PORTFOLIO MANAGERS' RECOLLECTED PERCEPTIONS OF RISK PERCEPTION AND RISK PREFERENCE AFTER EXPERIENCING THE PUNA ERUPTION

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Abstract

The dichotomous relationship between objective and subjective risk is omnipresent throughout the modern portfolio theory. Risk perception is the analysis of risk and the probability of the risk applied to financial projections. This objective measure of risk perception is tethered and often interpreted by the individual's subjective measure, known as risk preference. Modern portfolio theory assumes that the individual's risk preference is stable—that it does not change. Some recent literature suggests that risk preference is not stable—that shocks from natural disasters can influence it to change. Other studies find risk preference is stable after natural disasters. These studies are generally quantitatively based, which creates a challenge due to the dichotomous relationship between risk perception and risk preference. A change in either could influence the outcome of a quantitative study, and since risk perception and risk preference are intertwined, knowing which influenced the change is problematic. This generic qualitative inquiry study utilizes the recollected perceptions of Hawaii-based portfolio managers' risk perception and risk preference before, during, and after experiencing the 2018 Puna volcanic eruption as a mechanism of inquiry into the individual's construction of the stability of the individual's risk preference after a natural disaster. This study generally supports the findings that natural disasters do not change risk preference. The results further suggest that the conflicting results in the current quantitative literature on the constancy of risk preference may be due to the difficulty of separating the intertwined elements of risk perception from risk preference.

Dedication

This dissertation is dedicated to an extraordinarily loving wife. She supported my decision to earn a PhD—after having already supported me through a JD and through the coursework of an LLM in taxation. Next—I would like to thank our brilliant daughter for her love and support. I am proud of her stellar character and all of her achievements in life. I am so impressed with her notable works as a published authoress, and it is an honor just to be known as her father.

This dissertation is also dedicated to loving parents who met the needs of their family and the demands of raising six children—after serving in World War II—partially by delaying their own college educations. However, they instilled great respect, appreciation, and a deep desire for education in my siblings and me. Whenever my parents could—they led by example.

One of the first things my father did—after retiring from a long and very successful career—was to finish his college degree. My parents' lifetime emphasis on seizing every opportunity for education led to six bachelor's degrees, three master's degrees, a JD, an MD, and two PhDs among their six children.

Acknowledgments

Far too many have contributed to making this achievement possible to acknowledge them individually, so inclusion in groupings will have to do. First, I recognize all the teachers who have influenced my life from the beginning to the present day. Second, I acknowledge all of the professional, business, personal, and educational mentors who have given me a hand along the way. Third, I recognize the colleagues that supported me, challenged me, and encouraged me. Finally, I gratefully acknowledge those individuals from each group that took the time and cared enough about me to help me when I erred—to understand, fix, repair, and move on to incredible things. Without you all, this work, and my life's work, would not exist as they do today.

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CHAPTER 1. INTRODUCTION

The general topic area of this study is risk within the confines of the modern portfolio theory. The specific subject is the recollected perceptions of portfolio managers' risk perception and risk preference before, during, and after experiencing the 2018 Puna volcanic eruption. The study's participant sample is comprised of 17 portfolio managers who lived and worked in Hawaii immediately before, during, and immediately after the Puna volcanic eruption on the Big Island of Hawaii.

Risk is a combination of the probability of the desired outcome and the consequences that will ensue if the expected result does not materialize (Erdik, 2017). Portfolio management, under the modern portfolio theory, is the process of selecting an assortment of assets based on the analysis of the financial risk (risk perception) of each selected asset with the objective that the assembled portfolio of investments' combined effects optimizes the balance of risk and expected return (Rao et al., 2015). Portfolio managers are responsible for analyzing the risk versus the expected return of investment options and then balancing the portfolio so that optimization occurs at the client's level of risk preference. An essential factor in this analysis is price, and portfolio managers use modern portfolio pricing tools to determine an appropriate price for each investment in a portfolio.

The modern portfolio theory pricing models, including the flagship capital asset pricing model (CAPM), use two aspects of risk when establishing the price of an asset—risk perception, which is the financial analysis and review of the asset, and risk preference, which is often referred to as beta and calculated as the variance of the asset's historical price volatility (Smith & Walsh, 2013). For the pricing models to function as expected, risk preference, or the tolerance for risk, must remain stable over each individual's lifetime (Schildberg-Hörisch, 2018). Some

recent studies have found that natural disasters could influence the stability of the individual's risk preference (Chuang & Schechter, 2015; Schildberg-Hörisch, 2018; Wahdat et al., 2021). This study sought to uncover the recollected perceptions of Hawaii-based portfolio managers' risk perception and risk preference after experiencing the Puna volcanic eruption as a mechanism of inquiry into the stability of the individual's risk preference after experiencing a natural disaster.

This chapter begins with a description of the background that sets up the purpose of the study. This chapter continues with a description of the need for the study, followed by a description of the study's purpose and significance. Next, the research design is presented, followed by the research questions. This chapter finishes with definitions of the terms used in the study and discusses the study's assumptions and limitations.

Background of the Study

Historically, current finance theories are in their infancy—with their initial beginnings starting at the turn of the twentieth century as the mathematics of probability emerged. Early contributors included Louis Bachelier, with the publication of *Théorie de la Spéculation* in 1900. Bachelier's mathematic proofs beat Albert Einstein to what is currently known as Brownian motion—which is now part of *econophysics* (Bachelier, 2006). However, it was not until Harry Markowitz, in the early 1950s, presented a complex portfolio optimization formula using linear mathematics as his PhD dissertation that the modern portfolio theory began to take root (Maier-Paape & Zhu, 2018a, 2018b; Markowitz, 1952).

Within just a few years of Markowitz's dissertation, Markowitz's initial work was expanded individually by Markowitz, Sharpe, Lintner, and Mossin, resulting in the capital asset pricing model (CAPM) (Levy et al., 2012). This pricing model became the foundational tool of

the modern portfolio theory, with CAPM being the most widely utilized financial tool in developed nations worldwide (Himanshu, 2017). Their efforts provided both Markowitz and Sharpe with the Nobel Peace Prize in economics in 1990 (Levy et al., 2012).

Modern portfolio theory suggests that "investing is a compromise between risk and expected returns" (Vaclavik & Jablonsky, 2012, p. 474) and that the market risk inherent in any financial instrument may have less influence when it becomes part of a strategically assembled (managed) portfolio of investments (Maier-Paape & Zhu, 2018a). Theoretically, on the day it is built, a portfolio can be optimized with the perfect balance of risk against return according to each investor's risk preference (Mazzola & Gerace, 2015). This flexibility means a more aggressive (higher risk preference) investor can have an optimized portfolio that fits them, and a more conservative (lower risk preference) investor can have an optimized portfolio that perfectly suits them as well.

From its inception, attempts were made to prove the modern portfolio theory behind CAPM correct by creating optimized portfolios and analyzing the results over time. The results did not match the expected returns (Dempsey, 2013; Levy, 2010). There is a theoretical reason for this result—modern portfolio theory is an asset pricing theory, and CAPM is an asset pricing model—not a market behavior theory or market explanation model (Dempsey, 2013). But some researchers felt the reason the expected returns did not match actual returns could be attributed to one of the modern portfolio theory's underlying assumptions—the expected utility theory.

An underlying assumption of the expected utility theory is that people are rational and always act in their own best interest (Statman, 2018). In 1977, Kahneman and Tversky introduced the prospect theory as an alternative to the expected utility theory (Kahneman & Tversky, 1977). Behavioral economists prevalently use prospect theory to support their models.

Prospect theory has the underlying assumption that individuals make investment decisions based on what will make them most happy—which is not always what is in their best interest (Statman, 2018).

Comparing the modern portfolio theory and risk with prospect theory and risk, we see that under the modern portfolio theory, risk is measured by the variance in risk preference of all individuals (the higher the variance, the higher the level of risk). Risk under the prospect theory is the variance in everyone's choices about what makes them the happiest. While some might ask whether this makes a difference—and it may not—the modern portfolio theory's use of expected utility theory to suggest that individuals always choose the highest return for the least amount of risk, with mean-variance representing risk, makes it readily quantifiable—while the measurement of happiness of prospect theory is harder to quantify (Statman, 2018).

Applying behavioral finance, Feldman and Liu (2018) used an agent-based model (the sizes of positions held by managers of mutual funds) to predict the future prices of stocks. The authors find two interesting results: (a) the beliefs of the asset managers, as evidenced by the number of shares of specific stocks they had in their portfolios, were an excellent predictor of future values, and (b) high variances in the relative holding percentages of specific stocks were excellent predictors of recessions. Basically, future values could be predicted by analyzing the behavior (actions) of portfolio managers. Whether portfolio managers assemble their investment portfolios based on what is best for them as suggested by the modern portfolio theory, or on what makes them most happy or fulfilled as suggested by the prospect theory, the predictive power of the financial tools from the modern portfolio theory and the prospect theory rest on the assumption that people do not change their basic preferences—risk preference in the case of the modern portfolio theory and the happiness preference in the case of the prospect theory.

Although the modern portfolio theory assumes that risk preference remains constant during each individual's lifetime, surprisingly, there seems to be little published research that supports this assumption (Schildberg-Hörisch, 2018). One explanation for the lack of published research on the stability of an individual's risk preference comes from Chuang and Schechter (2015), where the authors state that a finding of consistency is not considered exciting or publishable, so the research is put in a file-drawer, never to see the light of day.

However, there is another possible explanation. From when Markowitz started in the early 1950s to today, the time frame is part of a phenomenally economically stable period. The economic stability is evidenced by, with only slight deviations from the mean, from 1870 to 2016, the United States' gross domestic product per person has grown 1.83 percent per year (Roser, 2013). The assumed consistency of risk preference may reflect the economy's long-term stability during this same period and not an inherently stable risk preference in each individual. Any change during this period would likely be gradual, similar to the gradual changes noted in the literature as a person ages. The literature suggests that risk preference changes with age. For example, research has found that an individual's risk preference typically changes around the age of 65 (Chuang & Schechter, 2015).

The stability of risk preference is crucial because the modern portfolio theory requires constant risk preferences for its models to have reliable predictive power (Schildberg-Hörisch, 2018). As mentioned above, the constancy of risk preference appears to have just been assumed, with any variance found in the research dismissed as noise.

> Stability of risk preferences implies that, in the absence of measurement error, one should observe the same willingness to take risks when measuring an individual's risk preferences repeatedly over time. Indeed, a standard approach in economics is to attribute

> any changes in measured risk preferences to measurement error and to consider them as meaningless noise. (Schildberg-Hörisch, 2018, p. 139)

In addition to the current research findings that risk preference changes with age, there is some evidence that natural disasters might also affect risk preference (Schildberg-Hörisch, 2018). Schildberg-Hörisch (2018) further find that the research on an investor's change in risk preference resulting from natural disasters is small and they suggest that future research on the topic will need to look at whether a change in the portfolio mix after a natural disaster is made because of a change in the portfolio managers' risk preference or a change in the risk perception based on changes in the projected return of a specific investment.

This distinction is crucial. If, after a natural disaster, portfolio managers change the way they manage their portfolios because they now project different returns, the underlying assumption of stability of risk preference is left unaffected. If, however, portfolio managers change their risk preference after experiencing a natural disaster, this would provide further evidence, along with the evidence of risk preference changing in individuals around 65 years of age, that risk preference is not constant over time. This finding would further erode the underlying assumption of constant risk preference in the modern portfolio theory.

An opportunity to conduct research on perceptions of risk perception and risk preference surrounding a natural disaster was presented when, on May 3, 2018, the Kīlauea volcano, located on the Big Island of Hawaii, erupted in the East Rift Zone. Known as the Puna eruption, it sent lava fountains up to 300 feet in height as they worked their way toward the ocean, destroying 700 homes, burying an essential highway, and causing hundreds of earthquakes (including a 6.9 magnitude earthquake on May 4). The eruption continued until September 4, 2018. The resulting vog (air pollution from sulfur dioxide and other gases and particles from an erupting volcano

reacting with moisture and oxygen in the presence of sunlight) created as the lava hit the ocean filled the air, even on the island of O'ahu. Damages are estimated at $800 million, representing a considerable amount considering Hawaii's population is only 1.4 million people. The flows created 875 acres of new land in the ocean. It was the most destructive eruption in the United States since the 1980 eruption of Mount St. Helens.

Current research is inconclusive as to changes in risk preference after an experience with a natural disaster. The stability of risk preference is a key assumption of the modern portfolio theory. This generic qualitative inquiry study explores the stability of risk preference by conducting semi-structured interviews with portfolio managers in Hawaii on their perceptions of risk perception and risk preference before, during, and after the Puna eruption.

Rationale

Statistical tools for analyzing risk preferences are commonly used since they generate the ability to contrast distributions across populations. Two specific methods are most common: self-reporting and incentivized experiments (Schildberg-Hörisch, 2018). These approaches are quantitative approaches. The problem with a quantitative approach to the subject of risk preference is that risk preference is subjective and interpretive by nature, which may be better explored by a qualitative approach (Merriam & Tisdell, 2015).

This problem is exacerbated by the concern that it is difficult to untangle statistical changes caused by changes in risk preference from those caused by changes in risk perception (Schildberg-Hörisch, 2018). Yet, quantitative studies continue to be predominantly used to analyze risk preferences (Chuang & Schechter, 2015). Since the objective measure, risk perception, is intertwined with the subjective measure, risk preference, an exploratory qualitative study may provide insights into whether shocks from natural disasters influence changes in the

objective analysis, or risk perception, or the subjective risk preference, the propensity to take risk, or both. This study utilized the recollected perceptions of Hawaii-based portfolio managers' risk perception and risk preference before, during, and after experiencing the Puna volcanic eruption as a qualitative inquiry mechanism into the stability of the individual's risk preference after a natural disaster.

Purpose of the Study

Schildberg-Hörisch (2018) states, "the literature review by Chuang and Schechter (2015) finds that natural disasters such as earthquakes, famines, floods, droughts, hurricanes, and tsunamis have been found to either increase risk aversion, or decrease risk aversion, or to have no (consistent) effect on risk preferences" (p.145). The inconclusive findings beg the question as to whether natural disasters influence risk preference or not. There is concern that the results may be inconclusive due to the intertwined nature of risk perception and risk preference (Schildberg-Hörisch, 2018). The purpose of this basic qualitative study is to let the recollected perceptions, obtained through interviews conducted with semi-structured questions, of Hawaii-based portfolio managers' risk perception and risk preference before, during, and after experiencing the Puna volcanic eruption, express personal constructions of the stability of the individual's risk preference after a natural disaster.

Significance of the Study

One of the primary benefits that portfolio management has received from the modern portfolio theory's pricing models, such as CAPM, is the ability to price investments based on an analysis of risk and expected return with predictability. For the pricing models to accurately determine the price of an asset, risk preference must remain constant over time, or at a minimum, not fluctuate outside of acceptable statistical error. While studies have shown that risk preference

changes around age 65, the changes are small enough and spread over time (everyone does not turn 65 simultaneously) to not statistically influence the pricing models' outcome under the modern portfolio theory. By studying the experience of portfolio managers before, during, and after a natural disaster, one might be able to develop an understanding of the inconclusive findings of previous studies on risk preference and natural disasters.

In direct contrast to the spreading out of people turning 65 over time, natural disasters often happen with little or no notice and simultaneously affect the general population. Even if the changes were minor in each individual, the aggregated changes in risk preference from the affected population could be statistically significant enough to cause the modern portfolio theory's pricing models to lose their predictive power—generating not only abnormal returns but also causing unpredictable price changes due to changes in risk preferences. Whether natural disasters influence risk preference is of interest to portfolio managers since risk preference changes could have a cumulative effect on their managed portfolios' value above value changes caused by natural disaster-influenced abnormal returns.

Research Questions

There are two research questions in this study.

Research question 1: What are the recollected perceptions of Hawaii-based portfolio managers regarding their risk perception before, during, and after experiencing the Puna volcanic eruption?

Research question 2: What are the recollected perceptions of Hawaii-based portfolio managers regarding their risk preference before, during, and after experiencing the Puna volcanic eruption?

Definition of Terms

Capital asset pricing model: Derived from the modern portfolio theory, the capital asset pricing model (CAPM) is a mathematical model that determines the theoretical price of an asset based on the asset's risk characteristics and the asset's expected return. This model is used in the decision-making process involved in determining the selection of assets in a managed portfolio (Dempsey, 2013; Levy, 2010).

Cumulative prospect theory: Cumulative prospect theory adds to prospect theory the rank-dependent expected utility cumulative probability distribution function, weighting an individual's decision towards the loss aversion when analyzed against potential gains (Babcock, 2015; Del Vigna, 2014).

Expected utility theory: The expected utility theory suggests that rational individuals base their decisions on which option proposes the highest degree of return that the individual's tolerance for risk, or risk preference, will produce (Kaneko, 2020).

Mean-Variance: Mean-variance, as used in the modern portfolio theory, represents the riskiness of an investment option, with assets that have price fluctuations with high mean-variances being riskier than assets with low price fluctuations.

Modern portfolio theory: Modern portfolio theory suggests that the mean-variance in the price of an asset serves as a measure of the risk of that asset and that placing diversified assets into a portfolio where each asset is analyzed by its contribution to the overall risk and return of the portfolio provides maximum return per acceptable level of risk (Markowitz, 1952).

Portfolio: A portfolio is a particular grouping of multiple assets held in a distinct group.

Portfolio management: Portfolio management is the process of analyzing the risk versus return of individual assets to be initially placed in a portfolio and then the process of monitoring, adding to, and subtracting holdings from the portfolio over a period of time.

Portfolio manager: A portfolio manager is the designated person responsible for conducting portfolio management.

Prospect theory: Prospect theory suggests that when faced with decisions that have risks leading to gains or risks leading to potential losses, people decide based on the individual's unique situation, called the reference point (Kahneman & Tversky, 1977).

Risk perception*:* Risk perception is the probability of negative outcomes weighted by the severity of their outcome. In the modern portfolio theory, it serves as the basis for calculating the premium that must be paid in order to accept a predicted risk (Wolff et al., 2019).

Risk preference: Risk preference is the propensity of an individual to make risker or less risky choices. It is the measure of the risk aversion propensity of an individual (Chuang & Schechter, 2015; Schildberg-Hörisch, 2018).

Risk tolerance: Risk tolerance is a synonym of and is commonly used interchangeably with risk preference. In this dissertation, risk preference will be the only term used for the concept of measuring the risk aversion propensity of an individual in order to avoid any confusion as to any difference in meaning between the two words unless risk tolerance appears in a direct quote.

Variance: The statistical measurement of the degree of spread out from the average value for a given item, making it more likely to predict the value of an item with low variance and less likely to predict the value of an item with a high variance.

Research Design

The research design is a basic qualitative study (Merriam & Tisdell, 2015). The qualitative research model allows the researcher to obtain a significant degree of detail from actual experiences (Creswell, 2014). This study sought to understand the perception changes in portfolio managers' risk perception and risk preference after experiencing a natural disaster. In this regard, the study utilized the constructionist philosophical tradition (Leedy et al., 2019). This study focused on a single, specific phenomenon of interest (the perceptions of risk perception and risk preference of portfolio managers in Hawaii before, during, and after the Puna volcanic eruption), representing a single thing with boundaries (Merriam, 1998).

This study method explores, through inquiry, portfolio managers' risk perception and risk preference. The inquiry design consists of two components, (a) data collection through interviews and (b) data analysis through coding (Yazan, 2015). These types of methods have been used in finance-related studies, such as the Cartier et al. (2018) research into funding mechanisms used by research funding organizations and the Iqbal et al. (2019) research into the processes used by business angels in rejecting investments. This study used semi-structured questions to invite the participants to express their recalled perceptions of risk perception and risk preference after experiencing a natural disaster.

Assumptions and Limitations

This study sits on a foundational base of assumptions and limitations. An awareness of these assumptions and limitations allows the reader to put the work into proper perspective. This section summarizes the assumptions and limitations of this work.

Assumptions

Assumptions are thought processes that are often taken as truth without proof. Assumptions serve as the foundations for setting premises and in formulating the questions for scientific study. Research assumptions come in three basic types, general methodological assumptions, theoretical assumptions, and topic-specific assumptions. Each of these is discussed next.

General Methodological Assumptions

This study sought to uncover the perceptions of Hawaii-based portfolio managers' risk perception and risk preference before, during, and after experiencing the Puna volcanic eruption as a mechanism of inquiry into the stability of the individual's risk preference after a natural disaster. The study is an exploratory qualitative study. The use of this research method brings with it some general methodological assumptions.

The essential ontological assumption involves the subjective nature of reality as it emerges continuously through human interaction (Hopper & Powell, 1985; O'Connor et al., 2008). Perceptions, behaviors, and experiences with reality are the subject of study, not the objective reality (Kakkuri-Knuuttila et al., 2008; Wai Fong Chua, 2005). As a result, the key to the approach is in observation, analysis of language, and the interpretation of data to lead to an understanding of the phenomenon (Hoque et al., 2013; Martins et al., 2020). In other words, we assume we can understand the concept of the experience of natural disasters on portfolio managers' risk perception and risk preference by talking with them, observing them, and noting their behavior.

The essential epistemological assumption involves the researcher's independence versus the researcher's participation in the study. In this study, an additional epistemological assumption

is made regarding the paradox of subjectivity (Durt, 2020). This study seeks to determine the perceptions of portfolio managers risk perception and risk preference. Some of their beliefs may be subconscious. In this study, the participants' conscious beliefs and understandings were described by the participants. The researcher interpreted the beliefs and understandings through observation and interpretation of the descriptions. Of necessity, the researcher worked with the participants to elicit an accurate description of these beliefs and interpretations during the interview process. The assumption is that through the interviews and analysis of the data from the interviews, the cooperation between the interviewer and interviewee yielded useful and accurate data on risk perception and risk preference.

The essential axiological assumption in this study involves the value given to risk by society. Modern portfolio theory suggests a balance between risk and reward and that risk can be measured and quantified. There is a general assumption in life that most people, given a choice between equal value, will choose the thing that carries the least amount of risk. Understanding the relationship between experiencing a natural disaster and risk perception and risk preference is assumed to be of value to society.

The essential generalization assumption involves the ability to infer the results of this study, which was conducted using a sample of the population of portfolio managers living and working within the State of Hawaii during 2018, to the general and significantly larger population of portfolio managers worldwide. Portfolio managers within the United States are subject to national rules and regulations and somewhat unified state-by-state Blue Sky laws. Portfolio managers are typically licensed through the National Association of Securities Dealers system. As a result, there is a general similarity among portfolio managers within the United

States. This similarity in training and education should allow the results to be generalized to the larger group of portfolio managers.

The essential causality assumption revolves around whether any finding of changes in risk perception or risk preference through the study would result from the influence of the natural disaster and not some other cause. Risk preferences have been found, absent some shock, to remain relatively constant and stable over a lifespan, supporting this assumption's validity (Chuang & Schechter, 2015). The calendar year 2018 is relatively free of other catastrophic events in Hawaii. Therefore, it is reasonable to assume that any change in risk perception or risk preference would be caused by the Puma eruption—primarily because such changes were self-identified by the participants as being a result of the Puna eruption and secondarily due to the lack of other similar events.

Theoretical Assumptions

The focus of exploratory inquiry sets the researcher on a path toward understanding how individuals experience a phenomenon (Jemna, 2016). As individuals experience a phenomenon, they determine the value of the economic relationships that emerge from the event (Vigliarolo, 2020). Theoretically, researchers can discover the values assigned to an event by allowing the participants to express themselves. In this process, researchers guide the study's participants by utilizing a series of carefully designed semi-structured questions (Kallio et al., 2016).

Semi-structured questions are designed to elicit an explanation of the participant's experience in depth. Interviews conducted through semi-structured questions allow each participant, within a flexible framework, to respond to the same questions (Dearnley, 2005). This in-depth process generates a more profound understanding than general surveys. Accordingly, the recommended number of participants for such studies ranges between five and 25 (Creswell,

2014). The ultimate number is indicated by reaching saturation, where no new information comes forward from additional interviews (Bradley et al., 2007).

Topic-Specific Assumptions

The general topic area of this study is risk within the confines of the modern portfolio theory. The study's specific subject is the recollected perceptions of Hawaii-based portfolio managers' risk perception and risk preference before, during, and after experiencing the Puna volcanic eruption. Risk perception results from the analysis of the probability of adverse outcomes weighted by the potential severity of the outcome. The study of risk perception, the framework within which portfolio managers determine the risk of a potential investment, involves the fields of economics and finance. Risk preference is the propensity of an individual to make risker or less risky choices, a spectrum that lies in the fields of sociology and psychology. The key area of the overlap between these fields is the concept of rationality (Helmut & Victor, 2018). Rationality assumes that people search for and then utilize the "best available resolutions to the problems we face in life" (Rescher, 2020, p. 87).

Humans are assumed to be goal-oriented beings who make decisions at different conscious rationality levels (Egidi, 2020). When it comes to making investment decisions, especially by portfolio managers who are hired and financially rewarded for higher returns within acceptable risk parameters, such choices would naturally be assumed to be made at high levels of conscious rationality. Therefore, the analysis process utilizes the modern portfolio theory's underlying assumption of expected utility theory—that portfolio managers make their decisions to maximize return within the bounds of acceptable risk (Kaneko, 2020).

With these assumptions in place, the research questions focus on the potential changes in risk preference (an acceptable level of risk) and the possible changes in risk perception (the

analysis process) before, during, and after an experience with a natural disaster, with a targeted focus on risk preference. Risk preference's sociological and psychological tie to an individual's propensity to take or reject risk is a societal construct. Therefore, this study perfectly fits within the theoretical framework of an explorative qualitative study.

Limitations

This study has limitations. The limitations derive from two aspects of the study, the design flow limitations and the delimitations, or the areas not included in the study. A summary of both follows.

Design Flow Limitations

One of the critical limitations in any qualitative study is the researcher's role in the data collection process (Chenail, 2011; Dearnley, 2005; Diefenbach, 2009). The exploration process in qualitative studies places the researcher as a facilitator—directly involved in the process of gathering the data. This position gives a researcher the capacity to influence the data. This limitation is addressed in this study by having an expert review of the semi-structured questions and an awareness by the researcher of this issue to be careful during the research process not to influence the participants or lead them in any manner.

An expansion of the previously listed limitation is that the researcher, during his career, served in the capacity of a portfolio manager. Therefore, it is paramount that the researcher keeps his perception of risk perception and risk preference experiences away from the study. This separation is vital during the coding and analysis of the data process. The researcher can and must remain detached from the data and allow the data to speak for itself.

An additional limitation is the current situation with SARS-CoV-2 (Covid-19). This study was conducted within the enormous shadow of a larger natural disaster, which raises the question

of whether participants could accurately focus on the influence of the Puna eruption during the impact time of Covid-19. However, it is believed that the participants can separate perceptions from the influence of the Puna eruption from those coming from Covid-19.

Delimitations

All individuals have their unique perceptions of risk perception and risk preference. However, this study deals only with a specific subset of the general population—portfolio managers. One of the reasons for this delimitation is that portfolio managers, unlike the general population, are trained to analyze risk. Since portfolio managers are trained under the modern portfolio theory, they are familiar with the concept of risk preference. This understanding makes it so the semi-structured questions can go straight to the heart of the research problem. Education about the concepts was not necessary.

Organization of the Remainder of the Study

The chapter has introduced the study's general topic of risk and its more specific focus on the recollected perceptions of Hawaii-based portfolio managers' risk perception and risk preference after experiencing the Puna volcanic eruption. This chapter described the study's background, the rationale for the study, the purpose of the study, the research questions, definitions of critical terms, the research design, and the study's assumptions and limitations.

Chapter 2 contains a literature review that includes methods, orientation, synthesis, and critique of the literature on the topic. Chapter 3 describes the methodology—including the study's purpose, the research questions, the research design, the target population and sample, the procedures, the instruments, and ethical considerations. Chapter 4 presents the study's findings, and Chapter 5 discusses the implications and recommendations arising from the study.

CHAPTER 2. LITERATURE REVIEW

In preparation for this study, I reviewed the literature on the general topic of risk and then specifically reviewed risk under the modern portfolio theory. This chapter begins with a description of the methods used to perform the literature search, followed by a description of the study's theoretical orientation. Next follows a review of the literature and a synthesis of the research findings. This chapter ends with a critique of the previous research methods and a summary of this chapter.

Although this is a qualitative study, it is, in essence, testing an underlying assumption of the quantitatively based modern portfolio theory. Therefore, this literature review focuses on the quantitative nature of risk and the critical position that the stability of risk preference holds within the modern portfolio theory. As a result, most of this literature review covers risk perception and risk preference in the modern portfolio theory's natural habitat of the quantitative world.

Method of Searching

A systematic search through the literature is essential, especially as a plethora of academic literature is added to databases every day, some of which may be applicable and much of which will not contribute to answering the research questions (Linnenluecke et al., 2020). This process starts with a fixed focal point with a clear focus on the most unbiased and precise portrayal of what is known and not known in the literature. As Linnenluecke et al. (2020) note, "a clear question focusing on interventions, mechanisms, and outcomes in a specific context is advantageous for a review, as it delineates clear boundaries" (p. 179).

There are two lenses through which this study views the world. The first lens is through the field of basic qualitative inquiry, which involves participants' personal constructions of their

understanding of a phenomenon. This lens forms the theoretical orientation and the methodology of this study. The second lens is the modern portfolio theory, which seeks the best solutions for constructing portfolios by matching appropriate risk perceptions (investment analysis) to the applicable risk preferences (the individual appetite for risk or risk avoidance). The two lenses come together in this study as it focuses on the Puna volcanic eruption—a phenomenon—and the recollected perceptions of portfolio managers' risk perception and risk preference—modern portfolio theory.

The research process began by using the Capella University general online summons and searching for *basic qualitative studies* and then separately *modern portfolio theory,* followed again separately by *risk* and then by *CAPM*. Search results were restricted initially to the most recent three years and peer-reviewed articles only. The purpose of this initial search was to review the general literature to determine common keywords and phrases—thus establishing support for the "clear question" described above.

Search results were stored utilizing the Zotero open-source reference management software. Selected articles were read and analyzed using Drawboard software on a Surface Pro, which allows for highlighting, notes, and comments to be written on the .pdf file of each article, which was then stored as a .pdf attachment in Zotero. Notes were also directly made into the notes tab in Zotero when it was beneficial to do so. The search results were stored in Zotero in folders created for each subject area, such as *basic qualitative study, modern portfolio theory, risk, risk perception, risk preference, natural disasters, semi-structured questions,* and *data analysis process.* These folders made it easier to find reviewed articles again, when needed, during both the review and the writing process.

The result of this initial step was to create more focused search questions. For example, *basic qualitative study* was further clarified by limiting it to articles in the fields of *finance* or *economics*. *Modern portfolio theory* returned thousands of papers that were not applicable to the research questions. Accordingly, the same search was made in Google Scholar with citation tracking, with the most often cited papers being selected. This method resulted in a manageable number of articles that provided sufficient depth in the background and the current status of the theory based on a review of highly cited articles over a more extended time period. The rationale for the limiting focus is that although modern portfolio theory is one of the lenses used to view the topic, it is a general theoretical lens. The main focus is on risk.

The systemic process continued by further refining the searches. The refinements focused on basic qualitative study, modern portfolio theory, risk, risk perception, risk preference, natural disasters, semi-structured questions, and the data analysis process. Ultimately, 2,120 articles were screened, resulting in 78 that specifically contributed to this literature review.

Theoretical Orientation for the Study

Modern portfolio theory is a relatively recent creation that has been modified and expanded during its only seven-decade history. When applied in practice, the theory utilizes general elements of risk and the individual aspects of risk perception (objective) and risk preference (subjective). This research focused on discovering the recollected perceptions of risk perception and risk preference of Hawaii-based portfolio managers before, during, and after experiencing the Puna volcanic eruption of 2018 through a qualitative approach.

Large-scale quantitative studies dominate the range of modern academic finance literature in absolute terms and relative to other disciplines under the greater umbrella of finance (Burton, 2007). The concentration is not surprising since finance deals with asset pricing, market

relationships, and economic data, which tend by their very nature to be analyzed through quantitative methods. Typical research in finance and economics seeks to determine the statistical relationship between an event and an outcome (Urban & Quilter, 2006), often with ex-post non-experimental time-series event studies (MacKinlay, 1997; P. Peterson, 1989), or statistical regression statistics to find correlations between events and prices of stocks (Mitchell & Netter, 1994), as well as relationships between natural disasters and abnormal returns (Alkhatib & Harasheh, 2018; Corrado, 2011; Punwasi & Brijlal, 2016; Urban & Quilter, 2006).

However, an area ripe for future research suggested by (Celik, 2012), which is still underserved today, is investigating the role that modern portfolio theory takes in actual financial practice. To discover actual practice requires involvement with those in actual practice, which tends to steer toward qualitative approaches rather than quantitative ones. An excellent way to find out what financial practitioners do is to ask them.

An opportunity to study possible changes in perceptions of risk perception and risk preference after experiencing a natural disaster came on May 3, 2018, when the Kīlauea volcano erupted on the East Rift Zone on the island of Hawaii—commonly referred to as the Puna eruption. The eruptions sent lava fountains of up to 300 feet in height toward the ocean, destroying 700 homes, burying an essential highway, and causing hundreds of earthquakes (including a 6.9 magnitude earthquake on May 4th). Vog (airborne sulfur dioxide and volcanic particles) filled the air all the way to Oahu. The impact was felt over a significant period of time until the eruption ceased on September 4, 2018. The Puma eruption caused an estimated $800 million of damages, and it created 875 acres of new land in the ocean.

The Puma eruption is a singular event—a phenomenon—shared by portfolio managers in Hawaii simultaneously, which suggests that the shared construction of risk perception and risk

preference may be developed through a basic qualitative study, which is "a research design in which a researcher tries to understand people's perceptions and perspectives relative to a particular situation" (Leedy et al., 2019, p. 233). As people experience a phenomenon, each individual determines and assigns some type of value to the economics of the event (Vigliarolo, 2020). These values may be unique or different in each individual, or patterns may emerge if, although determined individually, the values assigned by the individual are similar to values set by other event-participating individuals. Through basic qualitative study, a researcher can begin to understand the experience of a phenomenon through the eyes of the individuals who experienced it (Jemna, 2016). Theoretically, researchers can thus uncover, by allowing the participants of the phenomenon to express in their own words the values they assigned to the event, the effect that event had on their risk perceptions and risk preferences. To guide the participants through the expression process, the researcher leads the way by asking a series of carefully designed, semi-structured questions (Kallio et al., 2016).

Review of the Literature

This study sought to discover the recollected perceptions of risk perception and risk preference of portfolio managers after experiencing a natural disaster. The management and minimalization of risk with return are at the core of the modern portfolio theory. Yet, we each prefer risk differently. Even though we prefer risk differently, our risk preference's stability over time is assumed (Schildberg-Hörisch, 2018). Indeed, for the predictive powers of the CAPM and the subsequent models to hold, risk preference must be stable, or at a minimum, not vary in any statistically significant amount sufficient enough to affect economic conditions. For example, we know that risk preference changes around a person's 65th birthday, but not everyone turns 65 simultaneously, so the overall daily effect on the economy is nominal.

However, a natural disaster has two distinct points of departure from the changes occurring around age 65. First, not everyone turns 65 simultaneously, whereas all affected people experience a natural disaster simultaneously. Second, people know they will turn 65, and they prepare for it, whereas many natural disasters happen suddenly and without notice or warning.

This literature review is presented under two main headings—risk and modern portfolio theory. Risk is further broken down into objective and subjective risk subsections, which align with risk perception and risk preference, respectively, under the modern portfolio theory. The modern portfolio theory is further broken down into subsections of origination, expansion and modification, current status, risk and risk perception, risk and risk preference, and risk, risk perception, risk preference, and natural disasters.

Risk

The concept of risk in modern society begins by determining the nomenclature and classification of the systems where risk is found (Blumer, 1931; McPhail & Rexroat, 1979). Risk is a massive part of human understanding and human experience as there is little, if anything, in the experience of life that does not involve at least some element of risk. Risk is generally defined as the combination of two key elements: (a) an undesirable event and (b) a possibility the undesirable event will occur (Andretta, 2014; Hansson, 2010).

An event is typically considered to be an object—so one might assume that risk is objective and, therefore, likely positivist. In many cases, that would be true. However, the definition of risk also includes the modifier *undesirable*, which is subjective and, therefore, likely constructionist in nature. Both viewpoints are involved in the modern portfolio theory—risk perception being the analysis of the adverse event's financial impact, aligning with objective risk, and risk preference being the individual's tolerance or acceptable level of risk, aligning with

subjective risk. “Risk is therefore both a descriptive and a normative concept” (Renn, 1992, p. 56). Accordingly, there are two aspects (objective and subjective) that attach themselves to a singular event or object at risk of being affected by the undesirable event (Å. Boholm & Corvellec, 2011). Each of these aspects is covered separately below.

Objective Risk

“Throughout history, humans have striven to separate the real from the unreal, truth from untruth, and necessity from contingency” (H. Hermansson, 2012, p. 16). The constancy of dichotomous thinking about observed interactions and relationships is a part of life. “Ancient Greek philosophers distinguished between true, unchangeable knowledge based on reason, and more uncertain knowledge based on perceptions” (H. Hermansson, 2012, p. 16). Upon this dichotomy of thinking sits objective risk and subjective risk, with the objective risk being the “unchangeable knowledge based on reason” and the subjective risk being “knowledge based on perceptions.”

To illustrate the importance of the awareness of this dichotomy, Zahera and Rohit (2018) identify seventeen specific biases that color or influence investors’ view of risk, including such factors as herding effect, confirmation bias, etc. (Oehler et al., 2018). Overcoming the influence of subjective risk on objective risk analysis becomes problematic, a process that Howard (2014) describes as brutal since emotions must be forcefully removed from the process in order to separate objective risk from subjective risk. This brutal task is assigned to portfolio managers when assembling an optimized portfolio under the modern portfolio theory, as portfolio managers are asked to deal with risk and uncertainty in methodological dualism (Hoffmann, 2018; Méra, 2018).

Risk is laden in facts (Hansson, 2010). In our attempts to analyze potential objective risk, the methodology of choice is based on the theory of scenario structuring (Kaplan et al., 2001). Scenarios are bounded in the analysis by what is commonly taught in business schools as the best-case and the worst-case scenarios. As we objectively analyze the potentiality of risk, we seek to quantify it. The goal of quantifying objective risk is a cognitive process (M. Boholm, 2018) that requires removing bias and emotion from the process as much as possible. It is a matter of analyzing what can go right and go wrong and what likely consequences will result (Haimes, 2009). In the modern portfolio theory, this is known as risk perception.

Subjective Risk

As we gain experience with things, regardless of whether it is through first-hand experience or learning from the experience of others, we assign values to these things (Vigliarolo, 2020). Research has led us to understand that the brain has two competing functions—physically located in two separate parts of the brain—one that controls the cognitive processes and one that controls the emotional functions (Bechara, 2004, 2005). The cognitive function helps us discern and determine objective risk, while the emotional function helps us decern and determine subjective risk (Schiebener & Brand, 2015). Therefore, subjective risk is the interpretation of the value and the relationships we give to objective risk.

There are many factors that influence our interpretation of objective risk. For example, values and relationships are often culturally based, as many of our interpretations are made on what we are taught and what we observe (Å. Boholm & Corvellec, 2011; Lude & Prügl, 2019). Fisher (2020) found that Hispanics in the United States were more likely to take on higher levels of risk in some areas but less likely in other areas than their Caucasian counterparts. This influence even goes to whether we see an object as a risk in the first place, as some cultures see

risk in objects where others see none (Å. Boholm & Corvellec, 2011). Hermansson (2012) adds three distinct aspects of assigning a value to risk: framing, emotions, and value judgments.

Take flowing water. Watching flowing water in a river from a safe distance does not generally suggest risk, while flowing water going through your house would, especially if you got caught in it. Yet, Frank Lloyd Wright's famous Fallingwater House in Pennsylvania elicits no sense of risk as water flows through it. These are examples of framing.

Following the same example, if you nearly drowned once or had someone close to you nearly drowned, each of the three scenarios in the preceding paragraph would likely suggest a risk to you. Accordingly, emotion and experience influence our interpretation of the object. Value judgments can be assigned based on understanding and beliefs. In times of drought, fear of reduced water supply suggests a risk that water will not be available in the future. We can and do assign values to what we see.

The dichotomy of analyzing objective risk through the filters of subjective risk puts us in a challenging position. We view the world from where we see it. Gulliver was a giant, and then he was a dwarf. Yet, he did not change—it was everything around him that changed. From a subjective position, scale, function, and everything about it matter (Huber & Huber, 2019). So which is more important? The answer is neither. The two cannot live independently. Objective risk is real, as are its natural consequences (Avvisati et al., 2019; Berkes, 2007; Cao et al., 2015). Even if the potential risk never happens, its perception is just as real as if it did happen (Wolff et al., 2019). The ultimate reality is that we act and react accordingly, whether it happens or whether we believe it happens.

Since subjective risk is determined by individual thought processes based on education, experience, culture, framing, emotion, and value judgments, each individual creates their own

subjective risk. Even the act of asking someone to weigh the potentiality of risk affects the outcome (Ehm et al., 2018). What is subjectively risky for one individual will not be subjectively risky for another individual. Each is unique. In the modern portfolio theory, this is known as risk preference.

The Modern Portfolio Theory

We live in a world that lacks perfect foresight—and although we do our best to guess what will happen and then prepare for it—we never know for sure what will happen in the future. Portfolio managers use financial tools to predict the future value of assets, but there is an inherent possibility that the prediction will not match reality. This possibility of error is risk. As a result, when portfolio managers construct portfolios, they seek how to "best balance risk and return" (Kemp, 2010, p. 2). Which begs the question—what is "best"?

The modern portfolio theory focuses on finding the "best" balance of risk and return with the specific objective of eliminating all but systemic risk within the portfolio. The following sub-sections of this literature review will cover the origination of the modern portfolio theory and then the expansion and modification of the theory, followed by a review of the current status of the theory. The final subsections cover risk and risk perception (objective), risk and risk preference (subjective), and the influence of natural disasters.

Origination

The modern portfolio theory focuses on determining the "best" balance between the projected return and the risk that the projections might prove to be incorrect. Modern portfolio theory originates from the developments within the field of mathematics, specifically probability theory, that took place at the turn of the twentieth century. Early adopters of probability theory for finance include Louis Bachelier. He published his *Théorie de la Spéculation* in 1900, with his

mathematic proofs beating Albert Einstein to what is now known as Brownian motion (Bachelier, 2006). However, it was not until 1952, when Harry Markowitz presented a solution to a complex portfolio optimization problem using linear mathematics as his PhD dissertation at the University of Chicago, that modern portfolio theory began to emerge as an identified theory (Maier-Paape & Zhu, 2018a; Markowitz, 1952).

Within just a few years of Markowitz's dissertation, the initial work of Markowitz was refined individually by Markowitz, Sharpe, Lintner, and Mossin, resulting in, among other pricing models, the capital asset pricing model, known as CAPM (Levy et al., 2012; Lintner, 1965; Mangram, 2013; Sharpe, 1964). The results of these refining efforts provided both Markowitz and Sharpe with the Nobel Prize in economics in 1990 (Levy et al., 2012). Since its origination beginning in the 1950s, the modern portfolio theory and its capital asset pricing model have become the "gold standard" of finance (Olbrich et al., 2015).

The basic premise of the modern portfolio theory lies in the idea that an optimal portfolio of investments can be created for each individual investor's risk preference that will insulate the portfolio from non-systemic risk, thus providing the highest expected rate of return per acceptable level of risk (Rao et al., 2015). The underlying assumptions of the modern portfolio theory are that all individuals maximize their individual use (utility) of whatever they have (expected utility theory) and that the variance (standard deviation) created by the actions of these individuals, all looking out for their individual best interests within the marketplace, reflects the level of risk for single investments, with higher variance in the marketplace being riskier than investments with lower variance. Accordingly, "classical portfolio optimization derives an efficient frontier formed by portfolios, which maximize the economic return for a combination of assets given different levels of economic risk" (L. Ferreira et al., 2018, p. 932).

The details of the mathematics are not in question in this research—rather, the focus is on the measurement factors of risk. However, a basic understanding of the mathematics involved in the modern portfolio theory is important to understanding the potential impact of natural disasters on risk perception and risk preference. As mentioned previously, the modern portfolio theory begins with the mathematics of probability, utilizing this basic formula for predicting the value of an asset based on the chances of various outcomes:

$$\mathrm{E(X)} = \sum_{s=1}^{S} p_s \; x_s$$

where E is the expected value, X is a random asset, x_s is the realized value of X if outcome s occurs, S is the number of possible outcomes, and p_s is the probability that outcome *s* will occur. This formula, which gives us the expected value, can be altered to find the expected rate of return of a security or investment by swapping out the value of an asset for its rate of return (r_i), as follows:

$$\mathrm{E}(r_i) = \sum_{s=1}^{S} p_s \; r_{i,s}$$

Once the mathematics of probability have been used to calculate the expected rate of return, the modern portfolio theory moves on to the calculation of risk of assets and portfolios. The modern portfolio theory expresses risk as the dispersion of an investment's rate of return around the expected return. In other words, the risk of an investment is measured by the variability of the return using the standard deviation, as follows:

$$\sigma_i^2 = E[r_i - E(r_i)]^2 = \sum_{s=1}^{S} p_s \, [r_s - E(r_s)]^2$$

where σ_i^2 is in terms of the squared rate of return, with the square root of the variance being the standard deviation. Two additional statistical relationships are used in the modern portfolio

theory: the covariance and the correlation between returns, the only real difference being the method of calculation (Francis & Kim, 2013). Accordingly, the modern portfolio theory predicts the expected value of a portfolio as follows:

$$E(r_p) = E\left(\sum_{i=1}^{n} w_i r_i\right) = \sum_{i=1}^{n} w_i E\,(r_i)$$

With expected returns established, the modern portfolio theory addresses the question of the price to be paid to acquire the assets to be assembled into the portfolio. The "gold standard" (Olbrich et al., 2015) being the capital asset pricing model, as follows:

$$E(R_i) = R_f + \beta_i\big(E(R_m) - R_f\big)$$

where $E(R_i)$ is the expected return, R_f is the risk-free rate of interest, usually represented by the T-bill rate, β_i (commonly referred to as beta) is the sensitivity, or risk of the asset, and $E(R_m)$ is the expected return of the market, which is often represented by a large stock index number. The key component for this study is the focus on beta, which is the measurement of risk under the modern portfolio theory.

Expansion and Modification

From its inception, attempts were made to prove modern portfolio theory and its capital asset pricing model to be accurate by taking optimized portfolios and then analyzing the results over time. The results did not match the expected returns (Dempsey, 2013; Levy, 2010). There is a theoretical reason for this result—the modern portfolio theory and its capital asset pricing model are pricing theories and not market behavior theories or market explanation models (Dempsey, 2013). By definition, the modern portfolio theory and its capital asset pricing model are static—the optimal portfolio is only optimal when it is created. The market where the portfolio lives and the information used to make the portfolio change from the moment of

creation; therefore, the projected expected return can only estimate the actual ex-post yield, not predict it (Smith & Walsh, 2013). But this understanding has not stopped researchers from attempting to expand the modern portfolio theory and its capital asset pricing model into market explanation works.

A pioneer in the attempt to expand the pricing theory to a market explanation theory is Eugene Fama, who was awarded the Nobel Prize in economics in 2013. Fama proposed adding three and later five additional factors to the standard capital asset pricing model under the claim that the capital asset pricing model did not consider market momentum and other factors (Fama, 1970; Fama & French, 1996). These additions are commonly known as the Fama and French models.

By altering the focus of the modern portfolio theory from a price prediction process to a market explanation process, the Fama and French models opened the door to other alterations of the capital asset pricing model, allowing it to be adjusted to fit the needs of specific market segments. These segments include the optimal use analysis of environmental assets (Matthies et al., 2019), legally constrained investment portfolios managed by private bankers (L. Ferreira et al., 2018), and analysis of distribution channel options for biomedical manufacturers (Zhang et al., 2013). This flexibility is one of the reasons for the modern portfolio theory and its pricing models prevalent use throughout the world (Smith & Walsh, 2013).

One of the most recent developments in the modern portfolio theory is in the area of the measurement of risk. Both the traditional capital asset pricing model formulas and the Fama and French-based formulae utilize the mean-variance (standard deviation) in the range of market prices as the measure of risk. This measure creates a concave solution, which is commonly referred to as the Markowitz Bullet. The efficient frontier (optimized portfolio) is the point

where the concave risk versus return of a portfolio curve touches the selected risk preference market line (Fama, 1970). But other concave risk measures may also work.

For example, Matthies et al. (2019) introduce the use of alternative measures of risk (in place of mean-variance), such as lower partial moments or value at risk numbers. Since these measurements of risk generate a sharper concave curve, they make the elimination of the higher and lower ranges of risk more obvious. In complete reverse, convex-curved risk measures have been proposed in place of standard deviation mean-variance (Maier-Paape & Zhu, 2018a, 2018b). Additional options include downside multiple factor betas (Ayub et al., 2020). Regardless of the method used to calculate risk, the range of investment options that are placed into a portfolio by portfolio managers is based on the individual manager's risk perception (analysis) and risk preference (risk tolerance), thus creating an optimized portfolio based on each individual's risk preference (L. Ferreira et al., 2018).

Current Status

Awareness of the failure of Markowitz's mean-variance optimization solution (modern portfolio theory) to consistently produce the expected optimized results within portfolios seems to be omnipresent, but exactly why it fails seems to be elusive (de Jong, 2018). One of the common explanations is the idea that abnormal returns emerge due to the obvious—that even the best methods of predicting the future are not always accurate—thus, *ex-ante* will not always equal *ex-post* because of prediction error (Klein & Bawa, 1976). However, the search for predictive models continues, with some researchers, rather than adding momentum and other factors, as did Fama and French, to find ways to make the modern portfolio theory models fit after-the-fact real-life, by challenging the underlying assumption of the modern portfolio theory—the expected utility theory.

The primary tenant of the expected utility theory is that people are rational and that they always act in their own best interest (Statman, 2018). However, Statman (2018) goes on to explain that people often act irrationally, i.e., not in their best self-interest. One of the most prevalent emerging theories is prospect theory, which has led to the behavioral portfolio theory.

Kahneman and Tversky (1977) introduced the prospect theory as an alternative to the expected utility theory. The basis of prospect theory is that individuals, when given a choice, select what will make them most satisfied based on current reference points, not on what is always the best for them (Statman, 2018). Applying behavioral finance in real life, Feldman and Liu (2018) used an agent-based model (the sizes of positions held by managers of mutual funds) to predict the future prices of stocks. The authors find two interesting results: (a) the belief of the asset managers, as evidenced by the number of shares of specific stocks they had in their portfolios, were an excellent predictor of future values, and (b) that high variance in the relative holding percentages of portfolio managers of specific stocks was an excellent predictor of recessions.

The primary tenant for behavioral finance is that it is not what is in the individual's best interest that drives the decision in the marketplace but rather the individual's personal beliefs that inspire action. Individuals (and even portfolio managers) are prone to make both cognitive and confirmation errors in their investment choices (Statman, 2018). As evidence:

> A quick Google search reveals that there are 101 cognitive biases, 27 social biases, and 49 memory biases reported by Wikipedia. Among them, 27 biases are regularly mentioned in behavioral finance. Primary examples of widely-recognized behavioral biases in finance include overconfidence, loss aversion, disposition effect, and anchoring effect. (Filbeck et al., 2017, p. 53)

That does not mean all choices are irrational. A recent study where participants were randomly assigned to a treatment group that received financial education or to a control group that received no training found that when the participants from both groups were given financial situational and conditional choices, the individuals in the control group did not perform as well as those in the educated group, which could indicate that behavior is at least somewhat dependent on knowledge (Fan & Chatterjee, 2018). Personality traits have also been found to influence decision-making. A recent study found that extroverts tended to take on more risk than introverts and that individuals with high cognitive scores tended to be less accepting of risk than those with lower scores (De Bortoli et al., 2019).

In short, the main difference between modern portfolio theory and behavioral theory is the focus on the primary assumption of each, expected utility theory versus prospect theory. Expected utility theory assumes for each individual's level of risk preference—the individual will always make the decision that returns the most, making it able to be derived mathematically. Prospect theory, based on the behavior attributes of individuals, cannot be mathematically calculated but must instead be inferred from studies of investor actions.

In 1995, at a statistical physics conference, the term *econophysics* was introduced to the world to describe the cross-over of advanced statistical physics into the realm of economic and financial research (Dönmez & Atalan, 2019). As a simple example to explain, consider a common physics problem where a limited but precisely counted number of gas particles are placed in a perfectly square container. The particles continually bounce off each other and off the container's sides. For any given temperature, advanced statistical physics can 3-dimensionally chart the interactions (Bao & Fritchman, 2018).

In the same manner, advanced statistical physics is being applied to finance and economics, with markets serving as the container, and stocks, bonds, etc., serving as the gas particles. Computers are used to analyze the relationships between an enormous number of variables, such as stock prices for each publicly traded stock globally, key interest rates, money supply, etc. The resulting analysis is used to create models, such as the Johansen-Ledoit-Sornette model, which has been successful in predicting market crashes (Jhun et al., 2018). To give an idea of the massive amount of data that is analyzed using these processes, Ghosh et al. (2018) analyzed $2.8 \cdot 10^9$ data points in their analysis of the CNX Nifty HFT (Indian Stock Market), on a tick-by-tick basis, covering only a time-period from February 1, 2013, to December 30, 2016.

Research in *econophysics* has applied the models of heat exchange, including the Brownian motion, similar to models from statistical thermodynamics (Thébault et al., 2018) and the statistical distributions of Bose-Einstein condensates, the latter even being combined with Pareto law to replicate distribution of wealth in populations (Staliūnas, 2005). Additionally, a process designed to analyze DNA, detrended fluctuation analysis, has been used in conjunction with detrended cross-correlation analysis to determine the relationships between the S&P Clean Energy Index, the New York Stock Exchange Index, and crude oil prices (P. Ferreira & Loures, 2020).

Econophysics will continue to expand as computing power continues to increase and as the application of statistical physics to finance becomes more accurate through the educated trial and error process of seeing which physics systems match specific financial markets. While these methods produce mostly market behavior models, some have powerful prediction capacities. However, *econophysics* does not (at least yet) have pricing models, so in this regard, it is similar

to behavior theory and different than modern portfolio theory—being more descriptive than nominative in nature.

Risk and Risk Perception

Risk is defined in the modern portfolio theory's CAPM as the "dispersion of outcomes around the expected value" (Francis & Kim, 2013, p. 15). Accordingly, it makes intuitive sense that the lower the dispersion—where the prediction was correct most of the time—the lower the risk. Also, it intuitively makes sense that where the prediction was incorrect more of the time, the higher the risk.

The best approach to protect an investment portfolio from an utterly uncertain future would be to hold all assets in an equal amount (de Jong, 2018). This unweighted portfolio approach would be at one end of the spectrum of future possibilities. At the other end of this spectrum is the point where the future is predictable. At this point on the spectrum, the best approach to protect an investment portfolio would be to hold concentrations of assets with the highest concentrations being held in the assets having the lowest price variance, i.e., risk (de Jong, 2018). Between these two extremes of complete foreseeability and complete unforeseeability, the best approach to protect an investment portfolio would be to have each asset in the portfolio "contribute equally to the overall price variance" (de Jong, 2018, p. 217) of the portfolio. This protection is at the heart of the modern portfolio theory.

Some authors, such as Garcia et al. (2020), have suggested approaches using credibility theory. The authors, in what appears to be an error in attributing credit, attribute credibility theory to a modern author and call it "fuzzy," but credibility theory dates back to Thomas Bayes and Bayesian Statistics from the early 1700s. However, this error does not diminish the idea that credibility theory and Bayesian Statistics might have validity in predicting future events. de Jong

(2018) also suggests the use of Bayesian-based optimization analysis. Still, some authors suggest that more critical than the dispersion around the mean is whether the distribution is skewed, focusing on the reduction of downside risk potential (Föllmer & Weber, 2015; Righi, 2019). Each of these models and concepts focuses on the objective measurement of risk. It is interesting to note that the analysis involved in identifying risk perception need not be numerical or statistical. Analysis skills such as objective numeracy, sometimes found among successful portfolio managers, and soft skills, such as approximate number processing, can replace and, at times, surpass numbers and statistics when measuring risk and future investment performance (Mueller & Brand, 2018).

Analysts calculate the objective risk of an investment's future value based on a combination of investment factors (product, management, market, etc.) and economic factors. Although not always calculated the same way, independent analysts' work results tend to be similar during typical market conditions (Ehling et al., 2018). However, shocks to the market have been found to increase the range of predicted future values between analysts, with older, more experienced analysts securing a decided edge regarding the accuracy of their future asset valuations after market shocks (Ehling et al., 2018).

Long et al. (2018) point out the errors that occur in determining risk perception when investors do not understand the company or the product enough or where there is ambiguity (Cubitt et al., 2018). Part of this issue may belong to the investor's sophistication, as Stålnacke (2019) points out. Additionally, the effects of natural events can influence the interpretation of future events (Halkos & Zisiadou, 2020).

Risk and Risk Preference

Risk preference "can be defined as the maximum amount of uncertainty that someone is willing to accept when making a financial decision" (Kochaniak & Ulman, 2020, p. 4), and it plays a vital role in finance. Financial products are packaged and sold towards the various risk preferences of individuals (H. Fink et al., 2019) to the point that risk preferences are even analyzed by robo-advisors to provide customers with valuable information (So, 2021). The combined risk preferences of investors can influence the amount of risk found in overall markets (Cheng & Guo, 2020). Thus, understanding the nature of risk preference is essential to a complete understanding of the modern portfolio theory.

While it seems evident that some people are risk-takers and others are not, the ability to measure an individual's risk preference is elusive. Charness et al. (2020) studied five prominent risk preference tests and found that none of the testing results correlated to actual risk-taking performance in the field. Yet, Arslan et al. (2020) found that self-reported risk preference could be coded by researchers with some accuracy. One of the challenges is that noise within a market confuses investor analysis, which gets misinterpreted as risk preference (Ola et al., 2020).

Under the modern portfolio theory, each individual investor has a unique risk preference. Regardless of how the risk perception of an investment is measured, whether through the capital asset pricing model or the Fama and French models, the individual investor places in their optimal portfolio investments where the expected return and the potential risk match the risk preference. It is the anchor or basis against which risk perception is measured.

Chuang and Schechter (2015) compiled an extensive literature review of research on the topic of risk preference. Among their findings is that self-identifying surveys are better than social experiments at identifying the level of risk preference of an individual. The authors also

find that external stress on the participants at the time of the survey influences the result. And although they find no systemic changes in risk preference between short and long periods, they do find a linear decrease from adolescence to the age of 65 in the level of risk preference of individuals.

Constant Risk Preference Assumption

For its models to have reliable predictive power, modern portfolio theory assumes that risk preference remains constant (Schildberg-Hörisch, 2018). Until recently, the constancy of risk preference has just been accepted, and any variance found in the research was dismissed as noise. It has been noted that:

> Stability of risk preferences implies that, in the absence of measurement error, one should observe the same willingness to take risks when measuring an individual's risk preferences repeatedly over time. Indeed, a standard approach in economics is to attribute any changes in measured risk preferences to measurement error and to consider them as meaningless noise. (Schildberg-Hörisch, 2018, p. 139)

Contrary to the constant risk preference assumption, current research is finding a pattern that indicates that risk preference changes with age and that natural disasters have the ability to affect risk preferences (Schildberg-Hörisch, 2018). The research on an investor's change in risk preference resulting from natural disasters is small. Future research on the topic will need to look at whether a change in the portfolio mix after a natural disaster was made because of a change in the portfolio managers' risk preference or because of a change in the projected return of a specific investment (Schildberg-Hörisch, 2018).

In support of constant risk preference, we find Chuang and Schechter (2015). These authors suggest that one reason for the lack of published research on the constancy of risk

preference is the file-drawer effect, i.e., a finding of constancy is not considered exciting or publishable, so the research is placed in a file-drawer, never to see the light of day. The authors did find constancy in risk preference except that shown as a linear decrease in the level of risk preference from adolescence to the age of 65. The authors found the research evidence to be inconclusive on whether shocks, such as natural disasters, influenced a change in risk preference (Chuang & Schechter, 2015).

Risk, Risk Perception, Risk Preference, and Natural Disasters

The literature indicates that natural disasters influence abnormal returns (Koerniadi et al., 2016). For example, on March 11, 2011, an earthquake measuring 9.0 on the Richter scale caused massive damage, as did the tsunami it triggered, which combined to decimate the coastal areas of the Tohoku region of Japan (Kume et al., 2018). This disaster was directly linked to both positive and negative abnormal returns in the regional and national investment markets in Japan—and international markets—including companies with no trading or business relationships with Japan (Valizadeh et al., 2017). Tao (2014) conducted a similar study on the effects of the 2013 Lushan earthquake in China, finding abnormal returns were created in local, regional, and national markets for up to 10 days following the quake. Similar to earthquakes, hurricanes and tropical storms have been linked to abnormal returns in the United States when predicted paths deviate from expected paths (Feria-Domínguez et al., 2017; J. Fink & Fink, 2014; Rehse et al., 2019).

The direct consequences of a singular event can be gigantic, as evidenced by Valizadeh et al.'s (2017) findings that the direct damages from the 2011 earthquake and resulting tsunami in Japan were $211 billion, not including the business losses, which in turn affected financial

markets around the globe. Similar results have been found with hurricanes in the United States (Feria-Domínguez et al., 2017; J. Fink & Fink, 2014; Rehse et al., 2019).

Regardless of the size of the damages, there appears to be no effect on the pricing of risk in the marketplace so long as the potential for a natural disaster is known. For example, as mentioned above, no abnormal returns are experienced when hurricanes stay on their predicted courses (Feria-Domínguez et al., 2017; Rehse et al., 2019). Likewise, an extensive study of people living in the Campanian region of Southern Italy found no abnormal return effect even though the region is routinely afflicted by floods, landslides, earthquakes, and volcanic eruptions (Avvisati et al., 2019). What happens if an expected natural disaster does not happen at all? Research indicates that when the probability of natural disasters is sufficient to convince people it will happen and then it does not happen within the expected timeframe, abnormal returns are generated (Isore, 2018).

Synthesis of the Research Findings

A predominant theme becomes apparent from the review of the literature involving risk. This theme is that individuals view risk through two methods: (a) objective risk, or risk perception, which is anchored against (b) subjective risk, or risk preference. Risk preference is considered to be a constant under the modern portfolio theory. This theme became the guide for the data collection for this study.

The review of the literature points out the dichotomist reality the Greeks knew a long time ago—that there is a difference between true, unchangeable knowledge based on reason (objective risk) and knowledge based on perceptions (subjective risk) (H. Hermansson, 2012). In the modern portfolio theory, the dichotomy of risk perception (objective risk) and risk preference (subjective risk) both influence and affect each other, and they work together in the process of

compiling an optimal portfolio. Both are independent and codependent in this process as each independently influences the other—and both are necessary.

In the confusion created by not fully separating these two distinct and independently important aspects, attacks have been made against the modern portfolio theory because it appears to not prove out in practice. As a result, some suggest that the modern portfolio theory is flawed because optimal portfolios do not perform as expected. The reality is that immediately after an optimally balanced portfolio is assembled by a portfolio manager, information changes. If the new information had been known, the portfolio would have been optimized differently from the beginning. However, this position, that *ex-post* data cannot prove the *ex-ante* portfolio was optimally balanced for risk, does not prove the original proposition that the portfolio was indeed optimally balanced in the first place. The only thing this understanding lets us know is that attempts to confirm that the modern portfolio theory and its starship CAPM are correct by using *ex-post* data are futile.

Taking this to the next step, the Fama and French line of reasoning, the concept that additional factors and variables need to be added to the original formula to make them more accurate, focuses on the descriptive proving the nominative. While it is interesting to note that in some situations, the *ex-post* tests on the Fama and French pricing models seem to be more accurate than CAPM, the reality is that the Fama and French models suffer from the same frailty as CAPM—*ex-post* data cannot prove the *ex-ante* portfolio was optimally balanced because of economic changes starting immediately after portfolio creation.

This brings us to the basic underlying assumption of the modern portfolio theory—that rational human beings, when given a choice between two investment options with the same level of risk, will choose the option with the highest return—known as the expected utility theory.

Noticing that investors sometimes select options other than the one with the highest return, Kahneman and Tversky (1977) proposed what is now known as prospect theory, which suggests that risk perception is not entirely objective in practice. This idea may or may not be correct. However, if the subjective analysis of the risk of an investment and its potential return is consistently applied, the end results of both the CAPM and the Fama and French models predictions would be the same under prospect theory as expected utility theory, so for all practical purposes, it would not matter whether there was a subjective component or an objective component—so long as it is consistently applied.

The strength and power that emanates from the modern portfolio theory and its pricing models are the ability to measure the risk of a specific investment by the variance found in its price, which makes it possible to price investments according to risk, whether the basis for the price fluctuation is objective or subjective. The ability to quantify risk by a number readily available in modern investment analysis toolkits gives portfolio managers a standardized and "gold standard" industry-accepted way to price assets within a portfolio based on risk. So, as the literature points out, risk perception (objective analysis) and risk preference (subjective risk propensity) influence the variance of the market price of an asset (Heo et al., 2018), and it is this combination, the objective and subjective, that predictably influence the markets, together.

Authors like Kumari and Mahakud (2015) completely miss the mark by making statements that the new paradigm of behavioral finance better explains the markets, and because of that fact alone, it should be ranked superior to and replace the modern portfolio theory. In reality, the two are complementary theories, not competing ones (Lekovic, 2019). The modern portfolio theory is nominative, and as such, it sets the rules for how an optimized portfolio should be constructed. Behavioral finance theory is descriptive and thus describes how investors

actually invest. The fact that many may only roll to a “California stop” at a stop sign does not mean that the rule that we should stop at the stop sign is incorrect. The non-compliance is accounted for in the mean-variance rules of the modern portfolio theory. If anything, behavioral finance theory answers the question as to why price variance exists and further supports the rationale that higher variance in price equates to higher risk as individual actions are making it riskier. If fewer people stop at a stop sign, the intersection will have a higher level of risk.

The point is that modern portfolio theory and the “expected utility theory has been well studied…however, behavioral patterns that are inconsistent with expected utility theory have been observed” (Wang et al., 2019, p. 1026). As Wang et al. (2019) point out, modern portfolio theory’s usage of expected utility theory cannot explain the Allais paradox, the Ellsberg paradox, the Friedman and Savage puzzle, and the Equity Premium Puzzle. This result, however, is not a failure of the theory, as it is nominative, but rather an application of the rules within society, which is subjective, which denotes and supports the concept that risk has two components—objective and subjective. This understanding brings us to this study's point—that is, exactly how are risk perception (objective risk) and risk preference (subjective risk), both of which are essential components of the modern portfolio theory, influenced by natural disasters.

Critique of the Previous Research Methods

As previously mentioned, the academic literature in the fields of finance and economics is dominated by quantitative studies, in both absolute terms and in relationship with other issues in the finance and accounting arena (Burton, 2007). This concentration is anticipated since finance deals with asset pricing, market relationships, and economic data—which tend by their very nature to be best analyzed through quantitative methods. As a result, the majority of the research in finance seeks to determine the statistical relationship between an event and an

outcome (Urban & Quilter, 2006), often with *ex-post* non-experimental time-series event studies (MacKinlay, 1997; P. Peterson, 1989), or statistical regression statistics to find correlations between events and prices of stocks (Mitchell & Netter, 1994), and with correlations with natural disasters that produce abnormal returns (Alkhatib & Harasheh, 2018; Corrado, 2011; Punwasi & Brijlal, 2016; Urban & Quilter, 2006).

The mathematical rigor and the certainty of quantitative analysis sit well in finance and economics. The vast majority of work within the fields of finance and economics is quantitatively based. It could be well said that finance professionals see the world through an analytical, quantitative lens. So, it comes as no surprise that the majority of research on risk preference is quantitatively based.

For example, Hermansson (2018) sought to determine whether risk preference could be linked to risk perception. To do this, she obtained subjective data to establish risk preference (self-survey) and objective data (banking information) to establish risk perception from 7,234 bank customers. All of the data (both subjective and objective) was analyzed using various accepted statistical programs. The result was a finding that there was a low correlation between risk preference and actual investment practice. Under the modern portfolio theory, the opposite finding should have emerged—there should be a strong correlation between risk preference and risk perception in actual practice. At least two possible conclusions could be made: (a) that the link between risk perception and risk preference under the modern portfolio theory does not exist, or (b) self-identified risk preference is not a valid measure of risk preference.

Risk preference, being subjective, is not easily uncovered through quantitative methods, as Millroth et al. (2020) showed after carefully analyzing over 70 instruments used over the years by researchers to quantify risk preference. The reason for this is that risk preference is uniquely

self-structured by the individual. Risk preference is comprised of the thoughts, experiences, education, culture, and other intangibles of the individual. In other words, the individual's perceptions. Perceptions are best explored through qualitative methods.

This study was designed to do just that—to explore changes in risk preference following a natural disaster through qualitative rather than quantitative methods. The semi-structured questions were designed to elicit each participant's lived experience. The researcher was exposed to the individual's thoughts, experiences, education, culture, and other intangibles through this process.

Summary

Risk perception and risk preference are the objective and subjective components of risk within the modern portfolio theory. Each independently and co-dependently contribute to beta, the measurement of risk in the capital asset pricing model. There are many quantitative studies that seek to prove the modern portfolio theory but since it is nominative (rule-based), descriptive results fail because of subsequent economic conditions. There is little qualitative research on the direct experience of portfolio managers' responses to natural disasters. This research fills a gap in the literature on how exogenous shocks such as natural disasters influence risk perception and risk preference (Schildberg-Hörisch, 2018).

CHAPTER 3. METHODOLOGY

This chapter describes the methodology of the study, beginning with a description of the purpose of this study, followed by the research questions and the research design. The target population and the sampling criteria are then covered. Next is a description of the procedures, including the participant selection process and the procedures implemented to protect the participants. This process is followed by an expert review of the semi-structured questions and then a description of the data collection process and data analysis process, including the instruments that were used in the study. Then the role of the researcher is described along with the guiding interview questions. Finally, ethical considerations are addressed, which is followed by a summary of this chapter.

Purpose of the Study

The modern portfolio theory has been consistently analyzed, challenged, and reviewed since its introduction in the 1950s. During that process, some of the underlying assumptions that have been taken for granted are being found to be unsupportable (Dittrich & Srbek, 2020). The failure of an assumption to withstand empirical testing and review does not necessarily negate the financial theory. Still, it does open up topics that deserve further study with an awareness of the validity, or lack thereof, of the traditionally-held history surrounding these economic assumptions (Best, 2020). The traditionally-held history suggests that risk perception is the objective application of financial principles to determine the potential value of an investment based on the knowledge and experience of the investor, which is variable—and that risk preference is the subjective tolerance of an investor toward levels or degrees of risk, which is assumed to be constant and consistently applied in practice throughout the investor's lifetime.

Under the modern portfolio theory, the constancy of an individual's risk preference has been assumed to remain constant over a person's lifespan, except for a known tendency to diminish somewhat—somewhere around age 65 (Chuang & Schechter, 2015). The empirical data has mostly supported this assumption (Chuang & Schechter, 2015). However, at the same time that the modern portfolio theory was introduced to the world, the world was in the middle of an amazingly long run of economic stability, with the gross domestic product per capita increasing significantly but with hardly any variance in the rate of increase from year to year (Roser, 2013). Viewing this history alongside the assumption might suggest that the assumption of constancy in risk preference could possibly be due to the combined experience of individual investors during stable economic times rather than an innate aspect of their persona (Vosgerau & Peer, 2019).

Recent studies have found that natural disasters influence abnormal returns in the marketplace, thereby influencing portfolio managers' analysis of expected returns—their risk perception (Danbolt et al., 2016). We would expect that natural disasters would impact portfolio managers' objective analysis (risk perception). At the same time, however, the research has been inconclusive about whether shocks, such as natural disasters, affect investors' subjective risk preference (Schildberg-Hörisch, 2018). This study aims to find information on the constancy of risk preference through the recollected perceptions of risk perception and risk preference of Hawaii-based portfolio managers before, during, and after their experience with the Puna volcanic eruption.

Research Questions

The Kīlauea volcano erupted on May 3, 2018, in the East Rift Zone on the Big Island of Hawaii. Known as the Puna eruption—it sent lava fountains up to 300 feet in height, which

worked their way toward the ocean, destroying 700 homes, burying an essential highway, and causing hundreds of tremors, including a 6.9 magnitude earthquake. The eruption continued until September 4, 2018. Vog (airborne sulfur dioxide and volcanic particles) filled the air all the way to Oahu. Damages are estimated at $800 million, representing a considerable amount considering Hawaii's population is only 1.4 million people. The flows created 875 acres of new land in the ocean. It was the most destructive eruption in the United States since the 1980 eruption of Mount St. Helens. This circumstance resulted in an opportunity to study the influence of this natural disaster on the risk perception and risk preference of Hawaii-based portfolio managers.

The research questions in this study are:

Research question 1: What are the recollected perceptions of Hawaii-based portfolio managers regarding their risk perception before, during, and after experiencing the Puna volcanic eruption?

Research question 2: What are the recollected perceptions of Hawaii-based portfolio managers regarding their risk preference before, during, and after experiencing the Puna volcanic eruption?

Research Design

This study utilizes the qualitative method to explore, through inquiry, portfolio managers' perceptions of risk perception and risk preference through a basic qualitative study (Merriam & Tisdell, 2015). The use of the qualitative method in finance and economics related studies is established as evidenced by the research found in Cartier et al. (2018) as they studied the funding mechanisms used by research funding organizations, Iqbal et al. (2019) as they explored the processes used by business angel investors in rejecting investment opportunities, and by Shah (2017) with research into why firms delete brands. The generic qualitative inquiry method

selected for this study is comprised of two distinct components being (a) data collection using semi-structured interviews and (b) data analysis through coding (Shah, 2017; Yazan, 2015) with these two distinct components congruently conducted and managed in a unified process that follows an acceptable research design theory (Englander, 2012). The understanding of a construct from the subjective vantage point of the individual is at the heart of this method (Flynn & Korcuska, 2018), and the process could be said to fall within a subcategory of interpretivism (Flynn & Korcuska, 2018) as the researcher seeks to understand the participants' lived and shared experiences with a phenomenon.

In this study, the unifying phenomenon is the Puna eruption (a natural disaster) and the two constructs being studied in relationship with the natural disaster are risk perception and risk preference. This study explores the relationships using semi-structured questions to invite the participants to express their lived experience of the natural disaster by describing their risk perceptions and their risk preference before, during, and after the Puna eruption—and the impact of those perceptions on their portfolio management, thus being "…an empirical inquiry that investigates a contemporary phenomenon within its real-life context" (Merriam, 1998, p. 27).

The best way to obtain information on how portfolio managers perceive risk and how they respond to changes in risk is to ask them directly. An alternative option, questionnaires, has two significant drawbacks. First, people tend to give short answers to surveys, which may or may not even go to the heart of the question. Second, ensuring the responses come from a representative sample of the population becomes problematic.

Another alternative option, a quantitative study of changes made to portfolios, also has two shortcomings. First, only publicly traded funds disclose their actual portfolio mix, which would eliminate private fund managers from the study. Second, even if the change in the

portfolio mix was made immediately after the natural disaster, there is no way of determining through a quantitative study whether the decision to change the portfolio would have been made because of the experience with the natural disaster or for some other reason.

Target Population and Sample

Here, the target population criteria are discussed. This discussion is followed by a description of why and how the sample inclusion criteria were created and how the sample size was determined. The procedures to be used follow in the next section.

Population

Several factors were considered and analyzed in determining the potential population for the study. The general topic of risk is reduced to a specific focus in this study—specifically, recalled perceptions of risk perception and risk preference after experiencing a natural disaster. Each individual has their own unique risk preference under the modern portfolio theory, which influences each one to perceive risk differently. Risk preference is assumed to be consistently applied throughout the individual's lifespan.

Since portfolio managers commonly use the modern portfolio theory's efficient portfolio tools and since portfolio managers are typically aware of the concepts of risk perception and risk preference, it made sense to limit the population to portfolio managers as they would be both (a) the users of modern portfolio theory and (b) the group best able to express their understandings of risk perception and risk preference in the light of a natural disaster. It was determined that any portfolio manager would have this knowledge, so all portfolio managers, whether representing clients, their company or workplace, or just a personal portfolio, would qualify to participate.

The next analyzed factor was the physical proximity to the natural disaster. There would likely be a significant difference between a person who felt the earthquakes and saw the lava

flows in their "backyard" to one who caught only a brief headline of the event. Accordingly, the proposed population was reduced to only portfolio managers living and working in Hawaii.

The next analyzed factor was the time proximity to the natural disaster. Evidence exists that natural disasters cause shocks in the markets, which in turn creates abnormal returns that last anywhere from 5 days to a few months (Koerniadi et al., 2016; Tao, 2014; Valizadeh et al., 2017), but since the markets strive for equilibrium, the abnormal returns are only short-term, and they do not cumulate (Halkos & Zisiadou, 2020). The Puna eruption commenced on May 3, 2018, and ended on September 4, 2018. Setting the time of proximity to begin January 1, 2018, and to end December 31, 2018, adds close to 4 months before the event and 4 months after the event, exceeding the time period where one would expect to find abnormal returns. Considering all these factors together, the population of potential participants in this study consists of portfolio managers living and working in Hawaii from January 1, 2018, to December 31, 2018.

Sample

Quantitative study samples are randomly selected from a population to ensure statistical reliability. Randomly selected samples are not always possible or even necessarily desirable in qualitative studies because the paramount issue is not randomness but representativeness (Englander, 2012). Thus, inclusion criteria are used to purposely select a homogeneous sample that adequately represents the population (Crist & Tanner, 2003; O'Hora & Roberto, 2019).

While a homogeneous sample is often suggested, there may be times when the sample might better serve the research by selecting specific separating factors (Palinkas et al., 2015). There are eight major islands within the State of Hawaii, namely Hawaii, Maui, Moloka'i, Kaho'olawe, Lanai, O'ahu, Kauai, and Ni'ihau. The Puna eruption took place on the island of Hawaii. The State of Hawaii, by landmass, is the third smallest state in the United States, but the

island chain spreads out over a span of 1,523 miles, which is roughly equivalent to the distance between Denver, Colorado, and Washington, D.C. Therefore, it seemed advisable to ensure that the sample of the population of portfolio managers in the State of Hawaii included a representative from each section of the islands in the chain, if possible. However, two of the major islands were eliminated due to legal restrictions to access (Ni'ihau) and no population (Kaho'olawe). The distance of each island from Hawaii, the population of each island, whether they were included in the inclusion factors, and a brief description of the rationale behind the inclusion decision is presented in Table 1.

Table 1

Location of Potential Participants in the State of Hawaii

Island	Distance in miles from Hawaii	Population	Attempted to be included in the study	Rationale
Hawaii	0	186,738	Yes	Physical location of the Puna eruption
Maui	79	167,417	Yes	Closest island; 3rd largest population
Kaho'olawe	80	0	No	No population
Lanai	108	3,102	Yes	Next closest island
Molokai	127	7,404	Yes	4th closest island
O'ahu	189	953,207	Yes	Largest population
Kauai	296	72,293	Yes	Furthest away with access
Ni'ihau	326	130	No	Restricted access

Several practical issues became apparent early on, especially in finding portfolio managers on some islands. Nearly all the financial institutions, stockbrokers, etc., in the State of Hawaii, are located on the island of O'ahu. A concerted effort was made to find at least one participant of each isle. Still, the actual sample became heavily weighted towards O'ahu since

that is where most portfolio managers in the State of Hawaii reside and work. The ramifications of this are discussed in Chapters 4 and 5.

The next issue was the sample size. The sample size should be at least three (Englander, 2012). The suggested acceptable number of participants is between five and 25 (Leedy et al., 2019), with the majority view toward the lower part of that range (Eatough & Smith, 2017). The ultimate total of participants is where saturation is reached, i.e., the point where no new themes or categories are discovered through additional interviews (Al-Fadly, 2020; Bradley et al., 2007). The target number of participants was set at 15.

Procedures

This section describes the participant selection process. The selection process is followed by the procedures used to protect the participants. Next is a discussion of the expert review of the semi-structured questions, which is followed by a description of the data collection and the data analysis process.

Participant Selection

The first step was to identify potential members of the population. An internet search for portfolio management companies was done. Many of these companies list their portfolio managers' names, expertise, licenses, and email addresses. A list of people known to be private investors was also compiled. An IRB-approved recruitment email was sent to these portfolio managers. The email included a listing of the inclusion requirements and invited those interested in participating to reply to the email.

I then directly contacted each potential participant who replied to the email on the phone. Using an IRB-approved screening script, I verified that they met all of the requirements to be

included in the study. If the potential participant met the criteria, I answered any questions and reviewed the next steps in the process.

The next step in the process was to send the IRB-approved informed consent form. This form was sent via the web-based program DocuSign (www.docusign.com), allowing for certification and online signature verification. Once the signature confirmation was received from DocuSign, the interview session appointment was made.

Protection of Participants

The State of Hawaii had one of the nation's highest levels of lockdown during the data collection process due to the SARS-CoV-2 situation. As a result, all of the interviews, which otherwise would have been conducted in person, were performed using Zoom. I conducted each interview session from a private office with the door shut. Each participant was encouraged to select an appropriate, private location for the interview. In some ways, this method even better protected the participants. No one could see me entering a participant's office or them entering my office, thus ensuring complete anonymity of the interview session taking place. At the beginning of each interview, the demographic questionnaire was administered. The participants were made aware that if at any time they felt uncomfortable, they could stop the session, and they were also informed that they could completely withdraw from participation at any time during the process.

All of the transcripts were carefully reviewed for any possible identifying information. For example, if a participant mentioned the specific name of their company, that name was redacted before analysis. The participant's name was replaced by a unique participant identification number on all the data. As a result, the data, as it began to be analyzed, could not be identified as belonging to any particular participant.

Expert Review

The preliminary draft of Chapter 1 of this dissertation and a copy of the proposed semi-structured questions were sent to a professor that has conducted many studies using qualitative methods and semi-structured questions. Their credentials include an MBA and a PhD along with both the CHE and CHIA professional designations. They spent approximately two weeks thinking about the study and the questions after reading Chapter 1 and the semi-structured questions before responding.

The response agreed with the theoretical foundation and the belief that the research could provide some "interesting insight." They also felt the "questions should provide you with some rich data." However, they thought it might be challenging to summarize and identify trends or shared insights based on these open-ended questions and qualitative responses. This comment, however, was toward the limitations of basic qualitative studies in general and not the specific theoretical framework or the specific semi-structured questions used in this study.

The real concern they had with the framework and the questions was the ability to link the volcanic eruption to actual changes in portfolio management. They felt that unless the portfolio manager lived very close to the eruption site or unless the portfolio manager had investments that either had abnormal gains or abnormal losses, that any discussion with a participant might run the risk of being theoretical or academic-based instead of experience-based. However, they did not feel that negated the validity of the theoretical foundation and that if the data could be segmented appropriately, information on what the lived-experience-based participants stated versus what the theoretical or academic-based participants said could provide interesting contrasts. With these comments in mind, additional questions were added to the

demographic questionnaire, including questions on whether the participant had assets at risk of loss as well as whether the participant experienced an actual loss from the volcanic eruption.

Data Collection

The interview sessions were conducted via the online program Zoom. Each session was recorded using the Zoom meeting recording software, recording both the video and audio of the session. A backup recording was simultaneously made that recorded only the audio. This backup would only be used in the event of a failure of the Zoom meeting recording software to record the session correctly.

Each session was conducted by my first checking each of the participants' demographic question answers with the participant for accuracy. Each of the semi-structured questions was then asked in sequential order. The sessions were directly transcribed while being conducted using the Otter Professional Zoom plug-in. I then listened to each interview while reading the transcriptions, going over them line-by-line, making changes wherever necessary to make the transcription a perfect written replica of the oral interviews. All personal identifying information was then removed from the transcript, and the separate word file of each interview was uploaded into the MAXQDA program, labeled as participant 01, participant 02, and so on.

All recordings were digital, and all the transcripts were digital. These items comprised the data for this study. This data was stored on two external, portable hard drives, one for use and the other for backup. Digital copies of the recruitment emails were transferred to the portable hard drives and then were deleted from the servers. The digitally signed informed consent was similarly treated. The recording sessions were downloaded to the external, portable hard drives and then deleted off the cloud services of Zoom and Otter. The result is that all data is stored

only on the two external, portable hard drives, with no copies left on any computer or in any cloud program.

Data Analysis

Giorgi et al. (2017) suggest a 5 step process for analyzing data under a quantitative approach:

1. Read the transcription in its entirety to grasp the overall picture.
2. Assume a scientific reduction attitude.
3. Create parts by delineating meaning units.
4. Intuit the meaning units into lifeworld expressions.
5. Use the transformed expressions to describe the structure of the experience.

Eatough and Smith (2017) refine the overall process expressed by Giorgi et al. (2017) for situations, such as this study, where the focus is on the detailed investigation of a specific topic in order to discover the "relationship between what people think (cognition), say (account) and do (behavior)" (Eatough & Smith, 2017, p. 201) using flexible and imaginative designs.

I chose to follow the procedures for analysis listed in Rädiker and Kuckartz (2020) and in Saldaña (2021). Since the research questions were specifically focused on the perceptions of Hawaii-based portfolio managers' risk perception and risk preference before, during, and after their experience with the Puna eruptions, categories and codes were created for the codebook that included the major categories of risk perception and risk preference—along with the codes before, during, and after. A complete listing of the categories and codes is included in Table 5.

The data analysis was then conducted. During this process, each transcript was analyzed one at a time, from start to finish, before moving on to the next one. The entire transcript was first read from start to finish for content, then re-read and the categories and codes from the

codebook were applied to each transcript using the MAXQDA transcript labeling tools. The transcript was then re-read again to verify that the categories and codes were applied correctly as well as to catch any additional information that might be helpful. New codes were created during this process that were then applied to all the other transcripts as well. This meant that through this iterative process, each transcript was reviewed and re-reviewed multiples of times.

Once this iterative process had been completed, the coded materials were analyzed by both the researcher and the MAXQDA tools to bring supportable themes to light. As these themes were uncovered, the transcripts were then re-read with these themes in mind (Williams & Moser, 2019) to gather and organize information to support or refute the themes. The surviving themes and the data to support them were noted and a list of common threads, codes, and themes that came out of this process was then made. This data analysis was then distilled and is presented in Chapters 4 and 5.

Instruments

In this section, the documentary instruments are described. Next, the physical instruments are identified, followed by a discussion of the role of the researcher as an instrument. This section finishes with a presentation of the semi-structured questions used in the interview sessions.

Documentary Instruments

There are several documentary instruments. These instruments include the following:

1. Informed consent form.
2. Demographical questionnaire.
3. Semi-structured questions.
4. Video and sound recordings of interview sessions.

5. Transcription of interview sessions.

Capella University's Institutional Review Board approved the informed consent form and it informs the participants of their rights and obligations. The Demographical Questionnaire provides background information on the participants, including sex, age, years of education, degrees, certifications, professional licenses, island, and years of experience. The video and sound recordings were made by Zoom and were downloaded to the external, portable hard drives. An Otter plug-in made the transcriptions.

Physical Instruments

The physical instruments include:

1. Computer with a web camera for interview sessions.
2. A computer for access to data and programs.
3. External, portable hard drives

The Computer with Web Camera and the Computer for access to the data and programs are the personal property of the author and are kept within a private, locked, when not in use, office. The external portable hard drives are also the personal property of the author, and they are appropriately secured. Upon completion of the research, all data was removed from the cloud, and the computer and the hard drives will be securely stored for the requisite period and will then be destroyed.

Software Instruments

The software instruments include:

1. Microsoft Word
2. Microsoft Excel
3. Zoom

4. Otter
5. MAXQDA Analytics Pro

The author holds a Zoom Pro subscription and an Otter Pro subscription. At these levels, Zoom and Otter can be integrated for simultaneous recording and transcription of the interview sessions. The interviews were transcribed and placed into a Microsoft Word document. The researcher then listened to the recorded interview and made edits as needed to ensure accuracy in the transcription. Microsoft Excel was used to chart and analyze the demographic data of the participants, such as licenses, ages, degrees, etc. Word and Excel are part of a Microsoft's Office 365 subscription, which is owned by the author. Ultimately, all of the Word document information and the Excel document information were imported into the MAXQDA Analytics Pro program. The author holds a current MAXQDA license.

The Role of the Researcher

There is a consensus that the researcher is an significant instrument in basic qualitative studies (Merriam & Tisdell, 2015) and especially in the semi-structured qualitative interview process (Chenail, 2011; J. S. Peterson, 2019; Pezalla et al., 2012; Rubin & Rubin, 2005). The first way the researcher is an instrument is the researcher designs the questions and the processes before the data gathering processes even commence. The researcher then directly obtains the data through personal contact with the participants. In this study, that personal contact was made over a video Zoom call. The researcher's skill in making contact and asking questions makes a difference in the data that is received.

I am trained in making contact and asking questions. The United States Military trained me to be an interrogator. The best interrogators are skilled in eliciting information without the subject even being aware of the fact information is being received. It is also essential that the

interrogator does not taint the data, i.e., the interrogator should never lead the subject but instead wait for the subject to put the words together in their own way. This skill of not leading the subject has also been practiced by me in my 30-year career as a licensed attorney, in both courtroom and formal deposition work, including witness interviews where the integrity and preciseness of the data are paramount.

I also have direct experience with the subject matter of this study. I have a BA degree in finance, and I have worked in financial-related fields for most of my career. Part of my career included serving as a portfolio manager of several multi-million-dollar investment portfolios. This portfolio manager experience allowed me to converse in the same language, in financial terms, as the study's participant portfolio managers. Still, it needs to be set aside during the data gathering and the analysis process.

Giorgi et al. (2017) describe this process of setting aside personal experience as transcendental reduction—where knowledge from any source other than the participant is to be set aside or made non-functional during the analysis process. I am experienced in separating myself from the data as it was a requirement both in my military service and my law work. Being aware and constantly reminding myself (doing a self-assessment) after reviewing each dataset helped to ensure this happened.

Demographic and Guiding Interview Questions

The demographic questions were designed to gather essential data about the nature, including experience, education, and other factors, of the sample:

With is your gender?

How old are you?

What is your highest earned degree?

What licenses do you hold or have you held?

What certifications have you earned?

Do you manage funds for your own account, funds for a company, or funds for clients?

How many years of experience do you have in making investments?

Did you experience any losses directly related to the Puna eruption?

Did you have any investments at risk at any time during the Puna eruption?

The semi-structured questions were designed to guide the participant through the process of constructing and describing their explanations of their experience with the Puna eruption, specifically with perceptions of risk perception and risk preference.

Question 1

Describe to me the methods and tools you use to analyze the investment risk of a potential investment for your portfolios? Please explain.

Question 2

Thinking back to just before the Puna volcanic eruption, through the period of the eruption, and then to the period after the eruption, describe to me any changes in the methods and tools you use to analyze the investment risk of a potential investment for your portfolios resulting from your experience with the natural disaster. Please explain.

Question 3

Describe to me your own risk preference, in other words, your personal risk tolerance or propensity to take on risk. Please explain.

Question 4

Thinking back to just before the Puna volcanic eruption, through the period of the eruption, and then to the period after the eruption, describe to me any changes you perceived in your own risk preference resulting from your experience with the natural disaster. Please explain.

Question 5

Are there any other thoughts you have about the analysis of the investment risk of a potential investment or the analysis of your risk preference that you would like to share with me? Please explain.

Ethical Considerations

Gaillard and Peek (2019) rightfully suggest the need for a specific code of conduct for researchers investigating issues following natural disasters, even though it is generally accepted that the knowledge learned would be beneficial (Browne et al., 2018). However, this study is different in that the type of issues raised by Gaillard and Peek (2019) pertains to dealing with people that were physically harmed or who were in peril of harm as a result of a natural disaster. The population and the sample of this study received no physical harm, and none were in any real physical danger. Accordingly, the ethical considerations focus on the protection of the privacy of the participants.

The interview questions are designed to determine the participants' perception of risk in managing their portfolios before, during, and after a natural disaster. Risk is a constant aspect of a portfolio manager's job. The analysis of the risk associated with investment decisions is part of their daily job, so they are accustomed to the topic and the actual use applied to their positions. It is, therefore, unlikely that the interview process will cause discomfort since the subject area is a

significant part of their daily job. There could be possible issues if specific comments were identified as coming from one particular participant that could affect employment or reputation and be emotional or stressful. Therefore, all identifying information was removed by the author from the data before any analysis, and no identifying information was used in writing this dissertation.

The most significant practical challenge of this study is to obtain the participation of qualified portfolio managers and, once received, to get them to divulge their risk perceptions and their risk preferences. Thus, one of the critical elements in soliciting participation is to design the study so that a reader of this dissertation can match no individual or company, or portfolio manager with the results and conclusions. This protection goes beyond the typical movie credit disclaimer that no identification with actual persons (living or deceased), places, buildings, and products is intended or should be inferred. It must not be possible for a link to be made. This separation of the obtained data from the source of the data is not only an essential element of the process of convincing qualified portfolio managers to participate, but it is also an ethical issue as well.

The risk to the participants in this study lies in the ability of a reader of the study to identify the participant to an identifiable result or conclusion. To eliminate this possibility, once the transcription of each interview was made, the transcription was separated from its identifying source, and no reference is made within the study that could lead back to the source.

Also, there is an ethical consideration that applies to the researcher, i.e., that the questions and process are not influenced by the researcher's bias (Wadams & Park, 2018). It is incumbent upon the researcher to be aware of potential bias and influence. This bias is minimized through the interview questions' testing process and the focus by the researcher on not leading the

subjects to any conclusion (Kaczynski et al., 2014). This study is not a replication nor a copy study, so no permission from prior authors is required.

This study does contain ethical risk, which was managed following the guidelines of the Belmont Report (United States Department of Health and Human Services, National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, 1979). It is noted that portfolio managers tend to be highly educated (at least a college degree and often an MBA or more). They also hold various State and Federal Securities Licenses as well as other licenses. Portfolio managers are used to dealing with complex legal documents and extensive State and Federal Regulations, so they are not a group that needs special protection outside the need to protect privacy.

Summary

This study aims to collect the recollected perceptions of Hawaii-based portfolio managers' risk perception and risk preference before, during, and after experiencing the Puna volcanic eruption as a mechanism of inquiry into the stability of the individual's risk preference after experiencing a natural disaster. The research questions mirror the study's purpose. The study uses a generic qualitative inquiry design. The target population is comprised of portfolio managers who lived and worked in the State of Hawaii from January 1, 2018, through December 31, 2018, and the target sample size is 15. The sample selection process purposely seeks to include portfolio managers from nearly all the islands in Hawaii. The procedures for selecting the participants and analyzing the data have been described and data collecting instruments identified. There are ethical issues, but they have been adequately addressed. The next chapter details the findings from the analysis of the data.

CHAPTER 4: FINDINGS

Introduction: The Study and the Researcher

The purpose of this chapter is to describe the application of the methodology discussed in the previous chapter to the sample and then to express the findings resulting from the analysis. This introduction section includes a description of the study and the researcher's background, his experience with this project, and the effects the researcher may have had on the study. Next, information about the sample is presented, followed by an explanation of how the research methodology was applied to the research data. This chapter finishes with the presentation of the data and the analysis results, along with a summary.

The Study

This study obtained and then analyzed portfolio managers' perceptions of their risk perception and risk preference before, during, and after experiencing a natural disaster through a basic qualitative process utilizing semi-structured interviews followed by the coding and analysis of the data to find themes. The population for the sample is Hawaii-based portfolio managers that lived and worked within the State of Hawaii during the 2018 calendar year. The specific research questions are:

Research question 1: What are the recollected perceptions of Hawaii-based portfolio managers regarding their risk perception before, during, and after experiencing the Puna volcanic eruption?

Research question 2: What are the recollected perceptions of Hawaii-based portfolio managers regarding their risk preference before, during, and after experiencing the Puna volcanic eruption?

The Researcher

I was intrigued by the concept of abnormal returns and what creates them when I first learned about them in undergraduate school. With all the tools available to analyze markets and research companies, the idea that expected returns do not consistently match actual returns (abnormal returns) was an enigma to me—as was the reality that over the long term, even the most diligent portfolio managers are unable to consistently beat the market indexes (Perry, 2018; Zweig, 2017). Possible explanations would include the portfolio manager's analysis error, incomplete data, and the occurrence of unforeseen circumstances.

While reading a journal article on the market effects of hurricanes in the United States, I was struck by the suggestion that hurricanes only influence abnormal returns when they deviate from their predicted course (Feria-Domínguez et al., 2017; J. Fink & Fink, 2014; Rehse et al., 2019). It was not the actual natural disaster (the markets already factored that in) that influenced the abnormal return but the surprise or deviation from the expected course. Simultaneously, I was researching the various explanations for the numerous findings that modern portfolio theory optimized portfolios seemed to consistently not perform as expected (Dempsey, 2013; Levy, 2010). During this process, I investigated behavioral theory and *econophysics* concepts and the comparisons between the idea of expected utility (decisions made on what is economically in the best interest of the actor) and behavior decision factors such as happiness and even political motivations.

While reading Schildberg-Hörisch (2018), I was immediately struck by the question of the constancy of risk preference. A significant element of CAPM's predictive power is the reliance on individual investors' consistent application of risk preference since a change in risk preference automatically changes the price. Risk preference, under the modern portfolio theory,

is considered stable, so it is a constant, not a variable, in the mathematical formulas. The evidence is substantial that, for the most part, risk preference is, indeed, constant (Chuang & Schechter, 2015). However, in light of what happens when unexpected natural disasters occur, can the resulting shocks influence a change in risk preference? Schildberg-Hörisch (2018) found inconclusive research findings on whether these shocks affected risk preference.

On May 3, 2018, the Puna eruption started. Eruptions on the island of Hawaii are not uncommon (like hurricanes in Florida) since both the Kīlauea and Mauna Loa volcanoes are among the most active in the world. However, the Puna eruption exploded through a somewhat unexpected fissure in a somewhat unexpected location—spewing a lava trail that reached up to the equivalence of an eight-story building into a residential area. The erupting lava made its way to the ocean, creating about 875 acres of new land. The eruption created vog, which is air pollution comprised of sulfur dioxide, other gases, and particles (volcanic ash), which filled the skies even on the island of O'ahu. It also produced laze, which is acid rain and air pollution that is created when hot lava hits saltwater, creating airborne hydrochloric acid. The eruptions ceased on September 4, 2018.

I initially thought to analyze this natural disaster as a quantitative event study—looking for abnormal returns based on complex statistical analysis such as that done in Valizadeh et al. (2017). However, the utilization of event studies using advanced mathematics to find abnormal returns is well documented and they beg the question of causation. However, as I looked at all the research and these circumstances together, I realized that the Puna eruption yielded an opportunity to conduct a qualitative study on perceptions of risk preference before, during, and after an experience with an unexpected natural disaster by interviewing portfolio managers living and working in Hawaii immediately before, during, and after the Puna eruption.

While my financial education is quantitatively based, my career has had both quantitative and qualitative elements. I was trained as an interrogator and taught how to get participants to feel it is in their best interest to share information. I was taught to use the same processes when conducting depositions and conducting interviews with witnesses as an attorney. Asking people questions is routine for me.

Accordingly, I played a significant role in the data collection and data analysis. My understanding of abnormal returns, risk perception, and risk preference, as a seasoned practitioner involved with each aspect, allowed me to understand and elicit the descriptions of the perceptions of the portfolio manager participants. The view taken in this study is not that of an academic looking in from the outside but rather that of a researcher from the inside seeking to understand his surroundings. Through this process, I obtained data that expressed the perceptions of portfolio managers on risk perception and risk preference before, during, and after the Puna eruption.

Description of the Sample

The population of potential participants for this study consists of portfolio managers living and working in Hawaii from January 1, 2018, to December 31, 2018. The sample size for a basic qualitative study should be at least three (Englander, 2012). The acceptable number of participants is suggested to be between five and 25 (Leedy et al., 2019), with the majority view toward the lower part of that range (Eatough & Smith, 2017). The ultimate total number should depend on where saturation is reached, i.e., the point where no new themes or categories are discovered through additional interviews (Al-Fadly, 2020; Bradley et al., 2007).

Following the procedures described in Chapter 3, a sample of 17 portfolio managers agreed to participate in the study—the number of participants falling within the recommended

range suggested by Eatough and Smith (2017), Englander (2012), and Leedy et al. (2019) and two above the initial target of 15. A review of the data obtained from these 17 participants indicated that saturation was reached as no new themes or categories emerged as the interviews continued. With the diversity found in the sample, further interviews would most likely yield no additional themes or categories.

Table 2

Ages and Average Age of the Participants

Ages	Average age
28, 30, 38, 40, 42, 48, 55, 57, 58, 59, 62, 63, 64, 66, 68 68, 79	53 years

The participants' ages range from 28 to 79, with an average age of 53 years. The average years of portfolio management experience is 24 years. Two participants are high school graduates, seven hold undergraduate degrees, five have master's degrees, and three hold a doctorate. The participants represent a broad reach within the population, not only in age and experience but also in occupations.

Table 3

Years and Average Years of Experience of the Participants

Years of Experience	Average Years of Experience
4, 4, 5, 18, 18, 20, 20, 24, 25, 25, 28, 30, 30, 30, 37, 41, 50	24 years

The occupations of the 17 participants include a derivatives trader, four investor/promoters, two attorneys, two stockbrokers (one an agency owner and the other works for one of the largest brokerage houses in the world), a CIO (chief information officer), two real estate broker/investors, a general manager, a teacher, a director of marketing, an MIS manager, a

professor, and a senior vice president. All the participants managed their own portfolios, and seven of the participants, in addition to their own portfolios, managed others' investments. Licenses held by the participants include real estate broker, Series 3, 6, 7, 9, 63, 65, and 66 securities licenses, all insurance licenses, and attorney at law.

Table 4

Highest Earned Degree of the Participants

Highest Earned Degree	# of Participants
High School	2
Undergraduate	7
Masters	5
Doctorate	3

The plan was to obtain participation from all the major occupied islands in the state of Hawaii. Two of the islands, Maui and Kauai, are not represented in the participant group. However, these two islands have relatively small populations (167,417 for Maui and 72,293 for Kauai). They have a minimal number of portfolio managers. None responded to the invitation email. This factor is not believed to be fatal for several reasons. First, there was no difference between the findings from the participants on the island of Hawaii from those on O'ahu, and Maui is between these two islands. Since the same results were on O'ahu as on Hawaii, it would likely be a safe assumption that the results would have been the same on Maui due to its location between the two. Second, Kauai is 296 miles from Hawaii, versus O'ahu's 189. The excess distance and the lack of population make Kauai of limited interest. The vog from the eruption affected O'ahu, while it did not reach Kauai.

One segment is missing from the participants, and that is females. Based on the websites for portfolio management companies, there is no question that males dominate the industry in

Hawaii. The researcher sought diligently to secure female participants from the population. None replied to the IRB-approved email. This factor is noted in Chapter 5 as a limitation and a possible area for future study. No other sources of data were accessed. No participants withdrew from the study.

Research Methodology Applied to the Data Analysis

Each interview was individually conducted via Zoom Meetings. Each meeting was recorded using Zoom's recording system and was simultaneously transcribed via Otter into a word document. The recordings were then replayed while the researcher read the transcript. The transcripts were edited to ensure they matched the original recording. The transcripts were then stripped of all personally identifying information so the data itself could not identify the participant, and each of the transcripts was uploaded into the MAXQDA program into a document group entitled "interviews." Each transcript was assigned participant numbers from 01 to 17, and the demographic information for each was entered into the Data Variables Editor for Document Variables. The data collection process culminated with 152 pages of transcripts in MAXQDA, ready for the coding process.

The coding procedure was set to match the specific research questions. The research questions are (a) what are the recollected perceptions of Hawaii-based portfolio managers regarding their risk perception before, during, and after experiencing the Puna volcanic eruption? and (b) what are the recollected perceptions of Hawaii-based portfolio managers regarding their risk preference before, during, and after experiencing the Puna volcanic eruption? Following the procedures for analysis listed in Rädiker and Kuckartz (2020) and those in Saldaña (2021), the coding system (coding manual) was set to match the research questions, and the codes were placed into the coding system in MAXQDA. The coding system is replicated in Table 5.

Table 5

Categories and Codes from the Interview Guide

Topics and Codes	Code Description
Risk Perception	Participants' descriptions of the tools and methods used to analyze the economic risk of a potential investment
Perception Before	Participants' descriptions of risk perception before the Puna eruption
Perception During	Participants' descriptions of risk perception during the Puna eruption
Perception After	Participants' descriptions of risk perception after the Puna eruption
Perception Changes	Participants' descriptions of changes made in their tools and methods after experiencing the Puna eruption
Risk Preference	Participants' descriptions of their personal tolerance (risk preference) toward risk
Preference Before	Participants' descriptions of their risk preference before the Puna eruption
Preference During	Participants' descriptions of their risk preference during the Puna eruption
Preference After	Participants' descriptions of their risk preference after the Puna eruption
Preference Changes	Participants' descriptions of changes made to their risk preference after experiencing the Puna eruption
Preference Tempered By	Participants' descriptions of things that temper or cause them to act contrary to their risk preference
Other	Additional codes that developed out of the data analysis process
Confusion	Where the participants' description stated it pertained to risk perception or risk preference when it clearly was the other
Covid	Participants' unsolicited descriptions or statements on SARS-CoV-2

With the data and the coding system loaded into MAXQDA, the analysis of the data began. The process comprised the following procedures, which were fully completed for each participant transcript prior to moving on to the next participant transcript:

1. The transcription was read through in its entirety to grasp the overall picture.
2. The researcher then read through the transcription again, applying the codes to each section as warranted.
3. The researcher then reread the transcript, verifying that the coding was correctly applied.
4. The transcription was then again read through in its entirety, with the researcher looking for any ideas, themes, or possible new codes that were not already in the coding system.

Presentation of Data and Results of the Analysis

This study sought to uncover the recollected perceptions of Hawaii-based portfolio managers' risk perception and risk preference before, during, and after experiencing the Puna volcanic eruption as a mechanism of inquiry into the stability of the individual's risk preference after a natural disaster. The data and results are presented in this section by first giving the information on risk perception. A presentation on risk preference then follows.

Risk Perception

Risk perception involves the analysis process of the probability of adverse outcome weighted by the severity of the potential outcome. In the modern portfolio theory, it serves as the basis for calculating the premium that must be paid in order to accept a predicted risk. Risk also serves as the motivating factor for diversifying investments within a portfolio. In essence, risk perception is a term that covers the analysis process of both the pricing of a specific investment

and the analysis process of what investments are placed into a portfolio and the percentage of the portfolio total for each investment put into the portfolio.

Table 6

Risk Perception Themes

Risk Perception Themes
At the Start of the Event:
Emergency analysis of additional risk resulting from the event
During the Event:
Mitigation
Determination of the possible duration of the event
Search for opportunities
After the Event:
Natural disasters factored into future analysis

The participants' perceptions of risk perception (the objective analysis of risk) changed during the before, during, and after the Puna eruption time periods. Although change was nearly universal throughout the sample, what changed varied among the participants. Five themes emerged from the analysis of the data, which are summarized in Table 6. The results of the analysis of the data are described below under the subheadings of immediate response, mid-eruption response, and going forward response.

But before we get there, it is helpful to understand the participants' risk perception analysis processes in general terms. The participants described their risk analysis process using words such as liquidity, volatility, intuition, value, expertise, indicators, return on investment, potential allocation, and the ability to sleep at night. For example, participant 1 stated that they looked for higher volatility in investments because they created the most possibility for profits as

a derivatives trader. Participant 2 spoke of "betting on the rider" and "going by the gut." They also described the search for "value." Participant 3 addressed returns and the rate of returns, as did Participant 4. Participant 5 brought in using "computer programs that analyze the market as they have indicators to indicate and to basically minimize risk." Participant 6 described an extensive process of analysis, suitability, appropriateness, and long-term profitability.

Participant 7 is a heavy user of spreadsheets, number analysis, and STARCO. Participant 8 utilizes their personal knowledge combined with what can be learned online, plus a breakdown and analysis of past performance. Participant 10 focuses on the company's projections and the projected return on investment. Participant 11 has different methods for each type of investment, whether stock, something like BitCoin, real estate, etc. Participant 13 works for a large, multinational investment firm, and they use several proprietary tools. Participants 15 and 17 use advice from paid advisors and also their own analysis, depending on the situation, and participant 16 relies almost exclusively on paid analysts, taking their recommendations.

Although each participant's process for analyzing objective risk was different, they all went straight to identifying their processes for objectively analyzing the investment risk of a particular investment opportunity. Each participant could quite readily describe their process, indicating it was a process that they were well aware of and had thought out in advance.

The pervasiveness and specificity of the process are evidenced by the data. For example, Participant 6 stated that the "allocation model mean asset allocation basically divvies things up, and it allows you to control your volatility a lot better over time." Participant 1 stated that:

> analyzing liquidity, analyzing the market environment would be based on volatility, and then going into that, into those particular companies or underlying assets, and then

> choosing the correct strategy for the correct environment—like that would be my analysis, my process.

Participant 2 is heavy into track record and history and then picks up deals when aberrations happen. They stated:

> I'm a value investor, so I really take a look and say, okay, has this company been around for a long time and where, you know, some event has caused this decline in the price. I want to buy it at that point. I mean, recently, Boeing. I bought a lot of Boeing stock when they were really getting hammered because of the faulty systems there. And, you know, now they're way up again, so I mean, those are the kinds of things I look at, is, these, these companies.

As can be seen, the participants have different ways of perceiving risk perception, but they all have several things in common. The participants have set processes they use to analyze and quantify the risk in potential investments. Once quantified, they are placed in the portfolios according to their investment objectives based on their individual balancing principles. They also use various tools applicable to their goals to analyze and measure risk and to balance their portfolios. These processes were all in place before the Puna volcanic eruption took place.

Immediate Response

The immediate response of the participant portfolio managers to the Puna eruption was heavily dependent on the assets held by each manager in their portfolios. For example, Participant 1 took no immediate action because none of the assets in their portfolios were or would be affected by the local nature of the natural disaster. With the exact opposite response, Participant 7, whose portfolios included movie production assets, immediately reached out to all the major insurance companies to determine exposure, but not for the reasons one might suspect.

This portfolio manager had no investments in the insurance companies themselves, nor were they looking for insurance coverage, but rather, insurance companies represent a significant source of funding for movie production, which, if they suffered excessive loss payouts, would have less money to invest into movies. These two examples highlight the central theme coming out of the immediate response, which is an emergency analysis of the natural disaster's added risk on the managed portfolios. The two sides of this are illustrated by the interview with Participant 10 when they said:

> Two things would stand out. Number one would be where is my money invested? If I was invested in property that was in the path of the lava flow, then yeah, I'd be worried. I'd be hecka worried. But if I was invested in, say, a tour company that was shuttling people out to go see the lava flow, well, then I'd be celebrating.

For portfolio managers managing client funds, the situation became two-fold since, while analyzing the portfolios for potential problems resulting from the Puna eruption, they simultaneously had to deal with calming their clients. Participant 13 recalled having to remind their clients:

> How many natural disasters have we gone through? How many sicknesses or illnesses has the economy gone through? Financial breakdowns. Real estate, like, you name it, when you zoom in, it looks scary. Like you think, whoa, like, man, this is a terrible time to be invested in stuff. But every time you zoom out, you'll see, hey, like wow, if I would have just stayed in I would have made money, or I would have been right back where I was at if I would have stayed in if, you know, 12 months later, six months later.

The immediate response category can be summarized as taking the emergency measures necessary to, as much as possible, get out of immediate danger to a position of relative safety

from which the situation can be more extensively analyzed. The actions taken here are basically reactions to the situation. From this more relatively safe position, the participants were able to safely analyze the situation to determine their mid-eruption responses.

Mid-Eruption Response

The participants' descriptions of their risk perceptions during the event exhibited a significant degree of practicality about the event. One of the things that was stressed multiple times was the idea of being judicious and not overacting. This concept was expressed by Participant 6 as they spoke about helping their clients:

> I don't know what the next year is going to bring. If I did, I wouldn't be working, you know. I'm just a human being trying to look at it from a long-term perspective, and then we just work to get them on training and get them onto asset allocation training and have them stick with it knowing that there are, there are times when there's potential down and, you know, not to try to sell it.

Participant 1 addressed the situation by stating that "when there's chaos, I see opportunity. Right?" Participant 3 said, "if I had the extra money and thought it was a good deal, then I'd probably, probably jump on it."

The mid-eruption response of the participant portfolio managers to the Puna eruption was dependent again upon the assets held by each portfolio manager. It was also dependent upon the risk preference of the portfolio manager and their clients. With the immediate or emergency response taken care of, the portfolio managers started turning their attention toward ongoing mitigation issues and possible investment issues. Two themes emerged from the data: (a) mitigation based on guesses as to how long the natural disaster would continue and (b) investment opportunities. As one participant put it:

> When the eruption went off in May, or whenever it was exactly, I mean, you had people like, at first, the first initial reaction is like, oh, it's going to go away. June, July, oh, it's not. And then the panic begins to set in around August, September, people are selling their houses and moving and stuff like that, because they didn't know. They thought this would be forever. (Participant 6)

Another participant stated:

> I had some real estate…and I needed to decide about when to sell it. So, the concern at that time was when is this vog going to stop or when is it going to start again? If it's gonna get worse, then maybe I need to sell right now. (Participant 2)

While some portfolio managers were dealing with these mitigation issues, others were looking for opportunities created by those concerned about the outcome. As Participant 2 noted, "Well, I think I sold too soon. I did the conservative thing, and so the buyer turned around a year later and made a significant gain." Participant 13 stated, "I call it discount season." Participant 1 referred to it as "scooping it up." Participant 1 went on further to state:

> It has affected my investments. We actually purchased two pieces of property—one of them being directly affected by prices—because they were deflated, where I picked up an acre on the Big Island."

Participant 1 again, later in the interview, added, "Because now, I mean, I've tried to scoop up some more." This combination of people selling because they believe the natural disaster will continue to create losses and other people buying because they believe the depressed prices to be an opportunity summarizes this theme. The mid-eruption phase theme is mitigation and its flip-side, opportunity. As the Puna eruption ceased on September 4, 2018, the participant portfolio managers moved into the going forward phase.

Going Forward Response

The going forward response of the participant portfolio managers to the Puna eruption was relatively consistent across the entire sample of portfolio managers, with the theme that the experience of the event would be factored into their risk perception analysis of future investments in a variety of ways. For example, Participant 1 stated, “It’s embedded. Let’s just say there was one in 100 chances. Now it happens. Now add that additional risk, whereas before, that risk didn’t exist.” Participant 2 stated, “It definitely made a change in me. It made me a little more skeptical of investing in real estate.” This participant is one of the participants that experienced actual losses from the Puna eruption in the portfolios they managed. They further elaborated, “I’m seeing that as a fear—something like that is going to happen again.” Natural disasters have become part of the risk perception process where it was not really in mind before the event.

Participant 3 stated they would now “analyze natural disasters and things like that” as part of their risk perception analysis. Participant 4 said they would “pay closer attention to, to any real estate investments that I was taking on, that, you know, take other things into consideration like a volcano, and where the flood line is, etc.” Participant 6 stated, “from a psychological standpoint, it reminded me of how cycles work—preparing for cycles—and living through them successfully.” Also mentioned was portfolio allocation—making sure that potential natural disasters could only affect a small portion of the portfolio. Participant 6 described it this way:

> So, concentration, and you have clients in California, and if they have, you know, 70% of their net worth in California real estate, you know, that's just something that needs to be

aware of, you know, and maybe there is only a 0.001% chance, but what if California falls off into the ocean?

Summary of Themes on Risk Perception

The data presents a picture of the recollections of the portfolio manager participants experience with the Puna volcanic eruption in themes. The themes that emerged from the data include the immediate analysis of the added risk that the natural disaster exposed to the managed portfolios. This initial response was accomplished relatively quickly. Next came the mitigation of risk, the question of how long it would last, and the seeking of investment opportunities during the eruption period. Finally came the embedding of the event into their processes of analyzing the potential risk of investments for their portfolios going into the future.

Risk Preference

Risk preference is the propensity of an individual to make risker or less risky choices. It is the measure of the risk aversion propensity of an individual. Part of the rationale for selecting portfolio managers as the population to be studied is that they are trained in the concept of risk preference. For example, the CFA Institute ethics rules state that:

> One of the most important factors to be considered in matching appropriateness and suitability of an investment with a client's needs and circumstances is measuring that client's tolerance for risk. The investment professional must consider the possibilities of rapidly changing investment environments and their likely impact on a client's holdings, both individual securities and the collective portfolio. The risk of many investment strategies can and should be analyzed and quantified in advance. (CFA Institute, 2014)

The participant's knowledge and awareness of the principle of risk preference allowed the discussion to take place without education on the terminology. The analysis of the data

revealed three themes: (a) no change in risk preference, (b) terminology confusion between risk perception and risk preference, and (c) temperance of risk preference. Each will be addressed individually in the sections below.

Perceptions of Risk Preference after Experiencing the Puna Eruption

A very noticeable difference in the tone and length of the participants' answers to the semi-structured questions was experienced when it came down to risk preference. The preceding interview questions were answered in paragraphs. The question "Thinking back to just before the Puna volcanic eruption, through the period of the eruption, and then to the period after the eruption, describe to me changes you perceived in your own risk preference resulting from your experience with the natural disaster," the answers were very short and to the point, as demonstrated in Table 7.

The data seems clear that the participants perceived no change in their personal risk preferences. However, when prompted to explain, either by silence or direct question, the additional responses showed some confusion created from the terminology routinely used in the industry. Specifically, the confusion between terms used to describe risk perception and risk preference.

Confusion Between Risk Perception and Risk Preference

While the participants quickly understood and were familiar with the concept of risk preference, some of their expanded responses tended to mix the issues in large part due to similarly used terminology within the definitions of risk perception (objective risk) and risk preference (subjective risk). For example, many participants mentioned that they would become more "aggressive" in investing on the Big Island because investments could be "scooped up" for cents on the dollar. But, when questioned further about this, they clarified that by "aggressive,"

Table 7

Perceived Changes in Risk Preference

Participant	Response
Participant 1	"For me, personally, no."
Participant 2	"I don't think it had an effect at all."
Participant 3	"I'm probably the same."
Participant 4	"No, none."
Participant 5	"No."
Participant 6	"Nope, no."
Participant 7	"No change."
Participant 8	"Nothing changed"
Participant 9	"I still just go by my gut a lot."
Participant 10	"No, no."
Participant 11	"There is no difference."
Participant 12	"None."
Participant 13	"My risk tolerance is still aggressive."
Participant 14	"No, no, not really."
Participant 15	"There were no changes for me."
Participant 16	"No change."
Participant 17	"Well, it would have made me more reluctant to buy any real estate on the Big Island. [laughs]"

they meant that they believed their analysis (risk perception) would possibly reveal that there were deals to "scoop up," so they would make more investments (become more aggressive) on Hawaii than they otherwise would—so this is an issue of analysis of risk and potential return (risk perception) and not risk preference. In other words, they were not increasing their

propensity for risk—they just analytically saw the potential advantage, evidenced by the additional description from Participant 4:

> So, my risk tolerance has changed according to basically the buffer that I have to maintain my lifestyle. And because I don't live so lavishly and I've built a great, you know, what's it called, like, retirement fund, so to speak, I'm okay with losing several different individual investments, losing it all if I have to. Because it will not change the way that I eat. (Participant 4)

At first blush, this participant's response would appear to be addressing risk preference since they used the term risk tolerance. However, the description given by the participant is really an objective analysis process, not a subjective preference. The participant here describes allocation, which is classic portfolio analysis. Yet they used a risk preference synonym when identifying it. This statement could easily have been coded in a study to risk preference, taking just the term risk tolerance at face value for it's synonym risk preference in the participant's statement, when the content and context clearly show it to be risk perception.

Temperance of Risk Preference

A third theme came out of the analysis of the data. The participants expressed an awareness that their risk preferences, though not changed or altered by events, could be tempered by them. An example of this came from a discussion with Participant 4 when they said, "So my risk preference never changed between single and married. However, my risk preference changed; it went from night-to-day when we had kids." As they discussed this further, it became apparent that their innate level of risk-taking had not changed. Instead, the addition of kids into the equation became a factor in the risk perception analysis process, i.e., the possible impact that an extensive loss would have on their children made the potential return not worth the possible

risks. I restated it this way, seeking confirmation—"So it sounds like you're always looking at potential risks and analyzing the opportunities and or the detriments that come from it." Participant 4 agreed with that clarification.

Participant 13, when discussing the often-noted trend of investors becoming more conservative around age 65, stated that even that may be more of an analysis situation rather than an actual change in risk preference, "Just like analyzing where you're at in your life, and then realizing the timeline has become shorter (participant13)". The same age-65 question was answered interestingly by Participant 2. "I put four children through private school and college here in Hawaii with the money that would have been in my retirement. So, I've always felt like I needed to aggressively make up for it (Participant 2)". Here, again, the innate risk preference is not altered, but rather the analysis of the situation precipitated a different investment course of action.

Summary of Themes of Risk Preference

The data analysis indicates that the sample of portfolio managers living and working in Hawaii during 2018 perceived no change in their personal risk preference from their experience with the Puna volcanic eruption. As the participants explained their basis for no change, evidence of confusion resulted from common risk perception and risk preference terminologies, such as the word "aggressive," which can refer to either the risk analysis or the tolerance of risk. The final theme is that risk preference can be tempered by events or analysis of the investor's position. The participants could hold back their natural aggressiveness or push past their natural conservatism depending on the analysis of the situation, resulting in their actions being, at least temporarily, contrary to their innate preference.

Summary

This study involved 17 participating portfolio managers who lived and worked in Hawaii from January 1, 2018, through December 31, 2018. The data is comprised of the responses to the demographic questions and semi-structured interview questions. The research methodology, when applied to the data, presents a picture of the recollections of the portfolio manager participants' perceptions of risk perception and risk preference before, during, and after experiencing the Puna volcanic eruption of 2018.

The themes that emerge from the analysis of the data regarding risk perception, or the objective analysis of risk, are:

1. The immediate analysis of the added risk that the natural disaster exposed to the managed portfolios. This was accomplished quite quickly at the start of the eruption.
2. Then during the eruption came the mitigation of risk, the question of how long it would last, and the seeking of investment opportunities.
3. After the eruption came the embedding of the event into the participant portfolio managers' processes of analyzing the potential risk of investments for their portfolios going into the future.

The themes that emerge from the analysis of the data regarding risk preference, or the subjective measure of risk, are:

1. There is no change to the personal risk preference of the participants after their experience with the Puna eruptions.
2. Evidence of confusion from common terminology used to describe elements of both risk perception and risk preference.

3. Risk preference can be tempered by events and objective analysis of the investor's current position.

The results presented in this chapter will be further discussed and interpreted in Chapter 5.

CHAPTER 5. DISCUSSION, IMPLICATIONS, RECOMMENDATIONS

This chapter concludes this dissertation by first presenting a summary of the results, a review of the literature that was published after this study was started, and a discussion of the results and conclusions based on the results. Next, a comparison of the findings with the theoretical framework and previous literature and an interpretation of the findings is presented. These sections are followed by discussing the limitations, implications, and recommendations arising from this study. This chapter then ends with a final conclusion.

Summary of the Results

An extensive literature review by Chuang and Schechter (2015) found risk preference to be stable during an individual's lifetime, with the noted exception of a trend to become more conservative around age 65. A subsequent literature review by Schildberg-Hörisch (2018) found conflicting and inconclusive findings on whether natural disasters had or had no effect on risk preference. The purpose of this study was to gather the recollected perceptions of Hawaii-based portfolio managers' risk perception and risk preference before, during, and after experiencing the Puna volcanic eruption as a qualitative inquiry into the stability of the individual's risk preference after a natural disaster.

One of the primary benefits that portfolio management has received from the pricing models, such as CAPM, derived from the modern portfolio theory, is the ability to price investments based on an analysis of risk and expected return with predictability. For the pricing models to accurately determine the price of an asset, risk preference must remain constant over time or, at a minimum, not fluctuate outside of acceptable statistical error. While studies have shown that risk preference changes around age 65, the changes are small enough and spread over

time (everyone does not turn 65 simultaneously) to not statistically influence the pricing models' outcome under the modern portfolio theory.

In direct contrast, natural disasters often happen with little or no notice and simultaneously affect the general population. Even if the changes were small in each individual, the aggregated changes in risk preference from the affected population could be statistically significant enough to cause the modern portfolio theory's pricing models to lose their predictive power—generating not only abnormal returns but also causing unpredictable price changes due to changes in risk preferences. This question is of interest to portfolio managers—whether natural disasters influence risk preference—since risk preference changes could have a cumulative effect on their managed portfolios' value above value changes caused by natural disaster-influenced abnormal returns.

A review of the literature began with the general topic of risk. Risk is broken down in the literature into two components, objective risk, which in the modern portfolio theory is commonly called risk perception, or our analysis of risk—and subjective risk, which in the modern portfolio theory is commonly called risk preference, or our propensity towards taking or accepting an analyzed risk (Andretta, 2014; Blumer, 1931; Hansson, 2010; McPhail & Rexroat, 1979). Thus, risk perception and risk preference are the objective and subjective components of risk within the modern portfolio theory. Each independently and co-dependently contribute to beta, the measurement of risk in the capital asset pricing model. Many quantitative studies seek to prove the modern portfolio theory, but since it is nominative (rule-based predictions of the future), descriptive results fail because of the influence of subsequent economic conditions (Dempsey, 2013; Levy, 2010; Smith & Walsh, 2013).

The amount of research on an investor's change in risk preference resulting from natural disasters is small. Future research on the topic will need to look to whether a change in the portfolio mix after a natural disaster is made because of a change in the portfolio managers' risk preference or because of a change in the projected return of a specific investment (Schildberg-Hörisch, 2018). This study fills a gap in the literature on how exogenous shocks such as natural disasters are perceived by portfolio managers.

This study used a qualitative design. The target population was comprised of portfolio managers who lived and worked in the State of Hawaii from January 1, 2018, through December 31, 2018. The sample includes 17 portfolio managers from the islands of O'ahu and Hawaii that experienced the Puna eruption at least on some level. A specific set of demographic questions and semi-structured questions were administered to the participants during a live, recorded, and then transcribed Zoom meeting. The data were analyzed using coding to produce the following themes:

Risk Perception:

At the start of the eruption:

Emergency analysis of additional risk resulting from the event

During the eruption:

Mitigation

Determination of possible duration of the event

Search for opportunities

After the eruption ceased:

Natural disasters factored into future analysis

Risk Preference:

No change in risk preference

Terminology confusion between risk perception and risk preference

Temperance of risk preference

Research Published After This Study Commenced

The researcher received final topic approval for this dissertation study following his last required residency in February 2020, which was followed by his comprehensive exams during the Spring quarter of 2020, and final IRB approval for this dissertation in August 2020. During this time period, the world was significantly influenced by the governmental actions and shutdowns resulting from the SARS-CoV-2, commonly known as Covid-19. The influence of these shutdowns and the pandemic on psychological, financial, and economic issues began to be immediately studied by academia. These studies, along with others, give some additional insight into our understanding of risk perception and risk preference when influenced by natural disasters, as summarized below.

Risk Perception

As would be expected, Covid-19 has altered the way people act and the way people think. The academic community rushed to publish numerous articles on aspects of risk perception after only a few months of experience with the natural disaster and the government lockdowns—and before things began to reopen once again. The results of this research match the findings of this study. For example, one study found a decaying power of events (Nils & Iurii, 2021) in the risk analysis process, similar to the expression of Participant 1 of this dissertation study:

> I think they will now always account for that externality into their analysis up to the point that the market becomes so great that they forget about it. Right? They forgot that there

was a financial crisis 12 years ago—so I say, near term towards the event, they will now add that additional risk in their analysis whereas before, that risk didn't exist. (Participant 1)

Additional research found that the growing interconnection of the global supply chain increased to the potential of cascading, catastrophic risk (Kong & Sun, 2021), that Covid-19 requires a rethink of predictive models (Bhattacharya et al., 2021), and that specialty crop farmers that experienced loss increased the risk premium they demanded (Wahdat et al., 2021). Even movies about human-caused natural disasters influence economic behavior (Kim, 2021). In these studies, the analysis process (risk perception) of people has been found to change with lived experience with natural disasters.

The reality that risk perception changes are present is evidenced by the findings of research that showed that the projections and portfolios were altered starting at the very beginning of the Covid-19 crisis and had to be continually adjusted as new information came in because the first adjustments failed to meet the mark (Ren & Li, 2021) and that when current mean versus medium stock index measurements were analyzed against the beginning of the Covid-19 crisis, abnormal returns were present (Sinha et al., 2020). All these articles agree with and support the findings of this study that natural disasters affect risk perception and that portfolio managers alter their portfolio mix accordingly.

Risk Preference

Research published after the commencement of this study is not as clear on the matter of risk preference, which is what set up the research questions for this study in the first place. For example, two studies found that decisions were being made on emotions (Bhanot et al., 2020; Zhang et al., 2021), with which maybe everyone with experience with life would agree. But the

authors linked emotion with risk preference, not risk perception, which leads us to whether this is part of risk perception or risk preference. The better argument may be that it fits more within risk perception because emotions would influence the decision-making process but would not affect risk preference (risk tolerance). The willingness to jump out of an airplane with a parachute on any given day may be influenced by the state of mind on any given day. Still, the propensity to take such a risk is likely not affected by emotion, just the analysis on that given day. Again, this may be part of the confusion in descriptions of risk preference intermingled with risk perception, as mentioned in Chapter 4, and an area for further research discussed below.

One recent study supports the finding of this study that the Puna eruption did not change perceptions of risk preference is a finding that the home culture of the portfolio managers continues to influence a person's risk preference even when the portfolio manager moves to and works in another country (Jiao, 2020). Basically, once it is set, it is set. However, a different finding came out of a study on people who lost everything in a recent typhoon in the Philippines. That study found no change in the risk preference of those who experienced the typhoon with the typical type of losses associated with such storms—but that there was a significant increase in the risk-taking preference of those who lost everything (Abatayo & Lynham, 2020). Their risk preference level increased. However, this may be more of an analysis issue than a preference issue since they may feel they have no choice but to make up for lost time.

In this study, some of the participants in Hawaii experienced direct losses from the volcanic eruption, but they were not significantly harmed. The same may hold for those who suffered losses from the Covid-19 pandemic, so we may generally expect not to see changes in risk preference there either. What we may learn from Abatayo and Lynham (2020) is that as a

person approaches a complete loss of everything from a natural disaster, it could influence a change in risk perception.

Discussion of the Results

The dichotomy between risk perception (objective) and risk preference (subjective) is similar to the Ancient Greek philosophers' paradox of knowledge from perception and knowledge from reason (H. Hermansson, 2012). When analyzing the potential risk (risk perception) of an investment option, the portfolio manager seeks to separate what is real from what is not real, and the result of this analysis makes the investment option either acceptable or not acceptable based upon the portfolio managers (or their client's) risk preference. This process is well understood and is an accepted, fundamental principle of the modern portfolio theory. This section discusses the results of this study while breaking the results down into the elements of risk perception and risk preference.

Risk Perception

Since risk perception is based on experience-based knowledge, it is not surprising that this study found that the experience of the Puna eruption natural disaster changed the Hawaii-based portfolio managers' risk perception. It is not like the risk was not there before the event. It might even have been an expected risk, albeit possibly remote—remote enough that portfolio managers ignored the threat. After all, it is an unreasonable expectation that portfolio managers can anticipate everything. Historically, the lower east rift of the Kīlauea volcano erupted in 1840, with its next eruption in 1955—with the next eruption being the 2018 Puna eruption (United States Geological Society, n.d.). This history means that of the 17 participants in this study, only three participants were alive the last time this area experienced an eruption, and they would have

been too small to remember it. So, as one of the participants put it, it was something like "one in 100 chances," but it now becomes real and something to factor into their investment analysis.

The changes followed a logical course. First, at the start of the eruption, an emergency analysis of additional risk resulting from the event was conducted. This can be likened to a "getting out of the way" or "seeking shelter" type of action that is solely for removal from harm. Then, as the eruption continued, mitigation efforts (often selling) were taken. The portfolio managers also tried to determine how long the eruption would continue and how, if it continued, it would affect their portfolios. At the same time, the portfolio managers were also searching for opportunities arising from the same actions taken by some to mitigate the risk. After the eruption ended, the portfolio managers added the possibility of natural disasters into their risk perception (objective risk) analysis in the future.

None of these themes are surprising, as objective measurements are based on experience. As science makes more and more discoveries, we measure things based on the combined knowledge of the past plus the new discoveries. The same happens with the objective measurement of risk or risk perception. As our understanding of risk increases, our ability to objectively measure it increases as well. Yet, experience seems always to be the best teacher. The universe of known information about objective risk or risk perception is vast, and it is likely that no one on earth knows it all. Portfolio managers make their measurements based on what they know, which is a combination of what they have learned plus what they have experienced. The direct exposure to the Puna eruption gave them experience with a natural disaster in such a way that natural disasters have now become part of their regular analysis process.

Risk Preference

Risk preference is at the heart of this study. As Schildberg-Hörisch (2018) noted, there has been conflicting research conducted on the question of whether natural disasters influence risk preference. Despite the psychological-based research on the stability of an individual's propensity to take risks, little has crossed over into financial or economic studies. While the stability of risk preference is assumed under the modern portfolio theory, testing has been inconclusive—except where the research has documented a general change in risk preference when a person turns 65.

A possible reason for the lack of research on the stability of risk preference is that it is not easily researched through quantitative studies, and the fields of finance and economics are quantitatively based. A case in point is the author of this study. My undergraduate and graduate school curriculum have all been quantitatively based. Even my current PhD program has been quantitatively based, with two advanced statistics courses but with no classes in qualitative studies. Working on this dissertation came with an extensive learning curve in qualitative analysis. The uniqueness of each individual's risk preference makes the topic of change of risk preference hard to quantify since it cannot be generically measured across a population—hence the benefit of a qualitative study on the subject.

The purpose of this qualitative study was to obtain the recollected perceptions of Hawaii-based portfolio managers' risk perception and risk preference before, during, and after experiencing the Puna volcanic eruption as a mechanism of inquiry into the stability of the individual's risk preference after experiencing a natural disaster. So the question is—do natural disasters change the perceptions of risk preference of those who experience them? The answer

from this study is that natural disasters do change the perceptions of risk perceptions (objective risk) but that they do not change an individual's perceptions of risk preference (subjective risk).

Conclusions Based on the Results

In this section, the findings are compared against the theoretical framework and the previous literature, and the results are interpreted.

Comparison of the Findings with the Theoretical Framework and Previous Literature

The modern portfolio theory began with Markowitz (1952) proposing a solution to a complex portfolio optimization problem using linear mathematics. The linear mathematical formulas contain risk preference as a constant, meaning it does not change from investment to investment nor from time to time within the individual. From its initial creation down to the present day, modern portfolio theory-based research is dominated by large-scale, quantitative studies (Burton, 2007). The overall general economic conditions have been relatively stable since the introduction of the modern portfolio theory and its pricing models in the 1950s (Roser, 2013). During this same time, investors' risk preference has been assumed to be constant (Chuang & Schechter, 2015).

The majority of the research involving natural disasters and the modern portfolio theory are event studies utilizing advanced statistics seeking to discover relationships between the event and abnormal returns in the marketplace (Alkhatib & Harasheh, 2018; Corrado, 2011; Punwasi & Brijlal, 2016; Urban & Quilter, 2006). Beginning as early as Celik (2012), researchers suggested the need to investigate the role modern portfolio theory took in actual financial practice. Notably missing is research on changes in risk perception and risk preference resulting from natural disasters. Chuang and Schechter (2015) concluded that there were no systemic changes in risk preference after an extensive literature review except for the changes that

occurred at approximately age 65. Schildberg-Hörisch (2018), in a subsequent follow-up literature review, noted that there was some evidence that extreme shocks, including natural disasters, could change risk preferences but that the literature contained contradictions, so the finding was determined to be inconclusive.

The findings of this study suggest that natural disasters do not affect perceptions of risk preference. In obtaining the data, however, the researcher discovered something that may be the cause of the inconclusive findings that Schildberg-Hörisch (2018) found in the literature. The research process used to obtain most of the data for published articles between Chuang and Schechter (2015) and Schildberg-Hörisch (2018) was self-identifying survey instruments. During the semi-structured interview process in this study, I noticed a nearly universal issue as the participants described their risk preference—whether their risk preference changed from before to after the Puna eruption, and whether they made changes to their portfolio mix as a result of changes in their risk preference. Although each participant understood the concept of risk preference, their answers contained things that would better belong to risk perception—and indeed, with follow-up questioning, each confirmed the issue and the parts that belonged to risk perception. As a result, the inconclusive findings uncovered by Schildberg-Hörisch (2018) may result from false self-identification of risk preference versus risk perception in the survey instruments.

Interpretation of the Findings

The findings of this study fit perfectly within the theoretical framework and the literature review in Chapter 2. The results also fit with the methodology in Chapter 3 and with the scope of the published research after this study commenced. Everything in the literature and even common experience makes us appreciate the understanding that there is a dichotomy of thought

between our objective analysis of risk (risk perception) and our propensity or desire to take a risk (risk preference).

Our passion, or lack thereof, to take risks is constant—it is in our nature. This desire is the anchor against which we each quantify risk perception when analyzing and quantifying the risk of an investment. One side, risk perception, uses all the options at its disposal to analyze the objective risk of an investment. But the other side is the ultimate anchor that sets the standard against which objective risk is used and interpreted. The analysis side changes based on experience. The nature side does not.

Natural disasters can create unexpected situations. When this dissertation topic was approved at my final residency in Atlanta in February 2020, I easily traveled between my home and Atlanta. The school provided hand sanitizer as a precaution. I then attended a major convention in New Orleans for my work the first week of March, but attendance was less than expected due to fear of Covid-19. While attempting to celebrate my daughter's birthday only a week or so later at a spa resort, my family was forced out before the scheduled departure date due to the mandate of the Governor of the State and the President of the United States that everything be closed for two weeks. Two years later, some places are barely starting to open up fully again.

When portfolio managers in Hawaii experienced the Puna eruption, they analyzed the situation and made changes to their portfolios based on the new circumstances. Still, that analysis was permanently anchored against the individuals' propensity to take risks—or risk preference, which was not changed. We see that same thing with Covid-19, which could also explain the different attitudes and responses. Some people have a low tolerance for risk. These people analyze the information about Covid-19 and support closing everything, the masks, and other

mandates. Other people have a high tolerance for risk. These people analyzed the same information about Covid-19 and wondered why we were doing all this. It is not that they necessarily deny the existence of the risk—but instead, they feel the level of risk is acceptable.

This dichotomy between the objective, anchored by the subjective, makes the modern portfolio theory and its star formula, CAPM, work. If there were no variance in the objective analysis of risk, there would be no measurement of investment risk based on this variance. If there were no anchors, i.e., if risk preference was not a constant, there would be no predictive value in the modern portfolio theory's pricing formulas and, therefore, no optimized portfolios. While the low-risk-takers may never understand the high-risk-takers and vice versa, the reality is that each anchors their analysis of the same objective risk differently. And that perception does not appear to change after a lived experience with natural disasters.

Limitations

The structural designs for qualitative research have become well-defined and well-delineated, as is the exploration of experience with events through the use of interviews utilizing semi-structured questions (Giorgi et al., 2017; Leedy et al., 2019). In this study, the design worked well, providing conclusive findings on all the research questions. However, there were some limitations experienced during the implementation of the data gathering procedure.

The most obvious was already mentioned in the preceding chapters—the inability to obtain female participants. As previously noted, the field of portfolio management in Hawaii is dominated by males. A quick review of portfolio management companies on the internet reveals that most firms have only one or two female portfolio managers, if any at all. However, no female portfolio managers responded to the participation solicitation emails. The researcher

attempted to gain female participants by sending follow-up emails to female practitioners but received no replies. The failure to obtain female participants should not be catastrophic.

The reason it might not be catastrophic is that, as mentioned in this dissertation, elements of modern portfolio theory are omnipresent in finance and economics, and modern portfolio theory with it its asset pricing models are the gold standard of finance, being taught in every business school (Levy, 2010). Accordingly, there would likely be no difference between the implantation of the elements of modern portfolio theory and the risk perception analysis process between females and males—and likely as well no difference in the influence of the Puna eruption on risk preference. Still, verification of this assumption would be beneficial.

Another limitation is the number of participants. Following the procedures described in Chapter 3, a sample of 17 portfolio managers agreed to participate in the study. The number of participants falls within the recommended range suggested by Eatough and Smith (2017), Englander (2012), and Leedy et al. (2019). While 17 participants is two over the target and it appears that saturation was reached since no new themes or categories emerged, some issues should be noted.

The median age of the participant group is 58 and the median age of the portfolio management industry as a whole is 48 (U.S. Bureau of Labor Statistics, 2020), making the sample older than the population of portfolio managers as a whole. While the data from this study did not show a difference between the responses of the older versus the younger participants, a closer to the population norm sample may have different results. Also, although the total number of participants fit well within the established norms, interviewing additional participants could have provided extra depth.

Another limitation is the nearness of the eruption to the portfolio managers. As mentioned in Chapter 3, the expert review of the semi-structured questions raised the issue of actual loss or actual exposure to loss from the Puna eruption. The majority of portfolio management firms and portfolio managers live on the island of O'ahu. This distance/experience factor does not appear to be an issue since all the participants modified their risk perception and their asset mixes as a result of the Puna eruption, and there was no noticeable difference between the participants' responses regardless of their distance from the eruption site.

A final limitation is the researcher. As mentioned, my training is largely in the quantitative arena. This qualitative study came with a very steep learning curve, and there were challenges during the process because of that inexperience during the data collection process. My mentor and my committee, along with others in key positions and Capella University, were extremely helpful in correcting errors and ensuring that proper procedures were learned and implemented. Still, a more experienced qualitative researcher may have obtained more data and/or analyzed the data differently.

There is also a known delimiter. This study only investigated the influence of natural disasters on portfolio managers. This population was specifically chosen because the population is trained in modern portfolio theory and is trained to deal with risk perception and risk preferences as job requirements of the profession, which eliminated the need to educate the participants on the meanings of terms, etc. There are many investors that do not have portfolios. There may be a difference because of this training on perceptions of risk perception and risk preference before, during, and after an experience with a natural disaster.

Implications of the Study

The findings of this study confirm the rationale for risk preference to be a constant in the asset pricing models derived under the modern portfolio theory (Levy, 2010; Levy et al., 2012). The findings also support a hypothesis that the inconclusive findings in the literature by Schildberg-Hörisch (2018) on whether shocks such as natural disasters influence risk preference may be based on self-reporting (self-awareness) issues as participants respond to surveys—compared to that which can be discovered through the discussion that comes out of the semi-structured questioning process with a live interviewer.

From a practical standpoint, portfolio managers may take comfort from the finding that risk preference is not affected by natural disasters. Portfolio managers are required by professional standards to match their clients' risk preferences to the portfolio. The findings of this study should give comfort to portfolio managers that when natural disasters happen, they should adjust the portfolio mix based on the economic impact of the event, but they can move forward with just the risk perception process without worrying that their client's risk preference was altered. This means that practitioners do not have to recreate the entire portfolio based on a change in the anchor of a modified risk preference—they only need to adjust the mix based on the new objective risk information.

Researcher's Bias—Reflexivity

As mentioned in Chapter 3, the researcher plays a significant role in the process of a qualitative study. In fulfilling this role, the researcher becomes an instrument used in the study. In this study, the researcher set the parameters, established the boundaries, elicited the data from the participants through interviews, and ultimately, through the iterative coding and data analysis

process, became the judge of what the data revealed on the topic of risk in the modern portfolio theory. Independence from the data and neutrality in the process is challenging.

This challenge was tough during the interview process as I found this role much harder to play than I had previously imagined. One of the most challenging parts came from my industry and educational experience. I have been working in finance-related sectors since 1981. As a result, risk perception and risk preference are topics I have dealt with for four decades. If that was not enough, my current doctorate studies included these topics—and I then immersed myself in the literature on these topics to complete Chapter 2 and find the research questions for this study through the literature review.

My familiarity and expertise with the subjective matter influenced my interpretation of participant statements during the interviews. This influence exhibited itself in the ways I sought to clarify participant statements. On occasion, after a long or after a somewhat confusing participant response, I would attempt to summarize what I understood them to say. In so doing, I used words that would elicit a response that would specifically answer this study's research questions, which tainted the data and the information in subsequent data received from that participant, which then had to then be removed from the analysis.

Underlying factors influencing my actions are the extensive training I received and my extensive work with quantitative research, where the focus is on the quickest and most efficient tests to find for either the acceptance or rejection of a hypothesis. This quantitatively based focus on specific answers ignores the richness that develops out of proper qualitative studies. Indeed, the findings and conclusions of this study could not have emerged without the participants' freedom to express their thoughts, feelings, and perceptions using their own wording and terms without my leading them with leading follow-up questions.

My dissertation experience resulted in me obtaining a deeper understanding of the essential structuring of qualitative study data gathering and the absolute adherence to the structure once it is established. I have discovered the richness and depth of the information that can be learned through qualitative studies. There is no question in my mind that my future research will include a significant amount of qualitative work, and I look forward to ensuring bias is kept within proper bounds.

Recommendations for Further Research

The researcher recommends two areas for additional research: (1) those developed directly from the data, and (2) those based on delimitations.

Recommendations Developed Directly from the Data

The data suggests that self-awareness of risk preference, or one's own propensity to take risky actions, is a challenge. This self-awareness issue may be the reason for the inconclusive findings from the literature by Schildberg-Hörisch (2018). Further research into the best methods and even the ability to self-identify risk preference through quantitative survey methods may be warranted.

Another recommendation is a study to re-evaluate the accepted premise that risk preference changes around age 65. Discussions with some of the older participants (those over 65), while not part of the purpose of this study, did bring light to this issue enough to suggest that risk preference does not change around age 65, but rather the changes are due to changes in risk perception. Some said that they might need the money in a few years, so longer-term investments were eliminated. Also, some mentioned that investments with higher risk were no longer desirable because there was less time to make money back if a loss was incurred. These statements might suggest that what has been designated in the literature as a change in risk

preference at 65 is a change in risk perception as the time factor and the ability to absorb losses is calculated into the analysis. Older investors might not become more conservative. Instead, their analysis may be what leads them to take on less risky investments.

Recommendations Based on Delimitations

As mentioned above, this study only investigated the influence of natural disasters on portfolio managers due to the short time frame dissertations require and the necessity to produce a viable result within the confines of the dissertation process. As a result, the population for this study was specifically chosen because the population is trained in modern portfolio theory and is trained to deal with risk perception and risk preference as job requirements of the profession. This training eliminated the need to educate the participants on the meanings of terms, etc. However, there are many investors that do not have portfolios. There may be a difference because of this training on the influence of a natural disaster on risk preference.

Conclusion

Ever since Markowitz (1952) first proposed a linear mathematical solution for optimizing investment portfolios by diversification based on risk preference in his PhD dissertation, academia in the fields of finance and economics has sought to prove or disprove modern portfolio theory (Dempsey, 2013; Levy, 2010). Others, seeking a market behavioral model instead of a market pricing model, added additional elements, modified key assumptions, and created new theories (Fama, 1970; Fama & French, 2015; Jovanovic & Schinckus, 2013; Lekovic, 2019). No matter what the justification, alteration, or creation concluded, two key elements remained: there is an objective and a subjective component to risk.

The objective component of risk involves the external analysis of data. This objective component is where the portfolio manager digs into the numbers, searches through the economic

indicators, searches for trends, etc., to determine the chances of accurate investment projections. This process is known as risk perception. The subjective component of risk involves the personal makeup of the individual. Some people are perfectly fine with the idea of jumping out of an airplane with a parachute, while others will not even get into the plane in the first place. This concept is known as risk preference. The modern portfolio theory sets individual prices and portfolio optimization as a combination of these two, with risk preference set as an unchanging constant by the individual that requires price adjustments based on the results of the objective analysis—the idea being that the high risk-taker might pay the operator to jump out of a plane while the operator might have to pay the low risk-taker to do the same thing. The objective risk analysis for each is the same, but a pricing difference is required depending on the risk preference. The variance between these two is the measurement of investment risk.

So, what if risk preference, rather than being a constant, was a variable? That could possibly explain why empirical proof of CAPM is so elusive (Smith & Walsh, 2013). But the findings in the literature suggest risk preference is stable with the exception of a general turn toward becoming less aggressive around age 65 (Chuang & Schechter, 2015). But as research into the abnormal returns that are created as a result of natural disasters increased due to the computer capacity increases that allowed for the running of more complex statistical analysis, questions began to be raised as to whether substantial shocks, such as natural disasters, could influence a change in an individual's risk preference (Schildberg-Hörisch, 2018).

On May 3, 2018, the Kīlauea volcano erupted along the lower rift, which is a relatively rare occurrence—this being only the second time since 1840 (United States Geological Society, n.d.). Commonly referred to as the lower Puna eruption, it continued for 124 days, wiped out subdivisions, and crossed an important highway, thereby blocking critical access to many

communities as it made its way to the ocean, where it then ultimately created 875 acres of new land before stopping on September 4, 2018.

This event created the opportunity to investigate the recollected perceptions of Hawaii-based portfolio managers' risk perception and risk preference before, during, and after experiencing the Puna volcanic eruption as a mechanism of inquiry into the stability of the individual's risk preference after a natural disaster through a semi-structured question qualitative study. As might have been expected, the first result was a finding that the Puna eruption changed the perceptions of the Hawaii-based portfolio managers' risk perception (the analysis process). The second result was that the Puna eruption did not change the perceptions of risk preference of the same portfolio managers.

From an academic standpoint, the interviews revealed that even highly-trained portfolio managers who are well versed in the modern portfolio theory's risk preference concept tended to mix risk perception issues into the questions discussing risk preference. Once the interviewer clarified the responses with the participants, it was easily separated. Most of the studies between Chuang and Schechter (2015) and Schildberg-Hörisch (2018) that led Schildberg-Hörisch (2018) to find the conflicting data on the influence of natural disasters on risk preference to be inconclusive may be a result of false self-identification of risk preference on the survey instruments. The finding in this study that perceptions of risk preference remain stable supports the rationale for risk preference being a constant in asset pricing formulas created under the modern portfolio theory.

From a practice standpoint, portfolio managers may benefit from the finding that risk preference is not influenced by natural disasters. Portfolio managers, per industry standards, are required to set up client portfolios in alignment with the client's risk preference. The finding that

when natural disasters happen, risk preference does not change means they would not have to alter a portfolio to match a new risk preference—they only must alter the portfolio mix based on the changes in risk perception.

References

Abatayo, A. L., & Lynham, J. (2020). Risk preferences after a typhoon: An artefactual field experiment with fishers in the Philippines. *Journal of Economic Psychology*, *79*, 102–195. https://doi.org/10.1016/j.joep.2019.102195

Al-Fadly, A. (2020). Impact of COVID-19 on SMEs and employment. *Entrepreneurship and Sustainability Issues*, *8*(2), 629–648. https://doi.org/10.9770/jesi.2020.8.2(38)

Alkhatib, A., & Harasheh, M. (2018). Performance of exchange traded funds during the Brexit referendum: An event study. *International Journal of Financial Studies*, *6*(3), 1–12. https://doi.org/10.3390/ijfs6030064

Andretta, M. (2014). Some considerations on the definition of risk based on concepts of systems theory and probability. *Risk Analysis: An International Journal*, *34*(7), 1184–1195. https://doi.org/10.1111/risa.12092

Arslan, R. C., Brümmer, M., Dohmen, T., Johanna, D., Hertwig, R., & Wagner, G. G. (2020). How people know their risk preference. *Scientific Reports (Nature Publisher Group)*, *10*(1). https://doi.org/10.1038/s41598-020-72077-5

Avvisati, G., Bellucci Sessa, E., Colucci, O., Marfè, B., Marotta, E., Nave, R., Peluso, R., Ricci, T., & Tomasone, M. (2019). Perception of risk for natural hazards in Campania Region (Southern Italy). *International Journal of Disaster Risk Reduction*, *40*, 101–164. https://doi.org/10.1016/j.ijdrr.2019.101164

Ayub, U., Kausar, S., Noreen, U., Zakaria, M., & Jadoon, I. A. (2020). Downside risk-based six-factor capital asset pricing model (CAPM): A new paradigm in asset pricing. *Sustainability*, *12*(17), 6756. https://doi.org/10.3390/su12176756

Babcock, B. A. (2015). Using cumulative prospect theory to explain anomalous crop insurance coverage choice. *American Journal of Agricultural Economics*, *97*(5), 1371–1384. https://doi.org/10.1093/ajae/aav032

Bachelier, L. (2006). *Louis Bachelier's theory of speculation: The origins of modern finance* (M. Davis & A. Etheridge, Eds.). Princeton University Press.

Bao, L., & Fritchman, J. C. (2018). Information of complex systems and applications in agent based modeling. *Scientific Reports (Nature Publisher Group); London*, *8*, 1–11. https://doi.org/10.1038/s41598-018-24570-1

Bechara, A. (2004). The role of emotion in decision-making: Evidence from neurological patients with orbitofrontal damage. *Brain and Cognition*, *55*(1), 30–40. https://doi.org/10.1016/j.bandc.2003.04.001

Bechara, A. (2005). Decision making, impulse control and loss of willpower to resist drugs: A neurocognitive perspective. *Nature Neuroscience*, *8*(11), 1458–1463. https://doi.org/10.1038/nn1584

Berkes, F. (2007). Understanding uncertainty and reducing vulnerability: Lessons from resilience thinking. *Natural Hazards; Dordrecht*, *41*(2), 283–295. https://doi.org/10.1007/s11069-006-9036-7

Best, J. (2020). The quiet failures of early neoliberalism: From rational expectations to Keynesianism in reverse. *Review of International Studies*, *46*(5), 594–612. https://doi.org/10.1017/S0260210520000169

Bhanot, S. P., Chang, D., Cunningham, J. L., & Ranson, M. (2020). Emotions and decisions in the real world: What can we learn from quasi-field experiments? *PLoS One*, *15*(12). https://doi.org/10.1371/journal.pone.0243044

Bhattacharya, S., Smark, C., & Mir, M. (2021). Covid 19: Social, financial and economic implications. *Australasian Accounting Business & Finance Journal*, *15*(1), 1–4. https://doi.org/10.14453/aabfj.v15i1.1

Blumer, H. (1931). Science without concepts. *American Journal of Sociology*, *36*(4), 515–533. https://doi.org/10.1086/215473

Boholm, Å., & Corvellec, H. (2011). A relational theory of risk. *Journal of Risk Research*, *14*(2), 175–190. https://doi.org/10.1080/13669877.2010.515313

Boholm, M. (2018). Risk association: Towards a linguistically informed framework for analysing risk in discourse. *Journal of Risk Research*, *21*(4), 480–501. https://doi.org/10.1080/13669877.2016.1223158

Bradley, E. H., Curry, L. A., & Devers, K. J. (2007). Qualitative data analysis for health services research: Developing taxonomy, themes, and theory. *Health Services Research*, *42*(4), 1758–1772. https://doi.org/10.1111/j.1475-6773.2006.00684.x

Browne, K. E., O'Connell, C., & Yoder, L. M. (2018). Journey through the Groan Zone with academics and practitioners: Bridging conflict and difference to strengthen disaster risk reduction and recovery work. *International Journal of Disaster Risk Science*, *9*(3), 421–428. https://doi.org/10.1007/s13753-018-0180-y

Burton, B. (2007). Qualitative research in finance – pedigree and renaissance. *Studies in Economics and Finance*, *24*(1), 5–12. https://doi.org/10.1108/10867370710737355

Cao, G., Xu, W., & Guo, Y. (2015). Effects of climatic events on the Chinese stock market: Applying event analysis. *Natural Hazards*, *77*(3), 1979–1992. https://doi.org/10.1007/s11069-015-1687-9

Cartier, Y., Creatore, M. I., Hoffman, S. J., & Potvin, L. (2018). Priority-setting in public health research funding organisations: An exploratory qualitative study among five high-profile funders. *Health Research Policy and Systems; London*, *16*. https://doi.org/10.1186/s12961-018-0335-8

Celik, S. (2012). Theoretical and empirical review of asset pricing models: A structural synthesis. *International Journal of Economics and Financial Issues; Mersin*, *2*(2), 141–178. https://econjournals.com/index.php/ijefi

CFA Institute. (2014). *Code of ethics and standards of professional conduct*. https://www.cfainstitute.org/-/media/documents/code/code-ethics-standards/code-of-ethics-standards-professional-conduct.pdf

Charness, G., Garcia, T., Theo, O., & Claire, V. M. (2020). Do measures of risk attitude in the laboratory predict behavior under risk in and outside of the laboratory? *Journal of Risk and Uncertainty*, *60*(2), 99–123. https://doi.org/10.1007/s11166-020-09325-6

Chenail, R. J. (2011). Interviewing the investigator: Strategies for addressing instrumentation and researcher bias concerns in qualitative research. *The Qualitative Report*, *16*(1), 255–262. https://doi.org/10.46743/2160-3715/2011.1051

Cheng, H., & Guo, R. (2020). Risk preference of the investors and the risk of peer-to-peer lending platform. *Emerging Markets Finance & Trade*, *56*(7), 1520–1531. https://doi.org/10.1080/1540496X.2019.1574223

Chuang, Y., & Schechter, L. (2015). Stability of experimental and survey measures of risk, time, and social preferences: A review and some new results. *Journal of Development Economics*, *117*, 151–170. https://doi.org/10.1016/j.jdeveco.2015.07.008

Corrado, C. J. (2011). Event studies: A methodology review. *Accounting & Finance*, *51*(1), 207–234. https://doi.org/10.1111/j.1467-629X.2010.00375.x

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). SAGE Publications, Inc.

Crist, J. D., & Tanner, C. A. (2003). Interpretation/analysis methods in Hermeneutic interpretive phenomenology. *Nursing Research*, *52*(3), 202–205. https://doi.org/10.1097/00006199-200305000-00011

Cubitt, R., van de Kuilen, G., & Mukerji, S. (2018). The strength of sensitivity to ambiguity. *Theory and Decision*, *85*(3–4), 275–302. https://doi.org/10.1007/s11238-018-9657-9

Danbolt, J., Siganos, A., & Tunyi, A. (2016). Abnormal returns from takeover prediction modelling: Challenges and suggested investment strategies. *Journal of Business Finance & Accounting*, *43*(1/2), 66–97. https://doi.org/10.1111/jbfa.12179

Dearnley, C. (2005). A reflection on the use of semi-structured interviews. *Nurse Researcher*, *13*(1), 19–28. https://doi.org/10.7748/nr2005.07.13.1.19.c5997

De Bortoli, D., da Costa Jr., N., Goulart, M., & Campara, J. (2019). Personality traits and investor profile analysis: A behavioral finance study. *PLoS One; San Francisco*, *14*(3). https://doi.org/10.1371/journal.pone.0214062

de Jong, M. (2018). Portfolio optimisation in an uncertain world. *Journal of Asset Management; London*, *19*(4), 216–221. https://doi.org/10.1057/s41260-017-0066-3

Del Vigna, M. (2014). A note on the existence of CAPM equilibria with homogeneous cumulative prospect theory preferences. *Decisions in Economics & Finance*, *37*(2), 341–348. https://doi.org/10.1007/s10203-012-0140-8

Dempsey, M. (2013). The capital asset pricing model (CAPM): The history of a failed revolutionary idea in finance? *Abacus*, *49*, 7–23. https://doi.org/10.1111/j.1467-6281.2012.00379.x

Diefenbach, T. (2009). Are case studies more than sophisticated storytelling?: Methodological problems of qualitative empirical research mainly based on semi-structured interviews. *Quality and Quantity*, *43*(6), 875–894. https://doi.org/10.1007/s11135-008-9164-0

Dittrich, L. O., & Srbek, P. (2020). Is violation of the random walk assumption an exception or a rule in capital markets? *Atlantic Economic Journal*, *48*(4), 491–501. https://doi.org/10.1007/s11293-020-09686-y

Dönmez, C. Ç., & Atalan, A. (2019). Developing statistical optimization models for Urban Competitiveness Index: Under the boundaries of econophysics approach. *Complexity*, *2019*, 1–11. https://doi.org/10.1155/2019/4053970

Durt, C. (2020). The embodied self and the paradox of subjectivity. *Husserl Studies*, *36*(1), 69–85. https://doi.org/10.1007/s10743-019-09256-4

Eatough, V., & Smith, J. (2017). Interpretative phenomenological analysis. In *The SAGE Handbook of qualitative research in psychology* (pp. 193–209). SAGE Publications Ltd. https://doi.org/10.4135/9781526405555

Egidi, M. (2020). Can rationality in economics and sociology be framed under unified common principles? *Œconomia. History, Methodology, Philosophy*, *10–1*, 155–170. https://doi.org/10.4000/oeconomia.7720

Ehling, P., Graniero, A., & Heyerdahl-Larsen, C. (2018). Asset prices and portfolio choice with learning from experience. *Review of Economic Studies*, *85*(3), 1752–1780. https://doi.org/10.1093/restud/rdx077

Ehm, C., Laudenbach, C., & Weber, M. (2018). Focusing on volatility information instead of portfolio weights as an aid to investor decisions. *Experimental Economics*, *21*(2), 457–480. https://doi.org/10.1007/s10683-017-9537-0

Englander, M. (2012). The interview: Data collection in descriptive phenomenological human scientific research. *Journal of Phenomenological Psychology*, *43*(1), 13–35. https://doi.org/10.1163/156916212X632943

Erdik, M. (2017). Earthquake risk assessment. *Bulletin of Earthquake Engineering*, *15*(12), 5055–5092. https://doi.org/10.1007/s10518-017-0235-2

Fama, E. F. (1970). Efficient capital markets. A review of theory and empirical work. *The Journal of Finance*, *25*(2), 383–417. https://doi.org/10.1111/j.1540-6261.1970.tb00518.x

Fama, E. F., & French, K. R. (1996). Multifactor explanations of asset pricing anomalies. *The Journal of Finance*, *51*(1), 55–84. https://doi.org/10.1111/j.1540-6261.1996.tb05202.x

Fama, E. F., & French, K. R. (2015). A five-factor asset pricing model. *Journal of Financial Economics*, *116*(1), 1–22. https://doi.org/10.1016/j.jfineco.2014.10.010

Fan, L., & Chatterjee, S. (2018). Application of situational stimuli for examining the effectiveness of financial education: A behavioral finance perspective. *Journal of Behavioral and Experimental Finance*, *17*, 68–75. https://doi.org/10.1016/j.jbef.2017.12.009

Feldman, T., & Liu, S. (2018). A new predictive measure using agent-based behavioral finance. *Computational Economics; Dordrecht*, *51*(4), 941–959. https://doi.org/10.1007/s10614-017-9652-1

Feria-Domínguez, J., Paneque, P., & Gil-Hurtado, M. (2017). Risk perceptions on hurricanes: Evidence from the U.S. stock market. *International Journal of Environmental Research and Public Health*, *14*(6), 600. https://doi.org/10.3390/ijerph14060600

Ferreira, L., Borenstein, D., Righi, M. B., & de Almeida Filho, A. T. (2018). A fuzzy hybrid integrated framework for portfolio optimization in private banking. *Expert Systems with Applications*, *92*, 350–362. https://doi.org/10.1016/j.eswa.2017.09.055

Ferreira, P., & Loures, L. C. (2020). An econophysics study of the S&P Global Clean Energy Index. *Sustainability*, *12*(2), 662. https://doi.org/10.3390/su12020662

Filbeck, G., Ricciardi, V., Evensky, H. R., Fan, S. Z., Holzhauer, H. M., & Spieler, A. (2017). Behavioral finance: A panel discussion. *Journal of Behavioral and Experimental Finance*, *15*, 52–58. https://doi.org/10.1016/j.jbef.2017.07.008

Fink, H., Geissel, S., Sass, J., & Seifried, F. T. (2019). Implied risk aversion: An alternative rating system for retail structured products. *Review of Derivatives Research*, *22*(3), 357–387. https://doi.org/10.1007/s11147-018-9151-0

Fink, J., & Fink, K. (2014). Do seasonal tropical storm forecasts affect crack spread prices? *Journal of Futures Markets*, *34*(5), 420–433. https://doi.org/10.1002/fut.21607

Fisher, P. J. (2020). Financial risk tolerance among white and hispanic households. *Journal of Personal Finance*, *19*(1), 33–47. https://doi.org/10.2139/ssrn.2941172

Flynn, S. V., & Korcuska, J. S. (2018). Credible phenomenological research: A mixed-methods study. *Counselor Education and Supervision*, *57*(1), 34–50. https://doi.org/10.1002/ceas.12092

Föllmer, H., & Weber, S. (2015). The axiomatic approach to risk measures for capital determination. *Annual Review of Financial Economics*, *7*(1), 301–337. https://doi.org/10.1146/annurev-financial-111914-042031

Francis, J. C., & Kim, D. (2013). *Modern portfolio theory: Foundations, analysis, and new developments*. John Wiley & Sons, Incorporated.

Gaillard, J. C., & Peek, L. (2019). Disaster-zone research needs a code of conduct. *Nature*, *575*(7783), 440–442. https://doi.org/10.1038/d41586-019-03534-z

Garcia, F., González-Bueno, J., Guijarro, F., Oliver, J., & Tamošiūnienė, R. (2020). Multiobjective approach to portfolio optimization in the light of the credibility theory. *Technological and Economic Development of Economy*, *26*(6), 1165–1186. https://doi.org/10.3846/tede.2020.13189

Ghosh, B., Krishna, M. C., Rao, S., Kozarević, E., & Pandey, R. K. (2018). Predictability and herding of bourse volatility: An econophysics analogue. *Investment Management & Financial Innovations; Sumy*, *15*(2), 317–326. https://doi.org/10.21511/imfi.15(2).2018.28

Giorgi, A., Giorgi, B., & Morley, J. (2017). The descriptive phenomenological psychological method. In *The SAGE Handbook of qualitative research in psychology* (pp. 176–192). SAGE Publications Ltd. https://doi.org/10.4135/9781526405555

Haimes, Y. Y. (2009). On the complex definition of risk: A systems-based approach. *Risk Analysis: An International Journal*, *29*(12), 1647–1654. https://doi.org/10.1111/j.1539-6924.2009.01310.x

Halkos, G., & Zisiadou, A. (2020). Is investors' psychology affected due to a potential unexpected environmental disaster? *Journal of Risk and Financial Management*, *13*(7), 151. https://doi.org/10.3390/jrfm13070151

Hansson, S. O. (2010). Risk: Objective or subjective, facts or values. *Journal of Risk Research*, *13*(2), 231–238. https://doi.org/10.1080/13669870903126226

Helmut, S., & Victor, L. (Eds.). (2018). *Rationality in the social sciences* (1st ed.). Springer.

Heo, W., Grable, J. E., & Rabbani, A. G. (2018). A test of the relevant association between utility theory and subjective risk tolerance: Introducing the Profit-to-Willingness ratio. *Journal of Behavioral and Experimental Finance*, *19*, 84–88. https://doi.org/10.1016/j.jbef.2018.05.003

Hermansson, C. (2018). Can self-assessed financial risk measures explain and predict bank customers' objective financial risk? *Journal of Economic Behavior & Organization*, *148*, 226–240. https://doi.org/10.1016/j.jebo.2018.02.018

Hermansson, H. (2012). Defending the conception of "objective Risk." *Risk Analysis: An International Journal*, *32*(1), 16–24. https://doi.org/10.1111/j.1539-6924.2011.01682.x

Himanshu, J. (2017). Constructing international equity portfolio for BRIC nations using modified global CAPM returns. *Abhigyan*, *35*(1), 25–49. https://www.fsm.ac.in/abhigyan-2017

Hoffmann, C. H. (2018). On conceptualizing risk: Breaking the dichotomy between Knightian risk and uncertainty. *Quarterly Journal of Austrian Economics*, *21*(3), 209–245. https://qjae.scholasticahq.com/

Hopper, T., & Powell, A. (1985). Making sense of research into the organizational and social aspects of management accounting: A review of its underlying assumptions. *Journal of*

Management Studies, *22*(5), 429–465. https://doi.org/10.1111/j.1467-6486.1985.tb00007.x

Hoque, Z., Covaleski, M. A., & Gooneratne, T. N. (2013). Theoretical triangulation and pluralism in research methods in organizational and accounting research. *Accounting, Auditing & Accountability Journal*, *26*(7), 1170–1198. https://doi.org/10.1108/aaaj-may-2012-01024

Howard, C. T. (2014). Behavioral portfolio management. *Journal of Behavioral Finance & Economics, Forthcoming*, 37. https://doi.org/10.2139/ssrn.2210032

Huber, C., & Huber, J. (2019). Scale matters: Risk perception, return expectations, and investment propensity under different scalings. *Experimental Economics*, *22*(1), 76–100. https://doi.org/10.1007/s10683-018-09598-4

Iqbal, N., Mushtaque, T., & Shahzadi, I. (2019). Business Angels and investment rejection reasons: A qualitative study by using exploratory sequential mixed method. *Journal of Business Strategies; Karachi*, *13*(1), 161–182. https://doi.org/10.29270/jbs.13.1(2019).081

Isore, M. (2018). Changes in natural disaster risk: Macroeconomic responses in selected Latin American countries. *Economies; Basel*, *6*(1), 13. https://doi.org/10.3390/economies6010013

Jemna, L. M. (2016). Qualitative and mixed research methods in economics: The added value when using qualitative research methods. *Journal of Public Administration, Finance and Law*, *9*, 154–167. https://ideas.repec.org/a/aic/jopafl/y2016v9p154-167.html

Jhun, J., Palacios, P., & Weatherall, J. O. (2018). Market crashes as critical phenomena? Explanation, idealization, and universality in econophysics. *Synthese; Dordrecht*, *195*(10), 4477–4505. https://doi.org/10.1007/s11229-017-1415-y

Jiao, W. (2020). Portfolio manager home-country culture and mutual fund risk-taking. *Financial Management*, *49*(3), 805–838. https://doi.org/10.1111/fima.12265

Jovanovic, F., & Schinckus, C. (2013). The emergence of econophysics: A new approach in modern financial theory. *History of Political Economy*, *45*(3), 443–474. https://doi.org/10.1215/00182702-2334758

Kaczynski, D., Salmona, M., & Smith, T. (2014). Qualitative research in finance. *Australian Journal of Management*, *39*(1), 127–135. https://doi.org/0.1177/0312896212469611

Kahneman, D., & Tversky, A. (1977). Prospect theory. An analysis of decision making under risk. *Econometrica*, *47*, 313–327. https://doi.org/10.21236/ada045771

Kakkuri-Knuuttila, M.-L., Lukka, K., & Kuorikoski, J. (2008). Straddling between paradigms: A naturalistic philosophical case study on interpretive research in management accounting. *Accounting, Organizations and Society*, *33*(2), 267–291. https://doi.org/10.1016/j.aos.2006.12.003

Kallio, H., Pietilä, A.-M., Johnson, M., & Kangasniemi, M. (2016). Systematic methodological review: Developing a framework for a qualitative semi-structured interview guide. *Journal of Advanced Nursing*, *72*(12), 2954–2965. https://doi.org/10.1111/jan.13031

Kaneko, M. (2020). Expected utility theory with probability grids and preference formation. *Economic Theory*, *70*(3), 723–764. https://doi.org/10.1007/s00199-019-01225-4

Kaplan, S., Haimes, Y. y., & Garrick, B. j. (2001). Fitting hierarchical holographic modeling into the theory of scenario structuring and a resulting refinement to the quantitative definition

of risk. *Risk Analysis: An International Journal*, *21*(5), 807–807. https://doi.org/10.1111/0272-4332.215153

Kemp, M. (2010). *Extreme events: Robust portfolio construction in the presence of fat tails*. John Wiley & Sons, Incorporated.

Kim, H. H.-D. (2021). Impact of environmental disaster movies on corporate environmental and financial performance. *Sustainability*, *13*(2), 559. https://doi.org/10.3390/su13020559

Klein, R. W., & Bawa, V. S. (1976). The effect of estimation risk on optimal portfolio choice. *Journal of Financial Economics*, *3*(3), 215–231. https://doi.org/10.1016/0304-405X(76)90004-0

Kochaniak, K., & Ulman, P. (2020). Risk-intolerant but risk-taking—Towards a better understanding of inconsistent survey responses of the Euro area households. *Sustainability*, *12*(17), 6912. https://doi.org/10.3390/su12176912

Koerniadi, H., Krishnamurti, C., & Tourani-Rad, A. (2016). Natural disasters—Blessings in disguise? *Singapore Economic Review*, *61*(1), 1–17. https://doi.org/10.1142/S021759081640004X

Kong, F., & Sun, S. (2021). Better understanding the catastrophe risk in interconnection and comprehensive disaster risk defense capability, with special reference to China. *Sustainability*, *13*(4), 1793. http://dx.doi.org.10.3390/su13041793

Kumari, J., & Mahakud, J. (2015). Does investor sentiment predict the asset volatility? Evidence from emerging stock market India. *Journal of Behavioral and Experimental Finance*, *8*, 25–39. https://doi.org/10.1016/j.jbef.2015.10.001

Kume, M., Mori, S., Kitano, J., Sumi, T., & Nishida, S. (2018). Impact of the huge 2011 Tohoku-oki tsunami on the phenotypes and genotypes of Japanese coastal threespine

stickleback populations. *Scientific Reports*, *8*(1), 1–11. https://doi.org/10.1038/s41598-018-20075-z

Leedy, P. D., Ormrod, J. E., & Johnson, L. R. (2019). *Practical research: Planning and design* (12th ed.). Pearson.

Lekovic, M. (2019). Behavioral portfolio theory and behavioral asset pricing model as an alternative to standard finance concepts. *Ekonomski Horizonti*, *21*(3), 255–271. https://doi.org/10.5937/ekonhor1903263L

Levy, H. (2010). The CAPM is alive and well: A review and synthesis. *European Financial Management*, *16*(1), 43–71. https://doi.org/10.1111/j.1468-036X.2009.00530.x

Levy, H., De Giorgi, E. G., & Hens, T. (2012). Two paradigms and Nobel Prizes in economics: A contradiction or coexistence? *European Financial Management*, *18*(2), 163–182. https://doi.org/10.1111/j.1468-036X.2011.00617.x

Linnenluecke, M. K., Marrone, M., & Singh, A. K. (2020). Conducting systematic literature reviews and bibliometric analyses. *Australian Journal of Management*, *45*(2), 175–194. https://doi.org/10.1177/0312896219877678

Lintner, J. (1965). Security prices, risk, and maximal gains from diversification. *The Journal of Finance*, *20*(4), 587–615. https://doi.org/10.1111/j.1540-6261.1965.tb02930.x

Long, A. R., Fernbach, P. M., & De Langhe, B. (2018). Circle of incompetence: Sense of understanding as an improper guide to investment risk. *Journal of Marketing Research*, *55*(4), 474–488. https://doi.org/10.1509/jmr.16.0429

Lude, M., & Prügl, R. (2019). Risky decisions and the family firm bias: An experimental study based on prospect theory. *Entrepreneurship Theory and Practice*, *43*(2), 386–408. https://doi.org/10.1177/1042258718796078

MacKinlay, A. C. (1997). Event studies in economics and finance. *Journal of Economic Literature*, *35*(1), 13–39. https://www.aeaweb.org

Maier-Paape, S., & Zhu, Q. J. (2018a). A general framework for portfolio theory—Part I: Theory and various models. *Risks; Basel*, *6*(2). https://doi.org/10.3390/risks6020053

Maier-Paape, S., & Zhu, Q. J. (2018b). A general framework for portfolio theory-Part II: Drawdown risk measures. *Risks*, *6*(3). https://doi.org/10.3390/risks6030076

Mangram, M. E. (2013). A simplified perspective of the Markowitz Portfolio Theory. *Global Journal of Business Research*, *7*(1), 59–70. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2147880

Markowitz, H. (1952). Portfolio selection. *The Journal of Finance*, *7*(1), 77–79. https://doi.org/10.1111/j.1540-6261.1952.tb01525.x

Martins, A., Fontes, A., Rodrigues, L. L., & Silva, A. P. (2020). Qualitative research in the accounting field: Insights towards the grounded theory approach. *European Conference on Research Methodology for Business and Management Studies*, 165–173. https://doi.org/10.34190/erm.20.059

Matthies, B. D., Jacobsen, J. B., Knoke, T., Paul, C., & Valsta, L. (2019). Utilising portfolio theory in environmental research – New perspectives and considerations. *Journal of Environmental Management*, *231*, 926–939. https://doi.org/10.1016/j.jenvman.2018.10.049

Mazzola, P., & Gerace, D. (2015). A comparison between a dynamic and static approach to asset management using CAPM models on the Australian securities market. *Australasian Accounting Business & Finance Journal; Wollongong*, *9*(2), 43–58. https://doi.org/10.14453/aabfj.v9i2.4

McPhail, C., & Rexroat, C. (1979). Mead vs. Blumer: The divergent methodological perspectives of social behaviorism and symbolic interactionism. *American Sociological Review*, *44*(3), 449–467. https://doi.org/10.2307/2094886

Méra, X. (2018). On conceptualizing risk: A comment on Hoffmann. *Quarterly Journal of Austrian Economics*, *21*(3), 246–255. https://qjae.scholasticahq.com/

Merriam, S. (1998). *Qualitative research and case study applications in education*. Jossey-Bass.

Merriam, S., & Tisdell, E. (2015). *Qualitative research: A guide to design and implementation* (4th Edition). Jossey-Bass.

Millroth, P., Juslin, P., Winman, A., Nilsson, H., & Lindskog, M. (2020). Preference or ability: Exploring the relations between risk preference, personality, and cognitive abilities. *Journal of Behavioral Decision Making*, *33*(4), 477–491. https://doi.org/10.1002/bdm.2171

Mitchell, M. L., & Netter, J. M. (1994). The role of financial economics in securities fraud cases: Applications at the Securities and Exchange Commission. *The Business Lawyer*, *49*(2), 545–590. JSTOR. https://www.jstor.org

Mueller, S. M., & Brand, M. (2018). Approximate number processing skills contribute to decision making under objective risk: Interactions with executive functions and objective numeracy. *Frontiers in Psychology*, *9*. https://doi.org/10.3389/fpsyg.2018.01202

Nils, B., & Iurii, M. (2021). Bayesian estimation and likelihood-based comparison of agent-based volatility models. *Journal of Economic Interaction and Coordination: JEIC*, *16*(1), 173–210. https://doi.org/10.1007/s11403-020-00289-z

O'Connor, M. K., Netting, F. E., & Thomas, M. L. (2008). Grounded theory: Managing the challenge for those facing institutional review board oversight. *Qualitative Inquiry*, *14*(1), 28–45. https://doi.org/10.1177/1077800407308907

Oehler, A., Horn, M., & Florian, W. (2018). Young adults' subjective and objective risk attitude in financial decision making. *Review of Behavioral Finance*, *10*(3), 274–294. https://doi.org/10.1108/RBF-07-2017-0069

O'Hora, K. A., & Roberto, K. A. (2019). Navigating emotions and relationship dynamics: Family life review as a clinical tool for older adults during a relocation transition into an assisted living facility. *Aging & Mental Health*, *23*(4), 404–410. https://doi.org/10.1080/13607863.2017.1423028

Ola, A., Holm, H. J., Jean-Robert, T., & Erik, W. (2020). Robust inference in risk elicitation tasks. *Journal of Risk and Uncertainty*, *61*(3), 195–209. https://doi.org/10.1007/s11166-020-09341-6

Olbrich, M., Quill, T., & Rapp, D. (2015). Business valuation inspired by the Austrian school. *Journal of Business Valuation and Economic Loss Analysis; Berkeley*, *10*(1), 1–43. https://doi.org/10.1515/jbvela-2014-0001

Palinkas, L. A., Horwitz, S. M., Green, C. A., Wisdom, J. P., Duan, N., & Hoagwood, K. (2015). Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. *Administration and Policy in Mental Health*, *42*(5), 533–544. https://doi.org/10.1007/s10488-013-0528-y

Perry, M. (2018, October 18). More evidence that it's really hard to 'beat the market' over time, 95% of finance professionals can't do it. *American Enterprise Institute: Carpe Diem*.

https://www.aei.org/carpe-diem/more-evidence-that-its-really-hard-to-beat-the-market-over-time-95-of-finance-professionals-cant-do-it/

Peterson, J. S. (2019). Presenting a qualitative study: A reviewer's perspective. *Gifted Child Quarterly*, *63*(3), 147–158. https://doi.org/10.1177/0016986219844789

Peterson, P. (1989). Event studies: A review of issues and methodology. *Quarterly Journal of Business and Economics: QJBE; Lincoln*, *28*(3), 36. http://business.creighton.edu/qjfa

Pezalla, A. E., Pettigrew, J., & Miller-Day, M. (2012). Researching the researcher-as-instrument: An exercise in interviewer self-reflexivity. *Qualitative Research*, *12*(2), 165–185. https://doi.org/10.1177/1468794111422107

Punwasi, K., & Brijlal, P. (2016). The market reactions to share repurchase announcements on the JSE: An event study. *Investment Management and Financial Innovations*, *13*(1), 191–205. https://doi.org/10.21511/imfi.13(1-1).2016.06

Rädiker, S., & Kuckartz, U. (2020). *Focused analysis of qualitative interviews with MAXQDA*. Maxqda Press.

Rao, G., Sudheer, K., Vinay, H., & Babu, S. (2015). Construction of an optimum portfolio using Markowitz & Sharpe's models. *ICRBIT - 2015*. International Conference on Research in Business Management & Information Technology. https://doi.org/10.16962/elkapj/si.bm.icrbit-2015.25

Rehse, D., Riordan, R., Rottke, N., & Zietz, J. (2019). The effects of uncertainty on market liquidity: Evidence from Hurricane Sandy. *Journal of Financial Economics*, 318–322. https://doi.org/10.1016/j.jfineco.2019.04.006

Ren, Z., & Li, S. (2021). Predictability of analysts' forecast revision under COVID-19: Evidence from emerging markets. *Emerging Markets Finance and Trade*, *57*(6), 1689–1698. https://doi.org/10.1080/1540496X.2020.1865149

Renn, O. (1992). Concepts of risk: A classification. In *Social Theories of Risk*. Prager Publisher. http://elib.uni-stuttgart.de/handle/11682/7265

Rescher, N. (2020). *Ethics matters: Ethical issues in pragmatic perspective* (1st ed.). Palgrave Macmillan.

Righi, M. B. (2019). A composition between risk and deviation measures. *Annals of Operations Research*, *282*(1–2), 299–313. https://doi.org/10.1007/s10479-018-2913-0

Roser, M. (2013). Economic growth. *Our world in data*. https://ourworldindata.org/economic-growth

Rubin, H. J., & Rubin, I. S. (2005). *Qualitative interviewing: The art of hearing data* (2nd ed.). SAGE Publications, Inc. https://doi.org/10.4135/3781452226

Saldaña, J. (2021). *The coding manual for qualitative researchers* (Fourth). SAGE Publications, Inc.

Schiebener, J., & Brand, M. (2015). Decision making under objective risk conditions- A review of cognitive and emotional correlates, strategies, feedback processing, and external influences. *Neuropsychology Review*, *25*(2), 171–198. https://doi.org/10.1007/s11065-015-9285-x

Schildberg-Hörisch, H. (2018). Are risk preferences stable? *The Journal of Economic Perspectives; Nashville*, *32*(2), 135–154. https://doi.org/10.1257/jep.32.2.135

Shah, P. (2017). Why do firms delete brands? Insights from a qualitative study. *Journal of Marketing Management*, 1–18. https://doi.org/10.1080/0267257X.2017.1319405

Sharpe, W. (1964). Capital asset prices: A theory of market equilibrium under conditions of risk. *The Journal of Finance*, *19*(3), 425–442. https://doi.org/10.1111/j.1540-6261.1964.tb02865.x

Sinha, M., Jalan, R., & Singh, R. (2020). Investigating the financial impact of coronavirus on leading stock indices. *Indian Journal of Commerce and Management Studies*, *11*(3), 8–22. https://doi.org/10.18843/ijcms/v11i3/02

Smith, T., & Walsh, K. (2013). Why the CAPM is half-right and everything else is wrong. *Abacus*, *49*, 73–78. https://doi.org/10.1111/j.1467-6281.2012.00387.x

So, M. K. P. (2021). Robo-advising risk profiling through content analysis for sustainable development in the Hong Kong financial market. *Sustainability*, *13*(3), 1306. https://doi.org/10.3390/su13031306

Staliūnas, K. (2005). Bose-Einstein Condensation in financial systems. *Nonlinear Analysis: Modelling and Control*, *10*(3), 247–256. https://doi.org/10.15388/NA.2005.10.3.15123

Stålnacke, O. (2019). Individual investors' sophistication and expectations of risk and return. *Review of Behavioral Finance*, *11*(1), 2–22. https://doi.org/10.1108/RBF-08-2017-0087

Statman, M. (2018). A unified behavioral finance. *Journal of Portfolio Management; New York*, *44*(7), 124–134. https://doi.org/10.3905/jpm.2018.44.7.124

Tao, Z. (2014). Short-term economic effect of the M7.0 Lushan Earthquake. *Natural Hazards; Dordrecht*, *70*, 1247–1261. https://doi.org/10.1007/s11069-013-0871-z

Thébault, K., Bradley, S., & Reutlinger, A. (2018). Modeling inequality. *The British Journal for the Philosophy of Science*, *69*(3), 691_718. https://doi.org/10.1093/bjps/axw028

United States Department of Health and Human Services, National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research. (1979). *The*

Belmont report: Ethical principles and guidelines for the protection of human subjects of research (45 CFR 46). http://www.hhs.gov/ohrp/regulations-and-policy/belmont-report/

United States Geological Society. (n.d.). *Kīlauea 1955 Lower East Rift Zone Eruption in Lower Puna*. Retrieved July 5, 2021, from https://www.usgs.gov/volcanoes/kilauea/kilauea-1955-lower-east-rift-zone-eruption-lower-puna

Urban, J. M., & Quilter, L. (2006). Efficient process or "Chilling Effects"? Takedown notices under Section 512 of the Digital Millennium Copyright Act. *Santa Clara Computer and High - Technology Law Journal; Santa Clara*, *22*(4), 621–693. https://doi.org/10.31235/osf.io/pyzua

U.S. Bureau of Labor Statistics. (2020). *Employed persons by detailed occupation and age*. https://www.bls.gov/cps/cpsaat11b.htm

Vaclavik, M., & Jablonsky, J. (2012). Revisions of modern portfolio theory optimization model. *Central European Journal of Operations Research: CEJOR; Heidelberg*, *20*(3), 473–483. https://doi.org/10.1007/s10100-011-0227-2

Valizadeh, P., Karali, B., & Ferreira, S. (2017). Ripple effects of the 2011 Japan earthquake on international stock markets. *Research in International Business and Finance*, *41*, 556–576. https://doi.org/10.1016/j.ribaf.2017.05.002

Vigliarolo, F. (2020). Economic phenomenology fundamentals, principles and definition. *Insights into Regional Development*, *2*(1), 418–428. https://doi.org/10.9770/IRD.2020.2.1(2)

Vosgerau, J., & Peer, E. (2019). Extreme malleability of preferences: Absolute preference sign changes under uncertainty. *Journal of Behavioral Decision Making*, *32*(1), 38–46. https://doi.org/10.1002/bdm.2088

Wadams, M., & Park, T. (2018). Qualitative research in correctional settings: Researcher bias, Western ideological influences, and social justice. *Journal of Forensic Nursing*, *14*(2), 72–79. https://doi.org/10.1097/jfn.0000000000000199

Wahdat, A. Z., Gunderson, M. A., & Lusk, J. L. (2021). Farm producers' household consumption and individual risk behavior after natural disasters. *Agricultural and Resource Economics Review*, *50*(1), 127–149. https://doi.org/10.1017/age.2021.2

Wai Fong Chua. (2005). Radical developments in accounting thought. In N. Macintosh & T. Hopper (Eds.), *Accounting, the social and the political* (1st ed., pp. 55–66). Elsevier Science.

Wang, R., Xu, Z. Q., & Zhou, X. Y. (2019). Dual utilities on risk aggregation under dependence uncertainty. *Finance and Stochastics*, *23*(4), 1025–1048. https://doi.org/10.1007/s00780-019-00399-y

Williams, M., & Moser, T. (2019). The art of coding and thematic exploration in qualitative research. *International Management Review; Marietta*, *15*(1), 45-55,71-72. https://www.imrjournal.org

Wolff, K., Larsen, S., & Øgaard, T. (2019). How to define and measure risk perceptions. *Annals of Tourism Research*, *79*, 102759. https://doi.org/10.1016/j.annals.2019.102759

Yazan, B. (2015). Three approaches to case study methods in education: Yin, Merriam, and Stake. *The Qualitative Report*, *20*(2), 134–152. https://nsuworks.nova.edu/tqr/vol20/iss2/12

Zahera, S. A., & Rohit, B. (2018). Do investors exhibit behavioral biases in investment decision making? A systematic review. *Qualitative Research in Financial Markets*, *10*(2), 210–251. https://doi.org/10.1108/QRFM-04-2017-0028

Zhang, Y., Gao, J., Luo, X., Wu, X., & Bao, H. (2021). Dynamic evolution of public's positive emotions and risk perception for the COVID-19 pandemic: A case study of Hubei Province of China. *Mathematical Problems in Engineering*, *2021*. https://doi.org/10.1155/2021/6680303

Zhang, Y., Xie, G., & Chen, J. (2013). Choosing third-party logistics for biomedical companies with improved CAPM model. *Sensors & Transducers; Toronto*, *161*(12), 466–471. http://www.sensorsportal.com/HTML/ST_Journal.htm

Zweig, J. (2017, June 23). Stock picking is dying because there are no more stocks to pick. *Wall Street Journal*. https://www.wsj.com/articles/stock-picking-is-dying-because-there-are-no-more-stocks-to-pick-1498240513