
Morningstar Risk Profiler Methodology

Morningstar Analytics

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Overview

This document provides details on the methodology underlying the suitability framework in the Morningstar Risk Profiler. The Risk Profiler is composed of two primary components:

- ▶ A psychometric risk tolerance questionnaire that measures an individual's psychological willingness to take risk.
- ▶ The Professional Judgment Matrix, or PJM, a component that integrates the psychological attribute of the individual (tolerance) with other financial and factual considerations, such as risk required, risk capacity, time horizon, prior investment experience, financial knowledge and more, to arrive at an aggregate treatment for a portfolio or group of accounts, called a suitability score.

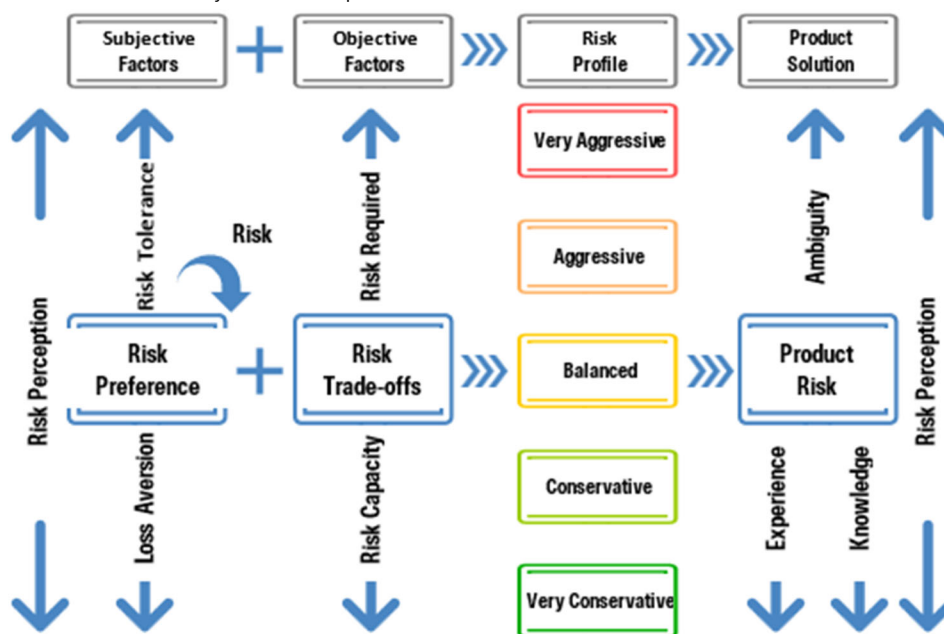
An individual has one tolerance but can have different portfolios dedicated to different goals and therefore can have different suitability scores for each. The Professional Judgment Matrix, as the name implies, is supported by research, but we have found significant variation in the industry. Firms can customize the rules to align with their policies or professional judgment.

Defining the Components of Risk Profiling

As an outcome of a research study completed on behalf of the Ontario Securities Commission in 2015,¹ a framework 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.

We have mapped the best understanding from the academic world to the articulated requirements of the regulators to arrive at a defensible and effective model that encapsulates the decision rules used by financial professionals. We call this model the Professional Judgment Matrix, or PJM.

Exhibit 1 Visual Summary of Risk Concepts



Source: Morningstar.

There are four discrete stages in the process to support suitability:

- ▶ **Risk Tolerance:** Assess the psychological or subjective traits of the individual.
- ▶ **Risk Profile:** Adjust for other personal factors like composure, experience, and knowledge, and for each portfolio the need, liquidity, and time horizon.
- ▶ **Risk Capacity:** Back-test to ensure the client is aware of and can live with a worst-case outcome from the strategy.
- ▶ **Implementation:** Select products that are suitable for the individual and the specific portfolio.

The subsequent sections of this document outline the specifics of each stage.

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

Psychometric Risk Tolerance Questionnaire

A fundamental attribute of the individual recognized by every regulator is risk tolerance. Risk tolerance refers to the psychological trait of an individual's willingness to take financial risks. For example, how much a person is willing for their portfolio to diminish for a chance to make bigger returns. Generally, the higher the risk tolerance, the higher the level of risk a person is willing to take.

Risk tolerance is often confused with loss tolerance. How somebody feels about taking risk when choosing between alternative courses of action, including the possibility of unfavorable outcomes (risk tolerance) is one thing. How somebody will subsequently feel if one of the possible unfavorable outcomes actually occurs (loss tolerance) is another. Risk tolerance is relevant to how someone makes decisions. Loss tolerance is relevant to how someone reacts to an event.

When we talk about a client being comfortable with a portfolio, we mean comfortable with the level of risk inherent in that portfolio. We are not predicting how the client will feel if one of the bad risks eventuates. How the client will react to an unfavorable outcome (loss tolerance) is not predictable with any certainty.

Essentially, the Morningstar Risk Tolerance Questionnaire, or RTQ, enables the client to give the financial professional clear instructions about the level of risk they choose to take at the time decisions are being made. The financial professional is entitled to rely on those instructions. While nobody enjoys an unfavorable outcome, there is a significant difference between being unhappy with the outcome and being unhappy with the advice that led to the outcome.

It is likely, though by no means certain, that a client's reaction to an unfavorable outcome will be consistent with what he or she said about the level of risk they were willing to take. The better the client knows themselves, the more consistent the reaction will be. But, in any event, the Morningstar RTQ brings the client back to what he or she said at the time the decision was made and demonstrates how that decision led to the course of action that was followed.

Psychometrics Standards

Over the past 100 years, considerable effort has been devoted to establishing standards for measuring value-expressive attributes, such as risk tolerance. The research was done by psychologists and statisticians, and the discipline they developed is known as psychometrics.

Psychometric standards can be applied to questionnaires ranging from opinion polls and market surveys, through to tests of IQ, personality, aptitude, and so on. A robust questionnaire is, in psychometric terms, one that is valid and reliable, where:

- ▶ Valid means that it measures what it claims to, and
- ▶ Reliable means that it does so consistently, with a known level of accuracy.

A psychometric assessment must go through a rigorous development process comprising usability trials and norming trials and must meet an internationally accepted set of psychometric standards.

- ▶ In usability trials, a large pool of questions is tested for understandability and answerability. This can involve researchers sitting with subjects who are encouraged to verbalize their thoughts as they examine the questions. Questions that seem straightforward are often revealed to have poor understandability and/or answerability.
- ▶ In norming trials, questionnaires comprising questions with high usability are tested on representative samples to determine the statistical value of the questions and the scoring algorithm. Questions that appear insightful often have little or no statistical value in differentiating one respondent from another.

Typically, development requires multiple loops through both trial processes. The Morningstar RTQ has been through four such loops. For more information on the questionnaire, please refer to the *Morningstar Risk Profiler Psychometric Questionnaire Methodology* document and detailed discussion of the application of psychometrics in risk tolerance assessment can be found in the paper *Insights on Measuring Risk Tolerance from Psychology and Psychometrics*.² The Morningstar RTQ has been certified by the University of New South Wales' Applied Psychology Unit to meet international psychometric standards.³

The Morningstar RTQ

- ▶ There are two versions of the questionnaire: a 25-question questionnaire and a 10-question questionnaire. The 25-question covers a wide range of financial issues, not just investment issues. The 10-question is a subset of the 25, which focuses more on investment issues.
- ▶ Individuals are scored on a scale of 0 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 0.91 (Cronbach's Alpha) for the 25-question version and a reliability of 0.84 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 2. The middle segment is the Mean plus or minus half a Standard Deviation, that is, from 45 to 54. Segments on 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

² Roszkowski, M. J., Davey, G., & Grable, J. E. (2005). "Insights From Psychology and Psychometrics on Measuring Risk Tolerance". *Journal of Financial Planning*, 18(4), 66.

³ <http://www.riskprofiling.com/Downloads/UNSWFinaMetricaCertification.pdf>

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 RTQ 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.

Risk Tolerance Report

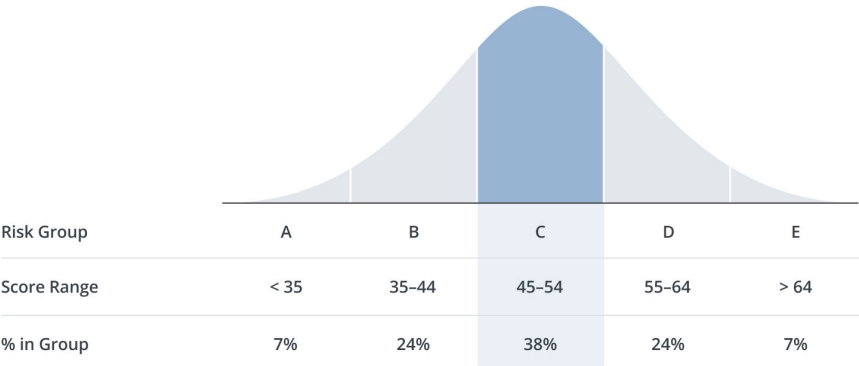
Risk Tolerance Score

This section of the report provides an overview of the individual's score, risk group, and self-estimate (only available for the 25-question version), as shown in Exhibits 2 and 3.

Exhibit 2 Risk Tolerance Score—10-Question Questionnaire

Your risk tolerance score

Your risk tolerance score is **46 out of 100**, which is a slightly-lower-than-average score, lower than 64% of all scores. This score enables you to compare yourself to a representative sample of the adult population. When scores are graphed, they form a bell-curve. To make the scores more meaningful, the 0 to 100 scale has been divided into five risk groups. Your score places you in **risk group C**.



Source: Morningstar.

Exhibit 3 Risk Tolerance Score—25-Question Questionnaire

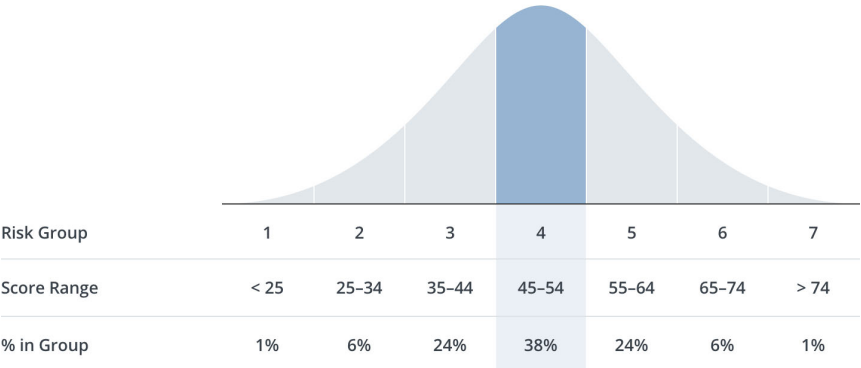
Your risk tolerance score

Your risk tolerance score is 50 out of 100, which is the average score. This score enables you to compare yourself to a representative sample of the adult population.

When scores are graphed, they form a bell-curve. To make the scores more meaningful, the 0 to 100 scale has been divided into seven risk groups. Your score places you in **risk group 4**.

In answer to the last question, you estimated your score would be 50. Congratulations! You picked your score exactly.

Most people under-estimate their score by a few points.



Source: Morningstar.

Risk Group and Differences

The risk group descriptions reflect the typical answers of individuals whose scores fall within that group.

Although the Morningstar RTQ is demonstrated to be a valid and reliable measure of risk tolerance, it is important to identify limitations of the outputs it generates ⁴ and recognize that there are still many aspects of the advisory process that rely on the professional judgment of a financial professional. The questionnaire is designed to highlight inconsistencies ⁵ in answers for the individual's self-awareness and to allow financial professionals to further engage for clarification.

People do not necessarily answer the Morningstar RTQ consistently. If you consider that the score represents an overall evaluation of the individual's answers to the questionnaire, some answers will reflect less risk than would be expected from the score and others more risk. These differences, shown in the description (only for the 25-question version) and highlighted in a table are what makes each individual unique. The objective is for financial professionals to recognize these differences and determine if they are material in their understanding of the individual and will impact the advice or guidance they will deliver.

⁴ The Financial Conduct Authority (UK) guidance on Assessing Suitability recommends that users understand the limitations of the risk-profiling tool they use: <https://www.fca.org.uk/publication/finalised-guidance/fsa-fg11-05.pdf>

⁵ The SEC (US) guidance for robo advisers highlights the need to address inconsistent client responses: <https://www.sec.gov/investment/im-guidance-2017-02.pdf>

The description, as modified by the reported differences, is a verbatim statement by the individual about themselves in relation to risk. Exhibit 4 shows the 10-question description and differences table. Exhibit 5 shows the 25-question description, with reported differences, and differences table. For example, in Exhibit 5, the individual usually feels somewhat pessimistic about major financial decisions after he makes them compared with somewhat optimistic for the group (Q7).

Exhibit 4 Risk Group—10-Question Questionnaire

Your Risk Group

The following provides a summary of the typical attitudes, values, preferences, and experiences of those in your risk group. It summarizes how those in your risk group usually answer the risk tolerance questionnaire.

Investors in risk group C think of "risk" as "uncertainty" and are prepared to take a medium degree of risk with their financial decisions. When things go wrong financially they are as likely to adapt somewhat uneasily as somewhat easily. For most, a fall of 20% in the total value of their investments would make them feel uncomfortable, but for some it would take a 33% fall. etc...

Your Differences

It is not uncommon for some of the answers given in the risk tolerance questionnaire to differ from those typically given by people with similar risk tolerance.

	A	B	C	D	E
Q1 Self-Rating			●		
Q2 Adaptability			●		
Q3 Meaning of Risk			●		
Q4 Losses v. Gains	●				
etc...					

Source: Morningstar.

Exhibit 5 Risk Group—25-Question Questionnaire

Your Risk Group

The following provides a summary of the typical attitudes, values, preferences, and experiences of those in your risk group. It summarizes how those in your risk group usually answer the risk tolerance questionnaire. **Three** of your answers differed from this description. They are shown near the investor descriptions and in the differences summary that follows. These differences are normal, they fine-tune the description to you personally.

Making financial decisions

Investors in risk group 4 think of "risk" as "uncertainty" and are prepared to take a medium degree of risk with their financial decisions (Q3 & 10). They have a reasonable amount of confidence in their ability to make good financial decisions and usually feel somewhat optimistic about their major decisions after they make them (Q12 & 7). When faced with a major financial decision some are usually more concerned about the possible losses while others are usually more concerned about the possible gains (Q6).

You usually feel somewhat pessimistic about your major financial decisions after you make them.

etc ...

Your Differences

It is not uncommon for some of the answers given in the risk tolerance questionnaire to differ from those typically given by people with similar risk tolerance. Sometimes the difference indicates more risk tolerance and sometimes less.

	1	2	3	4	5	6	7
Making Financial Decisions							
Q3 Meaning of Risk				●			
Q10 Current Risk-Taking				●			
Q12 Confidence in Decisions				●			
Q7 Feels After Decisions		●					
Q6 Losses vs. Gains				●			
etc ...							
Source: Morningstar.							

Adjustment and Consistency Measure

Most of the time the differences are not material, but sometimes—about 3% of the time— they are. In such cases, the simplest solution is to adjust the score. The descriptions for each risk group (people of similar risk tolerance) provide a basis for adjusting the score. For example, those in risk group 5 typically say they can (emotionally) handle a 20% fall in the value of their investments. However, it is possible that somebody who scores 57, which falls into risk group 5, could say that they cannot handle any fall in the value of their investments, which is more typical of someone in risk group 2.

The ensuing discussion will almost certainly result in a decision that the individual's risk tolerance is less than the reported score indicates and that it would be more appropriate to work with a reduced score for the purpose of determining an investment strategy.

The report also identifies individuals who are considered less *traited* for risk tolerance (and may not consistently exhibit their risk tolerance in future contexts) by flagging those with extremely high, very high or high levels of inconsistencies in their answers.

We recommend that financial professionals resolve any differences (or inconsistencies) in answers through discussion and adjusting the score where appropriate. This discussion and the agreed score should be documented and signed off by the client. The agreed score would be used for further analysis.

Inconsistencies are not a negative characteristic—some people are just less consistent than others. However, it is helpful to both clients and financial professionals for this to have been identified openly at the very start of the relationship.

Discussing the Risk Tolerance Report

The primary purpose of the risk profiling process is to identify an investment strategy that best fits the client's circumstances, aspirations, risk capacity, and risk tolerance. Below are actions financial professionals can take to ensure that they have instructions upon which they can rely, and to help them quickly develop an in-depth understanding of their clients' risk tolerance.

- ▶ **Confirm report accuracy:** Ask the client whether the report is accurate. Some clients will be surprised by their scores and may question the accuracy of the report. Ask them to review the risk group description, as modified by any differences, and point out any "inaccuracies." If they identify something they consider inaccurate, go back and review the actual answer. It is possible that a mechanical mistake was made when completing the questionnaire. One such mistake will not affect the risk tolerance score by more than a couple of points. The mistake should be noted, and the score can be used as it stands. If there are multiple mistakes, the questionnaire should be repeated. Sometimes clients will confirm that the report is an accurate summary but will still have difficulty accepting their score. Explain that the score is simply the result of an objective, statistical comparison between their answers and the answers given by a sample of the adult population. If their score is lower than expected that's because they underestimate the risk tolerance of the adult population, and vice versa if their score is higher than expected. In either case, ask them to talk about how they formed their views about other people's risk tolerance. Who are they comparing themselves to?
- ▶ **Explore investment choices:** Explore the Investment section and any differences reported there. Such differences will occur in virtually all assessments. Now is a good time to begin educating the client about risk and return and managing their expectations.
- ▶ **Check risk groups:** On average, men are at the high end of Risk Group 4 (25Q)/C (10Q) and females are at the low end of Risk Group 4 (25Q)/C (10Q). Where a client is two or more risk groups away from these averages, they are "outliers", and this should be discussed.
- ▶ **Check Self-Impression (25 only):** If your client's estimate of their risk tolerance is ten or more points away from their actual score you should certainly discuss this with them. It is likely that the issue will have already been raised under report accuracy above. But, if it hasn't,

you should raise it, following the explanation outlined previously. Even if the difference is only five points, there should be some benefit in a brief discussion.

- ▶ **Check number of differences:** Typically, there will be from one to four (25Q) or one to three (10Q) differences. Differences occur because, while those within a risk group are similar, they are not clones. Clients whose scores fall at either end of a risk group tend to have more differences than those in the middle. The number of differences is an indication of the client's consistency when it comes to financial issues. Occasionally, a client will have many differences—eight or more indicates a lack of consistency in financial matters. This is not a negative characteristic; it just means that some people are less consistent than others.
- ▶ **Explore differences:** Differences provide an opportunity to open up discussion. Each represents an aspect of the client where they differ from those with whom they are otherwise similar. Differences that are significantly outside the range are more important than those just outside. For any difference, low or high, it is appropriate to ask why the client thinks it might be that they chose a lower/higher option than is typical of their risk group. But it's important not to make too much of any difference. Remember, these are real people, not clones. However, you should look for any difference between the level of risk your client is now willing to take, in Making Financial Decisions and the level they've taken previously, in Financial Past. If there's been a change, you'll want to know why.
- ▶ **Inconsistencies:** Where client's answers indicate a high to extremely high level of inconsistency, financial professionals may consider these actions, in addition to those described above,
 - ▶ A retest after six months or more regular testing may be advisable to confirm the original results.
 - ▶ Further education and discussion on risk and return to confirm whether expectations are consistent with answers provided in the questionnaire.
 - ▶ Explore reactions to various stress scenarios to confirm whether reactions are consistent with answers provided in the questionnaire.
 - ▶ Explore past behaviors to confirm whether they are consistent with answers provided in the questionnaire. For example, were you invested during the stock market correction? How did you feel and react?

Professional Judgment Factors

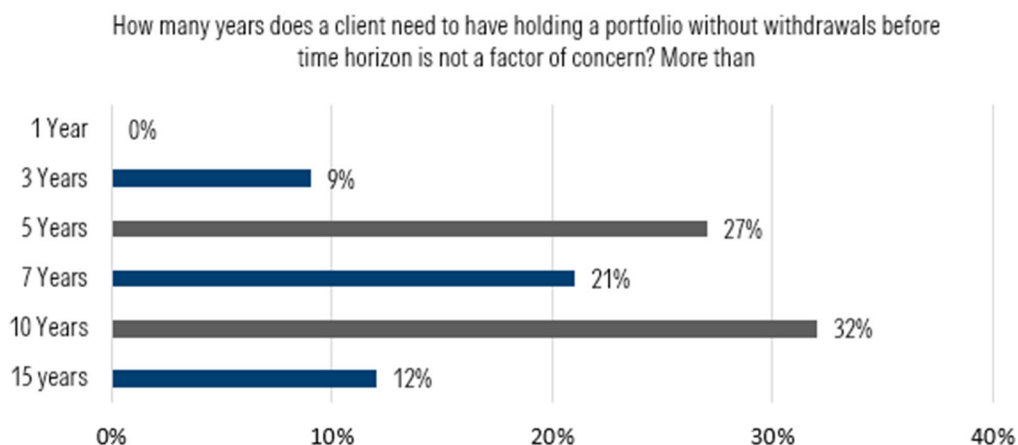
The Professional Judgment Matrix approach looks at four factors (time horizon, composure, experience, and knowledge) and determines at what levels it should act as a cap to restrict the recommendation from exceeding a given threshold, unless the response/value is above a certain limit or the financial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

Adjusting for Time Horizon

Time horizon is the time period where an individual expects to hold an investment for. It is a function of the goals or expected use of funds. See *Risk Required: The Client's Goals* below for further details on time horizon and other liquidity considerations.

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 6 shows the range of responses from hundreds of financial professionals in multiple countries on the impact of time horizon.

Exhibit 6 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 7 were derived by reviewing the patterns of falls and recovery to value for a set of benchmark portfolios based on the Morningstar® Target Allocation Index, or TAI, Family, across six markets (US, CA, UK, EU, AU, and NZ) using historical indexes data from January 1973 to December 2022. The benchmark portfolios were scaled in increments of 10% equity/growth exposure.

To determine suitable time frame for each level of equity/growth exposure across the risk spectrum, we look to the minimum time frame it takes for the benchmark portfolios to return a positive return, i.e.,

what is the minimum time frame required to recover from any fall during the study period. Appendix 1 provides further details of the analysis.

Exhibit 7 Suggested Time Horizon Consideration

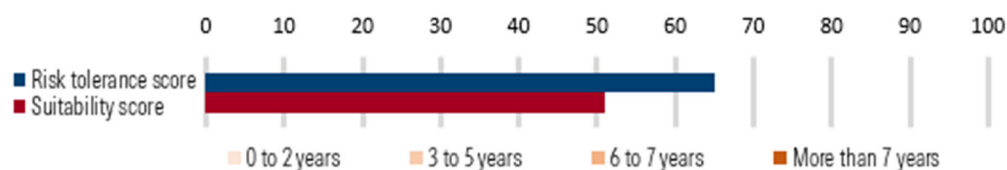
Time Horizon	Risk Tolerance / Suitability Score	Growth Assets	MPRS (U.S./CA/U.K./JP)
Less than 3 years	15	0% to 10%	0 to 7
3 to 5 years	51	40% to 59%	28 to 41
6 to 7 years	70	70% to 89%	49 to 62
More than 7 years	100	> 91%	> 64

Source: Morningstar.

For a very short time horizon of 0 to 2 year, the portfolio should hold no or very little equity to minimize any short-term volatility. Once time horizon exceeds seven years, there is essentially no cap (100 is the maximum score). This is consistent with the results presented in Exhibit 6, where most financial professionals (65%) believe a time horizon of more than seven years is no longer 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. Some financial professionals believe time horizon remains a concern for longer periods, but this may be based on a planning desire for the portfolio to revert to the mean (not simply recover losses) and the client to achieve their goals.

For example, a client with an initial risk tolerance score of 65 and a time horizon of four years would have the initial risk tolerance score of 65 adjusted to a suitability score of 51 because of the time horizon cap.

Exhibit 8 Risk Tolerance and Time Horizon Mapping



Source: Morningstar.

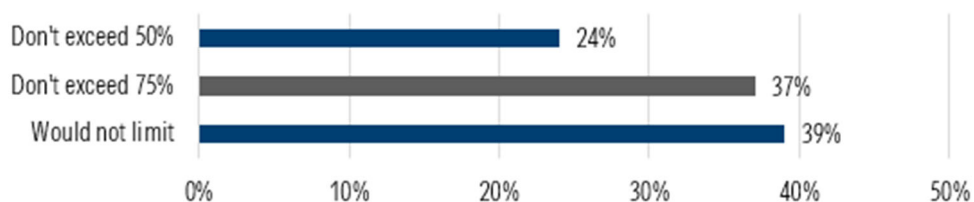
Adjusting for Composure, Experience, and Knowledge to Investment Policies

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. The Morningstar Experience questionnaire (see Appendix 2) gathers information on the individual's composure, experience, and knowledge, and can be administered separately or incorporated into the fact-find workflow.

- ▶ **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 need to 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. 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 (see Other Considerations below for further discussion on this). However, a sizeable proportion (39%) would not limit at all, experience and knowledge are viewed as optional components in the investment guidance process, as they may change the composition of the investments selected for implementation (i.e., complexity of investments) but should have a limited impact on the overall pecuniary expectations of the investment plan. If an individual has no prior experience with equity or no or limited knowledge about investing, this may also be used as a cautionary sign to restrict their use of high equity portfolios.

Exhibit 9 Experience Consideration

If a client has a high tolerance for risk and a long time horizon but has never owned any equities in the past, would you limit the amount of equities in their portfolio?



Source: Morningstar.

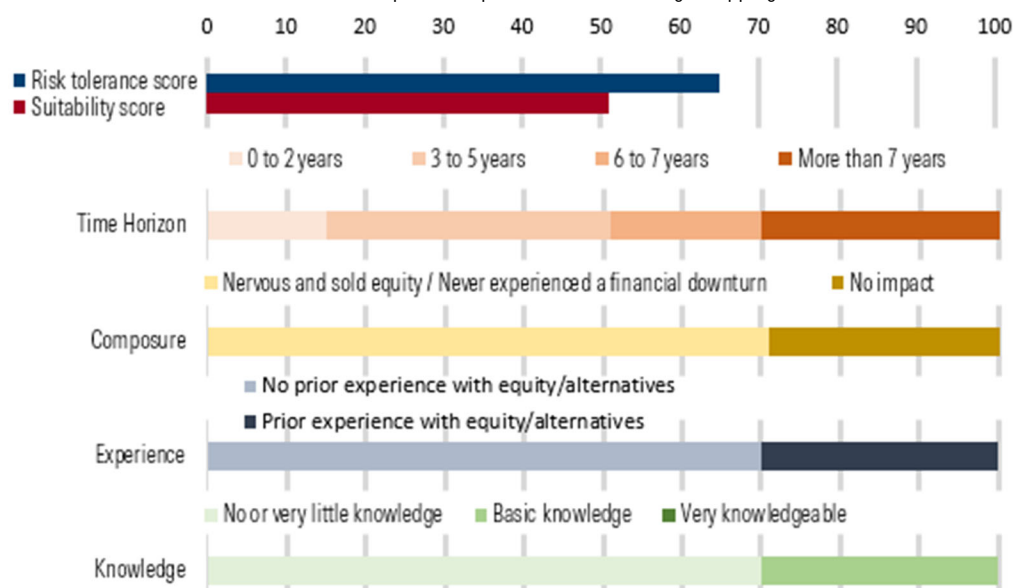
The suggested caps for composure, experience, and knowledge are shown in Exhibit 10.

Exhibit 10 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	70	70% to 89%
	No impact during a financial downturn	100	> 91%
Experience	No/limited prior equity/alternative experience	70	70% to 89%
	Prior experience of at least 1 year	100	> 91%
Knowledge	No or very little knowledge about investing	70	70% to 89%
	Basic knowledge about investing	100	> 91%
	Very knowledgeable about investing	100	> 91%

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 limited knowledge of investing. The caps for composure, experience, and knowledge (70,100, 70, respectively) are all above the adjusted score of 51 (due to time horizon), no further adjustment is required, and the client would have a suitability score of 51.

Exhibit 11 Risk Tolerance, Time Horizon, Composure, Experience and Knowledge Mapping

Source: Morningstar.

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 Required: The Client's Goals

Risk required is the risk associated with the return required to achieve an individual's goals from the financial resources available. Risk and return go hand in hand: higher returns require higher risk.

In some jurisdictions, regulation specifically warns financial professionals from using risk need as a reason to place a client in a level of risk for their portfolio that is outside their risk tolerance. It is easy for individuals to dream of ways to spend money (goals) that far outreach their ability to achieve with their investments alone. For individuals with unrealistic expectations, a “reality check” may be beneficial by helping them identify and quantify financial goals in terms of what an investment strategy can reasonably be expected to deliver. Where there is a gap between what is required to achieve an individual's goals and their risk comfort, advice can start by considering available goal levers first—like reconsidering goals (when it starts, how much is required) or increasing savings to meet these goals—before considering increasing the investment risk level above a client's tolerance. It will not help the client to achieve their goal if they crystalize losses in the first major market downturn. In the event this is the only recourse, financial professionals are well advised to have clearly documented and communicated the risks to the client.

The issue of the liquidity needs is tied to several factors, like how long until funds need to be withdrawn, how long must the funds last, and the amount of the withdrawals. If the goal is a lump sum/point-in-time goal, then the initial date is the horizon. If it is a multiyear goal, the horizon can be set to when a percentage of the goal has been realized. As a simple example, let's assume that the set percentage is 33%, and now consider a goal of \$10,000 a year starting in five years that will run for 10 years (assuming no inflation). In this case, 33% of the funds will be required by year four of the goal, or nine years from now. Where the client has multiple goals funded by a single portfolio, a best practice is to combine all goals being funded from the portfolio and estimate the total amount funding all goals and when the threshold is crossed.

In practice, the depletion of investments in a financial plan can be subject to many other factors, including but not limited to:

- ▶ Contribution and withdrawal rules of regulated account types.
- ▶ Tax-optimization strategies.
- ▶ Optimization of government benefits where there are optional election dates and benefits.

For short- to medium-term goals, the PJM framework provides a cap to restrict the recommendation from exceeding a given threshold. For longer-term goals, greater than seven years, financial professionals need to discuss with the client a suitable course of action to meet any shortfalls (or surpluses).

Risk Capacity

Risk capacity is the level of financial risk the client can afford to take without jeopardizing the achievement of important financial goals below an acceptable level. Risk capacity is generally assessed by stress-testing the financial plan to identify possible, but low probability, of negative outcomes. Risk capacity is not a test if the client is OK if markets drop and recover in a couple years, but rather if worst-case outcomes persist.⁶

Almost all regulators recommend the need to assess risk capacity, yet there is little definition on how to do so. A variety of factors can be considered in assessing capacity:

- ▶ **Pensions/other incomes:** When a client has other sources of income to help fund a goal, even if the portfolio performs poorly, the client may be fine and therefore is considered to have more risk capacity.
- ▶ **Required/desired:** When we understand a goal for a client and know the amounts required (no flexibility) or desired, it provides a floor to how low the income can go before the client has a serious problem. Some goals may be of low importance, meaning that an underperforming portfolio is not material, while funding of other goals (like retirement) may be very important to the client.
- ▶ **Debt:** The level of debt and future cash flow requirements to service debt increases the level of required income for a goal, as the debt must be serviced (it is required). Low debt can provide increased flexibility and capacity.
- ▶ **Tax optimization and other strategies:** If a financial professional can reduce the tax liability of a client, this means less money can stretch further in funding the goal. This will increase the capacity.

There are a significant number of subtleties, as outlined above, which can influence the risk capacity of a client. While a financial professional would ask the client additional questions around these subtleties when providing a comprehensive planning service, it is time-consuming in an investment planning scenario. A more practical and dynamic process would be to ask the client to specifically confirm their acceptance of the relationship between the downside risk and achieving the goal. We believe this incorporates the client's level of flexibility for the goal and acceptance of the risks with the recommended or desired investment profile. Some suggested risk capacity analyses are outlined below.

- ▶ **Certainty of Outcome:** Modeling the range of possible outcomes over the time horizon. For example, in Exhibit 12, the black line is illustrative of the expected balance in the portfolio, including proposed contributions and withdrawals, as well as other incomes and expenditures including taxes. The risk capacity question framed like this shows depletion of funds in 2050 versus 2053. Is this acceptable?
- ▶ **Favorable and Unfavorable Markets:** Another way of viewing the certainty of outcome is by showing the capital and savings base, the income range if we have unfavorable markets, and the income range if we have better-than-expected markets. Research has shown that most

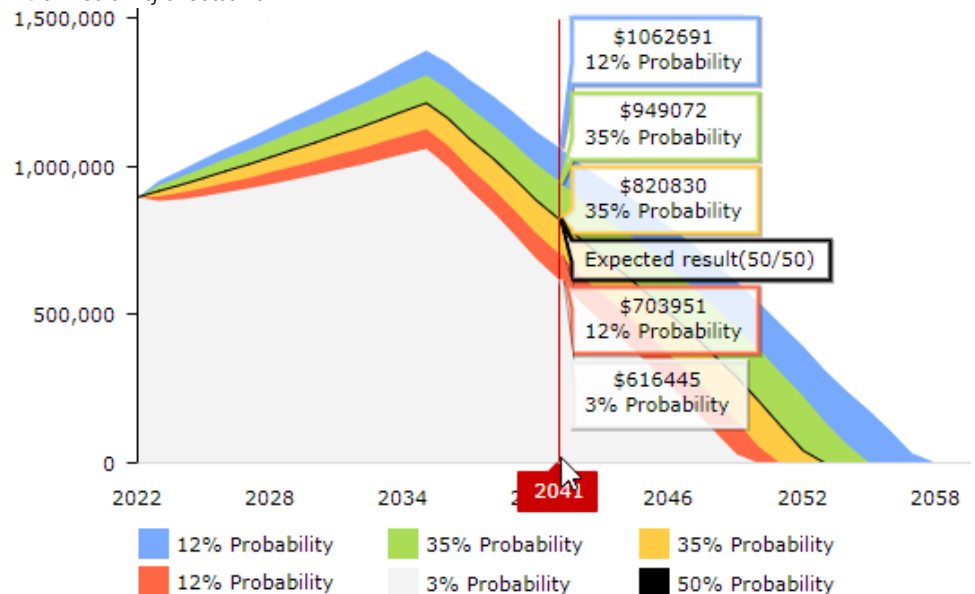
⁶ Brayman, Shawn & Fagan, Ben. "Defining and Measuring Risk Capacity," *Journal of Personal Financial Counseling*, Summer 2011.

people can relate better to an income value than a capital value from a framing perspective. People with low incomes tend to overvalue lump sums while those with higher incomes undervalue them. For example, Exhibit 13 illustrates an after-tax indexed value of the income from the portfolio for the duration of the goal. The darker blue (pensions and other revenues) is the result of government pensions and private pensions. This income is not at risk and increases capacity. The light blue represents the income from accumulated capital that would be available unless markets remain 2 standard deviations below the mean over time. The green represents the range of incomes from cumulative returns better than 2 standard deviations below the mean to the expected return, and finally the yellow-green is if returns exceed the expected return. The risk capacity framed with this illustration would be: “Is the client retiring with an income of about \$48,000 a year as opposed to the desired \$55,000 a year?”

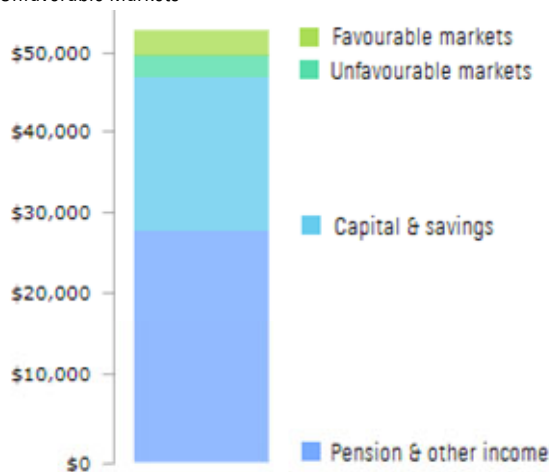
- **Value at Risk, or VaR:** Showing the size of potential falls on a year-by-year basis and how long it would take to recover in value. It should be observed that VaR is really a tolerance issue rather than capacity if the client has no immediate need for the funds. Any drop in value does not necessarily impact achieving the goal as long as the client allows markets to recover.

By allowing clients to toggle between different investment scenarios and seeing the effect it has on potential outcomes, income ranges, and potential falls, and confirming their acceptance of the risk they are comfortable with, it is a more engaging and robust assessment of risk capacity.

Exhibit 12 Certainty of Outcome



Source: Morningstar.

Exhibit 13 Favorable and Unfavorable Markets

Source: Morningstar.

Other Considerations

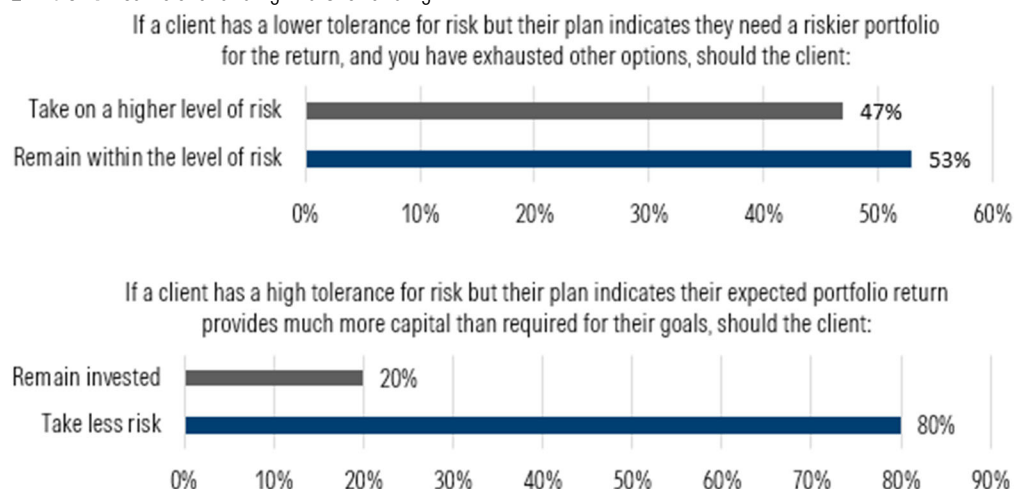
In this section, we've identified several known considerations that fall outside the PJM framework where a financial professional needs to discuss with the client a suitable course of action and then adjust the investment profile accordingly.

- ▶ **Fund depletion:** In a complex case, funds will rarely be evenly depleted. Pensions may be deferred and begin being paid later than the start of the goal, requiring proportionately more investment funds to be used sooner. There will be a rate of return attached to the investments, which means that in early years of the goal there will be higher income replenishing the funds utilized. This will result in a more conservative depletion than estimated. The selection of the 33% factor and the offset of the two factors herein are considered reasonable.
- ▶ **Insufficient funding:** If the client has a stated goal that significantly exceeds their ability to fund it, then capital might be depleted sooner during the lifetime of the goal or the client will need to take more risk. This could or would be a poor plan. In a survey of financial professionals, when asked whether clients should take on more risk or remain within tolerance level when a higher level of risk is required, the result was fairly even, see Exhibit 14. Financial professionals can adjust the client's Suitability score higher to meet risk required.
- ▶ **Liquidity analysis:** Financial professionals may want to identify any short-term liquidity shortfall that may arise over the next three years, which is particularly useful where the client has multiple goals over different time frames. The objective is to highlight funding needs that can only be met by liquid investments, as ideally you do not liquidate equities in the depth of a market decline.
- ▶ **Overfunding:** Where the client has more than enough money to fund the goal, the client may choose to take less risk than what they are able to tolerate, or to spend more money on the goal, which would drop the percentage of the goal funded. When asked whether clients should take less risk or remain within tolerance level when the portfolio is expected to return more capital than required, the majority of financial professionals would choose to take less

risk (see Exhibit 14). Financial professionals can adjust the client's Suitability score lower when there is a capital surplus.

- ▶ **No experience, high risk tolerance, and a long time horizon:** This is when a client has very little or no investment knowledge and/or experience but has high risk tolerance and a long time horizon. The latter two would usually lead to a relatively high risk/return strategy. It may be worth considering and discussing with the client a start-slow approach whereby a low-to-moderate risk/return strategy is adopted initially to allow for the client to gain some knowledge and experience before shifting to the long-term high risk/return strategy. While this may not be financially optimal, it is behaviorally sound and, over the long term, any cost should be relatively small. In interviews of recognized global leaders in this area, as well as in broader surveys, some financial professionals made statements like "I do not recommend training wheels" or "The client is hiring my experience." Our approach with the PJM is to err on the side of the conservative.
- ▶ **High capacity, no experience, or short time horizon:** Consider a case where a client has significant assets (perhaps from the sale of a business), has never invested in equities outside of their business, and their desire is specifically to open a stock-trading account to "play." Since there is no prior equity experience, a Suitability score cap of 70 would apply. However, high capacity may offset lack of experience if the portfolio is a small amount of the client's holdings. Financial professionals should be able to adjust the client's Suitability score higher to account for the higher capacity.
- ▶ **Wealth:** Research indicates that although a client may have one risk tolerance that is stable, there can be different buckets of money earmarked for different goals, and that these buckets can have different investment profiles. If a bucket contains a small portion of a client's overall wealth and they have a high-risk tolerance, this could override considerations like time horizon, as other resources may be able to help address the need if the client experiences short-term declines.

Exhibit 14 Insufficient Funding and Overfunding



Source: Morningstar.

Risk Comfort Ranges

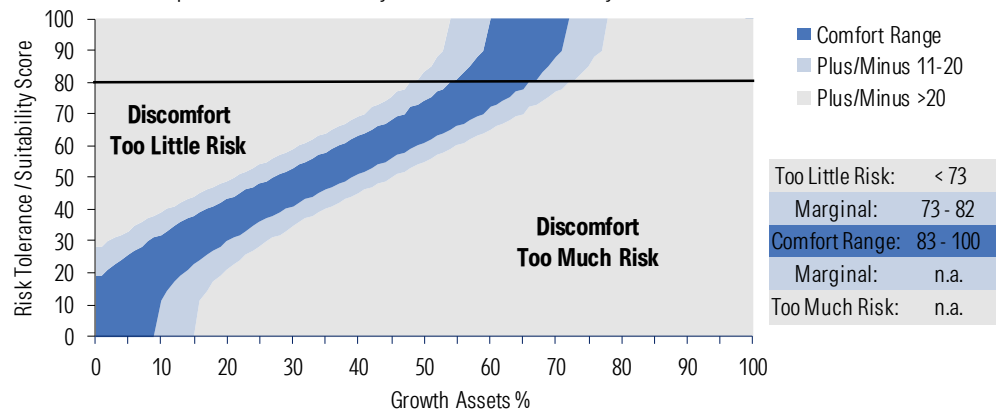
The process of developing suitable advice is based upon obtaining the client's properly informed commitment to a set of trade-offs between conflicting alternatives. Effective trade-off decisions can only be made when the elements of the trade-off have been separated and can be clearly understood and compared. A key trade-off decision commonly confronted by clients is between the level of risk the client would normally choose to take and investment risk associated with the return required to achieve their goals having regard to their risk capacity.

Up to now, the result of the psychometric risk tolerance questionnaire sets the initial high-water mark for the suitable investment profile and the PJM provided a framework to account for other behavioral and financial factors in a consistent and defensible manner to arrive at a suitability score. The next stage is transforming the suitability score into a range of Morningstar Portfolio Risk Scores, or MPRS, to facilitate the trade-off decision process. 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 MPRS. For example, a suitability score of 80 translates to 92% 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.

For an individual with a suitability score of 80, the Risk Comfort Range is between 82% to 100% growth assets, as shown in Exhibit 16. Discomfort from either too much risk or too little risk shouldn't begin to occur until the level of growth assets goes outside this range. The chart below shows the gradation from the Risk Comfort Range (dark blue), the Marginal Comfort Range through to Discomfort (light blue) for the 0-100 suitability score range, and the Risk Comfort Range for a score of 80 (horizontal black line).

Exhibit 15 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.

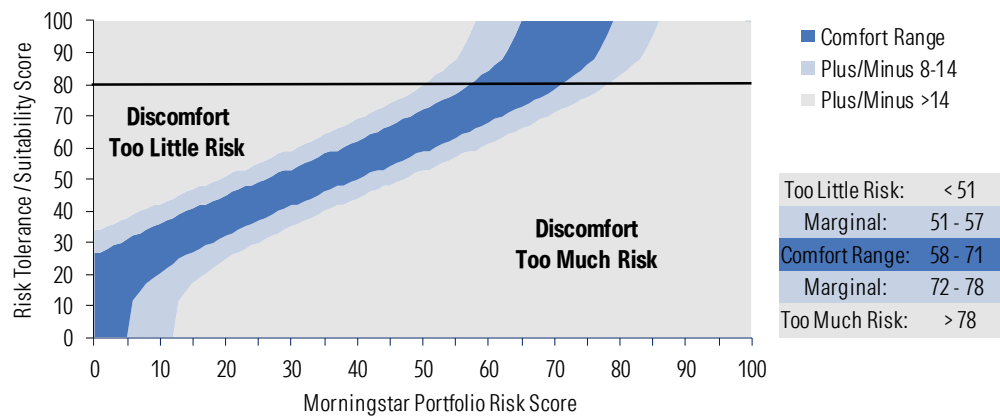
Morningstar Portfolio Risk Scores

The MPRS 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 MTAs. 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.

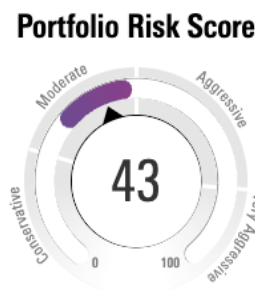
Since the Morningstar Target Allocation Indexes are representative of well-diversified asset-allocation benchmarks, this allows us to establish a linear regression relationship between the overall equity exposure, or growth assets, and the MPRS. So that a 50% equity exposure translates to an MPRS of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

Exhibit 16 shows the Risk Comfort Ranges with the X-axis now reflecting the MPRS. The Risk Comfort Range for a suitability score of 80 (horizontal black line) is an MPRS of 58 to 71.

Exhibit 16 Risk Comfort Range for U.S., Canada, U.K., and Japan

Source: Morningstar.

Exhibit 17 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 56. The Portfolio Risk Score (43) falls within the bounds of the Risk Comfort Range.

Exhibit 17 Risk Comfort Range of 34-47 (Suitability Score of 56) and Morningstar Portfolio Risk Score of 43

Source: Morningstar.

For markets outside of U.S./CA/U.K. and JP 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 15.

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 together 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 Band 1, 2, or 3—but not from higher-risk bands.

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.

Comparing Risk Tolerance, Risk Required, and Risk Capacity

Assume Jean and Bill, with risk tolerance scores of 54 and 45, respectively, as shown in Exhibit 18—their Current Portfolio has an MPRS of 30 and their Target Portfolio (the portfolio required to achieve their goals with regard to their risk capacity) has an MPRS of 50. Both are likely to find that the volatility of the Target Portfolio is outside their Risk Comfort Ranges, though it will be Bill more than Jean.

The financial professional's role is to facilitate the trade-off discussion by suggesting alternatives and illustrating resulting outcomes and their consequences. Jean and Bill may consider, individually or in combination: easing goals (delay, reduce, or forgo), investing more (spend less, save more), or taking on risk outside their risk comfort ranges knowing that they may be uncomfortable from time to time (but not so much risk that one or both of them are likely to panic in a major downturn).

Exhibit 18 Comparing Risk Tolerance, Risk Required, and Risk Capacity



Source: Morningstar.

If the analysis had shown that the Target Portfolio was expected to do considerably better than was required to achieve their goals, then Jean and Bill may consider, again individually or in combination: increasing goals (accelerate, increase, or add), investing less (spend more, save less), or taking on less risk, assuming that this increased the likelihood of them achieving their goals.

Mapping to an Investment Profile

Although the suitability score is a continuous score from 0 to 100, almost all investment advisory firms define investment profile bands to group clients, facilitate communication, categorize risk profile levels, and to categorize investment solutions risk. Often there will be a default investment profile

representative of a target asset allocation for each of these bands, so that illustrative levels of risk and return can be shown to the client.

Exhibit 19 shows a sample of six investment profiles with their respective ranges. Having an illustrative portfolio is important to provide inputs for risk capacity analysis. An individual can have a suitability score of 40 and be at the top of the Conservative band, in which case the individual may be better suited to investments more aggressive than Band 2/Conservative. For firms whose systems cannot continuously scale the risk of the solution, the suitability score would map into their respective investment profile bands.

Exhibit 19 Sample Investment Profile Bands

Investment Profile	MPRS	Suitability/Risk Tolerance Score Range
Ultra Conservative	2	0 - 29
Conservative	20	30 - 43
Moderately Conservative	30	44 - 51
Moderate	39	52 - 60
Moderately Aggressive	51	61 - 73
Aggressive	64	74 - 100

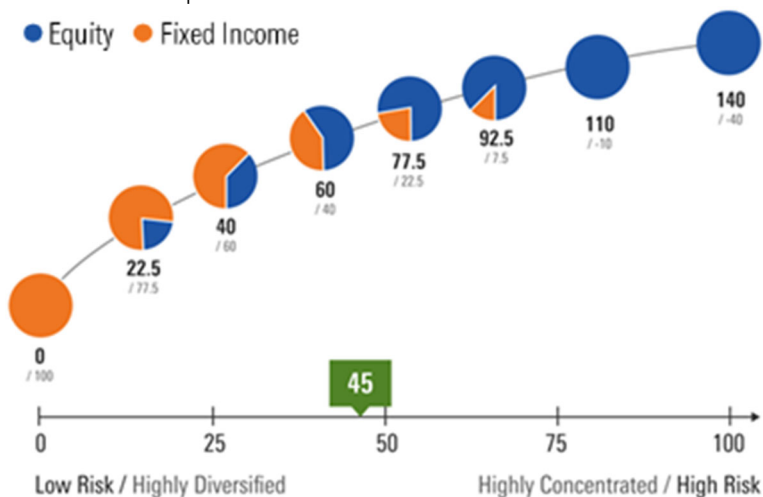
Source: Morningstar.

Implementation

Generally, the work up to this stage is considered education or guidance rather than regulated advice, as specific investment products have not been recommended. The Implementation stage is where we cross that threshold and begin using the Know-Your-Client, or KYC, data gathered to recommend a portfolio and disclose specifics about the products, the risk, costs, and so forth. The determination of suitability and know your product is by itself very complex and relies on the professional judgment of the regulated firm or financial professionals.

Portfolios have varying degrees of risk exposures, and the volatility present in the market evolves through time. Exhibit 20 illustrates a stylized risk/return frontier based on the MPRS. Moving from left to right along the risk spectrum, we move from low risk to high risk. The Ultra-Conservative mix typically consists of an all-cash mix while the Ultra-Aggressive asset-allocation mix represents a slightly leveraged, diversified all-equity mix.

Exhibit 20 Asset-Allocation Risk Spectrum



Source: Morningstar.

The key aspect of MPRS is that any portfolio and many funds and ETFs can be scored. 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.

An important aspect of the MPRS score is that it is stable over time. The challenge with most traditional quantitative scores is that they can result in changes of risk measures of the portfolio, potentially triggering the need for the financial professional to move the client to more-conservative solutions unnecessarily and, in doing so, crystalizing losses, and not allowing the proper recovery that financial professionals work so hard to educate their clients to expect. The MPRS solution is uniquely designed to rectify this challenge.

Summary

The Morningstar Risk Profiler is built on an unprecedented depth of research and defensibility, combining the best scientific understanding of the psychological willingness to take risk with a broad and configurable integration of issues required by regulation or supported by client best interest to arrive at an evidence-based, tempered by professional judgment, suitability score, which scales from 0 to 100.

For firms using traditional categorization of the risk of products into risk groups, the client can be mapped into a corporately defined investment profile band. For firms looking for a truly personalized scaling of the risk most suitable to the client, a unique Risk Comfort Range is defined, providing guidance on a comfortable fit and a marginally comfortable fit (stretch).

For firms using the more-robust Morningstar Portfolio Risk Score, which provides a stable, continuous scaling of portfolio risk based on a transparent and objective criterion, the solution provides an automated mechanism to provide a risk score on basic portfolio funds up to complex bespoke portfolios for a client.

Developing appropriate investment strategies for your clients require a holistic approach that balances their Required-Risk, Risk Comfort, Risk Capacity, and nonpecuniary factors. While an accurate, objective risk tolerance assessment is an important step, it alone should not be the sole method for making recommendations for portfolio asset allocation or investment products. Some subjectivity, or noise, in the assessment process cannot be eliminated. For example, some individuals may struggle to understand the questions or may not have clearly defined risk preferences. There is no guarantee that the Morningstar RTQ or its scoring method completely assesses a person's tolerance for risk or attitudes about gains and losses.



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Appendix 1: Time Horizon

The Risk Spectrum

The risk spectrum is based on the Morningstar® Target Allocation Index Family. The Morningstar Categories that serve as the anchor points vary across the different markets but in all cases result in a base risk spectrum ranging from 0 (lowest risk/cash) to 110 (110% equity). For example, the U.S. TAI allocations are shown below. Using the same methodology as described in the Morningstar Portfolio Risk Scoring Methodology, we rescaled the TAIs and created 12 anchor points, to provide a consistent risk spectrum across the markets ranging from 0 MPRS (0% Equity) – TAI #0 to 110 MPRS (110% equity) – TAI #11.

Exhibit 24 Morningstar U.S. Target Allocation Index Family

Asset Class	Left Extension	Conservative	Moderate Conservative	Moderate	Moderate Aggressive	Aggressive	Right Extension
US Equity	0.0%	16.5%	28.5%	47.5%	56.5%	70.5%	83.3%
DM xUS Equity	0.0%	5.0%	9.5%	10.5%	17.5%	18.0%	21.4%
EM Equity	0.0%	1.0%	2.0%	2.0%	4.0%	4.0%	4.8%
US Core Bond	0.0%	49.0%	38.0%	26.5%	13.0%	4.5%	0.0%
Global Core Bond ex US	0.0%	9.5%	8.0%	4.0%	2.0%	0.0%	0.0%
US High Yield	0.0%	10.5%	8.5%	4.0%	3.0%	0.0%	0.0%
Cash	100.0%	8.5%	5.5%	5.5%	4.5%	3.0%	-10.0%
Total Equity	0.0%	22.5%	40.0%	60.0%	77.5%	92.5%	110.0%

Asset Class	TAI#0	TAI#1	TAI#2	TAI#3	TAI#4	TAI#5	TAI#6	TAI#7	TAI#8	TAI#9	TAI#10	TAI#11
US Equity	0.0%	7.3%	14.7%	21.6%	28.5%	38.0%	47.5%	52.6%	58.8%	68.2%	76.2%	83.3%
DM xUS Equity	0.0%	2.2%	4.4%	6.9%	9.5%	10.0%	10.5%	14.2%	17.2%	17.8%	19.5%	21.4%
EM Equity	0.0%	0.4%	0.9%	1.4%	2.0%	2.0%	2.0%	3.1%	4.0%	4.0%	4.3%	4.8%
US Core Bond	0.0%	56.9%	50.6%	44.3%	38.0%	32.3%	26.5%	18.8%	11.6%	5.9%	0.0%	0.0%
Global Core Bond ex US	0.0%	11.0%	9.8%	8.9%	8.0%	6.0%	4.0%	2.9%	1.7%	0.3%	0.0%	0.0%
US High Yield	0.0%	12.2%	10.8%	9.6%	8.5%	6.3%	4.0%	3.4%	2.5%	0.5%	0.0%	0.0%
Cash	100%	9.9%	8.8%	7.2%	5.5%	5.5%	5.5%	4.9%	4.3%	3.3%	0.0%	-10.0%
Total Equity	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	110.0%

Source: Morningstar.

Portfolio Performance Research

The portfolio performance research involved back-testing the performance of TAIs #0 to #11 on a month-by-month basis from Jan 1, 1973, to Dec 31, 2023 (the Study Period) for AU, CA, NZ, U.K., and U.S. For EU, with the Euro starting in 1999, the study period is Jan 1, 1999, to Dec 31, 2023.

Portfolio performance over one to 10-year periods in increments of one year are calculated by using asset-class total-return indexes as proxies for asset class performance. No allowance was made for fees and taxes. Portfolios are rebalanced annually. (Where coverage is not available, an appropriate substitute is made to backfill to 1973 – such as, developed markets is used for emerging markets for the period 1973 to 1987.) The indexes chosen for the U.S. are shown below.

Asset Class	Index
US Equity	From 1992: Morningstar US Market TR USD From 1979: Russell 3000 TR USD From 1973: S&P500 TR USD
Developed ex US Equity	From 1999: Morningstar Developed Markets ex-US NR USD From 1973: MSCI EAFE GR USD
Emerging Markets Equity	From 1999: Morningstar Emerging Markets NR USD From 1988: MSCI EM GR USD From 1973: MSCI EAFE GR USD (Note: no EM data before 1988, use Developed Markets)
US Fixed Income	From 2000: Morningstar US Core Bond TR USD From 1976: BBgBarc US Agg Bond TR USD From 1973: Proxy based on 10-year US Govt Bonds
US High Yield Fixed Income	From 2000: Morningstar US HY Bd TR USD From 1987: ICE BofA US High Yield TR USD From 1973: IA Bloomberg US HY Corporate Bonds
Global Fixed Income ex US	From 2000: Morningstar Global ex-US Core Bond GR Hedged USD From 1990: BBgBarc Gbl Agg Ex USD TR Hdg USD From 1986: JPM GBI Global Traded TR Index From 1973: Lehman Composite
Cash	From 2000: Morningstar USD 1M Cash TR USD From 1978: ICE BofA US 3-Month Treasury Bill TR USD From 1973: US 182-Day T-Bill
Inflation	U.S. All items CPI

For example, there are 493 120-month (10-year) periods between January 1973 to December 2022.

Period 1: Jan. 1, 1973, to Dec. 31, 1982

Period 2: Feb. 1, 1973, to Jan. 31, 1983 ...

Period 493: January 1, 2013, to December 31, 2022

The annualized return for each of the 481 periods is $= (\text{Portfolio end value at Period}x+12/ \text{Portfolio end value at Period}x)^{(12/m)}-1$. Where m = number of months (for example, 120 for 10-year period).

The Best (maximum), Good (95th percentile), Average, Poor (5th percentile), and Worst (Minimum) return of the 493 periods is then derived. The same process is followed for each of the other periods: 1, 2, ... 9-year. The historical nominal annualized returns for U.S. TAI #5 over one- to 10-year periods are shown below. To determine the suitable time frame for each of the anchor points across the risk spectrum, we look for the minimum time frame when the Worst outcome over the study period is positive. For example, for U.S. TAI #5, the minimum time frame is five years to ensure a positive return or three years at the 95th percentile. The global results are shown below.

TAI#5	1 yr	2 yrs	3 yr	4 yrs	5 yrs	6 yrs	7 yrs	8 yrs	9 yrs	10 yrs
Avg.	8.90%	8.95%	9.10%	9.14%	9.18%	9.22%	9.27%	9.31%	9.36%	9.42%
Poor	-5.39%	-1.95%	1.59%	3.09%	3.91%	4.80%	5.13%	4.94%	4.73%	4.98%
Worst	-18.60%	-8.24%	-2.63%	-0.19%	1.19%	3.30%	3.10%	2.57%	2.45%	3.16%

	Growth	Global Min		Global Max		Global Average	
		Worst	Poor	Worst	Poor	Worst	Poor
TAI #0	0	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*
TAI #1	10	5.0*	2.0	5.0*	2.0	5.0*	2.0
TAI #2	20	4.0*	2.0*	5.0*	4.0*	4.8*	2.3*
TAI #3	30	4.0	2.0	5.0	4.0	4.2	2.7
TAI #4	40	3.0	2.0	5.0	4.0	4.1	2.8
TAI #5	50	4.0	3.0	5.5	5.0	4.7	3.3
TAI #6	60	5.0	3.0	6.0	5.0	5.3	3.6
TAI #7	70	5.0	3.5	6.0	6.0	5.8	4.3
TAI #8	80	5.5	4.0	8.5	6.0	6.3	4.9
TAI #9	90	6.0	5.0	8.5	6.0	6.6	5.3
TAI #10	100	6.0	5.0	11.0	6.0	8.4	5.7
TAI #11	110	6.0	5.0	11.0	9.0	9.3	6.3

* All TAI#0s were adjusted to 0 year, 100% cash is assumed to be risk free. If there is a negative value at year 10, then recovery is recorded as year 11 to indicate greater than 10 years. For the UK and EU, the time to recovery for TAI#1 were significantly higher than other countries, seven and nine years respectively compared to five years for other countries, due to very small and short-lived falls (less than one percent). UK TAI#1 and EU TAI#1 and #2 (worst) were adjusted to five years and EU TAI#1 (Poor) was adjusted to five years to account for the outliers.

Three approaches were considered on how best to map time horizon to growth, with the Best Fit cap considered most suitable.

1. A cubic polynomial function was used to determine (from a growth percentage) a specific time horizon compatible with that score based on the average response for each market.
2. A linear function was used to determine (from a growth percentage) a specific time horizon compatible with that score based on the average response for each market.
3. A cap set for a range of growth was used to determine (from a growth percentage) a specific time horizon compatible with that score based on the average response for each market. The caps were determined by the reviewing the average results and finding the most suitable bands.

	Growth	Average		Best Fit (Poly)		Best Fit (Lin)		Best Fit Cap	
		Worst	Poor	Worst	Poor	Worst	Poor	Worst	Notes
TAI #0	0	0.0	0.0	2.2	0.9	1.38	0.48	2.0	0 to 2 year, RT 15 (0-10% growth)
TAI #1	10	5.0	2.0	2.8	1.4	3.00	1.38	2.0	0 to 2 year, RT 15 (0-10% growth)
TAI #2	20	4.8	2.3	3.4	1.9	4.06	2.09	5.0	3 to 5 years, RT 51 (40 to 59% growth)
TAI #3	30	4.2	2.7	3.9	2.4	4.69	2.66	5.0	3 to 5 years, RT 51 (40 to 59% growth)
TAI #4	40	4.1	2.8	4.5	2.9	5.02	3.13	5.0	3 to 5 years, RT 51 (40 to 59% growth)
TAI #5	50	4.7	3.3	5.1	3.4	5.18	3.52	5.0	3 to 5 years, RT 51 (40 to 59% growth)
TAI #6	60	5.3	3.6	5.6	3.8	5.30	3.87	5.0	3 to 5 years, RT 51 (40 to 59% growth)
TAI #7	70	5.8	4.3	6.2	4.3	5.50	4.23	7.0	6 to 7 years, RT 70 (70-89% growth)
TAI #8	80	6.3	4.9	6.8	4.8	5.91	4.63	7.0	6 to 7 years, RT 70 (70-89% growth)
TAI #9	90	6.6	5.3	7.3	5.3	6.67	5.10	7.0	6 to 7 years, RT 70 (70-89% growth)
TAI #10	100	8.4	5.7	7.9	5.8	7.90	5.68	8.0	No cap after 8 years
TAI #11	110	9.3	6.3	8.5	6.3	9.73	6.41	8.0	No cap after 8 years

Appendix 2: The Morningstar Experience Questionnaire

Part of the process of designing investment portfolios is for us to have a good understanding of your general knowledge and experience with investing. Please provide the following information to assist us in this regard.

1. Financial knowledge has been determined to be an important factor in helping people understand the risk of investing. How knowledgeable are you about investing?
 1. I have no or very little knowledge about investing.
 2. I have basic to moderate knowledge about investing.
 3. I am very knowledgeable about investing.
2. What types of investments have you held in the past or currently hold? Select all that apply.
 1. CDs or money market account.
 - If selected: Years of experience?
 - Less than 1 year.
 - 1 to 3 years.
 - 4 years or more.
 2. Diversified investment account (managed funds, ETFs or separately managed account).
 3. Bonds or bonds funds.
 4. Stocks or stock funds.
 5. Alternatives or non-traditional assets (e.g., hedge funds, commodities, or private equity).
 6. None of the above.
3. Have you held a position where financial knowledge and expertise was a core component in the last five years?
 1. Yes.
 2. No.
4. Composure is a measure of your emotional state when markets go up and down in value. How did the last financial downturn affect your investment behavior?
 1. I have never experienced a financial downturn.
 2. No impact, I didn't make any changes to my investment plan.
 3. I saw an opportunity and bought more stocks.
 4. I was nervous and sold stocks.

Appendix 3: Contributors and Version History

Version 2.2, May 2026

Nicki Potts

Director of Financial Profiling & Planning

nicki.potts@morningstar.com

Updates in This Version

1. Update MPRS comfort ranges for U.K.

Version 2.1, May 2025

Nicki Potts

Director of Financial Profiling & Planning

nicki.potts@morningstar.com

Shawn Brayman

Former Morningstar Director of Financial Planning Methodology, Financial Planning

Updates in This Version

1. The Morningstar RTQ questionnaire and comfort ranges were updated to version 4 of the risk tolerance scale (Morningstar Psychometric Tolerance Methodology).
2. Inclusion of MPRS U.K. and JP comfort ranges.

Version 1.2, July 2024

Nicki Potts

Director of Financial Profiling & Planning

nicki.potts@morningstar.com

Shawn Brayman

Former Morningstar Director of Financial Planning Methodology, Financial Planning

shawn.brayman@morningstar.com



22 West Washington Street
Chicago, IL 60602 USA

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