STONEHEARTH
CAPITAL MANAGEMENT

DO YOU KNOW YOUR RISK SCORE?

2/28/17

What is Risk?

Risk is one of the most used and most misunderstood words in the investment management industry. Hopefully with this white paper and companion webinar we are going to be able to shed some light on this difficult topic. By doing so we hope you come away with a better understanding of risk and how it impacts your ability to achieve your individual financial goals.

WWW.STONEHEARTHCAPITAL.COM
199 ROSEWOOD DRIVE, SUITE 200 • DANVERS, MA 01923 • {978} 624-3000

Do You Know Your Risk Score?

RISK: HOW IT RELATES TO YOUR INVESTMENT PORTFOLIO

INTRODUCTION

We will start by reviewing the multiple definitions of risk used in our industry and present Stonehearth Capital's preferred definition of investment risk. We will then take a look at the various measures the financial industry uses to quantify and communicate risk to you. We will present what we feel is a better way to look at risk from an investors' perspective and why the most commonly used measures may not be sufficient. Risk is indeed a difficult and multi-faceted topic for investors to tackle, but understanding risk and its impact on your portfolio is critical to achieving your individual financial goals.

When trying to understand a complicated topic, such as risk, the best way to begin is to define what we are talking about. The Merriam-Webster dictionary defines risk[1] as:

- **Possibility of loss or injury**
- **Someone or something that creates or suggests a hazard**
- **The chance that an investment (such as a stock or commodity) will lose value**

This is a good place to start, but the risk we are talking about today is only within the realm of the financial world. In other words; investment risk. In the financial world advisors use a multitude of definitions to define risk. It usually relates to how they, the advisor, views risk and not how risk should be viewed from a client's point of view. A few examples of commonly used definitions of risk are:

1. VOLATILITY OF PORTFOLIO RETURNS

Volatility is perhaps the most commonly referenced risk measure. Typically, when the financial industry uses volatility of portfolio returns they are referring to the standard deviation of portfolio returns. Standard deviation is a measure of the dispersion of portfolio returns from its mean or average return. This is just a fancy way of saying how much your portfolio moved up or down compared to the average return during a predefined time period. The predefined time period is determined by the advisor and is usually based on the calendar cycle. The most common time periods used are monthly, quarterly, and annual which are defined by our calendar cycle. I believe this is a flawed definition of investment risk. The first thing that jumps out at me is that an investor's financial goals and market cycles do not fit neatly into the calendar framework. Market movements act independent of the calendar. Why does the performance of your portfolio matter more because the calendar moved to a new year? Investment risk should be based on your individual investment horizon and the time it will take to achieve your financial goals.

The up and down movement of your portfolio is also a flawed definition of risk since it does not distinguish between gains and losses. It treats both negative returns (bad) and positive returns (good) as equals from a risk perspective. Most investors (including me), would not view a high positive return as risky but that is just what happens when advisors use the volatility of portfolio returns to define risk. A simple

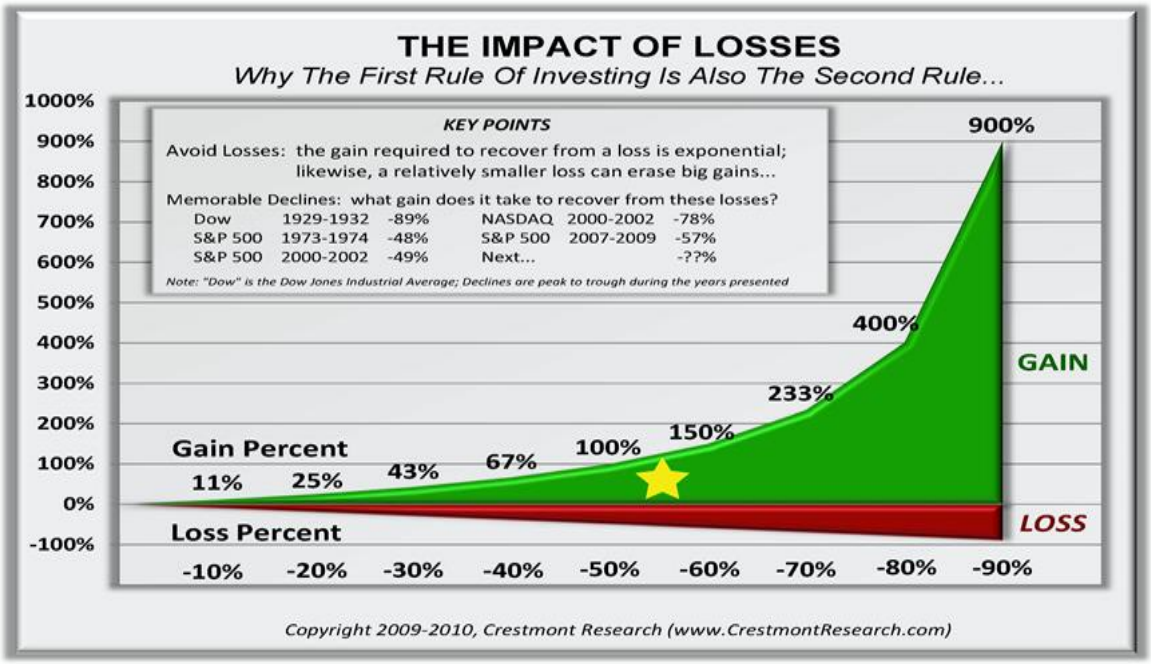
[1] Risk. (n.d.). Retrieved February 28, 2017, from https://www.merriam-webster.com/dictionary/risk

example will help illustrate the flaw in this concept. Portfolio A earns 5% in year one and 10% in year two. Portfolio B loses 5% in year one and 10% in year two. Both portfolios will be judged to have the same level of risk using volatility of portfolio returns. This example clearly shows the flaws in using the volatility of returns as a definition of investment risk.

2. PROBABILITY OF NEGATIVE RETURNS

More often than not, when using the probability of negative returns as a definition of risk, the financial industry will reference the number of up periods a portfolio had compared to the number of down periods it had. For example, they may say over the past three years (36 months) we had 30 positive months and only six negative months. They may also use a percentage. Given the same 30-to-6 ratio quoted previously, they would say in the past three years we have posted a positive return 83% (30 positive months divided by 36 total observations) of the time over the past three years.

The implication of using the probability of negative returns as a definition of risk is that all negative returns should be treated equally. I disagree with this premise since it does not take into account the magnitude of a negative return and the impact it has on an investor's portfolio. The magnitude of negative returns directly affects the probability of an investor meeting their financial goals as the chart below demonstrates.



You can see from the chart above that there is a big difference between losing 10% and losing 50% in terms of what you need to earn to get back to even. If you minimize your loss to 10%, you only have to earn 11% to get back to even while you will need to earn around 100% if you lose 50% to get to the same place. Clearly all losses are not equal.

The probability of negative returns also puts too much emphasis on the number of occurrences and minimizes the impact returns have on a portfolio. No one likes to have multiple negative returns, but there is a big difference in having numerous small negative returns combined with much larger positive returns then having numerous small positive returns and infrequent, but large, losses in a portfolio. Investors would

view the former return stream as less risky than the latter, but when using the probability of negative returns as your definition of risk, you end up with the exact opposite conclusion. The magnitude of losses in a portfolio have a direct impact on the riskiness of a portfolio which the probability of negative returns fails to sufficiently address.

3. RELATIVE PERFORMANCE TO A BENCHMARK

Besides the obvious calculation of just saying we outperformed by X percentage points, the financial industry may also quote a number called beta. Beta is calculated by using regression analysis. Beta represents the tendency of a portfolio's returns to respond to swings in the market. A beta of one would imply that a portfolio would post the exact same return as the market. A beta less than one implies that the portfolio would move less than the market, and a beta greater than one implies a movement greater than the market.

Relative performance shares a similar flaw to volatility of returns in that it fails to distinguish between positive (good) and negative (bad) returns. Having a beta greater than one in an up market is wonderful, but it is not so good in a falling market. In fact, using any benchmark as a beginning reference point fails to take into account the individuals own risk tolerance and does not even begin to address if the portfolio is able to meet your financial goals.

There is an old adage in the financial industry that goes "you can't eat relative returns." This was true when it was first said and remains true today. The essence of the saying is that benchmark returns have no bearing on an investment portfolio's ability to help a client achieve their financial goals. As such, how a portfolio performs in relation to a benchmark has no bearing on the riskiness of the investor's portfolio. We need only go back to the great financial crisis of 2008 to see when relative performance falls short of being a good definition of investment risk. In 2008, the S&P 500[2] index, one of the most well-known and widely used benchmarks in the financial industry, posted a negative 37% return. An investor that held a portfolio that outperformed the index by 10% still lost 27% of their portfolio value on an absolute basis. Losing 27% of an investment portfolio's value in one year is a good indicator that you have a very risky portfolio, but when viewed from the perspective of relative performance, it would not be classified as a risky portfolio to hold. Benchmarks do serve a valuable purpose in the financial industry, but using relative returns to a benchmark as a definition of risk is certainly not one of them.

4. STONEHEARTH CAPITAL MANAGEMENT: DEFINITION OF RISK

The definitions of risk we have explored so far are incomplete and all share similar drawbacks. They are backward looking in terms of assessing risk and are more relevant to the investment manager than the investor. They do not address the most important risk facing individual investors. Will you be able to achieve your financial goals?

In light of these known weaknesses Stonehearth Capital Management has developed our own preferred definition of investment risk. We define investment risk as the possibility of you, the investor, not being able to meet your long term financial goals. We feel that by framing risk from a client perspective we are better able to meet the needs of investors. This definition takes into account the fact that not all risk is bad. It is also forward looking in terms of defining risk since what could potentially happen in the future is much more important to an investor than what has already happened.

[2] S&P 500. (n.d.). Retrieved February 28, 2017, from http://www.dictionary.com/browse/sandp-500

Now that we have the basic framework for defining risk, we need to have a metric to help us measure and analyze risk in investment portfolios. We explored many options for measuring the level of risk in your portfolio before we found a company that has developed an appropriate risk measure for investors. The company is called Rixtrema and the software is called Portfolio Crash Testing. Portfolio Crash Testing is based on stress testing and provides insight into how an investors' portfolio is likely to behave in a multitude of macroeconomic scenarios. The Crash Test Score has the added benefit of clearly articulating the risk reward tradeoff investors face in their portfolios. Not all risk is bad, as there is no reward without risk. Investors should not try to minimize risk at all costs, but instead make sure they are taking the proper amount of risk in their portfolio. Taking the proper amount of risk in your portfolio is key to increasing the probability of achieving your long term financial goals. It also allows us to focus on what is more likely to happen in the future. We believe the Portfolio Crash Test Score is the most comprehensive and best measure of investment risk for individual investors.

The Portfolio Crash Test does not assume that investment returns are normally distributed, but estimates crisis correlations to produce more realistic results. We know from history that investment returns are not normally distributed and they do not fit into the ubiquitous bell curve. Risk should be measured as it behaves in the real world and not into unrealistic models like the bell curve. This allows for a more realistic projection of risk and a better framework for assessing the proper risk you should be taking in your investment portfolio. By properly assessing the risk you are taking we are better able to help investors achieve their long term investment goals.

The Portfolio Crash Test score uses your actual portfolio to project potential returns based on predefined potential future macroeconomic scenarios. It then calculates a score scaled from 1-to-100 with 100 being the riskiest portfolio. It calculates this score by averaging the three worst potential outcomes given your current portfolio holdings. The different scenarios presented allow us to analyze potential risks and rewards on an absolute basis. This allows for a more thorough understanding from an investors' point of view as to how their own portfolio will behave. Once we calculate a score, we can then compare different portfolios from a risk/return perspective to ensure you are taking the correct amount of risk given your own personal financial situation. This not only includes your long term financial goals but also your current financial strength and your personal risk preferences.

Below is the first page from the risk analysis report performed by Rixtrema. I am using the S&P 500 index compared to a simple 60/40 blended index made up of 60% S&P 500 index with 40% Barclays US Aggregate Total Return Index[3], which is used as a proxy for bond exposure. The S&P 500 index is on the left hand side, while the 60/40 split is on the right. You can see immediately that based on the Crash Test Score, the S&P 500 index is a much riskier portfolio then the 60/40 split portfolio. The S&P 500 index has a Crash Test Score of 70 while the 60/40 split has a much smaller score of 49. By using this simple example, you can easily see how we can compare two different portfolios from a risk perspective. You will also notice that the different scenarios with their expected returns are listed directly underneath each portfolio. From this, we can see that while the S&P 500 indeed has more risk in negative scenarios, it also has much more upside potential in positive scenarios.

[3] "Barclays US Aggregate Bond Index is a broad-based flagship benchmark that measures the investment grade, US dollar-denominated, fixed-rate taxable bond market. The index includes Treasuries, government-related and corporate securities, MBS (agency fixed-rate and hybrid ARM pass-throughs), ABS and CMBS (agency and non-agency)" ("US Aggregate Index", 2016).

US Aggregate Index (Publication). (2016, August 24). Retrieved February 28, 2017, from Bloomberg Barclays Indices website: https://data.bloomberglp.com/indices/sites/2/2016/08/Factsheet-US-Aggregate.pdf

[4] See footnote

By calculating different scenarios, both good and bad, we are better able to judge the risk reward imbedded in each portfolio. With this information in hand, we are able to make much better informed decisions about how risky a portfolio is likely to be. In other words, the Crash Test Score allows us to better understand and measure the probability of you not achieving your long term financial goals.

We have explored risk from multiple perspectives in this whitepaper and we have come to the following conclusions:

- Traditional risk measures are helpful but not complete.
- Risk is multi-dimensional and should be viewed from a risk reward tradeoff.
- Must be viewed from the investors' perspective and not the managers
- Investment risk is defined as the possibility of you not achieving your long term financial goals.

[4] Portfolio Crash Testing: Add Value For Your Clients With Stress Testing. (n.d.). Retrieved February 28, 2017, from https://rixtrema.net/portfoliocrashtest/

If you would like to explore your portfolio in more detail using the Crash test score methodology, please do not hesitate to contact us at 978-624-3000 or reach out to us via our website at www.stonehearthcapital.com.

Sincerely,

Christopher Gauthier, CFA
Chief Investment Officer
Chris@stonehearthcapital.com

Required Disclosure:

Stonehearth Capital Management, LLC is a Registered Investment Advisor. Registration does not imply a certain level of skill or training.

Opinions, estimates, forecasts, and statements of financial market trends that are based on current market conditions constitute our judgment and are subject to change without notice.

This material is for information purposes only and is not intended as an offer or solicitation with respect to the purchase or sale of any security.

Investing involves risk including the potential loss of principal. No investment strategy can guarantee a profit or protect against loss in periods of declining values.

Fixed-income investments are subject to various risks including changes in interest rates, credit quality, inflation risk, market valuations, prepayments, corporate events, tax ramifications, and other factors.

Opinions expressed are not intended as investment advice or to predict future performance.

Past performance does not guarantee future results.

Consult your financial professional before making any investment decision.

Opinions expressed are subject to change without notice and are not intended as investment advice or to predict future performance.

All information is believed to be from reliable sources; however, we make no representation as to its completeness or accuracy. Please consult your financial advisor for further information.

These are the views of Stonehearth Capital Management, LLC. Neither the named representative nor the named Broker/Dealer or Investment Advisor gives tax or legal advice. All information is believed to be from reliable sources; however, we make no representation as to its completeness or accuracy. Please consult your financial advisor for further information.

Rixtreme Disclsoure:

A Portfolio Crash Test is a stress-testing tool developed by RiXtrema, Inc. that uses simulations and statistical analyses to help investors and their financial professionals understand the risk profile of their investment portfolios. Stress testing does this by measuring how different macroeconomic scenarios could affect portfolio returns. In order to get the most out of your Portfolio Crash Test (sometimes called "PCT" below), it is important that you understand how the tool is designed and how it should and should not be used. To that end, we urge you to read the following information carefully.

All investments involve risk. Investing in equities (i.e., stocks) involves volatility risk, market risk, business risk and industry risk. Volatility risk is the chance that the value of a stock will fall. Market risk is the chance that the prices of all stocks will fall due to conditions in the economic environment. Business risk is the chance that a specific company's stock will fall because of issues affecting it. Industry risk is the chance that a set of factors particular to an industry group will adversely affect stock prices within the industry.

Investing in fixed-income securities (e.g., bonds) involves interest-rate risk, credit risk and inflation risk. Interest rate risk is the possibility that bond prices will decrease because of an interest rate increase. When interest rates rise, bond prices and the values of fixed-income securities fall; conversely, when interest rates fall, bond prices and the values of fixed-income securities rise. Credit risk is the risk that a company will not be able to pay its debts, including the interest

on its bonds. Inflation risk is the possibility that the interest paid on an investment in bonds will be lower than the inflation rate, thus decreasing purchasing power.

Even cash alternatives, such as money-market funds and US Treasury bills entail risk. In addition to inflation risk, investments in money market securities may involve credit risk and a risk of principal loss. Because such securities are neither insured nor guaranteed by any government agency, there is no assurance that the value of your investment will be held to $1 per share. US Treasury bills are subject to market risk if sold prior to maturity. Market risk is the possibility that the value, when sold, might be less than the purchase price.

International investing involves additional risks including, but not limited to, changes in currency exchange rates, differences in accounting and taxation policies and political or economic instabilities that can increase or decrease returns.

The PCT tool uses a stress-testing methodology that is widely accepted in the risk-management industry and is based on a factor risk model. This model describes relevant risk factors, such as liquidity, interest rates, equity, industry and other factors that explain a security's behavior. RiXtrema then calculates how each security in an investor's portfolio is exposed to each identified factor. Stated another way, we determine the "Beta" (the tendency of a security's returns to respond to swings in the market) of each security to each risk factor. Once this is accomplished, we create a matrix that describes the correlations between each of the factors and each of the securities in the portfolio, to arrive at a risk rating for each security. The aggregate risk of the portfolio is determined by aggregating each security's risk rating and weighting that rating by the security's position in the portfolio. The results shown in the PCT reports reflect the changes in a portfolio based on the factors used to model each scenario.

The key scenarios displayed in the PCT are created by RiXtrema's research department and board of scientific advisors. These scenarios are updated approximately monthly, and reflect RiXtrema's deep experience in risk analysis and assessments of relevant risk scenarios given the state of the markets at a particular point in time.

While RiXtrema selects scenarios it deems to be plausible, Portfolio Crash Tests do not forecast the likelihood that any particular scenario will come to pass. We do not believe it is possible to predict future market events and we discourage users of our stress-testing tool from trying to do so. Although each scenario is designed separately, taken as a whole, the scenarios simulated in a PCT report are designed to be comprehensive in the sense that they cover a variety of impacts on key risk factors.

Scenarios include positive events (events that would make portfolio returns rise) and negative events (events that would make portfolio returns fall). The positive events tend to occur over multiple years, while the negative events (crashes) are transient. In order to reflect this fact, the positive scenarios reflected in a PCT use estimates of annualized moves in factors, while the negative scenarios use peak-to-trough numbers.

RiXtrema's research team and scientific advisors determine the magnitude of shocks in each scenario by considering how the relevant factors moved in similar environments historically, and by then determining whether historical environments should be replicated or adjusted based on differences in the current environment. In the absence of historic events to use as a guide, RiXtrema decides whether to move the factor 1 standard deviation* (mild shock), 2 standard deviations (strong shock) or 3 or more standard deviations (extreme shock).

Each PCT includes a crash rating, which is a number from 1 to 100 that indicates the relative riskiness of the portfolio in question. The higher the number, the more vulnerable the portfolio is to losses in downside events. In order to arrive at this number, we start with the sum of the three largest losses that the portfolio would incur among all stress scenarios. We then compare that number to a table that maps the sum of the three losses to the crash rating.

This mapping process involves computing the sum of the three largest losses for the MSCI Emerging Markets Index (used as a proxy for a risky portfolio) and assuming that number to be a crash rating of 90. Anything above that number is extremely risky (e.g. individual emerging markets stocks), and ratings below that number signify relatively less risky portfolios. By way of comparison, the crash rating of the S&P 500 index is typically around 70.

Like all investment analysis tools, the PCT is a simulation based on certain assumptions. In simulating various macroeconomic environments and the impact those factors have on portfolio performance, the PCT model assumes that:

• The set of scenarios that occur in real life will resemble the simulated set. If there is a completely new scenario that contradicts presently modeled financial and economic relationships, the tool will be less useful.

• RiXtrema has captured all the key systemic factors.
• Securities betas do not change dramatically in stress events and remain close to what RiXtrema estimates based on their past history.
• The underlying data used in calculating the returns displayed in a PCT report are reliable.

Furthermore, while the PCT tool provides an easy-to-understand way to determine the risk profile of a particular portfolio, it is important that investors understand the tool's limitations, including the following:

IMPORTANT: The projections and other information generated by the Portfolio Crash Test tool regarding the likelihood of various investment outcomes are hypothetical in nature, do not reflect actual investment results and are not guarantees of future results.

• Portfolio Crash Tests do not forecast the likelihood that any particular scenario will come to pass.
• Because the tool's scenarios are updated from time to time, the results of the Portfolio Crash Test may vary with each use and over time.
• Performance results factored into the tool are calculated over many years; small changes can create large differences in future results.
• The Portfolio Crash Test is designed to be used with portfolios containing at least 5 different investments. Any risk assessment tool involves imprecision, and this imprecision may grow if the tool is applied to a single security or just a few securities.
• Portfolio Crash Tests do not select investments for you. You cannot use this tool alone to determine which securities to buy or sell or when to buy or sell them. Before making an investment decision, consult with your investment professional.
• This Portfolio Crash Test report does not provide legal, tax or accounting advice. Consult appropriate professionals for advice that meets your specific needs.
• In calculating the returns displayed in a Portfolio Crash Test report, RiXtrema relies on a variety of third-party sources for pricing information, mutual fund and ETF data, economic data and the like. While RiXtrema believes these sources to be reliable and the data to be accurate, it does not guarantee that this is so.