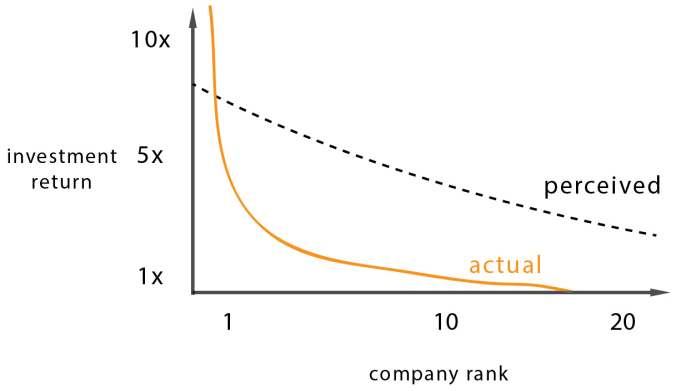


Figure 9: Venture capital returns are dominated by a few big winners.

13 Gordon details her 30 year plus study of ants in her 2010 book, *Ant Encounters*.

VCs effectively distribute their downside risk through many binary events, which allows a power law to emerge. **VCs are structured around Optionality.**

*A preview of Optimizing Resilience and optionality while eliminating the unproductive middle in capital allocation.*

Later in Chapter 5 we will further discuss how balancing Resilience and Optionality is the right way to optimize capital allocation decisions that allow for the most long term value creation. But, here is a quick preview: We talk a lot about dualities in this paper: tensions, balancing acts, long term vs. short term, experimentation vs. optimization, and Resilience vs. Optionality.

Figure 10: The odds of the kid winning are highly optional, but don't bet the portfolio on it!

It's important to note the most powerful investments merge dualities into one. Said differently, the dualities are perfectly balanced. Our favorite investment, occurs when a company embodies Resilience AND Optionality, BUT the market values the Optionality deep out of the money, while questioning the company's Resilience. This is where the analyst can most fully express skill: where investment returns are at their most nonlinear.

With the bulk of a portfolio concentrated in companies that express both Resilience and Optionality, we add a number of small positions with pure Optionality, much like a venture capitalist would structure their portfolio. We then attempt to eliminate the unproductive middle – avoid investing in companies that are *only* resilient or neither resilient nor optional.

Resilience buys you budget for Optionality. Having discipline in decision making and paying attention buys you the ability to think creatively and recognize when good portfolio allocation decisions arise. By optimizing for Resilience and Optionality and eliminating the unproductive middle, you avoid the illusion that you can predict the future.

**Ants have learned that Resilience is far more important than productivity optimization. VC's have learned that Optionality is far more important than their attempts at predicting the future. Neither depends on their ability to narrowly predict the future.**

Figure 11: Narrow predictions of the future are difficult.

Investors and CEOs often talk about conviction. By 'conviction', people tend to mean, "my view of how events are likely to turn out is different from others' view and more likely to be right because of reasons x, y and z" – these are what we call narrow predictions. To the extent we make predictions of the future, they are broad. We have conviction in our framework to identify companies with a combination of Resilience and Optionality to comprise the body of the portfolio (fewer, larger position sizes) while opening the portfolio up to as much pure Optionality as possible in the tail (more, smaller position sizes) and cutting out the middle. **Balancing Resilience and Optionality allows us to remain agnostic about various paths the future might take.**

# Chapter 3: Identifying Characteristics of Resilience & Optionality Companies

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We use several key investment attributes to identify businesses and trends that are likely to survive and flourish in a dynamic economic environment and populate our portfolio with an optimal balance of Resilience and Optionality. **These attributes are centered around three areas: Quality, Growth and Context.**

The first several characteristics revolve around quality: quality of the management team in terms of guiding the organization toward long-term thinking, helping foster a culture of innovation, empowering employees through decentralized decision making and building a company that adapts and evolves. The next characteristics revolve around growth: creating positive growth environments for the company and customers, maximizing duration of growth and constructive governors on growth. We call these characteristics non-zero sumness, S-curve duration and negative feedback loops. Finally, we consider the context in which we're investing through relative valuation analysis and evaluation of headwinds and tailwinds facing or benefiting companies.

## Quality:

### High-Quality Management Teams

**Management teams are often the trump card that drives everything else:** a bad management team in a great business results in a mediocre company; a great management team in an average business can build a great company; and a great management team in a great business marks an exceptional company. Truly great management teams don't tend to waste their time on bad businesses – neither should investors. Finding such a combination is rare, and dictates more thorough investigation.

There's an element of Quality we're talking about here that's very tough to define. To borrow a quote from *Zen and the Art of Motorcycle Maintenance:*

> *Any philosophical explanation of Quality is going to be both false and true precisely because it is a philosophic explanation. The process of philosophic explanation is an analytic process, a process of breaking something down into subjects and predicates. What I mean (and everybody else means) by the word 'quality' cannot be broken down into subjects and predicates. This is not because Quality is so mysterious, but because Quality is so simple, immediate and direct.*[14]

**A great management team will be focused on quality - vigilant and mindful, with every decision thoughtful and intentional.**

### Long Term Thinking | Culture of Innovation

The importance of long term thinking and adaptability represent key themes running through the length of our paper. To some, these might seem contradictory, but here we find another duality: management teams should clearly state long term intentions and act in a way that goes beyond optimizing for the quarter AND management teams should develop detailed plans but be ready to abandon them when the world throws them a curve ball. Long term thinking and adaptability are two sides of the same coin.

By long term, we mean focusing on customer needs

14 Persig grapples with what humans mean by Quality in his many "Chautauqua's" throughout his book, *Zen and the Art of Motorcycle Maintenance*. He ultimately concludes that quality is impossible to define and impossible to mistake.

over time – both what will change in customer needs, and more importantly what will NOT change. Long term thinking, and, perhaps more importantly, avoiding what we call "short termism" are critical to the ability of a company to evolve, adapt, and learn. Often a successful company will balance a focus on what will NOT change for their business with a strong ability to anticipate the evolving needs of their customers. A long-term focused company will generally make value-creating investments and thoughtfully approach decisions. We find these companies tend to be product and customer focused rather than sales and marketing or competitor focused. They tend to have **highly empowered employees, usually structured in small teams, and decentralized decision making**. Incentives are also aligned with the long-term thinking, i.e., they avoid an emphasis on quarterly and annual results. A lot of companies believe they think long term, but, in reality, are too wrapped up in short term incentives to make the right value creating decisions.

Jeff Bezos, CEO of Amazon.com, prides himself on long-term thinking. The team at Amazon regularly thinks about their business 10 years into the future, but they do it in a surprising way. They think about what's NOT going to change over that time period.[15] For example, while Amazon has no better idea what changes the future may bring over 10 years than anyone else, they can say with some degree of certainty that 10 years from today customers will likely want cheaper products, more selection and faster delivery. This is an important lesson. **Resiliency teaches us to plan for the future based on what's NOT going to change.** At the same time, Amazon loves to experiment – some of these, like the Kindle or Amazon Web Services, become major successes. Amazon offers a great example of Resilience and Optionality working together in a complementary manner at the company level.

Companies that successfully think long term and evolve are masters at balancing their own Resilience and Optionality they tend to thrive and accelerate in the face of new competitive challenges or economic uncertainty. The optimal combination of Resilience and Optionality will depend on the nature of the industry in which the company operates. In a dynamic industry, a company too focused on Resilience is likely to become entrenched in one particular ideology and fail to adapt quickly enough to changing trends. On the other hand, a company overly focused on experimentation (Optionality) leaves themselves vulnerable to shocks to the system if they don't have stable platforms (Resilience) to fall back on.

### Ability to Adapt and Evolve

Almost every business operates in one (or multiple) complex adaptive systems. As a consequence, most companies should be managed for an optimal balance of Resilience and Optionality. The appropriate amount of each will likely depend on the dynamics of the competitive industry structure, the needs of the customers, the pace of technological change, and the stage of such change. Management should focus their efforts less on strategy and competitive threats. Competitive actions and product or business model disruptions follow power law math, trying to correctly anticipate them is generally a waste of time.

Instead, businesses should be built to adapt, evolve, and learn. Innovation should be a key cultural attribute. Incentives and structure of the company should align to create an environment inside the company that promotes adaptability. Companies that focus more on what ***will not*** change over the long run, rather than what ***will*** change, are much more likely to

15 Bezos discusses the question of what's NOT going to change over the next 10 years in his chat with Werner Vogels at the 2012 Invent Day. Viewable here: http://www.youtube.com/watch?v=O4MtQGRIIuA

make the right decisions in the present. Complexity teaches us that as we harden the edges of the network through formalization, we make the system less adaptable and thereby more fragile. Although it appears counterintuitive, the system remains robust because the edges of the network are open to change. The silver bullet is that there is no silver bullet, only the willingness to try something new.

Figure 12: There are no silver bullets.

Companies that tend to thrive in complex adaptive systems operate increasing returns platforms with strong network effects. These companies build strong ecosystems in which their customers usually benefit more than the companies. They tend to enable other companies and customers, generating a win-win environment for everyone involved with the platform. Companies that create value while extracting low tariffs (charging as little as possible) on their ecosystem, especially in the Internet age, will be the biggest winners.

**Businesses will likely have certain products, services, or processes that can be optimized for Resilience. These are generally high return on capital, high incremental margin, recurring revenue, cash generative businesses that should be used to fund a series of Optionality investments around the core or adjacent competencies.** In the Resilient part of the business, emphasis is more on stability through economic cycles, margins, and free cash flow optimization.

In the Optionality part of the business, the organization should be highly focused on innovation, pioneering, and experimentation driven by small, decentralized, agile, cross disciplinary teams consisting of product, sales, and marketing people. Here, the organization should be centered on the unmet needs of the customer base while keeping in mind what is likely to not change over the long term.

If the company is overly focused on Resilience, they are highly likely to be disrupted by new technology, or, even worse, a competitor attacking with an entirely new business model. If the company is overly focused on Optionality, they may not withstand a shock to the system and live to fight another day. Management should therefore focus on: 1) determining the right balance of Resilience and Optionality based on the dynamics of their specific industry and product lifecycles, 2) optimizing the resilient part of the business, 3) empowering innovation and experimentation in the Optionality part of the business, 4) incentivizing long term thinking across the business, and 5) under-promising and over delivering to customers, employees, and investors.

### Decentralized Decision Making

Decentralization is essential to a company's ability to adapt and evolve. Interestingly, decentralization is NOT a characteristic we find in most companies. Instead, the most typical structure we find is one of tight central control over day-to-day operations from a hands-on management team (in particular a hands-on CEO). Often times, centralized/decentralized structure boils down to how the management team understands their role. To oversimplify, CEOs need to do two things well: manage the business operations efficiently and successfully deploy the cash generated by the business.[16]

In our observation, the vast majority of CEOs focus on efficiently managing daily operations –

16 In his book, *The Outsiders*, Thorndike chronicles the careers of what he calls "outlier CEOs" and, indeed, they are almost universally exceptional at capital allocation.

Figure 13: Companies should be decentralized like bees.

decentralization tends to make them uncomfortable, so the focus is turned toward tighter central control. This action gives employees less authority. A typical response is to take less responsibility in return.

However, a few CEOs understand their primary responsibility to be capital allocators, while business operations are given over to business unit managers. This has the effect of decentralizing operational control while centralizing cash and thereby capital allocation. Decentralized control gives mid-level managers more authority over day-to-day decisions, which yields a feeling of greater responsibility and creativity, and allows the management team a right to ask for accountability: **because only when accountability is married with authority can it legitimately be expected.**

This fundamental understanding of a CEO, allocator versus operator, represents a key variable to understanding a great long term investment. A **decentralized organization run by a small group of people at headquarters tends to be the fingerprint of a management team that understands their role to be capital allocators.** In other words, a decentralized company can react quickly and effectively to changing business conditions, while the management team adheres to tight parameters around what types of businesses the company will be involved with in the first place. This places decision making closer to customers and future products or services.

Management teams with the maturity to turn over daily operations to business unit leaders and let them run the business as their own are rare. Management teams skilled at capital allocation are rarer still. They intuitively grasp flat S-curves, non zero sum and Resilience/Optionality (see next section). This is where interviewing managements becomes so vital--answering this most important question: **Does the management take on a role as a capital allocator or an operator?**

Finally, because complex adaptive systems are best explained by power laws and thwart our ability to predict, **the best way to figure out how to experience large gains is to make as many mistakes as possible for the least possible cost per mistake.**[17] By definition, decentralization distributes mistakes while centralization focuses them. However, we should expect some centralized, option-at-the-top type companies to thrive out of luck. Over short periods of time, luck and foresight are indistinguishable.

## Growth:

### Non Zero Sumness (Win-Win)

Another attribute of companies we look for is maximization of nonzero sumness (NZS). In a complex world with increasing interdependence, the best outcome for all players is to make decisions that create positive nonzerosum scenarios.[18] An NZS interaction leaves both parties better off than if they had not transacted in the first place (i.e., a win-win scenario rather than a win-lose or lose-lose scenario).

**A company that operates a platform focused on creating value for all participants, including itself, is creating large amounts of NZS. Specifically, when companies create significantly more value for their**

17 In his book *Antifragile*, Nassim Taleb has intuitively grasped and scientifically explained asymmetric Optionality perhaps better than anyone.

18 Robert Wright's book, *Non Zero* factored prominently into our application of NZS at the company level to better think about the relationship of the company to the clients and employees.

**ecosystem than for their own treasury, the win-win positive spiral is optimal.** The relative level of NZS between customers and companies is generally more important than the absolute level – it will vary by industry.

As transparency and the velocity of information sharing increase in the world, it will become increasingly challenging for companies to extract positive sums from their customers. **While traditional investors seek businesses with "high barriers" and "wide moats," we believe this practice is misinformed. A barrier or moat today becomes a vulnerability tomorrow.** Rather than create large barriers (which often turn out to be temporary and/or artificial), companies should focus on maximizing NZS.

Long term thinking (beyond 5 years) is crucial for creating NZS because shorter term sacrifices are often required. Significant ongoing, long term investments are also required to continue innovation and nonzero value creation.

Companies that are disrupting large, established markets often do so with a value proposition that offers more opportunity for NZS. Often these companies are attacking an industry with large existing switching barriers, which allows the challenger to grow slowly (small position in a very large addressable market with the negative feedback loop of high switching costs) and invest for the long term with a disruptive model that creates more NZS for the ecosystem constituents. A good example of this would be e-commerce companies which offer more selection, lower price and in some cases more convenience to consumers – these companies have created a lot of value and steadily taken share from offline retailers.

NZS strategies often involve pricing a product or service at or below the Pareto efficient price. In a Pareto efficient scenario, a business is charging up to the point where customers would receive zero or negative return on investment, i.e., charging another dollar would mean the customer would go look for a cheaper or more effective solution. There are many externalities to take into account when thinking about pricing – for example there is the cost of a software license, but there are also the people and infrastructure costs along with long term maintenance fees. Another example is fast food – it is quite cheap and appears to offer a NZS scenario, but when you take into account the long term healthcare costs and burden to society, it is not Pareto optimal.

Another way to think about NZS is the Nash Equilibrium of Game Theory, where no player has anything to gain by changing their strategies (i.e., the maximum amount of Pareto efficient NZS is being created for all parties). However, in a complex world, disruptions to equilibrium are the norm. Recall from Power Law math – lack of equilibrium is the "equilibrium" state![19] Therefore, when companies create new products and services with increased levels of NZS, essentially, they are changing the rules of the Game (or even the Game being played). Thus, in a complex world, companies need to defend against the risk of the game changing – i.e., they need to be highly adaptable and capable of evolving.

There are two types of network effects that combine to mazimize NZS – price and quality. Many companies grow through lower priced products, while other companies grow with very high quality solutions. When you can combine a very high quality product or service with a low price, you have the Nirvana of network effects and NZS. This is very common for

19 This is the point of much of Brian Arthur's working paper, "Complexity Economics". He makes the point, "Equilibrium economics is a special case of non-equilibrium and hence complexity economics, therefore complexity economics is economics done in a more general way."

Internet companies to accomplish – the best quality for the lowest price has the potential to cause significant disruption of established markets and create customer loyalty.

Thinking about ants again – when you take into the account the risk of the entire the colony being wiped away in a flash flood, their optimal efficient strategy for survival long term is always to keep half the population in reserves. Along with balancing Resilience and Optionality, a company can achieve this type of winning strategy by pricing their products and services well below the point of Pareto efficiency and well off what would create a Nash equilibrium – **in other words create so much value for their customers over the long term itis very hard for a competitor to come in and change the game.** Many companies can get away with obfuscating and extracting more value from their customers in the short term, but, in the long run, evolution and information sharing win and new disruptive forces emerge. Michael Porter's famous "Five Forces" of competitive advantage need to be re-applied and re-examined in this framework (see Chapter 4 – Competitive Advantage: a New Framework). Companies want to create win-win scenarios for suppliers and customers – not extract too much value from either. **Pricing power could actually be a bad omen in this framework.**

Google is another great example of creating NZS. The primary driver of Google's business is Adwords, which is an auction based system where advertisers bid up to their maximum point of positive returns on ads, but no higher – Google prices their business as a Pareto efficient auction. Further, Adwords works because of transparency and information. **As transparency and the velocity of information rise in the world it will become increasingly challenging for companies to extract too much value from their customers.** Google actually keeps pricing low and innovation high in order to make sure companies and suppliers have no reason to join someone else's competitive platform.

For optimal NZS, pricing well below the point of maximum value extraction combined with long term focus and a big, addressable market with relatively high switching costs (negative feedback loop) creates very long duration growth. Short term thinking (losing site of the big picture) or lack of innovation and adaptability will be the primary reason a company creates fewer NZS markets and ultimately becomes a victim of disruption.

### Long Duration S-curve | Negative Feedback Loops

In investing and life there's no such thing as a free lunch. Or, in the terms of physics, nothing cheats entropy over time. There is a price for growth. We see this in nature – **animals quick to mature live relatively short lives and animals slow to mature live relatively long lives.** Imagine, for example, the two-week life of a fruit fly contrasted with the 80-year lifespan of a sea turtle. We often visualize lifecycle through an S-curve – quicker growth through the mid-point of a lifecycle and slower growth and decline later in the lifecycle.

For investors, understanding S-curves can be critical to the ability to make money. As a general rule, **most money tends to be made in a stock when the curve is convex and most money tends to be lost when the curve turns concave.**

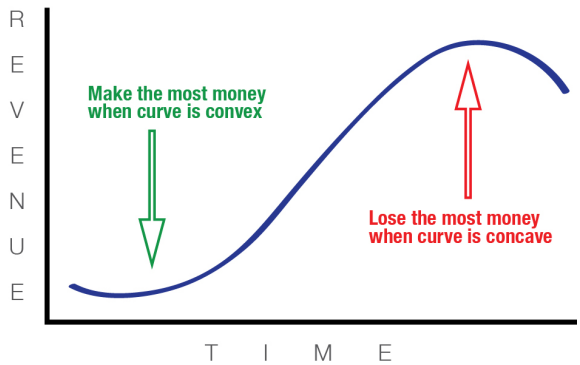



Figure 14: S-curves show where a company is in its growth.

The duration of the S-curve, or the S-curve's slope through time, gives us some indication of the life cycle of a product or a company. To take an extreme example, the S-curves of Groupon is more like a fruit fly while Procter and Gamble is more like a sea turtle. Ironically, it's the hyper-growth, compressed S-curves that often get the most attention from investors. However, quick, unchecked growth is extremely dangerous to a company's long-term health. These stocks offer plenty of allure, but usually end in investor tears.

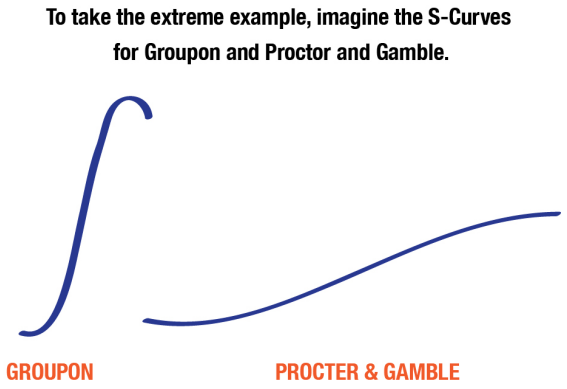



Figure 15: Compressed hyper growth (left) is fragile compared to steady long duration growth (right).

While nothing cheats entropy, some companies appear to do so because their growth is relatively slow and steady over a very long period of time. Because the period of convexity is so long, an investor can buy a stock at any number of times and still make a wise purchase in retrospect. **While fast growth is certainly sexy, it's slow growth over a long time that the market serially undervalues.** We argue that slow, long-duration growth stocks represent the ultimate value investment. In this equation, the period of time acts as an exponent to the steady growth rate. Said another way, a few more years of flat growth rate yields a nonlinear absolute return. For example, 15% growth over ten years ($1.15^{10}$) would deliver more than a 300% return. Not bad. But 15% growth over 15 years would almost double the 10 year return. If we could populate our top 20 positions with these types of resilient companies we'd only trim and add around periods of volatility and sip Mai Tai's while reading a good book the rest of the time.

However, as one might expect, these companies are rare. Most company's growth curves look like a power law – high growth up front followed by slow to no growth for a long time. BUT, companies with long-duration growth have growth curves that look like a flat line.

Finding stocks like this is not easy but the best place to start is with a superior management team offering great products/services in a good industry that represents a REALLY big total addressable market, or TAM. This

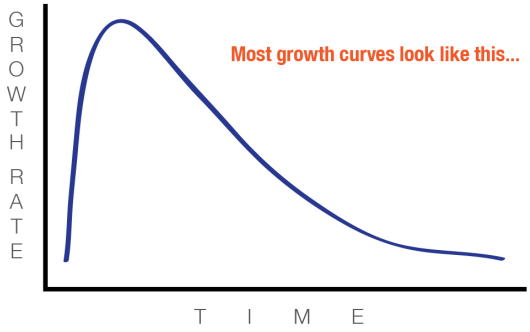
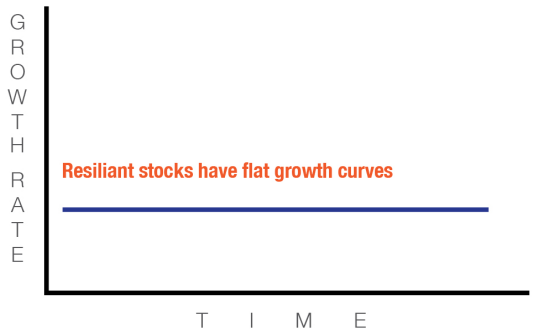



Figure 16: Typical rapidly growing company (top) compared to steady growing company (bottom). Note these charts are the 1st derivative of an S-curve.




allows the company to put up high levels of absolute growth over a surprisingly long time. Because of their very long period of convexity, it's difficult to understand

where the company is on the S-curve (although market share is probably the easiest). As long as the growth curve remains relatively flat, **these stocks can be bought without much risk over a long period of time (even though they almost always appear expensive relative to the market) because their period of compounding extends well beyond investors' typical timeframes.**

W. W. Grainger offers a great example. The company compounded operating income at 13.4% over the 50 years from 1962-2012. Because of Grainger's long period of compounding, an investor could have paid 200 times earnings in 1962 and still made the market return of 8% per year before dividends assuming a current multiple of 18 times.

This brings us to a short discussion on beta. According to economists, it's impossible to outperform the market without taking more risk (higher beta) than the market. With the types of stocks we're talking about that statement is empirically not true. Because long duration growth stocks tend to be more resilient than the market during bad periods, but grind steadily higher during good periods, they often exhibit betas lower than the market while posting significant outperformance over the longer term. And, indeed, we see this phenomenon in the Grainger example with massive outperformance and a beta of .96.[20]

To better understand the nature of growth, it's important to grasp positive and negative feedback loops.[21] Growth is a good thing, but hyper growth is a bad thing over the long term (although depending on the size of the TAM, sometimes hyper growth can go on for a really long time). The pace of growth can tell us a lot about the health of the company and the ecosystem. There's often a negative feedback loop in place with companies that exhibit the type of slower, long duration growth we're looking for and there's often a positive feedback loop in place for the type of companies that go into hyper-growth mode only to crash into the growth wall over a short period of time.

Hyper growth is dangerous and slow growth over a very long time is nirvana. In nature, we see positive and negative feedback loops with regularity. For example, the pine beetle ravaging the forests of the Rocky Mountains represents a classic positive feedback loop. Due to the loss of extended cold winters (which normally act as the negative feedback loop), pine beetles find their growth unchecked. They will continue to prey on susceptible pine trees until there is literally no more food left. Then their population growth will come to a crashing halt. We see something similar happening with the invasion of non-native Burmese pythons into the Everglades. Their inclusion at the top of the food chain has significant nonlinear implications for the ecosystem. As python numbers grow, wildlife sightings have fallen some 90%.

In the world and in companies we observe the same thing. Positive feedback sets things in motion through self-reinforcement, while negative feedback ensures stability against disruptions and excesses. We'd argue when a company comes into a large existing market with a disruptive product or business model, it's very similar to someone releasing a non-native Burmese python into the Everglades: **a new variable in a complex system changes the nature of the overall system in a nonlinear fashion.** Sometimes there's no negative feedback loop to check the new variables' growth, which leads to hyper growth and flame out. Sometimes hyper growth can go on for a VERY long time because the opportunity is so vast (all the prey

20 Many authors have grappled with the so-called, Low Beta Anomaly. For an overview of the work on this subject, take a look at the low-volatility anomaly Wikipedia page: http://en.wikipedia.org/wiki/Low-volatility_anomaly

21 Donella Meadows offers a fantastic short discussion of stabilizing and reinforcing feedback loops in her short book concerning system theory released in 2008. pp 27-34, *Thinking in Systems.*

animals in the Everglades, all the pine trees in the Rockies, or the entire retail market in the case of Amazon). And sometimes the new variable creates an entirely new TAM by shifting lower efficiency resources into a higher efficiency way of doing things. Remember the positive feedback loop of home prices, easy money, ratings agencies, collateralized debt obligations and credit default swaps? The system got bigger and bigger until it became unsustainable. Positive feedback loops perpetuate until they exhaust the resources needed to sustain them. Negative feedback loops are the checks and balances that keep a system healthy. It was the loss of proper oversight, caution from ratings agencies and lax lending standards that removed the negative feedback loop from what became the housing crisis. **Negative feedback loops are critical for a system's long-term health** (and for our purposes, the health of a company and their products).

We argue (perhaps counter-intuitively) that quick growth is a bad thing while long periods of relatively stable growth mark the most compelling companies given the market's ineptitude at valuing extended growth.

There's another dimension to the simple S-curve that adaptable companies do all the time: stacking a new S-curve on the concave phase of an old one.

**This represents an important aspect of combining Resilience (steady S-curve) with Optionality (adding on a new S-curve) – the ability to adapt and evolve.** In essence, when we invest in a 'value trap', that's exactly what we're betting on. We're betting that the company will use their large hoard of cash and know-how to disrupt themselves by stacking a new S-curve on top of their previous one. In practice this proves incredibly difficult as it disrupts original products. Leveraging existing or slightly different products into a new TAM seems a bit easier.

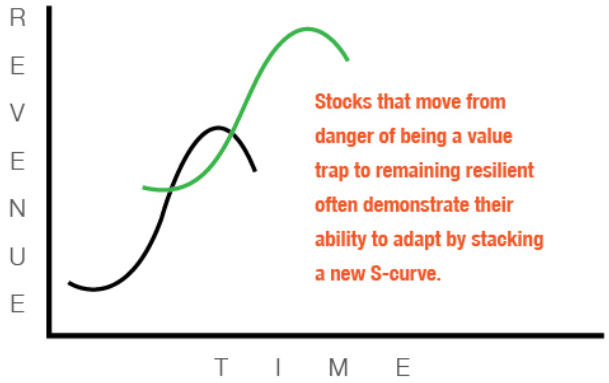



Figure 17: Companies that can stack new S-curves create Optionality on top of resilience.

To sum up, companies that have very long periods of convexity are shockingly resilient over a very long period of time. They tend to exhibit these qualities because they are taking share in a BIG TAM. Often there is some sort of negative feedback loop that keeps them from growing too quickly but extends their duration of growth.

Extended growth duration is extremely powerful because time acts as an exponent to growth. These companies tend to have lower risk than the market as measured by beta, but outperform the market because of their steady growth through time. S-curves give us another helpful lens to visualize Resilience and Optionality. Finding such a company like this and sticking with the stock through thick and thin marks one of the holy grails of investing.

The large S-curve diagram (Figure 18) illustrates this concept. Importantly, the blue pinwheel in the diagram represents relative valuation. Companies at higher points on the valuation scale relative to where they are on their Scurve are riskier. Resilience and Optionality stocks should ideally be purchased at the lower side of the pinwheel based on detailed modeling and scenario analysis of future cash flows.

## Context

Some may read our thoughts concerning the extreme fragility of narrow predictions and not understand how to incorporate the larger world around us without the input of economists or television pundits. To be clear, we believe the Resilience and Optionality framework makes prediction far less relevant. Said another way, our portfolio is not fragile to one particular view of the future coming to pass. However, we also realize that it's a mistake to not look out the window and consider an investment in light of the world around us. We call this contextual awareness or presence.

## Headwinds/Tailwinds

**Even the best management teams can't sell more buggy whips into a world being overtaken by the automobile.** All businesses face headwinds or tailwinds depending on the global climate toward their products or services. This is why in-depth research sits at the core of our process. Much of our research is directed toward understanding what's going on within the ecosystems we invest. What we mean by context is NOT next year's GDP numbers or future actions the Fed may or may not take. We don't obsess over precise predictions about what's going to happen next at the macro level. Instead, we focus on determining what will change and what will not change, and how that effects the ecosystem a company operates in. There is an enormous amount of noise in the world, but we are trying to pull out the important signals that contain real information about the external environment a company faces.

**The process of pulling signal from noise requires a vigilant presence – a mindfulness to determine what is noise, what will change, and what will not change. Our focus is on events and facts with a near disregard of commentary and opinion.**[22] Through this disciplined pursuit of context, we're often able to connect non obvious dots – **and it is the connection of non-obvious dots that yields insight not yet valued by the market.** What makes the process so difficult is that, like complex systems, connecting dots is a nonlinear process. One never knows exactly how or when a key dot might present itself. Instead the focus turns from busy work like email or meetings to a focus on being present and open minded, while delaying response. **One must be vigilant, and skillfully place themselves in places where luck has a better chance of striking.** For many of us trained in the fine art of doing, this can be deeply uncomfortable.

## Relative Valuation

Predictions are fragile. For stocks, predictions grow more fragile as valuation grows richer. For example, a long duration growth company trading at ten times cash flow is not all that fragile to growth expectations, higher future levels of profitability, or their ability to become successful in new business verticals. However, a company trading at ten times revenues is fragile to all of these variables. **The company trading at the higher valuation forces an investor to make narrow predictions.** Inversely, a rare (and often unrecognized) company with long-duration growth in front of them AND trading at a much lower valuation does not demand accurate, precise predictions – just sustainability of what's already been happening.[23]

All predictions are not equal. Some predictions, such as duration of growth, lend themselves to accurate

22 Prioritizing events and facts while discarding commentary and opinion is an information processing discipline we learned from our friends at Inferential Focus (http://www.inferentialfocus.com/). They are masters of context.

23 This is one of the central tenets to Benjamin Graham's investment style laid out in detail in Graham and Dodd's 1934 book, *Security Analysis*.

analysis much better than future levels of profitability or success in a new business vertical. Often, the most fragile stocks are those trading at rich valuations that already discount high future growth rates. These stocks offer multiple ways to lose and a narrow path to win. The companies may not be fragile, but their stocks are enormously fragile to disappointing Wall Street.[24]

One common sense approach to valuation is simply asking, **"How many predictions and what kind of predictions is the valuation forcing us to make?"** This question alone can often start and end the conversation on a new stock. The predictions we believe are most worth the risk concern duration of growth (see section on S-curves).

The matrix below Figure 18 (Figure 19) defines how we think about valuation, correlation of types of prediction and analyst acumen, portfolio construction and risks through the various stages of our S-curve framework.

24 We found Taleb's construct of fragility quite helpful in several parts of the paper. Fragility was a thought sitting in the back of our mind throughout much of the paper's writing.

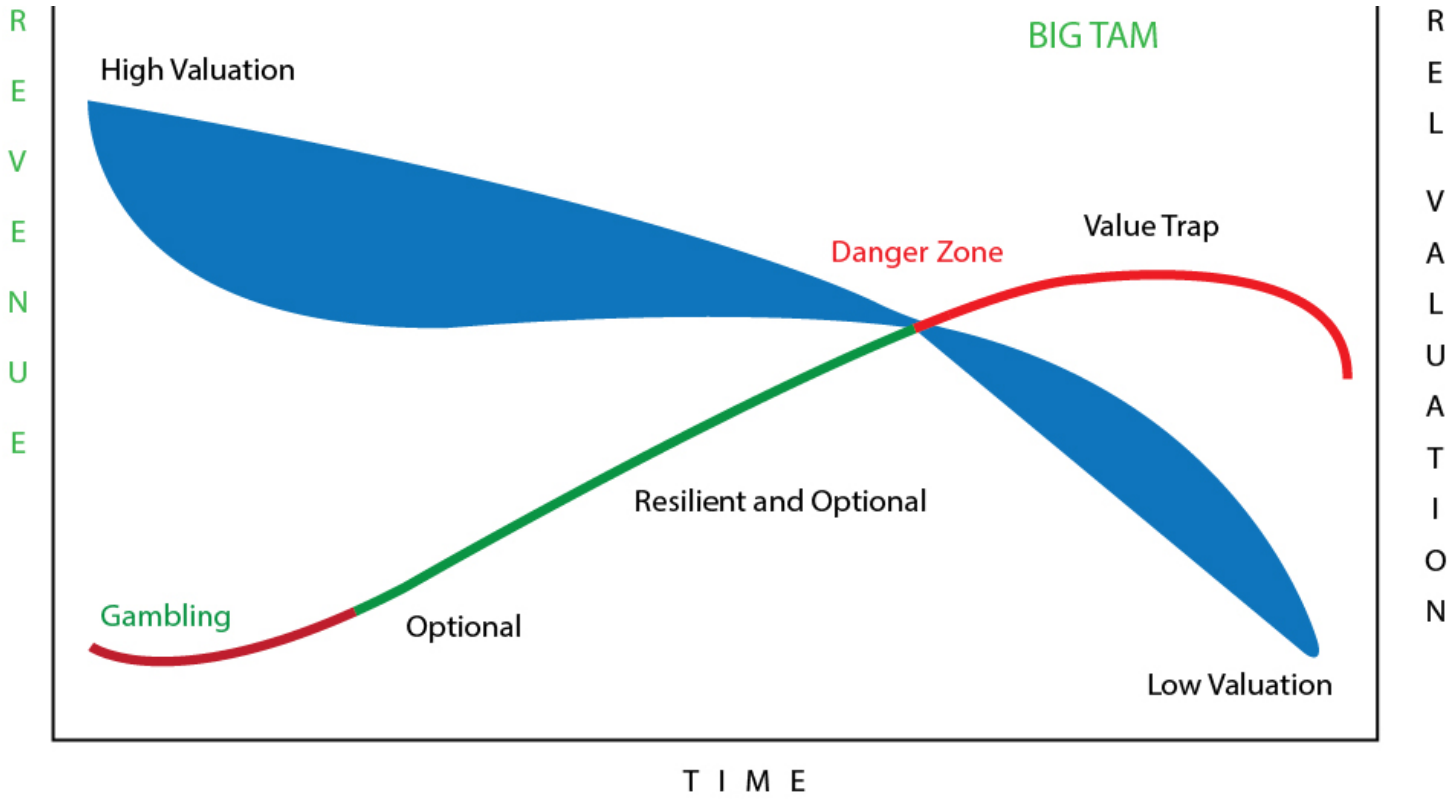



Figure 18: S-curve with different types of investments and valuation zones.

| S-Curve Matrix | Gambling/Early Optional | Resilient and Optional | Avoid/Value Trap |
|---|---|---|---|
| Slope of Curve | * Unsure if S-Curve will develop/Early Convex | * Clearly Convex | * Turning Concave/Clearly Concave |
| Valuation | * Binary | * Precision matters least here<br>* Duration of Convexity matters most<br>* Fair Value = Period of Convexity (Time)<br>* Expected Return = FCF Yield + Growth Rate<br>* Growth~Value | * Early stage Value Trap is almost always overval ued (but position can only clearly be seen w/benefit of hindsight)<br>* Valuation can be the most precise, but offers low visibility due to the deteriorating nature of the business |
| Prediction | * David Kills Goliath<br>* Extremely difficult to predict given complexity | * Because of Neg feedback Loop and NZS, Duration of growth is very long<br>* Good correlation with this type of prediction and analyst acumen | * Will utilize free cash flow from legacy biz to stack a new S-Curve<br>* Extremely difficult to predict given complexity |
| Portfolio Construction | * Distributed | * Concentrated | * Distributed |
| Fragile to | * Lindy Effect<br>The Lindy Effect is a simple heuristic which posits the longer a technology has been around, the longer it's likely to stay around. | * Duration of Growth/Valuation<br>* Shifting macro tailwinds | * Defending long duartion of growth when period of ccnvexity has passed<br>* Entrenched Thinking<br>* Selective Vision<br>* Overconfidence in new growth initiatives |

Figure 19: Different aspects of each phase of investing along the S-curve.

# Chapter 4: Competitive Advantage: a New Framework

# Chapter 4: Competitive Advantage: a New Framework

If we take a step back, an important aspect of Resiliency and Optionality business characteristics is a new way to think about competitive advantage. **Structural barriers to entry and traditional "moats" are largely an anachronism - a legacy of a world where information did not freely flow.** Friction in the system allowed for obfuscation and the creation of artificial barriers - this paradigm was the foundation of capitalism post the industrial revolution.

These barriers in most cases are now vulnerabilities. **Within a few years, over 5 billion citizens of the global economy will have smart phones – access to the world's information in their pockets in real time – which will eliminate most remaining friction that created artificial competitive advantage underpinning historical capitalism.**

The framework of Competitive Advantage first proposed by Michael Porter in 1979 (and elaborated in the 1980 book *Competitive Strategy*) has only a few redeeming features, and will ultimately cause more harm than good if applied to modern business analysis and strategy.[25] Clayton Christensen proposed the foundation of a new framework for competitive advantage in a 1995 article discussing disruptive innovation which was further explained in the 1997 book *The Innovator's Dilemma*.[26] While Christensen is correct about the institutional inertia that prohibits established companies from being disrupted (and therefore seeing their "moats" quickly disappear), he falls short of describing a framework to maintain the best possible competitive advantages. **In a world where extreme events are common, a framework based on the Resiliency and Optionality criteria creates the best potential for competitive advantage in the 21st century.**

## Porter's Five Forces and the Myth of Structural Barriers

Michael Porter's book *Competitive Strategy*, published in 1980, has informed corporate strategy and security analysis for over 3 decades. However, the popular concepts outlined in the book are now out of place and often foundationally wrong in an age of free flowing information. Porter's framework was based on mid-20th century oligopoly structures that largely existed as pre-information age artifacts. Written just before the popularization of the personal computer, it failed to anticipate the rapid evolution from high degrees of informational friction to virtually no barriers to information flow. While there are still pockets of information hoarding to be found throughout the global economy, these could largely disappear over the next decade as the vast majority of the world's population gains access to real time information through low cost smart phones, tablets, and wireless networks. Porter focused on profit first and product/customer second, or in some cases not at all. Porter described five forces of competitive advantage which we will examine here.

25 After his success with *Competitive Strategy*, Porter formed a consulting group which filed for bankruptcy in 2012. Steve Denning, a contributor for Forbes, offers a compelling article on the root causes behind Monitor's decline. Denning, Steve. "What Killed Michael Porter's Monitor Group, the One Force that Really Matters" Forbes.com. November 2012.

26 Christenson also used his ideas to found a consulting company. Interestingly, the company helped Intel introduce a low-end processor to neutralize the threat of AMD in the late 90's. However, we'd argue that Intel's business model garnered asymmetric profits relative to their customers – ignoring the principle of NZS. This oversight appears to have cost them dearly in the battle they now face with ARM who shares a win-win relationship with their customers. ARM dominates the mobile and embedded markets and it appears only a matter of time before they will breach the PC and server markets as well.

***Threat of New Entrants:*** Porter argues accurately that profitable markets will attract new entrants, but that certain barriers can make it less attractive for new entrants to invest capital in certain markets. This force largely relies on things like customer brand loyalty, patents, economies of scale, distribution control, etc. Some of these factors can truly be legitimate barriers, particularly patents, and government regulation, but most markets today sit vulnerable to new ways of disruption. Distribution has been completely reinvented as direct to the customer, whether it be a consumer or a business, and many classic distribution chains are being turned upside down. For example, e-commerce is replacing distributed store based inventory with centralized inventory and home delivery. **Modern businesses should rely on innovation and adaptability to build large platforms and network effects which make their businesses less vulnerable.**

***Threat of Substitute Product or Services:*** Switching costs are the primary driver of the threat of substitute products. As almost every product or service is increasingly dependent on information, switching costs are largely in decline for most categories. **A successful modern business should assume low or zero switching costs and make up for it in providing increasing amounts of value to customers for the same or less cost.** Successful companies should actually make it frictionless for customers to switch, but make sure to never give them any reason to do so – stellar customer service and innovation should meet and exceed needs of customers.

***Bargaining Power of Customers:*** The bargaining power of customers generally comes down to concepts in the first two of Porter's five forces. Low switching costs and low product differentiation or bad service gives customers reasons to leave or leverage lower pricing. Often this force is expressed as pricing power over customers - this is a dangerous way for companies to operate. Leverage over distribution channels and obfuscation of key pricing or availability information has been used in the past to create artificial advantages - these are not sustainable today. **Companies focused on maximizing NZS assure customers have no reason to switch to a competitor.**

***Bargaining Power of Suppliers:*** Companies that are reliant on critical components from suppliers are more vulnerable and have lower profit potential if the suppliers leverage their power. Supplier control of distribution channels is another legacy issue that is melting away in modern times. Companies should create win-win relationships with suppliers, just like they create with customers, in order to create the most value and sustainable ecosystem that maximizes NZS.

***Intensity of Competitive Rivalry:*** This force comes down to a multitude of catch all "barriers," however, there are several important and correct metrics to focus on. Innovation and adaptability are key to staying ahead of the competition, something with which Porter would not necessarily argue. However, other factors such as advertising spend and brand value are much less relevant in an age where word of mouth spreads like wildfire with both positive and negative ramifications.

The essence of Porter's Five Forces boils down to avoiding competition and driving profits rather than focusing on the needs of the customer. **This is the fatal flaw - barriers turn into crippling vulnerabilities in an age of instant and complete information. We are seeing these artificial "moats" destroyed one by one in the world of business, and even government regimes around the world.**

### Disruptive Innovation Shifts the Focus to the Customer, but Falls Short

Fifteen years after Porter, Clayton Christensen in his 1995 article and 1997 book, *The Innovator's Dilemma*, described how established companies with perceived "moats" are disrupted by both the changing needs of the customer and rivals that act more quickly. Often disruption, according to Christensen, comes from a seemingly inferior product at lower margin that meets the needs of most of the market. F**requently, disruption is not just a new product, but a new business model.** When a company is too focused on their most profitable customers they become afraid to disrupt themselves. Because of increased flow of information business model disruption is now a risk for all sectors of the economy, not just technology.

Companies overconfident in their own competitive advantage, often based on faulty Porter analysis, are most vulnerable to disruptive innovation. By focusing on their most profitable customers, companies often fail to see how the needs of the market are evolving. This opens the door for new solutions and new business models that ultimately end up meeting the needs of even the previously profitable customers.

Christensen believes there are two types innovation: 1) sustaining innovation that involves incremental improvements targeting the existing customer base; and 2) disruptive innovation that targets lower end customers or lower feature products. He suggests disruptive innovations are a threat because a low end product can evolve to be good enough for high end users (the core profits of a firm with so-called barriers to entry).

In contrast to Christensen, we make no differentiation in types of innovation – the entire focus of a company should be on constantly innovating and adapting.

**They should be disrupting their core products, not just sustaining them** – this disruption can take the form of new features, passing on lower costs, adding adjacencies, etc., creating more NZS through constant innovation. In this light, innovation is a core part of the DNA of a company, not something that should be segregated.

To use an example, Christensen argues that Internet banking was a "sustaining" innovation to established banking platforms, but not disruptive because the cost of money is the same for all banks. We argue that's not the case as companies reinvent the idea of "cost of money" through innovative lending peer to peer platforms.

Christensen argues companies should isolate disruptive innovation investments from the core part of their business, but we believe all innovation is critical and should be integral to all aspects of the business. He suggests innovation investments should be small and short, **but we find companies that often create the most value are willing to invest for the long term and sustain losses for an extended period of time.**

**Companies should focus on innovating for all their customers, especially the low end. The distribution of customer revenue for a company generally follows a power law, and the long tail of small customers frequently can be cultivated into very large customers. Focusing on disruptive innovation for this group of customers creates future Resilient revenues.**

In the context of S-curves, Christensen focuses on trying to slowly lengthen the curve and gradually increase the slope while we argue companies should focus on stacking new S-curves while maximizing NZS in existing products and services.

Christensen falls short of a complete framework for modern competitive advantage as he misses the critical

NZS factor and the backdrop of long duration growth and stability. By focusing on incremental innovation and isolating disruptive innovation from the DNA of a company he shifts the focus away from long term thinking and decreases adaptability – leaving all types companies in every industry vulnerable to true innovative disruption.

## A Proposed New Framework for Competitive Advantage

We believe the framework outlined in detail in the Resiliency and Optionality section of this paper – centered around specific characteristics of quality, growth and context – is superior to the Porter framework which is profit focused rather than customer focused. Further our new framework elaborates and expands on the customer focused framework of Christensen's disruptive innovation.

Although we believe this new factor model is important to set up potential competitive advantage, the reality is even these tenets create temporary and potentially fragile businesses. Why is that? Because, as we establish in the beginning of this paper, the world is dominated by complex adaptive systems. Each business and industry operates in a highly dynamic ecosystem that is evolving. These ecosystems are highly vulnerable to power law outcomes - **extreme events are not only common, they should be anticipated as the norm.**

By focusing on the key attributes of the new framework for competitive advantage, companies have a better chance of creating valuable long term businesses, but must always evolve to maintain their position. Resilience and Optionality is a framework for competitive advantage, but not necessarily sustainable competitive advantage. There are no charts or complicated formulas that guarantee success.

**Rather the implementation of this framework comes down to a vigilant and intentioned management team that fosters long term thinking, innovation, adaptability, and non-zero sumness - maximizing win-win scenarios for everyone in their ecosystem.**

# Chapter 5: Mindfulness and Humility

# Chapter 5: Mindfulness and Humility

In chapters 3 and 4 we developed a detailed framework for creating winning, long duration growth companies in a complex, unpredictable world. Before we turn to our next topic of constructing an investment portfolio it's important to explore an over-riding theme to this paper: mindfulness.

**Mindfulness is the disciplined act of paying attention.** The only way to improve the future is to open our eyes today - to be aware and awake to the changing environment around us. In order to adapt and evolve while building a business or investment portfolio for long duration value creation, we have to actually see the great opportunities when they come along. If we're constantly busy, or focused too much on the future, we'll make mistakes in the present, and worse yet, we won't learn from those mistakes. One could argue that mindfulness is that elusive definition of Quality that we mentioned in chapter 3, pursued by Pirsig in *Zen and the Art of Motorcycle Maintenance*. Quality derives from the simple act of caring enough to pay attention.

At several points in this paper we discuss the idea of the unpredictability of the future, however, that does not mean we cannot positively impact the future. Mindfulness today crafts behavior and decisions that set us up for a better future – in paying careful attention we can create a company or an investment portfolio that creates significant long term value. **When we care enough about every last detail, our obsession becomes passion, and that passion becomes an art. And when we create art, no matter what the context, we create the potential for a lasting and powerful impact on the world.**

**Just pay attention. It sounds so simple, but it's incredibly difficult and important.**

Why? Because millions of years of human evolution have wired the brain to work against us in the fast-paced, high-stakes modern world resulting in biases that can cloud our decision making.

## Bias, Mindfulness and Teams:

It turns out decisions deplete our will power, so much so that after a few waking hours in the deluge of the modern world, we significantly deplete our reserves.[27] One study analyzed more than 1,100 parole decisions over a twelve month period. Prisoners lucky enough to go before the parole board in the morning found themselves paroled about 70 percent of the time. Prisoners that faced the same board in the afternoon received parole at a rate of less than 10 percent.

Decision fatigue impedes our brain's ability to thoughtfully engage in analytical thinking. Once this happens we tend to default to more impulsive thinking. We take shortcuts that save us the brainpower required to engage analytical thinking and meaningfully pay attention the world around us. We create stories, often inaccurate, which then inform bad decisions. However, if we take time to step back and reflect, or better yet create an environment of fewer decisions to begin with, we can re-engage mindful, analytical thinking. Rigorous heuristics like the ones in this paper make decisions easier and can help us avoid dangerous shortcuts based on incomplete narratives.

Another common problem is identity protection bias, which causes us to become so attached to our viewpoints, that it threatens our very identity to accept alternate explanations. This creates an inability

27 For further reading on decision fatigue, we recommend the NY Times post, "Do You Suffer from Decision Fatigue?" which appeared on August 17th, 2011.

to disengage impulsive behavior and think deeply about changing information. The more we try to predict the future, the more we become committed to things happening in a certain way. Then, when new, contradictory evidence comes along, we become blind to it. By paying attention and not becoming overly focused on predicting the future in a world of extreme events, we can avoid the bad decision making that happens when our identity becomes wrapped up in a fixed world view.

Instead of bombarding our brains with noisy information and constant busyness, we need decision algorithms that inoculate us from unnecessary and dangerous bias. We think the framework of quality, growth and context explained in this paper is one such decision engine. We might determine a different or better decision engine that works for us, but what is important is to have a set of guiding principles – heuristics - that break us out of harmful biases and impulsive thinking. This allows us to engage mindfulness, and blend the appropriate levels of emotion and logic. It's also important to have other people who understand our framework around to call us out when we're too snowballed by our own bias to see clearly. We are much more capable of seeing others make biased decisions than ourselves. Because of this factor, we often say that investing is a team sport -- turns out, life is a team sport as well.

Time is also an important element to mindful decision making. If we don't allow for unstructured, free time to allow the obvious to actually be seen and understood, opportunities will fly by without being noticed. Often the difference between success and failure is allowing luck to find us at the right time. It's equally or more important to manage our time just as carefully as we would manage a company. We allocate our time like we would allocate capital – allowing for space to think and connect dots without distractions that cause us to default into fight or flight decision making.

As we create time and space to make mindful decisions, it's important to let go. Let go of the need to be busy. Let go of preconceived notions. Let go of the way we think things should be or will be. Let go of the flawed belief we can narrowly predict the future. Turn the 21st Century on its head: don't just do something, sit there.

## The practice of Mindfulness :

Here's where power laws come in again. While no one really seems to like volatility around their lives, because we live in a complex system, volatility is going to happen whether we like it or not. Why not embrace it? Our path through life is almost never a straight line to where we think we want to be. Instead, our path snakes around via a patchwork of shorter-term plans leading to a higher place of intent. Although we often try to avoid volatility, when we look back on our life, we understand it's the volatility that both made life interesting and us who we are today. Back to 80/20: 80% of the time life is business as usual, but 20% of the time, we face the unexpected. Recall the image of the river from Chapter 1? Volitility is what makes the river so interesting. Mindfulness is the art of embracing the volatility of life, learning from it and adapting to it.

Many of us often naively believe we can make detailed five year plans that will closely correspond to the future. However, it turns out that most of the time life is much more volatile than our imaginations.

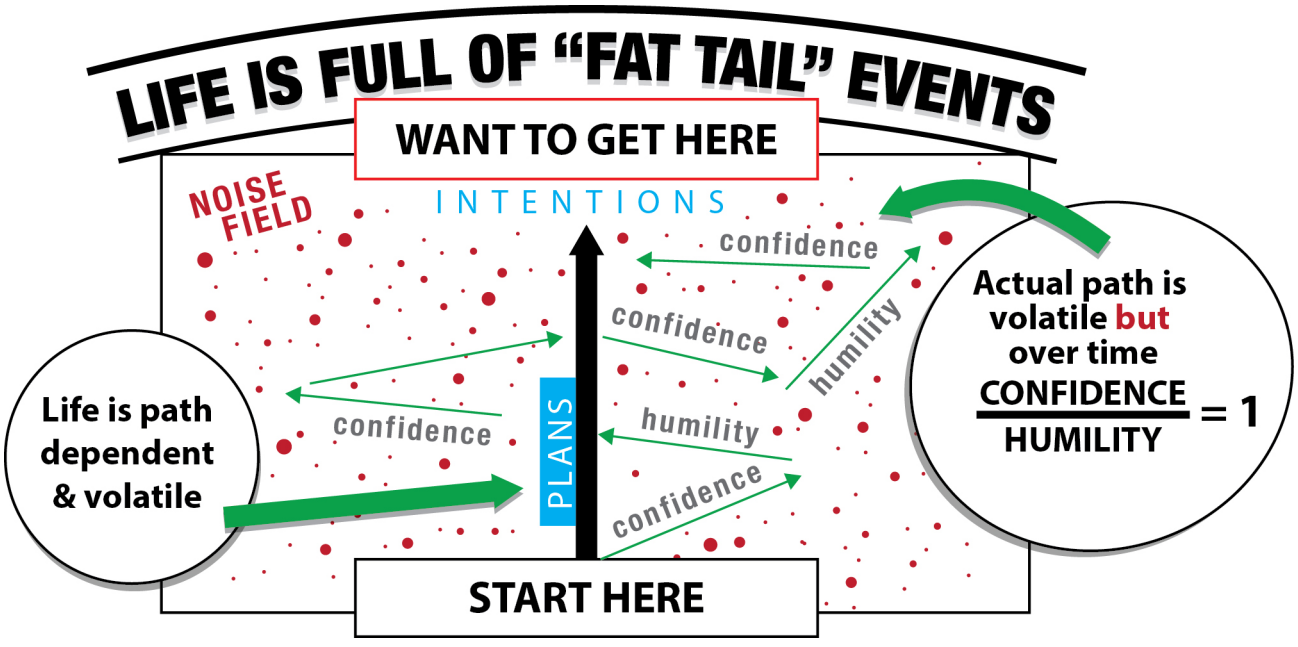
It's important to distinguish between long-term intent or desires and shorter-term plans or actions. Intentions are the things that DON'T change. They are the things that tend to follow a person through their life.

For example, people might think they want to make a lot of money, but what lies underneath that is really an intent to live life free from financial worry. The intent is more freedom, not necessarily great wealth although the person might decide to follow many plans to achieve more wealth. Alternatively, someone could have the long-term intent to help people live more healthy lives and take on the short-term plan of attending medical school or becoming an alternative practitioner. Plans tend to be linear and shorter-term, but complex systems are nonlinear, placing a premium on the ability to adapt our short-term plans to a changing landscape. Intent should serve as a north star throughout the winding paths life takes us down.

Remember our previous discussion of Jeff Bezos' focus on things that won't change? Great leaders and great companies seem to understand this concept – **instead of perfect, narrow five year plans, they tend to balance confidence with humility.**

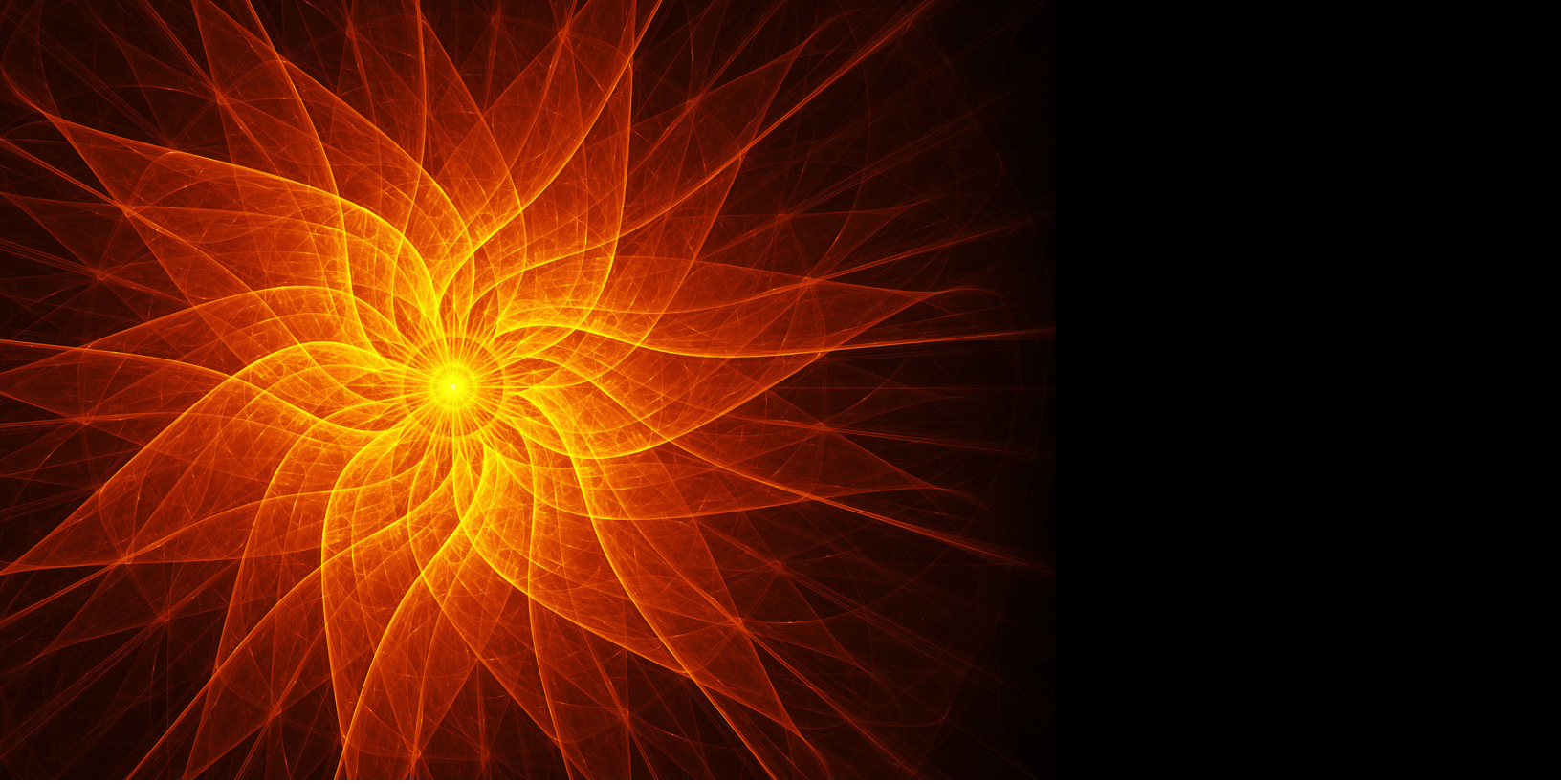
The humility to confidence ratio works like this: to begin to move toward a new intention requires a plan and a step toward that plan. To take the step, we need a lot of confidence – after all, the path of least resistance is often to do exactly what we did yesterday. However, life acts like a huge noise field where it's incredibly difficult to discern signal – there is an excess of possibilities out there. This is why mindfulness is so central to our framework. Identifying and avoiding cognitive bias helps us see and accept mistakes as we make them. An understanding of complexity crafts our ability be humble.

The "noisy" nature of life (and complex systems) often results in our initial step of confidence being slightly off course. Because we get off course, it's important to balance confidence with the humility to admit mistakes and course correct. At any one time outsiders might observe our behavior as arrogant/overconfident or demoralized. However it's really just confidence in the next step and humility that results in course correction. T**he trick is to have enough confidence to take the next incremental (and likely off-direction) step AND the humility to course-correct once a better direction becomes clearer.** Sometimes it takes a bit of arrogance to take the next step. And it takes a



lot of humility to admit it wasn't exactly the right step. However, on average, we should strive for humility to confidence ratio of around 1.

So, take a breath and calm your mind – wake up and pay attention to everything. Find the signal increasingly buried in the information deluge around us. Determine what is unlikely to change over the next decade or longer, then iterate in the present with careful attention and concentration. Set up free time and space to connect dots when opportunities present themselves. Use the framework of complexity, adaptability, long duration growth, positive and negative feedback loops, and the new concept of competitive advantage presented in this paper to create a decision framework for mindful allocation of time, capital, and resources.



# Chapter 6: Constructing a Portfolio in a Complex World

# Chapter 6: Constructing a Portfolio in a Complex World
## Balancing Resilience and Optionality while Avoiding Cognitive Bias

In a complex world, basing large investment decisions around a narrow prediction of future events is dangerous. Instead, we focus our capital allocation decisions on balancing Resilience and Optionality.

**In chapters 3 and 4 we laid out the criteria of what constitutes winning companies in the 21st century Information Age – our goal is to thoughtfully construct an adaptable portfolio of companies that are built to adapt using that detailed framework of Quality, Growth, and Context.**

**A portfolio that balances Resilience and Optionality is a barbell with the majority invested in concentrated positions in companies that combine both Resilience and Optionality. The remainder of the portfolio should maximize Optionality with a large number of distributed, smaller investments.** This duality creates a large, stable head of the portfolio, and a long optional tail. The long tail of Optionality names should follow something more akin to venture capital investing, where one can even be wrong more often than right and still produce superior, risk adjusted returns.

**An important part of this strategy is to squeeze out the middle of the portfolio.** Companies that combine both Resilience and Optionality should be at the head of the portfolio, while pure Optionality companies should be capped at a maximum position size in the tail of the portfolio. Everything in the middle is likely to be a market performer, taking away from potential long term returns, or fall into one of the common mistakes outlined below.

## Investment framework applied to a theoretical diversified stock portfolio:

### Resilient Companies with Optionality:

- Generally this bucket represents a small number of stocks (e.g., 10-20 companies) that account for ~50%+ of assets, usually over 2-3% of the portfolio each
- High levels of Quality, Growth, and Context: high quality management teams, cultures of innovation, long term focus, strong NZS, good positive and negative feedback loops
- Long duration growth and high potential for stacking new S-curves
- We tend to look at this type of company using a discounted cash flow model in order to determine the level of out of the money Optionality implied in the current price[28]

### Optionality Companies:

- Generally this bucket represents many small positions (two to four times the number of Resilient positions) that account for the rest of the assets, usually <1% each
- Large addressable markets and network effects
- Valuation can be less relevant given the difficult to quantify upside; often here the Kelley Criterion is useful[29]

28 DCF analysis is a method of valuing a security based on cash flows and the time value of money. http://en.wikipedia.org/wiki/Discounted_cash_flow

29 Kelly was an associate of Shannon at Bell Labs. He adapted what became known as the Kelly Criterion as an offshoot of Information Theory for their successful attacks on the blackjack table. f= (b*p-q)/b; f=the fractional bet; p=probability win,

We tend to use a simple valuation shortcut for both types of stocks: (free cash flow/enterprise value) + expected long-term growth rate = expected return. This back-of-the-envelope method quickly highlights the stock's dependence on either growth or profitability while offering a broad filter to determine if the stock is worth further analysis.

The S-curve framework described earlier sheds light on valuation and portfolio construction. We ask the question: is the company at the very beginning (a glorified start-up), early in the period of convexity, at the halfway mark or mature? Valuation precision tends to move inversely to company maturity. Early stage companies tend to face binary outcomes, making precise valuations virtually impossible. The key variable for more established companies on the convex part of the S-curve is the length time their opportunity set remains convex – duration of growth is virtually all that matters.

Companies past the mid-point of their S-curves will almost always be overvalued, although they appear cheap relative to previous levels – BUT, valuation represents a judgment that can only be correctly assessed with the benefit of hindsight. Finally, mature companies that have reached the concave section of the S-curve are in classic value trap territory and can perhaps be the most accurately valued. Ironically, we're often most ignorant of the company's future earnings power when it reaches this phase; management's ability to successfully reinvent the company matters more than valuation for these companies.

Finally, our Resilience and Optionality capital allocation decision framework offers a common-sense approach to risk while allowing insight derived from in-depth research to shine through. While the positions sizes in a portfolio might appear as a power law, the theoretical risk contribution will be more equally distributed, i.e., a large position represents the same risk as a very small position.

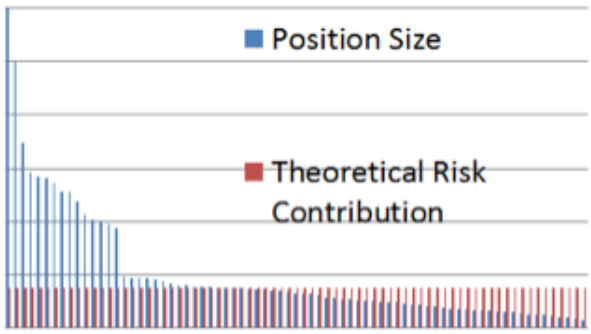



Figure 20: Each position contributes about the same amount of theoretical risk.

## Avoiding Common Mistakes of Cognitive Bias by Balancing Resilience and Optionality

As we explored in the section on mindfulness, we are all filled with cognitive bias – our brain constantly tries to convince and protect us by creating stories and narratives that are simply wrong. Having a strong decision framework for capital allocation helps avoid many of these mistakes. Simply paying attention, being present, and relying the tools that illuminate Resilience and Optionality will create the potential for better decisions.

q=probability lose and b=odds. Example: if there is a 50% chance we could double our money in an investment, then the equation would look like this: (1(.5)-.5)/1=0. Everyone will recognize this as a coin toss. There's nothing to be gained, so walk away. Or a 65% chance we could make 50%: (.5(.65)-.35)/.5=-.05 or "don't take the bet". But if there is a 20% chance it's a 5 bagger then: (5(.2)-.8)/5=.04 or the Kelly Criterion tells us to bet 4% of our total capital. The easiest way to conceptualize Kelley is: Edge/Odds = Bet Size. So the equation tells that we need to either be very certain of a high probability we will get a good return or at least believe there's a shot we'll get an amazing return. One obvious question is how do we know the correct probability to assign? Of course we don't, nor do we know the correct odds if the option hits, but the goal is to be directionally right on the option (which is where context through industry depth of understanding really helps). Then, you can back into the probabilities needed for an attractive bet. The practice is helpful in pushing the tail of the portfolio to more extreme optional positions.

Several common capital allocation decision mistakes are easily explained by this risk framework. These mistakes cause a failure to convert fundamental insight into above-average performance with below-average risk due to some avoidable portfolio construction errors.

**Owning Value Traps:** Stocks that start out as resilient but face difficult headwinds or are unable to stack new S-curves experience a fundamental increase in their business risk while remaining cheap, or even getting cheaper. Anchoring on valuation while the core business deteriorates represents a common mistake. We often refer to this as mistaking commitment for conviction.

**Owning Pure Optionality stocks at the top of the portfolio:** Often due to alluring and large potential upside, names that should be numerous and small in the tail, find themselves in the head of the portfolio. An option position that is too big can easily become a fatal mistake. Such a portfolio construction means the manager's tightly held views of the future had better prove correct. However, lots of Optionality positions at the tail of the portfolio don't depend on correct views of the future, nor can any one of those positions kill the performance of the total portfolio if the view turns out dead wrong. It's the difference between crashing a car into a wall at fifty miles per hour (large option positions going bad) or crashing a car into a wall at one mile per hour fifty times. The former will likely kill us, but the latter is just an annoyance.[30] A subset of this mistake is **Gambling – mistaking optionality for a pure roll of the dice.** If we are making a narrow prediction about a certain future outcome, then we are likely overly focused on the upside without an appreciation for the downside risk.

Figure 22: Many small crashes are survivable, one big crash is lethal.

Figure 21: Stocks that require narrow predictions should never be big positions.

**Owing too many stocks "stuck in the middle":** If a portfolio owns a lot of stocks with only Resilience, but no Optionality, it invokes a much higher reliance on narrow predictions and valuation sensitivity – it is likely these positions will not beat the market over time. These types of investments often have narrow addressable markets and lack the ability to stack new s-curves, or put another way they, they simply don't have high return opportunities to allocate capital.

**Round Tripping:** By carving out the middle of the portfolio, you can constantly re-assess whether a company is purely optional or combines Resilience and Optionality. This vigilance keeps you from investing in a company that becomes overpriced or requires more narrow predictions of the future to come true.

**Conversely, the framework is also instructive on where to make the most money with the lowest risk.**

**Resilient companies with and Optionality that grind out solid returns on capital:** These businesses represent the core of a portfolio. The critical factor

30 Taleb uses this illustration as he explains the non-linear nature of fragility in Chapter 18: On the Difference Between A Large Stone And A Thousand Pebbles, pp 267-300 in his 2012 book, *Antifragile*.

in analyzing these companies is understanding where their Resilience is potentially fragile. However, quarter-to-quarter volatility caused by macro shocks becomes the investor's friend in such businesses, allowing position sizes to be trimmed and added.

**Resilient companies with out-of-the-money Optionality:** This is the most powerful way to make money in our framework. Because the business is resilient, it can immediately become a large position without adding much risk. If the optional part of their business expresses itself, then the stock can go up multiples of the original price and it can be allowed to 'run' in the portfolio. The reality is stocks like this are VERY rare, which is why they must be capitalized on when found. A special subset of these stocks are resilient companies with out-of-the-money Optionality perceived by the market to be a value traps. These special situations have the potential to move from value trap, to Resilient, to Resilient with Optionality. A focus on what we described earlier as context helps identify these types of winning investments.

## Mitigation of Behavioral Mistakes

As investors, we are incessantly on the hunt for a secret that we are convinced to be true even as others remain skeptical. When we uncover such a "secret" in the form of a publicly traded company, we take a large position and watch the data points roll in over a period of years that confirm our initial beliefs, an apparent investing nirvana! **However, because we're human and prone to overconfidence, we make many cognitive mistakes as investors by virtue of our DNA working against us.** The classic explanation of this phenomenon is Prospect Theory[31]. Put simply, Prospect Theory says that people feel the pain of losing money more than the joy of making an equal amount of money. As a result, we tend to sell our winners too quickly and ride our losers too long. The framework mitigates several of these mistakes:

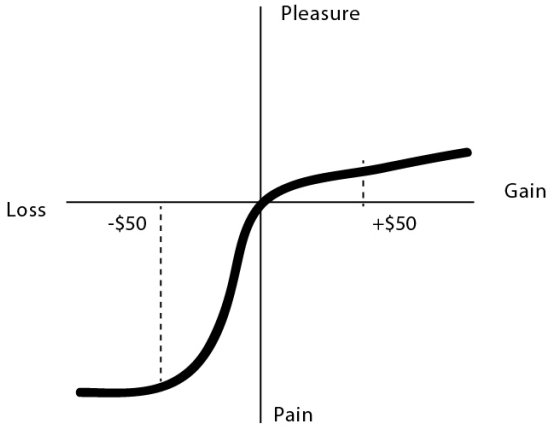



Figure 23: Prospect theory: we feel pain more than gain.

**Lengthening the tail of the portfolio:** Often we are victims of the endowment effect – the flawed belief that something I own now is more valuable than something I don't currently own. By extending the number of positions in the tail of the portfolio, we are minimizing this error.

**Trimming back optional names that move into the middle of the portfolio:** By keeping optional names below a preset maximum threshold, we are harvesting excess returns which makes it easier for us to add on volatility. This practice capitalizes on power law math in the macro economic environment, and mitigates our behavioral reluctance to add to a large position down meaningfully.

**Vigilant assessment of business risk:** By maintaining a consistent, intellectually-honest discussion on business risk of Resilient names, it becomes easier to heighten the discussion around a name pushing into Value Trap territory.

31 Prospect Theory was first laid out in a short 1979 paper by Kahneman and his collaborator, Amos Tversky entitled, "Prospect Theory: An analysis of Decision Under Risk".

Perhaps the most dangerous behavior many investors fall victim to is that that of 'conviction' turning to 'commitment' (recall our definition conviction earlier in the paper). Over time, our commitment to an idea born out of conviction can cause us to commit other behavioral mistakes like perceiving only certain segments of reality while ignoring others (i.e., confirmation bias), OR doubling down on an investment even when all of the data is telling us to take our lumps and walk away (indeed this is exactly how rogue traders get into their deep holes). And we might even go looking for people who agree with the initial decision even as we distance ourselves from the naysayers. **Working with other like-minded investors to keep you intellectually honest and avoiding narrow predictions can mitigate many of these common cognitive biases.**

**Always remember to be mindful – open your eyes and pay attention to every opportunity to make a decision. Combining mindfulness with a rigorous decision framework and capital allocation structure such as Resilience and Optionality creates a backdrop for avoiding common value destroying mistakes.**

# Chapter 7: Conclusion

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## The Importance of Mental Starting Points

There's a popular story about a distant mosque built 5 degrees out of alignment with Mecca. Although only a fraction off, the mosque resulted in prayers directed far away from their intended spot! Starting points matter. If we start with the assumptions that extreme events are more norm than exception and humans aren't that good at predictions, we end up in a VERY different spot when it comes to allocating capital. We believe these more accurate starting points result in an investment philosophy possessing the capability to deliver superior returns with less risk.

At a high level, we are simply shifting the mental starting point for range of outcomes. Because of the relatively narrow assumptions believed and taught by traditional economists and academia, most of us have come to accept that outcomes in the world are narrowly clustered around a mean (although most of us also grapple with this assumption intuitively). **In the real world many events fall outside of the narrow cluster, and human beings aren't good at predictions.** However, our revisionist memories tend to only recall the lucky predictions; which in turn fuels our serial overconfidence. Daniel Kahneman, one of the fathers of behavioral finance, co-developer of Prospect Theory and Nobel prize winner, puts it this way:

> *Most of us view the world as more benign than it really is, our own attributes as more favorable than they truly are, and the goals we adopt as more achievable than they are likely to be. We also tend to exaggerate our ability to forecast the future, which fosters optimistic overconfidence.*[32]

32 Kahneman, 255.

**A perpetual lack of equilibrium defines the world because the political economic landscape is a complex system demonstrating emergent, unpredictable behaviors.**

Complex systems teach us to stop trying to predict narrow outcomes around the future, to expect extreme events, focus on Resiliency, seek Optionality, and avoid what is neither Resilient nor Optional

**Resilience and Optionality is best uncovered through our focus on quality, growth and context (which create the potential for competitive advantage in the 21st century information age).** Because this strategy does not attempt to optimize risk/reward, it allows us to not be victims of cognitive bias that prove so erosive to long-term performance. Further, the strategy mitigates risk far better than most commonly accepted risk strategies which use math based on the wrong paradigms.

By applying this disciplined framework we attempt to inoculate ourselves from common cognitive bias mistakes. The brain is wired to create bias and work against good decision making, but paying attention, being present, and being awake allows us to see the best capital allocation opportunities. We believe the framework detailed in this paper will yield fantastic results over long time horizons for corporations and investors.

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