

How Novelty and Narratives Drive the Stock Market: Black Swans, Animal Spirits and Scapegoats

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Chapter 1: Stock Market Novelty and Narrative Finance

Where there is novelty, there is instability. Where there is instability there is uncertainty. Where there is uncertainty there are narratives – narratives are the currency of uncertainty. As the first two decades of the twenty-first century have made palpably clear, novel events such as 9/11, the subprime mortgage crisis, the fiscal cliff, the US-China trade war, Brexit, the US corporate tax overhaul of 2017, the COVID-19 pandemic, and the oil market crash of 2020, can lead to dramatic change in the relationships driving stock market returns. The timing and magnitude of instability from such large-scale “macro uncertainty” events are impossible to foresee ex ante and can be difficult to comprehend, even in hindsight. For each nonrepetitive event, investors were forced to abandon precise quantitative prediction and grapple with ambiguity about which forecasting model to place the greatest confidence in as visibility of the future was dim at best.

As evidence presented here shows, narratives about the economy, war, natural disasters, monetary and fiscal policy, social constructs, institutions, culture, political elections and so on, naturally and necessarily become part of investors’ information sets during unprecedented times. This book advances a view that nonrepetitive events cause instability and Knightian uncertainty (KU) in stock market relationships, forcing narrative-based emotions and cold calculation to be inextricably intertwined under the Novelty-Narrative Hypothesis (NNH).

The novelty of the COVID-19 pandemic and ensuing events of Q1 2020 unleashed into circulation stories that served as necessary simplifications for an unprecedented situation whose complexity was unfolding in unforeseeable ways in real time. Famous economist Frank Knight would have remarked that shutting down the Western world produced true, or Knightian, uncertainty in the stock market because the likelihood of its occurrence, and possible future states of the world, could not have been “reduced to an objective, quantitatively determined probability” (Knight, 1921, pp. 231-232). Even those wishing to liken the crisis to the swine flu or Spanish flu were left searching for the right narrative for comparison as, unlike other pandemics, COVID-19 brought economic and social interactions to an unprecedented standstill. The US was under a state of emergency, individuals were under stay-at-home orders, nonessential businesses shuttered: Economic and social distancing became the new reality overnight. Not only would the crisis impact stock prices as investors weighed the business and household costs with, among other factors, the stimulus and recovery measures instituted at the Federal Government and Central Bank levels, but it would also have greater implications for the economy as a whole. How long would it take for businesses and various industry sectors to recover? Would the conduct of business activity ever be the same?

From February to March 2020, when COVID-19 became more than a seemingly isolated virus thousands of miles away, US stock market participants revised their forecasting strategies in dramatic, unforeseeable ways. After reaching record highs in February 19, the Standard and Poor's 500 Index (SP500) lost over one-third of its total value by March 23, wiping out the entire gains of 2019 and bringing an end to the decade-long bull market. On March 16 alone the SP500 lost 12.7 percent – the third largest daily loss in over 100 years – triggering a Level 1 circuit breaker to halt all trading just minutes into the morning session. The COVID-19 impact on the broader economy was just as striking.

International supply chains seized up. Food distribution channels became severely kinked. Global oil demand plummeted. Consumers abandoned small-business commerce especially in the service sector. Initial jobless claims spiked from 282,000 in mid-March to 3 million the following week to over 6.5 million by March 28 to another 6.5 million by April 9. That is, over 16.8 million newly unemployed filed for insurance claims in just three weeks. Total private sector jobs declined by 701,000 in March – the first nonfarm payroll reduction in over nine years. The Federal Reserve Bank slashed its overnight borrowing rate by over 100 basis points in just three weeks while the US Federal Government's \$2 trillion stimulus measure stood as the largest in our nation's history.[1]

The future was bleak. Macro uncertainty was high and the trickle down into micro-level (firm and household) uncertainty was more of a flood rush. Many voices warned of deep recessions across the Western world, a possible reduction in Q2 US GDP by 30 percent, unemployment rates eclipsing 25 percent, and a 10 percent haircut to corporate profits.[2] As of this writing, the Bureau of Economic Analysis advance estimate for Q1 Real Gross Domestic Product reported the economy shrank by an annualized 4.8 percent.

No one could have foreseen the coronavirus pandemic or the full extent of its impact on communities and markets, households and firms, domestic and abroad. COVID-19 wasn't even part of investor discourse through the end of 2019.[3] Yet, in a matter of weeks, the inherent instability of stock markets was exposed on a grand scale as macro and micro uncertainty fused and the importance of narrative dynamics was brought to center stage. Stories surrounding COVID-19 and the Great Lockdown Recession were fueled by a combination of historic reversals in economic and financial trends, reliance on personal priors and judgement, and diffusion of extreme levels of emotion, panic, and anxiety – a potent combination for narrative propagation in financial markets. As news of an impending recession hit the shores of US stock markets like a tsunami, communication threads ensnaring COVID-19 were nothing short of ominous and exhausted media space daily.[4] It is no wonder the transmission of stories about major economic and financial events through society has been likened to the contagion and spread of infectious diseases (Shiller, 2017, 2019, 2020).

The COVID-19 story threads were expansive in their scope. Will a recession in the US occur and, if so, how deep will it be and for how long will it last? How much damage will be done to the labor market and how might the US handle tens of millions recently unemployed? How many jobs will be permanently lost? Will the small-business loan program work? In which industries will bankruptcies and unemployment be most concentrated? How will the bounds of our gigeconomy be tested as individuals pivot toward ever-more remote forms of commerce and employment? How will the capacity and quality of the US healthcare system be tested?

How will distribution hubs become reenvisioned across developed versus emerging markets? Will airlines receive a Federal Government bailout and what will the transportation industry look like in three months or three years hence? How will the OPEC oil dispute between Saudi Arabia and Russia impact supply-side factors important for stock market returns? Will financial markets shrug off the crisis and instead focus only on stimulus measures over the medium run? What new ideas, companies, social norms, healthcare, and government policies will emerge after the crisis has abated? Will COVID-19 become seasonal? What would a second wave look like? How will economic and diplomatic relations with the eastern Asiatic world be affected?

Investor interpretations of each query for forecasting returns live well beyond the bounds of conventional data releases. Rather, the ways in which participants think about the answers are enveloped in an interconnected web of narrative structure that they are exposed to and participate in on a daily basis. There are plotline involving prominent entities (protagonists in the form of government officials, central bankers, politicians, CEOs, countries, corporations, news organizations, social movements, and institutions) interacting each with particular sets of objectives (quests and goals) whose likelihood of coming to fruition is so highly dependent on myriad other factors and entity-decisions (interdependence on ally or opposition) that quantitative rule-based assessments of possible future states becomes inadmissible (indeterminacy of relationships driving outcomes).

It is the case that such plotlines are predominantly characterized by events that are nonrepetitive, or unscheduled, and, therefore, to some extent, historically unique. Yet, corporations must make million- and billion-dollar decisions today about which assets to invest in, which production processes to research and develop, which forms of human capital to employ, which funding sources to open up to and so on. The contingent nature of cash flow prospects into the dimly lit forecasting horizon necessitates narrative thought on behalf of any profit-seeking investor facing imperfect knowledge and inherent ambiguity about how the actual returns process will unfold. Yet, stock market instability and the KU it engenders are not just the consequence of major large-scale systemic events.

Novel events occur at the macro level, but also, and much more frequently, at the company, or micro, level – think bankruptcies, IPOs, debt restructuring, credit ratings, labor layoffs, product recalls, new R&D, management shake-ups, share buybacks and so on. Novel corporate events even reflect the relatively inconspicuous, sometimes mundane, sources of KU in the stock market, such as firm revisions to earnings guidance, changes to analyst ratings, rejections of acquisition bids, merger delays, facility closures, the setting of price targets, changes to executive salaries and so on. Indeed, there is a wide spectrum of Grey Swan events relevant for the stock market. Large-scale shifts in the process driving stock returns coupled with, and often amplifying, smaller-scale shifts imply that different types of change in market relationships are constantly unfolding each and every day. Forecasting the timing and magnitude of instability in all of its diversity and complexity *ex ante* is beyond human capacity.

When nonrepetitive events hit the stock market, investor reasoning bends toward storytelling as a useful form of survival tactic, defense mechanism, or cognitive satisficing tool when previous relations driving returns have come unhinged in unforeseen ways. This implies that capital

market forecasting models must reflect the roles of soft information that trigger cognitive functions such as resemblance that inform story structure and contextual meaning. Thinking about future developments impacting returns within a narrative framework is necessary under uncertainty and model ambiguity but also desirable to the mind. Story structure helps shape incomplete information and emotion into cognitive guideposts and anchors when novel events offer little basis for using past data in forecasting. Fortunately, advances in machine learning of unstructured text have provided major news analytics firms the processing tools necessary to track the universe of nonrepetitive macro and micro events and associated narrative considerations for the stock market.

Did you know that over two-thirds of the events explicitly identified in Dow Jones news reports as important for influencing US corporate prospects and share prices are considered unscheduled? Or that over four-fifths of macro events for the US are considered unscheduled? Or that there are over 1,300 different categories of unscheduled macro and micro events that might shake investors from their existing forecasting strategies in unanticipated ways? Or that the prevalence of micro uncertainty events dwarf macro uncertainty events in the stock market? But that the latter cause spillover effects onto the former when combined with narrative components of sentiment, novelty, relevance, and inertia? These key findings (presented in Chapters 5 and 8) suggest that stock markets are inherently unstable, true uncertainty is predominant, novelty is a ubiquitous feature of unforeseeable change in asset-price relations, and narrative dynamics are important linkages in this framework.

These are the pillars of NNH advanced herein. Simply put, this book is about the intimate connection between nonrepetitive events, narrative dynamics, and structural change in the US stock market through the philosophical lens of KU and the methodological lens of big data textual analysis of financial news reports. The objective is to inform observers of financial market outcomes on the ambiguity of historically unique events, the narrative reasoning surrounding them, on the unforeseeable change and uncertainty they engender, on the empirical tools that reveal their importance, and on the modeling approaches best suited to deal with such instability.

The story about stories is that humans have a propensity to tell them, to tell them in internally consistent ways over a period of time, in ways that rationalize the arrival of new information with their prior qualitative beliefs about how the world works. Narratives are about informational meaning and humans are undoubtedly meaning-makers. Narratives reflect culture, societal norms, and popular zeitgeist. They also captivate imagination, influence thought processes, and drive decision-making behavior in reflexive ways. Cognitive dissonance and cognitive consistency imply that the narratives people tell take on a qualitative, or directional, shape over time conveying a perceived “positive” versus “negative,” or “bullish” versus “bearish,” overall impacts in the aggregate.[5] Humans tell stories because stories themselves are alive and cognition demands it of us in a world where relational parameters often change in unique ways. Narratives seep into our consciousness. Some narratives are more flexible and can be contorted as time passes. Other narratives become increasingly cemented into our reasoning as we age. Of course, there is no objective way to think today about how we will think tomorrow about the future. Narratives hold the temporal clues.

Yet, studies connecting novel events and associated narrative dynamics are oddly absent from the vast majority of contemporary economics and finance research. Nobel Laureate Robert Shiller’s recent work (Shiller, 2017, 2019, 2020) has opened the door for the importance of narrative dynamics in explaining aggregate market outcomes. Shiller assumes that public interest as measured by tracking Google Ngram and ProQuest searches of terms such as “secular stagnation,” “stock market crash,” “Bitcoin,” “profiteer,” “housing bubble,” and “Laffer curve” is a proxy for narrative dynamics. Shiller connects the frequency of references to these terms, or percentages of articles containing them, to major events such as recessions, economic booms, and financial crises. His analysis likens the contagion effects of narratives to the transmission of disease from person to person by applying the word-counts and reference frequencies to the Kermack-McKendrick SIR infectious disease model. Under this account, the rate of narrative spread (infection rate) is equal to the contagion rate c times the product of those susceptible S times the number infected I all minus the product of the recovery rate r times the number of people sharing the narrative (i.e. infected) yielding the differential equation,[6]

$$\frac{dI}{dt} = cSI - rL \quad (1.1)$$

During a “narrative epidemic,” the public’s interest will follow a sort of bell-shaped curve skewed to the right. The model assumes to be independent of other outside ideas – essentially dismissing the diversity and interrelational nature of forecasting under market instability and uncertainty. To be sure, Shiller’s contributions in this area have advanced the view that “changing” narratives underpin their longevity and potency for impacting major economic events. And, like this book, Shiller connects story threads to factors reflecting culture, society, politics, and the zeitgeist of the times. However, in stark contrast to the chapters that follow, his work treats narrative dynamics as largely exogenous to the marketplace, germinating in the mind of one or just a few individuals. Additionally, Shiller frames the importance of stories for market outcomes as being amplified due to various mental and personality “disorders” and “conspiracy” thinking. By contrast, NNH implies that narrative dynamics are naturally at play in markets as investors interpret nonrepetitive events’ impacts on future returns as part of rational forecasting under unforeseeable change and the uncertainty it engenders.

Most of Shiller’s empirical analysis is based upon bag-of-word references tracking mentions from the internet database of books and articles. This book, too, presents several findings supporting NNH based on Google Trends searches and bag-of-word approaches. Shiller relates narrative dynamics (i.e. force, transmission, and duration) to whether the story thread is “punchy,” popular, or simple to understand. For Shiller, narratives cause major aggregate events such as economic recessions and depressions through feedback effects that do not necessarily reflect the underlying market conditions. This book, on the other hand, presents findings where the nonrepetitive events catalyze narrative dynamics that are shown to reflect univariate properties of the raw underlying data (Chapter 11 in particular). But, when narrative proxies do depart from the underlying data, which can be the case, this book shows that it is a consequence of the story thread tracking either the intensity and importance of the data or a time-varying set of fundamental factors (Chapters 2, 7 and 11).

Of course, Shiller’s earlier work on stock market “bubbles” and excess volatility popularized models of feedback effects between media-driven stories and asset demand that become

increasingly disconnected from fundamentals over time through investors' "irrational exuberance" (Shiller, 2000). By contrast, this book conducts in-depth empirical analyses relying on the dynamics of actual narrative components such as relevance, novelty, emotion, and inertia explicitly connected to contextualized stories about market fundamentals and other relevant events reported by major financial news firms as driving corporate prospects and stock price fluctuations day-to-day. The granular detail of textual news analytics applied to each one of the millions of narrative accounts is striking and enables a wide range of formal empirical assessments of NNH for the stock market.

Though Shiller's recent research has attempted to change the status quo, much work remains, especially on the analytical front. Based on the percentage of JSTOR articles that include the term "narrative," economics and finance are by far the lowest in rank when compared to other social sciences (Shiller, 2017). In Aliber and Kindleberger's classic book *Manias, Panics and Crashes: A History of Financial Crises* (Aliber and Kindleberger, 2017), there is not a single mention of the term "narrative." This introductory chapter advances a view of narrative economics and finance as applied to novelty-driven stock market instability, setting the analytical stage for the rest of the book and NNH. Historical context for narrative dynamics when market environments change in unforeseeable ways is sketched from a social science viewpoint. Importance of the nonrepetitive nature of unscheduled events for propagating narratives will be underscored. In doing so, the benefits from applying narrative analysis to financial news reports are emphasized with a foreshadowing of the main descriptive and empirical findings presented in subsequent chapters.

1.2 The Novelty-Narrative Hypothesis

In his presidential address to the American Economic Association, Shiller (2017, p. 967) defines narrative economics as, "the study of the spread and dynamics of popular narratives, the stories, particularly those of human interest and emotion, and how these change through time, to understand economic fluctuations." The term "narrative" for this book means a thematic string of stories that portray a consistent and simplified, yet subtly changing, view of a larger, more complex relational structure. The term "subnarrative" means a thematic string of more granular, or individualized, stories that contribute to the qualitative, yet subtly changing, inertia of a larger story thread, or narrative. Both narratives and subnarratives are part novelty, part emotion, part relevance, and part inertia. Much more on this in subsequent chapters.

Nowhere are notions of swirling narratives and contagious stories more commonplace than in the stock market. In July 2019, the US stock market extended an historic ten-year bull market run with the SP500 eclipsing 3,000 for the first time on July 10. With equity markets and the economy barreling along – nonfarm jobs just exceeded expectations by adding 224,000 jobs and government officials continued to tout the market's prosperous rise – it seems strange that a shift in underlying narratives may have been unfolding over the preceding twelve months. A Google Trends search for "recession" for the five-year period July 2014 through July 2019 is plotted in Figure 1.1.[7]

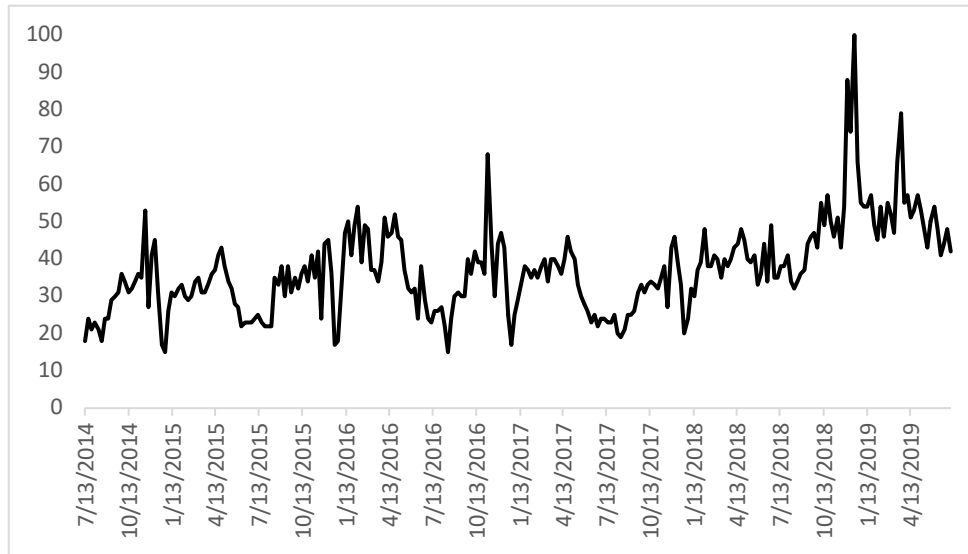


Figure 1.1 The figure plots the US Google Trends searches for “recession” during the five-year period July 2014 through July 2019. The vertical axis measures search interest.

The plot shows an upward trend in internet search interest for the word “recession” particularly evident from January 2018 through July 2019. The peak search interest occurred in December of 2018 with another evident spike in March 2019. A quick textual analysis from the December 4 *Bloomberg News* stock market wrap report reveals the subnarratives that contributed, in part, to the upward trending “recession” interest observed in Figure 1.1. The report reads,

U.S stocks plunged, with the Dow Jones Industrial Average tumbling almost 800 points, as a litany of concerns wiped out the rally in risk assets. Trade-sensitive shares sank as angst mounted that the U.S. and China made no meaningful progress on the trade front this weekend. Financial shares got hammered as the yield curve continued to flatten, with the last nudge from a hawkish comment by a Federal Reserve official...Adding to the risk aversion was news that U.K. Prime minister Theresa May’s push to avoid a so-called “hard Brexit” may be at risk. “Today’s move feels like the market is a scorned lover. It had believed, for whatever reason, that progress was being made at the G-20 and that turns out to be murky – it feels lied to,” said Michael Antonelli, a managing director at Robert W Baird & Co. “Then a pile of negative Brexit news, Williams starts to ramp up hawkish talk, then we have our yield curve acting like it got run over and boom, we puke.”

[*Bloomberg News*, December 4, 2018][8]

The excerpt suggests that trade-sensitive and financial shares contributed most to the market’s drop, but largely in the absence of conventional economic data releases or firm earnings announcements.[9] What toppled the market was that “angst mounted” over little progress in the US-China trade dispute, Theresa May’s efforts for a smooth Brexit “may be at risk,” and that Fed Official Williams’ hawkish “comments” were a “nudge” toward an inverted yield curve, a historic harbinger for an upcoming recession. These are the “litany of concerns” each emanating from a somewhat historically novel event; in this case, a wobbling trade negotiation and comments from a foreign prime minister and the vice chairman of the FOMC. Stories have inertia, due in part to the reinforcing prods of such novel events, and it is likely that versions of

these subnarratives were also underpinning a larger economic narrative connected to the March spike in “recession” search interest.

To be sure, whatever hard data is released by the Bureau of Economic Analysis, the Bureau of Labor Statistics and other government entities will also become part of the larger recession narrative, either reinforcing it or dampening it depending on its directional consistency with KU events’ interpreted impacts on outcomes. And, one cannot ignore the potential reflexivity of how market participants’ beliefs about the future, which drive their decisions today, help to shape the realized outcomes, and narratives, of tomorrow.[10] The higher order uncertainty effects from the interactions of macro and micro KU events will be discussed in Chapter 8.

Fast forwarding the five-year period by just eight months to include the COVID-19 crisis gives us a sample from April 2015 through March 2020 and an updated plot of Google Trends searches for “recession.” The results of Figure 1.2 are striking. The landscape of public interest in

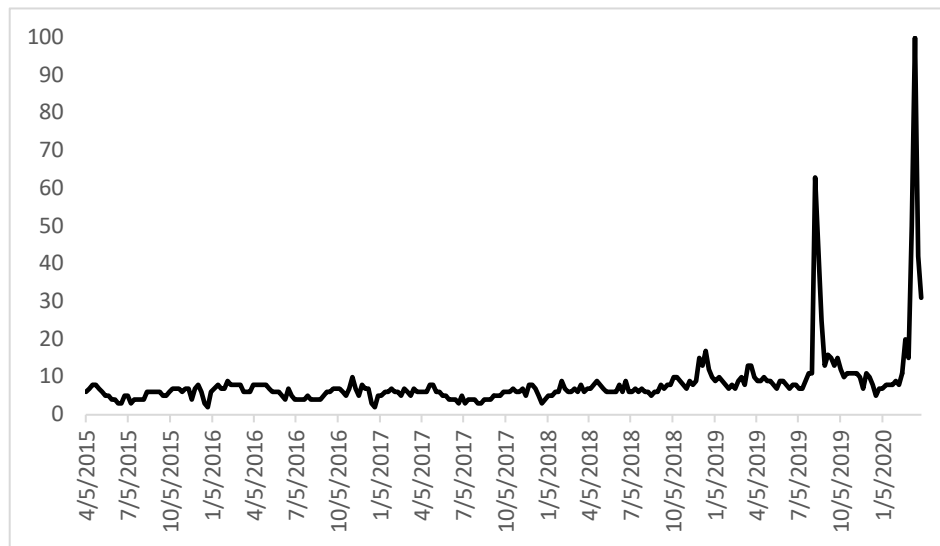


Figure 1.2 The figure plots the US Google Trends searches for “recession” during the five-year period April 2015 through March 2020. The vertical axis measures search interest.

“recession” changes dramatically once the COVID-19 crisis is introduced. Now, there are illustrative differences in recession queries clearly concentrated in the spikes during August 2019 and March 2020 with the global max occurring at the latter date. One quick look at the *Bloomberg News* wrap report for the stock market reveals the underlying fears of a COVID-19-induced economic recession during peak search interest on March 16.

The stomach-turning ride on global financial markets took a dramatic turn Monday, with U.S. stocks plunging the most since 1987 after President Donald Trump warned the economic disruption from the virus could last into summer. The S&P 500 sank 12%, extending losses as Trump said the economy could fall into a recession. Equities opened sharply lower after central bank stimulus around the world failed to mollify investors worried about the damage the coronavirus is inflicting on economies. The negative superlatives for American stocks are piling up. The S&P wiped out its gain in 2019 and is

now down almost 30% from its all-time high. The Dow Jones Industrial Average lost almost 13%, falling 3,000 points to close at a two-year low. The Russell 2000 had its worst day on record, losing more than 14%. “This is different. The thing that is scarier about it is you’ve never been in a scenario where you shut down the entire economy,” said Steve Chiavarone, a portfolio manager with Federated Investors. “You get a sense in your stomach that we don’t know how to price this and that markets could fall more.” While the Fed cut rates toward zero and stepped up bond buying, investors continued to clamor for a massive spending package to offset the pain from closures of schools, restaurants, cinemas, and sporting events. Companies around the world have scaled back activity to accommodate government demands to limit social interaction.

[*Bloomberg News*, March 16, 2020]

This particular news excerpt is likely to be read over and over again for years to come as it details a monumental day in US stock market history. First, the market tanked after President Trump announced that the “economic disruption from the coronavirus could last into the summer.” This is an example of a somewhat novel event, the presidential announcement, communicating the interpretations of an even more novel, and unforeseeable, event, COVID- 19, forecasting yet another nonrepetitive event, a depressed economy lasting months if not longer. Second, the stock market plunge itself is a novel event standing as the third-largest daily loss in over 100 years of recorded data.

Third, the report shows that stories are part KU events and part emotion by suggesting that “negative superlatives for American stocks are piling up” and that narratives surrounding the Central Bank stimulus attempts “failed to mollify investors worried” about the economic fallout from the virus. It then states that, by contrast, “investors clamored for a massive spending package” from the US Federal Government. It is interesting that the market clawed back some of the losses on sequential trading days March 23 through March 27 as details of the \$2 trillion US stimulus were becoming clearer and the bill was signed into law – the uncertainty was being reduced, albeit marginally. The Central Bank and US Government measures had different narratives associated with them - the former had a more “bearish” connotation for investors while the latter more “bullish.” Whatever their actual efficacy on local, regional, and national economies, investors attached different story threads to each policy prescription.

Fourth, the report speaks to the more nuanced factors at play in the economy, namely the broad closures of “schools, restaurants, cinemas, and sporting events” and the business pullback from “government demands to limit social interaction.” Finally, the report itself speaks to the KU surrounding the collective events and time period, suggesting that “This is different... scarier [since] you have never been in [such] a scenario.” And, that consequentially the market “does not know how to price this.” This was indeed an unprecedented period in the US, and around the world. And, the textual content of the stock market report was able to shed light on the novelty of events and their associated narratives and subnarratives influencing the dynamic and unforeseeable change in processes driving returns.

Salience theory suggests investors pay attention to asset-price payoffs that are most different (Bordalo et al, 2013). Narratology as applied to financial markets would suggest that investors pay attention first to the events that are most different (novel) and then, second, to a subset of those KU events whose associated subnarratives are qualitatively most consistent with

overarching narratives and expected returns. If a novel event's interpreted impact on returns can be contorted (some requiring more than others) to align with an investor's priors, training, judgment, beliefs, or intuition, it may become one additional string of a larger narrative thread. For example, concurrent subnarrative news about a merger, a pharmaceutical trial, a political election, and a firm's debt restructuring could inform a larger narrative about economic activity and bullish or bearish future returns. The qualitative consistency matters for narratological dynamics. When novel events unfold, selective similarity and cognitive satisficing are fuel for particular subnarratives to become amplified and part of larger narrative inertia over time. Indeed, results of these processes are evident in many of the financial news excerpts provided in this book.

Of course, there are myriad narratives, many conflicting, being spread amongst different social, economic, cultural, and political communities of people across different regions of the US at any given point in time. Nevertheless, how narratives emerge, interact, and change is not well-understood by economics and finance researchers. The underlying relationships are too complex to truly comprehend, especially within models that predetermine how change unfolds over time. As Shiller (2017) recognized, "the relation between narratives and economic outcomes is likely to be time-varying" (p. 997), that narratives are "major vectors of change in culture, in zeitgeist, and in economic behavior" (p. 972), and that it is, in part, the "change in narratives [which are important for] understanding fluctuations" (p. 967). One cannot discuss novelty and narratives without placing change, specifically unforeseeable change, in stock market relationships at the core of the analysis.

As will be seen from narrative evidence presented in Chapters 4 through 12, subsets of unscheduled corporate events that underpin investor beliefs about future stock returns undergo significant shifts in their importance during different subperiods of time such as those characterized by excess volatility. As markets have experienced with the Lehman Brothers bankruptcy, the subprime mortgage meltdown and ensuing global financial crisis, and now with the COVID-19 pandemic, price collapses are bellwethers for extended periods of financial calamity. Though no one knows how long they will last, dramatic reversals from asset-price peaks triggered by large-scale macro events are typically marked by waves of ensuing novel events and instability at the micro level. For the subprime mortgage crisis, the novelty of frozen commercial paper markets and excessive financial sector leverage led to highly irregular variation in investor beliefs through distorted assessments of "quantifiable risk" (Gennaioli and Shleifer, 2018).

The narrative connection between novel events, market instability, and uncertainty can be seen in the December 4, 2018 *Bloomberg News* stock market wrap report. Perhaps researchers and market professionals could assess with an objective probability distribution the possible outcomes and measurable odds therein for future interest rate decisions at FOMC meetings. This is largely a risk assessment since Fed Funds rate decisions are repetitively drawn observations based on routine calendar releases. However, the array of potential future outcomes from talks between President's Xi and Trump or from a no-deal Brexit are much less susceptible to the frequency-based statistics of standard deviation and expected value. Interestingly, the March 16, 2020 *Bloomberg News* wrap excerpt contained virtually no scheduled factors, such as quarterly earnings announcements, whose impacts on possible future states could reasonably have been

assessed with quantitative probability measures. Again, the nonrepetitive nature of KU events gives little basis for objective, probability-based forecasts *ex ante* and promotes the importance of narrative dynamics for thinking about the future. This situation is emblematic of what Frank Knight would consider true uncertainty.

In his 1921 book, *Risk, Uncertainty and Profit*, Frank Knight underscores the fact that “business decisions deal with situations which are far too unique...for any sort of statistical tabulation to have any value for guidance. The conception of an objective measurable probability...is simply inapplicable” (p. 231). Knight recognized that “unanticipated, dynamic changes” in relations driving future business conditions stem from nonrepetitive events. These are the key factors underpinning “real change,” the impacts of which are genuinely unknowable to any individual *ex ante*.^[11] Indeed, as Chapter 2 in this book shows, there is much empirical evidence of many different forms of structural change found in stock return relationships that would be difficult to fully anticipate in a probabilistic sense.

Knight was well aware of classical economics’ insistence that, “We must first discuss one change at a time, assuming the others suspended...This is the way our minds work” (1921, p. 16-17). However, the ability to statically “deal with a complex situation as a whole...rarely ever happens” (p. 17) in capitalistic markets. But it is not change as such that is the focus under true uncertainty. Knight makes the compelling connection that “Profits are...the result exclusively of dynamic change...” and quickly identifies “the fundamental question of the difference between a change that is foreseen a reasonable time in advance and one that is unforeseen...” (p. 35). As he put it, “if all changes were to take place in accordance with invariable and universally known laws, [so that] they could be foreseen for an indefinite period in advance of their occurrence... profit or loss would not arise” (p. 198).

This book builds on Knight’s astute observation that it is “unanticipated change” underpinning returns from business decisions by focusing on unscheduled macro and corporate micro events all too often overlooked by researchers, but the primary source of financial market instability. Much previous literature has assumed changing relationships in stock, and other asset, markets can be modeled in a determinate fashion *ex ante* with a stochastic process, such as a Markov switching rule. This is a fundamental departure from Knight’s assertion “that change in reality does not usually just happen, but is largely itself the result of human activity” (p. 36). In his Nobel lecture, Hansen (2013, p. 399) echoes Knight’s emphasis on the folly of representing participants’ understanding over time with determinate accounts by arguing that rational expectations models “miss something essential: [Knightian] uncertainty [arising from] ambiguity about which is the correct model” of the process driving aggregate outcomes.

Of course, some novel events cause changes in business contexts whose impacts on return relationships are more acute, such as labor strikes, data breaches, bankruptcies, CEO turnover, product recalls, and industrial accidents, while change from other events unfold only gradually over time, such as technological advancements, financial leverage, mergers and acquisitions, and capital investment projects. Whether sharp and transitory or gradual and persistent, novelty’s impacts on the stock market stem from “our ignorance of the future” (Knight, 1921, p. 198). After all, “It is a world of change in which we live, and a world of uncertainty. We live only by

knowing something about the future; while the problems of life, or of conduct at least, arise from the fact that we know so little. This is as true of business as of other spheres of activity” (p. 199).

How novelty drives structural change in the stock market and leads to popular stories is a central question of this book and the basis for NNH. The dynamics between novelty, instability, uncertainty, narratives, and emotion can be simplified in Figure 1.3 as a diagrammatic treatment of NNH for asset markets.

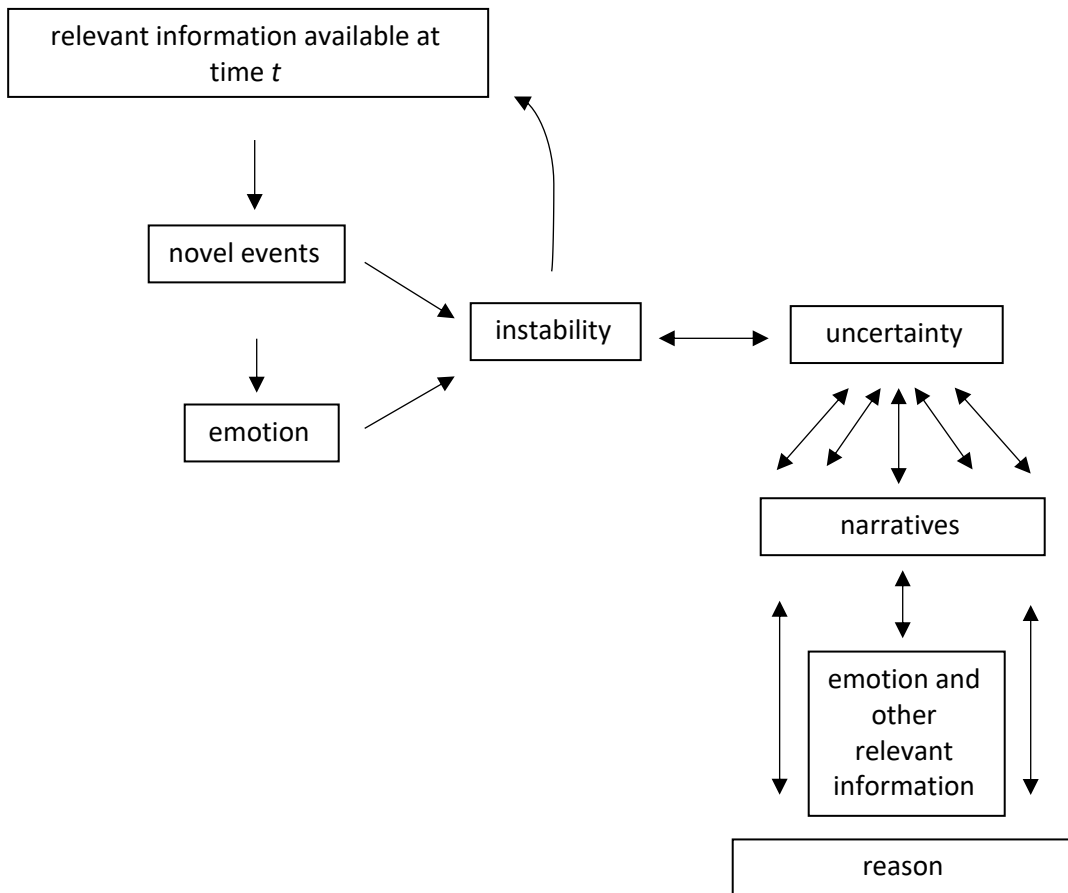


Figure 1.3 The figure plots a rough framework for sequential and interactive relationships between novel events, instability, uncertainty, narratives, and emotion in asset markets.

Several relational conclusions can be drawn based on Figure 1.3. First, novel events are part of the available and relevant information set at time t . Novelty creates emotion that together interact to cause instability in the relationships driving market outcomes. Instability, in turn, becomes part of the information set. Second, instability causes increased degrees of uncertainty in the marketplace that can feed back into the degree of instability present at any given point in time. Third, in the face of uncertainty, narratives emerge that contain emotion and other relevant information - say, macroeconomic or financial data also unfolding at time t . Narrative threads interact with each other and with participants' interpretations of information which may feed back into market uncertainty. Fourth, the narratives then lead to a reasoning or rationality for

thinking about the most appropriate forecasting strategy describing the processes driving future outcomes. The reasoning then undergoes feed back with narratives as one shapes the other and vice versa. Figure 1.3 is a dramatic simplification of the asset-market dynamics at play, but serves as a rough template for how novelty, instability, uncertainty, and narratives may all be related under NNH.

Chapter 2 presents the overarching idea of NNH and the empirical instability in relationships driving stock-price fluctuations and volatility. A cursory literature review of structural change in the US equity market will be presented and a case will be made for inherent model ambiguity and the rational need for investor sentiment and narrative interactions under uncertainty. Attention is paid to the different forms of transitory versus more persistent change in stock market relationships and the event categories likely underpinning them.

1.3 Narrative Dynamics and Emotion: Evidence from Other Disciplines

Imaginations may swirl and dramatic experiences may be recalled as the mind enters “narrative mode” (Bruner, 1986). Which forecasting strategy should one place the greatest confidence in for thinking about the future returns process today? Given the complexity of financial market interactions day-to-day, no one, let alone an economist or hedge fund manager, knows the answer in any definitive sense. This is one reason why the returns from speculation – “knowing better than the market what the future may bring forth” (Keynes, 1936, p. 170) – are so high. Individuals have an internal desire, especially when facing uncertainty, to form opinions based on their own stories, experiences, perceptions, and beliefs, about a particular situation. With “our ignorance of the future, incomplete knowledge, and imperfect inference, it becomes impossible to classify instances objectively, and any changes brought about in the conditions surrounding the formation of an opinion are nearly sure to affect the intrinsic value of the opinion itself” (Knight, 1921, p. 259).

Investor judgment requires narratives and emotions because it is the collection of experiences and stories which stick to our memories the most, prompting salient feeling, and that come to the forefront of our reasoning when making decisions about complex interdependent scenarios. For instance, Frydman et al. (forthcoming) find that stock market participants’ optimism or pessimism about the future affects how they interpret today’s news about dividends and interest rates when forecasting stock returns. The authors find, however, that this effect is highly irregular, both in timing and in magnitude.[12] Knight states that,

the ‘degree’ of certainty or of confidence felt in the conclusion after it is reached cannot be ignored, for it is of the greatest practical significance. The action which follows upon an opinion depends as much upon the amount of confidence (i.e. sentiment) in that opinion as it does upon the favorableness of the opinion itself. The ultimate logic, or psychology, of these deliberations is obscure, a part of the scientifically unfathomable mystery of life and mind.

(1921, p. 226-227)

This book offers an expansive treatment of the role of sentiment for NNH by assessing the emotional context surrounding nonrepetitive events’ interpreted impacts on future stock returns

with an event sentiment score (ESS). Stories are inherently emotional and popular stories elicit the most visceral of feelings and emotion. Following Knight (1921), Keynes (1936) and the recent theoretical advancements of Frydman et al. (2019) and Frydman and Goldberg (2015), this book argues for a fundamentals-based role for psychology in driving aggregate outcomes in financial markets.[13] Consistent with Hansen’s previously mentioned insight, novel events introduce ambiguity onto participants’ forecasts concerning which model is most useful for thinking about the future. There are tons of financial models potentially appropriate for understanding firm cash flow prospects and future returns at any given point in time – who can say with any confidence that a particular one is the right one for *a priori* thought when parameters shift in unforeseeable ways? Sentiment, as a critical component of narrative dynamics, helps to flesh out which model and forecasting strategy investors might place the greatest confidence in “calculating where they can, but often falling back for our motive on whim or sentiment or chance” (Keynes, 1936, p. 163).

That unforeseeable structural change necessitates narrative-based emotion is supported by well-developed research areas such as neuroscience, cognitive psychology, and sociology. Endogenous emotions are found to be connected to memory formation, individual identity, dramatic recall, imagination, and even physiological stimuli. Indeed, much of the evidence suggests that researchers in economics and finance have largely ignored the inherent interaction between emotions and cold calculation in explaining individual behavior in real-world situations commonly fraught with uncertainty.[14]

In fact, scientists in these fields have argued that the bulk of experimental evidence supporting a sentiment-based view of decision-making is entirely in line with rational behavior as defined by other social sciences at large. Commenting on the status of rational choice theory in economics, Verweij et al. (2015, p. 3), for instance, state, “In neglecting the role of emotions, rational choice theory is out-of-step with present-day neuroscience – a point that has been made by a variety of brain researchers.” Unfortunately, it has been longstanding practice in economics and finance to associate the effects of sentiment with forecasting errors, random perturbations, bouts of irrational behavior and other factors represented as being orthogonal to fundamental considerations and reasoning at large.[15] This may be one explanation for the lack of narratological studies in economics and finance. Beyond arguing for a mere synthesis between the two realms, this book argues that emotions and calculation share interrelational space underpinning rational forecasting behavior as implied by NNH.

Findings from disciplines outside of economics and finance support various links in the NNH apparatus. Chapter 3 briefly surveys the relevant evidence from the fields of neuroscience, psychology, anthropology, and sociology as they pertain to the dynamics of NNH. The evidence focuses on the role of affective states and emotions driving expectations when confronted with historically unique events. The findings referenced are from both experimental and natural settings. The chapter discusses the “narrative mode” framework of Bruner (1986) exploring the unsystematic part of the mind used to “imagine” possible states of the world. The famous cognitive psychologist elevated the idea that story-based thinking through linguistics and narratives brings meaning to novel experiences that inform day-to-day decision-making, especially when the surrounding environment is undergoing change. Additionally, views of “endogenous animal spirits” (DiMaggio, 2002), “emotional embeddedness” (Bandelj, 2009) and

“creative action theory” (Whitford, 2002; Joas, 1996) as they may be applied to structural change and uncertainty in stock markets will be discussed.

1.4 Textual Analysis, Financial News and Narratives

Volumes of textual analysis studies have investigated unstructured data from financial news reports, finance message boards, and corporate disclosures for their informational content in explaining stock market outcomes. Yet, research on KU through narrative news analytics is virtually absent in the contemporary finance literature.[16] Evidence of narrative dynamics in this book is based on millions of daily stock market news stories over the last two decades of data. The stock market stories are keenly able to detect the corporate, economic, cultural, social, institutional, and political trends affecting stock market behavior within the contextual zeitgeist of the times. The book presents the only comprehensive big data analysis of nonrepetitive events and associated narrative elements of emotion, relevance, novelty, and inertia applied to structural change in aggregate and firm-level stock market relationships.

Das (2014) and Loughran and McDonald (2016) offer excellent surveys of textual analysis in finance. Financial news analytics are able to deal with unforeseeable change in asset-price relations, to allow for fundamentals-based sentiment, and to track the rich and nuanced information, both quantitative and qualitative, that investors follow on a daily basis.[17] Chapter 4 discusses the benefits of financial news analytics for exploring NNH under KU as applied to the stock market. One section emphasizes the ability of textual data analytics to allow for the timing and magnitude of structural change to unfold in highly irregular and unforeseeable ways. Another area discusses its ability to gauge the relative and contingent importance of both macro and micro KU events for returns.

This book’s analytical assessment of NNH is based on the universe of financial news from *Dow Jones & Company*, which includes the *Wall Street Journal*, *Barron’s*, and *MarketWatch*, and the daily stock market wrap reports from *Bloomberg L.P.* These international firms are leaders of the financial news analytics industries. With over 25,000 employees combined worldwide, these firms have a global presence for high quality, reputable news analytics. Their newsfeeds are often found scrolling across screens at traders’ desks. Models of risk management, asset allocation, return prediction, and portfolio choice have seen improvement when news analytics output and proprietary data from these firms are quickly incorporated. Of course, the famous *Bloomberg* terminals offer software, data and news analytics used by the largest financial institutions, research organizations, and top business schools around the world. And data from *Dow Jones Newsfeeds* has been used in the most widely cited and seminal papers using textual analytics to investigate stock market behavior (e.g. Tetlock, 2007).

One section of Chapter 4, using an automated text mining program, presents narrative word clouds from *Bloomberg News* stock market wrap reports based on a lexicon dictionary of KU entities and events for the last twenty-eight years. The world clouds track the importance of the Mexican Peso crisis, NAFTA, Clinton’s presidency, the Russian debt crisis, to the battery of mergers in the late 1990s, to the global financial crisis, debt sequestration, and U.S. fiscal cliff to the Tax Cut and Jobs Act of 2017, to President Trump’s trade war with China, to Brexit, and to

the COVID-19 crisis. The word clouds illustrative variation of KU terms reported as driving daily stock prices is indicative of instability triggered by the novel events that are likely to have fueled investor narratives during different subperiods. Frequency histograms show that numerous KU entities and/or events are mentioned over 250 times in a given year's worth of daily wrap reports. The R code used to generate the word clouds and histograms is provided in Appendix A and can be used for applying the KU event lexicon dictionary to any financial text.

Alternatively, more formal time-series evidence on novel events and narrative dynamics for the US stock market presented in Chapters 5 through 12 is based largely on unscheduled events identified by the *RavenPack* news analytics platform over the period January 2000 through March 2020. *RavenPack* is a unique source of explanatory and predictive analytics derived from *Dow Jones Newsfeed*, *Wall Street Journal*, *Barron's* and *MarketWatch* articles published over the last two decades. The product dataset is rich with structured information including over 2,000 identifiable stock market event classifications, the majority (over two-thirds) of which are somewhat novel, or unscheduled, in nature. The primary *RavenPack* data source is based on millions of corporate-specific events identified from the equity news outlets as impacting firm investment prospects and/or share prices. The secondary dataset from the same news sources is based on macro US events such as Federal Reserve Bank activity, armed conflicts, trade agreements, fiscal policy changes, natural disasters, congressional hearings, and so on, and is used for the narrative-subnarrative investigation conducted in Chapter 8. Important for NNH, both datasets are sorted to include only those identified novel events which are classified as "unscheduled."

RavenPack automatically tracks and monitors relevant information on tens of thousands of companies, government organizations, influential people, key geographical locations, and all major currencies and traded commodities as they are related to outcomes observed in US equity markets. Among the many benefits for this book, *RavenPack* produces sentiment, novelty, relevance, and inertia scores (and 28 other metrics all described in Appendix C) of event classification data all in a matter of milliseconds of news' release. Output from the identified nonrepetitive events are used to produce KU indices which are interacted throughout the empirical chapters to generate proxy narratives at both the micro and macro levels.

Methodologically, the platform detects narrative dynamics by incorporating both algorithmic and human-expertise approaches to textual classification and data generation. Hybrid approaches such as *RavenPack's* to textual analysis are found to be the most promising for capturing intended context and relational meaning in big data environments. *RavenPack* quantifies positive and negative perceptions on facts and opinions reported in the financial news and understands the magnitude of event extremities. The platform continuously analyzes relevant information from all major financial newswires and other trustworthy sources, producing real-time news analytics with the ability to identify relevant "news" from "no news," important determinations shown to influence stock market behavior (Boudoukh et al, 2013; Chan, 2003). These features and more of the *RavenPack* analytical platform allow for identification of unscheduled events and the initial classification into narrative components in a consistent, transparent and tractable way making it an excellent candidate for assessing the implications of NNH from textual news accounts.

1.5 The KU Indices

Chapter 5 introduces the KU data classification hierarchy structure. The 51 KU groups into which the 1,395 unscheduled event categories are classified are discussed in detail. A KU event record - containing the 32 output fields from *RavenPack* - is offered as an example of an unscheduled events' scoring. Appendix D provides a glossary of every disaggregated unscheduled event category whether classified at the micro or macro level. Chapter 5 presents the baseline micro KU index generated from monthly count data for unscheduled corporate event categories tracked by the *RavenPack* platform along with an examination of its basic time-series properties. Variation in the micro KU index is compared to major episodes in US history.

Chapter 6 conducts a deeper analysis of the unscheduled corporate events by generating indices based on event relevance, novelty, inertia, and sentiment. Periods of "highest" narrative intensity are identified by combining the most relevant corporate KU events with those with the most extreme sentiment (optimism or pessimism) and highest degree of novelty. These are the periods against which the formal structural change analysis of stock market outcomes in Chapter 10 will be compared.

The KU sentiment measure based on *RavenPack* analytics is derived from three proprietary methodologies for identifying emotion that emphasize context and meaning: traditional, expert consensus, and market response. Event sentiment scores are based on a hybrid approach combining algorithmic processing powers with financial expert understanding of stock market context. The algorithms reach far beyond strict bag-of-words dictionary-based approaches to textual analysis while the manual component involves hundreds of financial market professionals trained on tens of thousands of financial news articles.[18]

Because story sampling is based on a limited data range, there always exists the possibility that new economic terminology, trends, types of reporting, or market forces may emerge after the sample period. Indeed, the meaning of narratives, and context within which they are understood, change over time, as do a nation's institutions, social values, and politics. In order to account for these temporal changes, all *RavenPack* classifiers are reevaluated on a quarterly basis.

Before the massive growth in computational power, researchers investigating narrative dynamics for the stock market resorted to crude metrics of manual reading of news, such as measuring headline-letter size (Niederhoffer, 1971). Since then, however, algorithmic advances in textual analysis have aspired to human-level reasoning for detecting relevance and meaning while allowing for exponentially greater volumes of input and faster processing speed. *RavenPack*'s platform is at the forefront of big data news analytics. That said, advances in manual rule-based applications to narrative analyses of the stock market are also discussed in this book and illustrated with a formal Scapegoat analysis of stock returns presented in Chapter 11.

Chapter 7 introduces another set of indices that measure the degree of compositional variation, or diversity, across KU groups over the sample period. Which stock market periods are characterized by many different KU-group narratives concurrently? Which periods are dominated by just a few? How does the diversity in corporate KU groupings evolve over time?

Which KU groups are most influential overall for the stock market? These questions and more will be investigated in this chapter.

Chapter 8 introduces the companion data to the corporate micro KU indices by tracking the unscheduled macro events related to the US over the sample period. Although macro KU events are dwarfed by the frequency of corporate KU events, there are numerous findings from this chapter that show a close connection between the two realms of nonrepetitive events. The two baseline indices share a very high correlation as do the first principal components of micro and macro narrative proxies that include sentiment, novelty, relevance, and inertia suggesting that the two levels of uncertainty share common narratological threads. Furthermore, there is evidence that the macro KU events statistically lead to micro events, which implies that unforeseeable change at the systemic level cascades and spills over onto lagging corporate novelty and associated smaller-scale instability.

However, the macro KU indices are shown to exhibit considerably less variation in both event count and group diversity over the sample period as compared to corporate indices. High narrative intensity periods connected to macro events fail to approximately align with those connected to micro events that are explicitly reported as influencing corporate prospects and share prices. Furthermore, the macro indices are unable to convincingly improve upon any of the empirical tests of stock market outcomes conducted in Chapters 9 and 10 when substituted for micro KU information. One interpretation is that corporate KU events are a more immediate and intimate lens into stock market instability because they track the nonroutine change that is churning on a smaller scale while simultaneously capturing the large-scale instability trickling (or rushing) down from major historical events. Taken together, the findings from this chapter give confidence that unscheduled corporate events are the more informative source for assessing narrative dynamics related to stock market instability and, therefore, are used for empirical analyses conducted in Chapters 9, 10, and 12.

1.6 Statistical Analysis of KU and Narrative Data

Chapter 9 presents the first set of empirical findings involving the micro KU indices generated in Chapters 5 through 7 and establishes a statistical and economically meaningful connection between novel corporate events and stock market relationships. Nonparametric correlation tests suggest that the baseline KU and KU variation indices share a statistical relationship with market outcomes at the aggregate and firm level, often with the correct hypothesized sign. For instance, a negative correlation is found between micro KU indices and SP500 prices and valuation ratios that implies an uncertainty premium may exist.

Furthermore, correlation and statistical “causality” tests find that the micro KU indices are inversely related to and “lead” the variance in analyst’ long-term projections of growth in earnings per share for the thirty firms in the *Dow Jones Industrial Average*. These results suggest that unscheduled corporate events may exert an informational effect whereby analysts glean more qualitative information about future returns from greater increases in the count and variation in KU events. For large enough subsets of KU events whose interpreted impacts on expected returns are believed to be directionally consistent with each other, the bounds of

analysts' long-run growth estimates are narrowed. Narrative threads that connect the groups of nonrepetitive corporate events would then serve to shape and clarify the overall degree of bullishness versus bearishness of the full information set for investor return forecasts.

Chapter 10 offers the second set of formal empirical tests, but now explicitly focusing on the relationships between corporate KU events, narratives, and stock market instability. An expanded structural break analysis of commonly-modeled stock market relationships describing aggregate and firm-level returns, market volatility, trading volume, and equity fund flows is conducted. One test allows for the periods of highest narrative intensity from Chapter 6 to be imposed as potential breakpoints in stock market relationships. Other instability tests are conducted that leave open the timing and magnitude of potential breakpoints for comparative analysis. The results suggest that structural breaks in factor-model relationships of aggregate and firm-level stock returns approximately align with periods of greatest narrative intensity based on interactions of relevance, novelty, and sentiment connected to the KU events. There is also supportive evidence for NNH applied to stock market volatility and ETF (exchange traded fund) flows.

Chapter 11 presents a manual rule-based narrative analysis of Scapegoat effects and instability in the stock market. Based on information contained in *Bloomberg News* stock market wrap reports, formal empirics show the dramatic variation in investor attention across a range of macroeconomic and financial factors for the stock market. Increases in attention around particular narratives, that is, Scapegoat factors, are found connected to fundamentals' autoregressive data generating process. One interesting finding is that investor narratives involving interest rates tend to comove positively with levels of underlying data on market-wide rates such as the 3-month Treasury bill yield. That is, when rates are historically high, stock market narratives involving interest rates increase substantially and vice versa. Results from the manual Scapegoat analysis provide insights into the close, but highly irregular, connection between stock market narratives and observed trends in conventional data on fundamentals.

Development of the macro and micro KU indices and subsequent narrative intensity analyses offer a range of possible applications for researchers and investors to consider for their own future work. Chapter 12 presents a case study applying the narrative frequency of the "dividends-earnings" corporate KU category to the present value model of aggregate stock market prices through a cointegrated vector autoregression (CVAR) analysis. The results suggest that adjusting for KU effects improves upon the statistical connection between aggregate prices and dividends. Moreover, a simple trading strategy that sells short (buys long) the aggregate market portfolio when narrative intensity is high (low) is shown to beat the market (albeit not adjusting for transactions costs) over the twenty-year sample period.

1.7 The Future of Macro Finance

Chapter 13 offers thoughts about the future of macro-finance based on the need for incorporating historically novel events and associated narratives more broadly into economics and finance research. Whether a potential Kuhnian paradigm shift toward narrative-based modeling approaches under uncertainty is commencing is discussed (Kuhn, 1970; Mangee, 2015). For

Kuhn, scientific revolutions occur when the statistical toolkits adopted, views of the world, and questions posed are challenged from within a scientific community. Ultimately, the researchers at large deem what is worthy of scientific status.

Throughout the chapter, emphasis is placed on extant methodological approaches to modeling aggregate outcomes that allow for historical events to change asset-price relationships in unforeseeable ways. A comparison of probabilistic versus nonprobabilistic representations of structural change in macro-finance models will be made in Kuhnian terms. In doing so, statistical frameworks for modeling revisions in participants' expectations which stop short of being fully prespecified are brought to the forefront (Frydman et al., 2019; Frydman and Phelps, 2013).

A brief Chapter 14 offers some main takeaways, concluding thoughts, and directions for future research. Lastly, Appendix B provides any reader, researcher, or student with the toolkit to conduct a manual, rule-based narratological analysis of unstructured stock market text under KU. The project includes a classification dictionary of fundamental, psychological, technical, and KU-specific factors along with a pretabulated Excel spreadsheet (available at the author's website) for scoring. The project's methodological approach enables the generation of unique time-series data on the influence of a wide array of factors deemed relevant for the stock market day-to-day. Importantly, the project allows for contextualized meaning and unforeseeable change in price relationships at all times, past, present, and future. The project can be applied to any financial text, offering limitless application to trading strategies and future research.

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Notes

[1] Daily SP500 data is based on closing prices and is collected from www.yahoo.com/finance. Initial jobless claims data is collected from the Bureau of Labor Statistics. Small-business and nonfarm payroll jobs data is collected from the ADP National Employment Report. Fed Funds data is collected from the Federal Reserve Economic Database (FRED).

[2] Consider the *Bloomberg News* stock market wrap report from February 25, 2020 that states, “The market is pricing in a significant slowdown in GDP and a 10% impact on earnings,” according to Zhiwei Ren, portfolio manager at Penn Mutual Asset Management. Consider further the *Bloomberg News* wrap report from March 23, 2020 that reads, “Morgan Stanley warned the epidemic could cause U.S. GDP to shrink a record 30% in the second quarter. Federal Reserve Bank of St. Louis President James Bullard said the country’s jobless rate may hit 30%.”

[3] The coronavirus was first mentioned in *Bloomberg News* end-of-the-day US stock market wrap reports on January 22, 2020.

[4] For example, as of March 12, 2020, the *Wall Street Journal* Economic Forecasting Survey found that, of the economists surveyed, the average expected probability for a recession occurring within the subsequent twelve months was 48.8 percent.

[5] When individuals subconsciously suppress information that conflicts with their prior beliefs about a particular situation this is known as cognitive dissonance. The elevation of other information that does align with their priors is cognitive consistency. See Schlicht (1983) for an application to utility theory and welfare economics and Hosseini (1997) for applications challenging neoclassical rationality under uncertainty.

[6] This is the baseline SIR model where contagion and recovery rates are assumed constant over time. See Kermack and McKendrick (1927) and Shiller (2017) for more details on the SIR model.

[7] For all Google Trends searches presented in this book, the vertical axis values, as per Google's explanation, "represent search interest relative to the highest point on the chart for the given region and sample period. A value of 100 is the peak popularity for the term. A value of 50 means that the term is half as popular. A score of 0 means there was not enough data for this term.

[8] John Williams is the president of the Federal Reserve Bank of New York and vice-chairman of the Federal Open Market Committee (FOMC).

[9] The US Department of the Treasury reports daily Treasury yield curve rates as its online resource center.

[10] For a treatment of this type of reflexivity in financial markets see, for example, Soros (1987).

[11] Keynes also shared Knight's view that we "cannot depend on strict mathematical expectation, since the basis for making such calculations does not exist" (Keynes, 1936, pp. 162–163). See Sakai (2018) for illuminating comparisons of Knight versus Keynes concerning their respective treatments of risk, ambiguity and uncertainty.

[12] Additionally, the authors provide evidence that sentiment's role in interpreting fundamental news also holds for ex post stock returns.

[13] Frydman et al. (2019) introduce theory dubbed the Knightian Uncertainty Hypothesis wherein the authors develop a way to recognize both risk and KU when confronted with time-series data on aggregate outcomes in macroeconomics and finance.

[14] For previous studies in cognitive psychology and neuroscience advancing past the duality of behavioral-emotion or calculated-cognition for successful decision-making, see Damasio (1994), Koenigs et al. (2007) and Krajbich et al. (2009).

[15] Even when the two categories of emotions and strict calculation are intentionally separated by researchers - as in the conventional dual-systems approach developed in neuroscience and psychology - the results suggest a very strong, if not disproportionate, role for emotionally intensive considerations to explain outcomes (Albrecht et al., 2010; McClure et al., 2007).

[16] The study by Friberg and Seiler (2017) is a rare exception. The authors use textual analysis of SEC filings to categorize firms and industries based on KU and ambiguity finding that those with higher values, as measured through bag-of-word term searches related to "uncertainty," are generally riskier, carry more liquidity, and seek greater hedging through the use of derivatives.

[17] This book focuses on aggregate and firm-level stock market behavior using narrative analysis of financial news reports. As such, the present analysis indirectly reflects information contained in corporate disclosures, 10-k reports, or firm-issued risk-prospecti. For financial risk studies focused on these sources of textual analysis, see, for instance, Campbell et al. (2014), Bao and Datta (2014), Loughran and McDonald (2016) and references therein.

[18] Many textual data analyses connecting market sentiment to stock returns utilize content analysis programs which employ simple word count or phrase level search algorithms, such as dictionary-based

information retrieval systems (Davis et al., 2006; Engelberg, 2008; Tetlock, 2007; Tetlock et al., 2008; Demers and Vega, 2008; Loughran and McDonald, 2011; Mangee, 2017, 2018).