MORNINGSTAR®

Morningstar Risk Ecosystem

An Integrated Client Risk Profiling and Portfolio Risk-Scoring System

Morningstar Inc.
April 2023

Contents

Overview

The suitability of portfolios and other financial products for a specific individual lies at the heart of delivering retail financial advice. How do we know that a recommended product, portfolio, or solution is suitable for a client and meets the required standard of care (such as fiduciary, client best interest)? Regulators globally take a principles-based approach and state that the professional judgment of the firm or financial professional providing the advice is the foundation, and the burden of proof lies with the financial professional that their recommendations are suitable.

Exhibit 1 Risk Ecosystem

One Connected Risk Ecosystem

In line with our mission to Empower Investor Success, we need to simplify the process of connecting a person's personal risk profile to the risk score of a portfolio so they can understand how finding the right fit is beneficial to their long-term success.

Source: Morningstar.

In the industry, this responsibility is often simplified to Know Your Client, or KYC, and Know Your Product, or KYP. Suitability is the common ground that brings them together. The rigor of the suitability process is determined by the regulated standard of care for any given jurisdiction.

Regulators provide various degrees of guidance to assist firms and financial professionals to meet a standard of care deemed appropriate but are careful to avoid a checkbox-style approval that implies the financial professional is not responsible to dig deeper and uncover consumer circumstances that might not be apparent, or to accept someone else's assessment of the risk of a product without appropriate due diligence.

The Morningstar Risk Ecosystem provides an evidence-based, transparent, and independent set of methodologies to provide a more rigorous and manageable process for firms and financial professionals. This document is designed to provide a high-level overview with additional supporting Morningstar

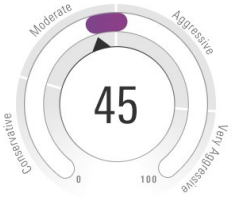
white papers that provide details on some of the specific components. The primary components of the framework include:

- **Morningstar Risk Profiler**: A best-in-class methodology for assessing an individual's risk profile, starting with a psychological measure of risk tolerance (willingness) utilizing a questionnaire that has been psychometrically validated, then integrating other client factors like prior investment experience, financial knowledge, client goals (time horizon, required return, liquidity), and the client's capacity for loss.
- **Risk Comfort Range**: A methodology to map the client expectation on risk exposure of portfolios (measured with the Morningstar Portfolio Risk Score) with their investor profile.
- **Nonfinancial Preferences**: A methodology to determine and align values and the desire for social or environmental impact with the construction of their portfolio. Note: Reference only but not included in this summary.
- **Morningstar Portfolio Risk Score (MPRS)**: A methodology that generates a measure of the risk of portfolios, and the products they are comprised of, based on its volatility relative to the Morningstar Target Allocation Indexes.

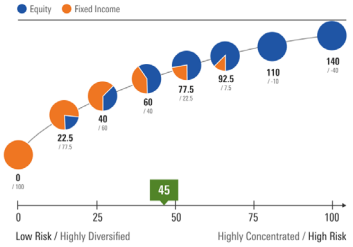
Morningstar's Risk Ecosystem assesses the level of risk appropriate for an individual, along with the risk inherent in a portfolio and the products that it includes. This integrated system used in the context of providing financial advice is depicted in Exhibit 2.

Exhibit 2 Morningstar Risk Profiler and Portfolio Risk Scoring System – The Advice Flow

The Morningstar Risk Profiler provides a risk tolerance score that can be adjusted by additional KYC considerations for each goal.



The score from the Morningstar Risk Profiler generates a range of Morningstar Portfolio Risk Scores that are a best fit for the portfolio goal.



MPRS scores the risk of a portfolio using our holdings-based Risk Model, and our multi-asset Target Allocation Indexes to define risk ranges.

Source: Morningstar.

Financial professionals can initiate the interaction with a client or prospect by analyzing an existing portfolio, determining if it is a comfortable fit or generating a risk profile for an individual, and then searching products or portfolios that are a best fit.

An important distinction of the Morningstar methodology is that both the risk profile of the individual and the risk score of a portfolio (by the nature of its design) should be stable over time. Research has shown that a valid risk tolerance measure (willingness) remains relatively stable and tends not to fluctuate with the markets. Changes in the financial markets are part of the expected journey for a client based on the appropriate portfolio, and an innovative aspect of the Morningstar Portfolio Risk Score is that it is designed not to vary dramatically with market changes, unlike many traditional statistical performances and risk metrics.

Risk tolerance is a psychological trait of an individual's willingness to take risk to achieve better financial returns. The Morningstar risk tolerance score is a statistical measure of risk tolerance of an individual relative to the overall population. It has been validated with over 2 million responses and researched by hundreds of academics globally. It is normally distributed with a mean of 50. Although tolerance forms the foundation of the risk profile, it is insufficient on its own to be the basis of advice and should be adjusted based on a variety of other factors, such as prior investing experience, investment knowledge, the time horizon of the investment, the return required by a client to achieve their goals, and the ability of the client to manage in the event that markets provide poor outcomes (capacity for loss). We call the aggregate score the suitability score and from this determine the Risk Comfort Range.

The Morningstar Portfolio Risk Score helps financial professionals understand the contributing factors to risk and what they can adjust to reduce unnecessary risk. Just because a portfolio has a score in the proper Risk Comfort Range, does not, in and of itself, make it a suitable investment.

It remains the responsibility of firms to evaluate the wide variety of other risks associated with particular investments such as manager risk, liquidity risk, currency risk, ESG risk, and so on.

Morningstar Risk Profiler

Risk profiling, or what is commonly called Know Your Client, is a complex, multifaceted regulatory requirement that has largely relied on the professional judgment of licensed financial professionals. Regulators, academics, and the industry often interchange terminology, causing confusion. For our purposes, the three primary aspects are:

- **Risk Tolerance** is the extent to which an individual is willing to risk experiencing a less-favorable financial outcome in the pursuit of a more favorable financial outcome. It's an emotional trade-off between risk and return.
- **Risk Capacity** is the ability of the individual to remain financially intact if potential poor market outcomes become a reality. Risk capacity asks: If an individual must liquidate for known and expected costs (their goal) in poor markets, will they be OK/have sufficient funds? Risk capacity is usually improved with fixed sources of income (pensions) and negatively impacted by lack of liquidity (like debt payments) that force use of investment capital in down markets.
- **Risk Profile**: Regulators often call out a variety of other factors about the individual or the goals that need to be considered in a suitability determination: The time horizon for use of funds, prior investing experience, level of financial knowledge, the need of the client to generate return to achieve goals, and more. When we combine all these factors, we have a Risk Profile.

Other factors may apply, such as the liquidity of the investments when funds are also required. Some regulators call out age as a specific factor in providing protection to senior citizens. Financial professionals and firms must be aware of these factors in each jurisdiction and, with increasing regulation, demonstrate that they have been considered appropriately in the delivery of advice.

Many traditional risk profiling questionnaires combine multiple factors in an unsubstantiated manner by assigning weights or scores for different components, adding them together, and assuming they map to an investment band and a portfolio for that band. Empirically, you cannot add (Tolerance + Knowledge + Time Horizon + Capacity) and infer the total has meaning (For example, Green + 37/Warm and Sunny).

- A long time horizon does not limit damage if a client is invested beyond their tolerance and liquidates unnecessarily at a loss.
- A high tolerance does not average out against a very short time horizon and justify large equity exposure.
- A high tolerance will not help pay the bills if a client has debt, with no pension income, and investment outcomes are poor (risk capacity).

We will discuss why combining multiple factors invalidates an assessment in the section on Measures of Reliability. A well-constructed system should measure the various aspects independently to determine what limitations they create, if any, on what constitutes a suitable investment in the client's best interest. For more information on the Morningstar Risk Profiler, please refer to the *Morningstar Risk Profiler Methodology* document.

The Morningstar Risk Tolerance Questionnaire

Within the Morningstar Risk Profiler, the assessment of the client's psychological willingness to take on risk to achieve higher returns is measured using the psychometrically validated Morningstar risk tolerance questionnaire.

- There are two versions of the questionnaire - a 25-question questionnaire and a 10-question questionnaire. The 25 questions cover a wide range of financial issues, not just investment issues. The 10 questions are a subset of the 25 which focuses more on investment issues.
- Individuals are scored on a scale of 1 to 100, where the higher the score, the more risk-seeking.
- Scores are normally distributed with a mean of 50 and standard deviation of 10.
- The questionnaire has a reliability of 0.9 (Cronbach's Alpha) for the 25-question version and a reliability of 0.84 (Cronbach's Alpha) for the 10-question version.
- Typically, researchers consider a score of 0 to 0.69 as Poor; 0.70 to 0.79 as Fair; 0.80 to 0.89 as Good; and 0.90 to 0.99 as Excellent.

To make the scores and reports more meaningful, we divide the population into seven risk groups as shown in Exhibit 3. The middle segment is the Mean ± half a Standard Deviation, i.e., from 45 to 54. Segments either side are then a Standard Deviation higher or lower, with the end segments covering the balance of the high and low 'tails' of the distribution.

Although it would be possible to have more bands, the reality is that the reliability of the measure would be less than a band. (Picture a thermometer with quarter-degree increments, but it can only measure to the nearest degree. It is a false "accuracy.") For the 10-question questionnaire, which has a slightly lower reliability, we simplify to five bands, effectively combining risk groups one and two and combining risk groups six and seven.

It is important to understand that the Morningstar risk tolerance score is a continuous scale from 0 to 100 and the construction of bands is strictly to allow illustrative descriptions. A best practice, and one supported in regulation in some jurisdictions like the United Kingdom, is to give feedback to a client with a clear narrative description of what their risk level is for their confirmation. It is not meaningful to tell a client: "You are a 4 of 7 on a risk scale," as, unlike a thermometer or ruler where the scale is understood relative to application, an individual has no context by which to understand the risk-taking behavior of the rest of the population.

Exhibit 3 Distribution of Risk Tolerance Scores

Risk Group	1	2	3	4	5	6	7
Score Range	< 25	25–34	35–44	45–54	55–64	65–74	> 74
% in Group	1%	6%	24%	38%	24%	6%	1%

Source: Morningstar.

Professional Judgment Factors

The psychological score for willingness to take risk is a scientifically validated measure, but regulators call out many other factors to be considered in determining a client's overall risk profile. As an outcome of a research study completed on behalf of the Ontario Securities Commission in 2015[1], a framework

[1] Current Practices for Risk Profiling in Canada and Review of Global Best Practices, Ontario Securities Commission, October 2015.

was articulated based on a global review of the latest research in the field of risk profiling, which helped to define many of the factors that come into play in arriving at a risk profile for a client. The project also highlighted some surprising gaps in academic research where the industry must continue to rely on professional judgment.

After determining the risk tolerance, we then combined other factors for consideration, such as time horizon, prior investing experience, investment knowledge, composure, need/goals, and capacity for loss.

These additional factors form the Professional Judgment Matrix (PJM) may constrain the profile score (for example, an individual with extremely high risk tolerance but with no prior equity-investing experience may be limited to a lower suitability score and not be put immediately into an aggressive equity portfolio). The suitability score ranges between 1 and 100.

Some of the considerations for professional judgment follow.

Handling Inconsistency

There is an implicit conflict in the delivery of advice where financial firms are concerned about the unwieldy number of forms, disclosures, and explanations they must provide a client when recommending investments versus the desire to provide excellent advice. Clients often are not forthcoming with important information. Systematized approaches offer consistency and minimum acceptable standards for large advisory field forces but can often make it difficult for firms and financial professionals to recognize outliers.

Risk tolerance questionnaires, like the 25-Question questionnaire, have sufficient questions that demonstrate a high degree of reliability, and even the 10-Question version has a Cronbach's Alpha of 0.84. It is important to note that the degree of error always increases with fewer questions.

In all instances, based on the norms group data (a sample representative of the population of interest) to draw on, a best practice is to call out statistical outlier responses of individual questions. In an advised proposition these provide an opportunity for the financial professional to further engage and discuss the variance with the client. In a guided proposition, firms can apply an override when particular questions have responses that vary from the overall risk tolerance result of the individual.

Exhibit 4 illustrates a client who answered the 10-Question questionnaire who is statistically consistent with an average risk taker, except for one question. In this case the client answered: "Any fall would make me feel uncomfortable," which is typical of individuals with a Very Low Risk Tolerance. A financial professional should discuss this with the client, whereas in a guided proposition the system will apply a reduction to the individual's risk score and call out the variance.

Exhibit 4 Differences – 10-Question

	Very Low	Low	Average	High	Very High
Q1 Self-Rating			●		
Q2 Adaptability			●		
Q3 Meaning of Risk			●		
Q4 Losses v. Gains	●		●		
etc…					

Source: Morningstar.

Clients with higher degrees of inconsistency should be targeted for an immediate retest and possibly with more frequent risk tolerance reviews. Research has shown that the psychological willingness of the individual to take financial risk is generally stable over time but can be impacted by material life events.

Risk Required--The Client's Goals

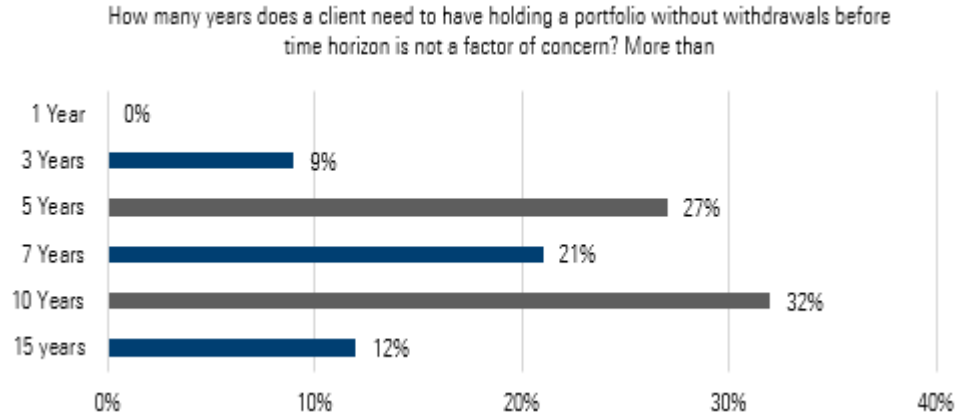
Risk required is the risk associated with generating the returns needed to make achieving an individual's goals with the financial resources available. Risk and expected return go hand in hand, where higher returns require higher risk.

The PJM approach is to look at four factors (time horizon, composure, experience and knowledge) and determine at what levels it should act as a cap to restrict the recommendation from exceeding a given threshold unless the response/value is above a certain limit or the financial professional documents why, in their professional judgment, the factor can be overridden.

Adjusting for Time Horizon

For time horizon, academics, practitioners, and regulators generally agree that shorter time horizons should normally be implemented with lower volatility portfolio recommendations. That said, research on professional judgment has found a wide disparity amongst financial professionals on what these should be. Exhibit 5 shows the range of responses from hundreds of financial professionals in multiple countries on the impact of time horizon.

Exhibit 5 Time Horizon Consideration



Source: Morningstar.

When determining a suitability score, a minimum consideration of time horizon in addition to risk tolerance and risk capacity is recommended. The suggested caps for time horizon, shown in Exhibit 6, were derived by reviewing the patterns of falls and recovery for illustrative portfolios across the risk spectrum using historical indexes data for major markets (AU, CA, U.S., U.K., IN and NZ).

To determine suitable time frame for each level of risk across the risk spectrum, we look to the minimum time frame it takes for the illustrative portfolios to return a positive return, i.e., what is the minimum time frame required to recover from any fall during the study period.

Exhibit 6 Suggested Time Horizon Consideration

Time Horizon	Risk Tolerance / Suitability Score	Growth / Equity %
Less than 1 year	14	0% to 10%
1 to 2 years	37	15% to 34%
3 to 4 years	52	40% to 59%
5 to 6 years	68	66% to 85%
More than 6 years	100	> 85%

Source: Morningstar.

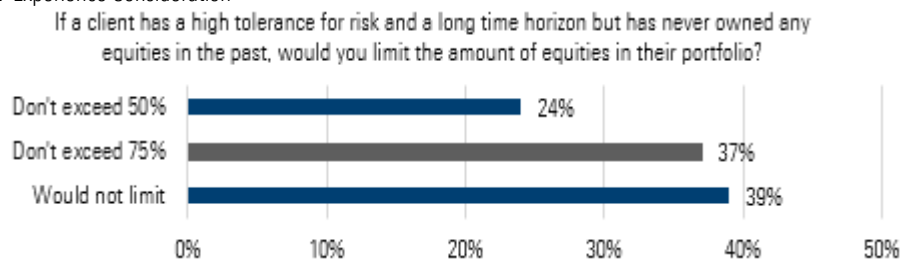
For very short time horizon of 0 to 1 year, the portfolio should hold no or very little equity to minimize any short-term volatility. Once time horizon exceeds six years, there is essentially no cap (100 is the maximum score), this is consistent with the results presented in Exhibit 5, where most financial professionals (65%) believe a time horizon of more than seven years to no longer be a factor of concern. This appears to be based on the ability for the portfolio to recover in a downturn to at least initial values. While some financial professionals believe time horizon remains a concern for longer periods, this may be based on a planning desire for the portfolio to revert to the mean (not simply recover loses) and the client to achieve their goals.

Adjusting for Composure, Experience, and Knowledge

Although time horizon is what we would consider a minimum for consideration in addition to an individual's risk tolerance, financial professionals, compliance managers, and regulators have always appreciated that there are additional factors that must be considered when we determine an individual's risk profile.

- **Composure**: A measure of an individual's emotional state when markets drop sharply in value. When things are going well, it's easy to be comfortable with investment risk, but when things are going badly, we may find we are not as resilient as we might have thought (loss tolerance). Generally, a more conservative approach is recommended for those who are less composed during market downturns. This is sometimes referred to as risk reactivity. Ideally, composure can be observed in historical transactional data, but without access to this data we ask a question about composure. If an individual has previously demonstrated a lack of composure by crystalizing losses in a downturn, this may be used as a cautionary sign to restrict their use of high equity portfolios.
- **Experience and knowledge**: Generally, the more knowledge and experience a person has with financial markets, the more resilient they are to fluctuating markets. In the literature, this is referred to as ambiguity risk, the fact that people without experience may think the worse-case and best-case outcomes are more extreme than in reality. Experience and knowledge result in more reasonable expectations. If an individual has no prior experience with equity, this is used as a cap to restrict a high equity portfolio. Similarly, with knowledge, if an individual has no or very little knowledge about investing, this is also used as a cap to restrict a high equity portfolio. Based on our ongoing research into professional judgment, when asked if they would limit the amount of equities in the portfolio for a client with a high tolerance for risk and a long time horizon, the majority of financial professionals (61%) would limit the amount of equities.

Exhibit 7 Experience Consideration



Source: Morningstar.

The suggested caps for composure, experience and knowledge are shown in Exhibit 8.

Exhibit 8 Suggested Composure, Experience and Knowledge Considerations

Factors		Risk Tolerance / Suitability Score	Growth / Equity %
Composure	Nervous and sold equity during a financial downturn or never experienced a financial downturn	68	66% to 85%
	No impact during a financial downturn	100	> 90%
Experience	No prior equity experience	68	66% to 85%
	Prior experience	100	> 90%
Knowledge	No or very little knowledge about investing	61	55% to 74%
	Basic knowledge about investing	68	66% to 85%
	Very knowledgeable about investing	100	> 90%

Source: Morningstar.

For example, take our client with an initial risk tolerance score of 65 and a time horizon of four years, and now let's assume this client has never experienced a downturn, has had prior experience with equity, and a basic knowledge of investing. The caps for composure, experience, and knowledge (68,100, 68, respectively) are all above the adjusted score of 52 (due to time horizon), no further adjustment is required, and the client would have a suitability score of 52.

We recommend that financial professionals review the suggested caps and ensure they are consistent with their beliefs in respect to professional judgment before implementation.

Risk Comfort Ranges

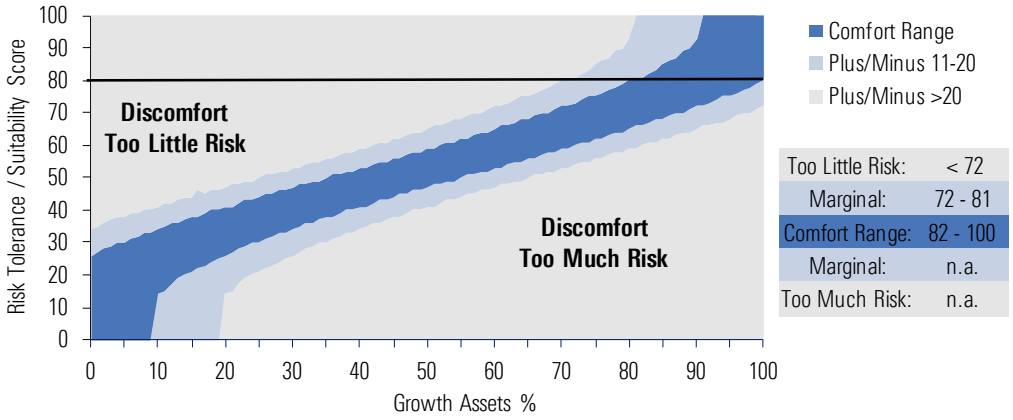
The next stage is transforming the suitability score into a range of Morningstar Portfolio Risk Scores, or MPRS. We first need to link the plain English of the risk tolerance questionnaire, via a score, to a portfolio parameter indicative of risk that would be meaningful to both clients and financial professionals, so that an apples-to-apples comparison between risk tolerance and investment risk can be made. This link is based on the client expectation of risky asset exposure (growth/equity versus defensive/fixed income) as outlined in the *Morningstar Risk Comfort Range Methodology* document.

In summary, a suitability score can be expressed in terms of a range of growth assets and refined to map to a range of Morningstar Portfolio Risk Scores. For example, a suitability score of 80 translates to 91% growth assets, meaning that a client with a suitability score of 80 will be comfortable with an asset allocation that has 91% growth assets (and 8% defensive assets).

Risk tolerance is not just an upper limit on a negative. Rather, it is where the individual balances the chance of a positive outcome against the chance of a negative outcome. So, not only can an individual be exposed to too much risk, he or she can also be exposed to too little risk. Hence, there will be a shading-in between comfort and discomfort on both the upside and the downside.

Exhibit 9 shows the Risk Comfort Range for a suitability score of 80 (horizontal black line) is growth assets of 82% to 100%.

Exhibit 9 Client Expected Growth Assets by Risk Tolerance / Suitability Score



Source: Morningstar.

It was important that the measure of the risk of the portfolio was expressed in the same metric (growth or equity asset exposure) as this "comfort expectation" of clients. Total growth exposure was a relatively simple value for financial professionals to calculate on any portfolio by looking at the underlying asset classes. When looking at some asset classes like "alternative investments," an assumption of 75% defensive and 25% growth/equity was used after extensive dialogue with fund managers. Financial professionals or bespoke mapping (looking at the fund prospectus) allowed alterations depending on the investment policy of the fund.

Morningstar Portfolio Risk Scores

The Morningstar Portfolio Risk Scores provides a far more robust methodology to frame the risk of any portfolio based on its relationship to an extended risk spectrum using the Morningstar Target Allocation Index family. Because the MPRS uses a volatility-based scoring approach, it is not prone to ambiguous

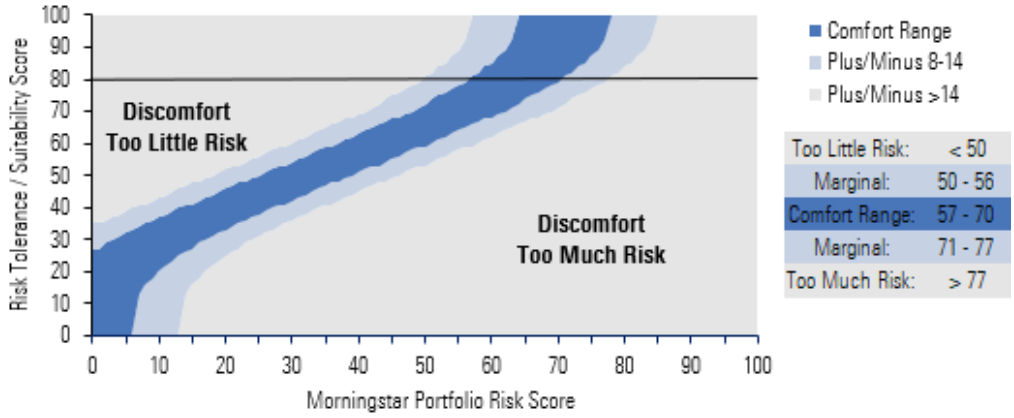
classification of growth assets and can incorporate diverse and non-traditional investment types (for example, alternatives) that do not fall neatly into an asset allocation approach.

To ensure the stability of volatility-based scores while retaining the benefits of asset-allocation-based approach, portfolios are scored based on their volatility relative to the Morningstar Target Allocation Indexes, or MTAIs. The indexes work as anchor points that measure the overall market condition and allow us to retain the connection to the traditional allocation views and risk classification.

Since the Morningstar Target Allocation Indexes are representative of well-diversified asset-allocation benchmarks, this allows us to establish a linear regression relationship between the overall equity exposure, or growth assets, and the Morningstar Portfolio Risk Score. So that a 50% equity exposure translates to an MPRS of 35 and a 100% equity exposure translates to an MPRS of 70.

Exhibit 10 shows the Risk Comfort Ranges with the X-axis now reflecting the MPRS for the U.S. and Canada where MPRS Risk Comfort Range is available. The Risk Comfort Range for a suitability score of 80 (horizontal black line) is an MPRS of 57 to 70.

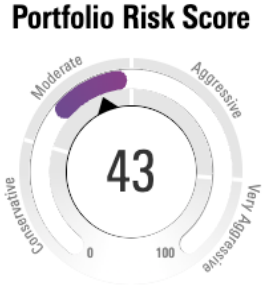
Exhibit 10 Risk Comfort Range for U.S. and Canada



Source: Morningstar.

Exhibit 11 illustrates what the financial professional and client would jointly see in the expression of the Risk Comfort Range. Here, it is presented in the orientation of the current or proposed portfolio with a Portfolio Risk Score of 43, in relation to the individual's Risk Comfort Range of 34-47. The Risk Comfort Range was determined as the range of 34-47 based on a suitability score of 57. The Portfolio Risk Score (43) falls within the bounds of the Risk Comfort Range.

Exhibit 11 Risk Comfort Range of 34-47 (Suitability Score of 57) and Morningstar Portfolio Risk Score of 43



Source: Morningstar.

For markets outside of U.S. and Canada where the MPRS Risk Comfort Range is not available, the Risk Comfort Range will continue to be expressed in terms of a range of growth assets as shown in Exhibit 9.

Risk Comfort Range is a crucial concept, as it diverges from most legacy solutions that simplified systems to categorize clients and products into static investment policy bands. Clients are grouped in these bands, and products and portfolios are rated to be appropriate for people in a specific band or higher. As an example, money market funds may be rated a 1, fixed income a 2, allocation funds a 3, large-cap developed equity a 4, and emerging-markets and small-cap funds a 5. If a client is placed in Band 3, they can be recommended products from Bands 1, 2, or 3—but not from higher-risk bands.

The products and portfolios are themselves scored using the Portfolio Risk Score on a scale from 0 to 80 for diversified asset-allocation portfolios, to whatever is appropriate above this, based on the risk of the portfolio. Asset-allocation funds generally score within 80, while a portfolio composed of one or two stocks might have a score in excess of 100.

The Risk Comfort Range introduces a tailored band for a client where the range is a good fit for them. This addresses issues with legacy systems where a client may be at the high end of Band 3 but still not allowed access to Band 4 products. This means that a portfolio or product may fall in the Risk Comfort Range of clients who, as an example, were historically in the high end of Band 3 and the lower end of Band 4.

The Risk Comfort Range is instrumental in providing more-tailored personal advice to clients and a more versatile ability to apply investment solutions. Financial professionals can blend adjacent preconstructed portfolios for a client, arriving at a best-fit solution from a risk-profiling perspective.

Morningstar Portfolio Risk Score

The Morningstar Portfolio Risk Score assesses risk and diversification to help investors, financial professionals, and those who oversee large groups of financial professionals to assess whether the riskiness of the portfolio matches the risk profile of an investor. It has optimal value when combined with the Morningstar Risk Profiler and the personalized Risk Comfort Range of an investor. The Portfolio Risk Score enables investors to be matched with suitable portfolios that align with their respective risk profile.

At the heart of the system is a risk-scoring engine that is capable of automatically analyzing millions of portfolios and assigning a numeric risk score in which diversified asset-allocation portfolios typically receive a score ranging from 0 to 80 and highly concentrated portfolios and asset-class-specific portfolios (such as a small-growth fund, a sector fund, or a country-specific fund) will typically receive scores between 80 and 100. Scores above 100 indicate elevated to extreme levels of risk and are probably not suitable to represent a complete investor portfolio. The score is based on the portfolio's relationship to an extended risk spectrum based on the Morningstar Target Allocation Index family.

The indexes of the Morningstar® Target Allocation Index family, or MTAI, provide consistent measures of risk by asset-class exposures to Morningstar building block indexes and are aligned with the Morningstar Category classifications for asset-allocation funds. The underlying index weights are derived from eligible open-end funds in Morningstar's fund holdings data and therefore reflect the collective wisdom of the numerous asset managers producing asset-allocation funds in the relevant categories. While one cannot invest directly in the Morningstar Target Allocation Index family, we believe the asset allocations embedded in these indexes represent appropriate asset-allocation portfolios for a wide variety of investors.

Calculating Morningstar Portfolio Risk Score

The process for calculating a Portfolio Risk Score begins by identifying the investments—mutual funds, exchange-traded funds, individual securities, and so on—in the portfolio. When deployed for home office analytics and monitoring, portfolios are typically identified using information from the Morningstar system or a template using Morningstar's unique security identification system. When deployed for direct use by a financial professional (or an individual investor), these users can leverage existing client portfolios or model portfolios or upload them using an import feature. Alternatively, they can analyze portfolios on the fly by entering portfolio positions.

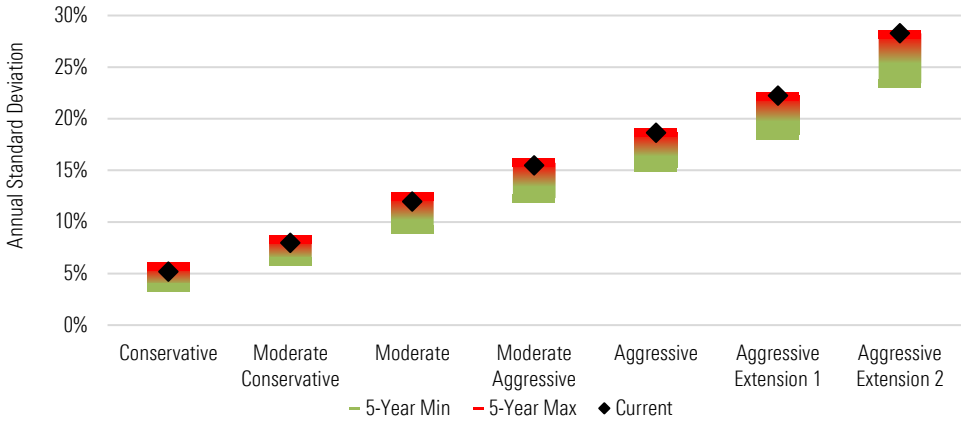
The automated analysis of a portfolio is dependent on Morningstar having at least 80% portfolio holdings coverage identified through Morningstar's Risk Model or 24 months (preferably 48 months) of trailing returns for the current constituents (mutual funds, ETFs, individual securities, and so on) of a portfolio. In general, for a portfolio to receive a Morningstar Portfolio Risk Score, the scoring engine requires Security IDs for 100% of the portfolio.

The Portfolio Risk Scores are calculated based on the estimated volatility of fund returns. The volatility estimates are primarily generated by the Morningstar Risk Model's holdings-based style analysis (HBSA) and supplemented by Sharpe's return-based style analysis (RBSA) for portfolios with insufficient holdings data.

To ensure that the risk scores are stable over time and not clustered around 15% to 20% volatility range, the risk scores are anchored to the risk bands derived from the long-term risk profiles of the U.S. TAIs as shown in Exhibit 12. The U.S. TAIs were chosen as a reference point to anchor the risk scores and define

the mapping between volatility ranges and risk bands. In other words, the risk scores are calculated relative to the U.S. market.

Exhibit 12 5-Year Volatility Profiles of U.S. Target Allocation Indexes



Source: Morningstar.

The volatility ranges of the risk bands were defined using the U.S. TAIs and extensions' 5-year volatility estimate history. Exhibit 13 provides definitions for the risk bands in terms of volatilities and risk scores. The risk scores are in proportion to volatility ranges with 28.2% volatility being a score of 100.

Exhibit 13 Mapping Between Portfolio Annual Volatility and Risk Scores

	Volatility Range	Risk Score Range
Conservative	0% - 6.8%	0 - 24
Moderate	6.8% - 13.4%	24 - 48
Aggressive	13.4% - 22.2%	48 - 79
Very Aggressive	22.2% - 28.2%	79 - 100
Extreme Risk	28.2% - 50%	100 - 200

Source: Morningstar.

Based on this volatility to risk score mapping in each risk band, we rank portfolios by volatility. Since percentile ranking can be unstable when the market environment shifts dramatically or securities are removed from or added to the investment universe, we've constructed a grid that is calibrated on an annual basis. For each risk band, we construct 10,000 equally spaced points that connect volatilities to risk scores. For example, the 5,000th point in the Conservative risk band is:

$$\text{Volatility} = \frac{5000}{10000} \times (6.8\% - 0\%)$$

$$\text{Risk Score} = \frac{5000}{10000} \times (24 - 0)$$

and the 15,000th point in the Moderate risk band is:

$$\text{Volatility} = 6.8\% + \frac{15000 - 10000}{10000} \times (13.4\% - 6.8\%)$$

$$\text{Risk Score} = 24 + \frac{15000 - 10000}{10000} \times (48 - 24)$$

Beyond the 50,000th point in the Extreme risk band, we simply extrapolate points from any two points in the Extreme Risk band. The risk band beyond Extreme cannot be reliably pre-defined because the maximum volatility is unknown until the universe is observed. Risk scores beyond 200 are capped at 500. Using two points in the Extreme risk band (v_1, v_2, rs_1, rs_2), and the portfolio volatility v_p,

$$\text{Risk Score} = rs_1 + (rs_2 - rs_1) \times \frac{v_p - v_1}{v_2 - v_1}$$

For more information on the MPRS, please refer to the *Morningstar Portfolio Risk Score Methodology* document.

Summary

Financial professionals have a duty to ensure the portfolios they are using are well-diversified and that they are assigning individuals to an appropriate risk-based portfolio. This process requires three evidence-based and defensible methodologies:

- Know Your Client: Risk Profiling
- Know Your Products: Morningstar Portfolio Risk Score
- Mapping client profile to suitable risky portfolios: Risk Comfort Range

Morningstar Risk Profiler incorporates a psychometrically validated risk tolerance questionnaire and integrates other factors required to be considered in the aggregate profile and provides the world's most researched and defensible risk profiling methodology. It is stable over time, which allows consistency in the suitability determination.

Morningstar Portfolio Risk Score is an objective and rigorous way for financial professionals (and individuals) to clearly understand how portfolio risk is measured, including assessment of non-traditional portfolio constructions that was otherwise challenging in the asset allocation approach.

This system enables investors, financial professionals, compliance personnel, and regulators to assess risk (using a risk score) relative to the long-term risk profiles of Asset Allocation Indexes, in which the indexes have been used to create an intuitive risk spectrum. The system re-calibrates the risk score grid to reflect changing volatility levels in the overall market. Because the risk score engine is powered by the Morningstar Risk Model, it can be further enhanced by the full capabilities of the holdings-based style analysis such as factor decomposition and in-depth analysis of risk attribution.

The scaling of the MPRS to industry-derived portfolios means that the scale remains more constant over time. If markets experience short-term volatility, both the yardstick, the MPRS, and the products are impacted in the same way, leaving the relative score more stable/unchanged by design.

Suitability is a determination of the best possible fit or match between a client and the investment solutions provided to them, with the rigor determined by the standard of care enforced by regulation. Clients placed in a 50/50 portfolio expect market bumps in the road during the journey. Uniquely, the Morningstar Risk Ecosystem provides the industry with a stable, transparent, and defensible measure for both the client and the portfolios provided to them, ensuring suitability is more efficient and less costly for all concerned.

References

Geoff Davey, 2015, “Getting Risk Right,” Investment Management Consultants Association, April.

Morningstar Portfolio Risk Score Methodology

Morningstar Risk Comfort Range Methodology

Morningstar Risk Profiler Methodology

Morningstar Risk Profiler: Psychometric Tolerance Methodology

Sharpe, William F. 1988. "Determining a Fund's Effective Asset Mix." *Investment Management Review*, December, P. 59.

Sharpe, William F. 1992. "Asset Allocation: Management Style and Performance Measurement." *The Journal of Portfolio Management*, Winter, P. 7.

22 West Washington Street
Chicago, IL 60602 USA