MORNINGSTAR®

The Morningstar Rating™ Methodology

Morningstar Research Report
13 June 2006

Contents

Introduction

The Purpose of the Morningstar Rating for Funds

This document describes the rationale for, and the formulas and procedures used in, calculating the Morningstar Rating™ for funds (commonly called the "star rating"). This version of the methodology was implemented effective June 30, 2002.

The original Morningstar Rating was introduced in 1985 and was often used to help investors and advisors choose one or a few funds from among the many available within broadly defined asset classes. Over time though, increasing emphasis had been placed on the importance of funds as portfolio components rather than "stand-alone" investments. In this context, it was important that funds within a particular rating group be valid substitutes for one another in the construction of a diversified portfolio. For this reason, Morningstar changed the methodology in 2002 to assign ratings based on comparisons of all funds within a specific Morningstar Category,™ rather than all funds in a broad asset class.

The star rating is based on risk-adjusted performance. However, different aspects of portfolio theory suggest various interpretations of the phrase "risk-adjusted." As the term is most commonly used, to "risk adjust" the returns of two funds means to equalize their risk levels through leverage or de-leverage before comparing them. Hence, a fund's score is not sensitive to its proportion of risk-free assets or its amount of leverage. The Sharpe ratio is consistent with this interpretation of "risk-adjusted."

If two funds have equal positive average excess returns, the one that has experienced lower return volatility receives a higher Sharpe ratio score. However, if the average excess returns are equal and negative, the fund with higher volatility receives the higher score. While this result is consistent with portfolio theory, many retail investors find it counterintuitive. Unless advised appropriately, they may be reluctant to accept a fund rating based on the Sharpe ratio, or similar measures, in periods when the majority of the funds have negative excess returns.

The other commonly accepted meaning of "risk-adjusted" is based on assumed investor preferences. Under this approach, higher return is "good" and higher risk is "bad" under all circumstances, without regard to how these two outcomes are combined. Hence, when grading funds, return should be rewarded and risk penalized in all cases. The new Morningstar Risk-Adjusted Return measure described in this document has this property.

This document describes the application of Morningstar Risk-Adjusted Return in determining star ratings for U.S.-based mutual funds. However, most of the methods and processes described here are applicable to other types of funds.

Fund Categories

Current List

There are 69 fund categories used in the United States by Morningstar. They are:

- Large Value
- Large Blend
- Large Growth
- Mid-Cap Value
- Mid-Cap Blend
- Mid-Cap Growth
- Small Value
- Small Blend
- Small Growth
- Specialty Communications
- Specialty Financial
- Specialty Health
- Specialty Natural Resources
- Specialty Real Estate
- Specialty Technology
- Specialty Utilities
- Long-Short
- Bear Market*
- Conservative Allocation
- Moderate Allocation
- Convertibles
- Target-Date 2000-2014
- Target-Date 2015-2029
- Target-Date 2030+
- Europe Stock
- Latin America Stock
- Diversified Emerging Markets
- Diversified Pacific/Asia
- Pacific/Asia (ex Japan) Stock
- Japan Stock
- Foreign Large Value
- Foreign Large Blend
- Foreign Large Growth
- Foreign Small/Mid Value
- Foreign Small/Mid Growth
- World Stock
- World Allocation
- Specialty Precious Metals
- Long Government
- Intermediate Government
- Short Government
- Inflation-Protected Bond
- Long-Term Bond
- Intermediate-Term Bond
- Short-Term Bond
- Ultrashort Bond
- Bank Loan
- Stable Value*
- High Yield Bond
- Multisector Bond
- World Bond
- Emerging Markets Bond
- Muni National Long
- Muni National Intermediate
- Muni National Short
- High Yield Muni
- Muni Single State Long
- Muni Single State Interm
- Mini Single State Short
- Muni California Long
- Muni California Int/Sh
- Muni Florida
- Muni Massachusetts
- Muni Minnesota
- Muni New Jersey
- Muni New York Long
- Muni New York Int/Sh
- Muni Ohio
- Muni Pennsylvania

*Ratings are not assigned to funds in the Bear Market category because their strategies for shorting the market vary so widely. The Stable Value category is only used for custom funds and separate accounts.

Categories as a Basis For Morningstar Rating Calculations

The Morningstar Rating compares funds' risk-adjusted historical returns. Among other things, the rating is designed to convey a sense of how skillfully a fund has been managed. Its usefulness depends, in part, on which funds are compared to one another.

It can be assumed that the returns of major asset classes (domestic equities, foreign equities, domestic bonds, etc.) will, over lengthy periods of time, be commensurate with their risk. However, asset class relative returns may not reflect relative risk over ordinary investor time horizons. For instance, in a declining interest rate environment, Treasury bond returns can exceed equity returns despite the higher long-term risk of equities; such a situation might continue for months or even years. Under these circumstances many bond funds outperform equity funds, for reasons unrelated to the skills of the fund managers.

A general principle that applies to the calculation of fund star ratings follows from this fact; that is, the relative star ratings of two funds should be affected more by manager skill than by market circumstances or events that lie beyond the fund managers' control.

Accordingly, the new Morningstar Rating calculation is based on fund categories.

Defining Fund Categories

The following considerations apply when Morningstar fund categories are defined:

- Funds are grouped by the type of investments that predominate in their portfolios. Where holdings data are unavailable, prospectus or other information may be used.
- In general, a single return benchmark should form a valid basis for evaluation of the returns—performance attribution—for all funds in a single category.
- In general, funds in the same category can be considered reasonable substitutes for the purposes of portfolio construction.
- Category membership is based on a fund's long-term or "normal" style profile. At a given point in time, the fund's current Morningstar Style Box™ assignment may differ from its Morningstar Category.

Style Profiles and Fund Categories

A style profile may be considered a summary of a fund's risk factor exposures. Fund categories define groups of funds whose members are similar enough in their risk factor exposures that return comparisons between them are useful[1].

The risk factors on which fund categories are based can relate to value-growth orientation; cyclicality; capitalization; industry sector, geographic region, and country weights; duration and credit quality; historical return volatility; beta; and many other investment style factors. The specific factors used are considered to be a) important in explaining fund return differences and b) actively controlled by the fund managers.

Because the funds in a given category are similar in their risk factor exposures, the observed return differences among them relate primarily to security selection ("stock picking") or to variation in the timing and amount of exposure to the risk factors that collectively define the category ("asset weighting"). Each of these, over time, may be presumed to have been a skill-related effect.

Note that if all members of a fund category were uniform and consistent in their risk factor exposures, and the risk factors were comprehensive, there would be no need to risk-adjust returns when creating category-based star ratings. However, even within a tightly defined category, the risk exposures of individual funds vary over time. Also, no style profile or category definition is comprehensive enough to capture all risk factors that affect the returns of the funds within a category.

Monthly Total Return

Morningstar calculates a fund's total return for a given month as follows:

$$[1] \qquad TR = \left\{ \frac{P_e}{P_b} \prod_{i=1}^{n} \left(1 + \frac{D_i}{P_i} \right) \right\} - 1$$

where

TR	=	total return for the month
P_e	=	end of month NAV per share
P_b	=	beginning of month NAV per share
D_i	=	per share distribution at time i
P_i	=	reinvestment NAV per share at time i
n	=	number of distributions during the month

Distributions include dividends, distributed capital gains, and return of capital. This calculation assumes that the investor pays no taxes, incurs no transaction fees, and reinvests all distributions paid during the month.

To account for the tax advantage enjoyed by municipal bonds, Morningstar adjusts the dividends that a municipal bond fund pays using the following formula:

$$[2] \qquad TDiv_i = \frac{Div_i}{(1 - t_{Si})(1 - t_{Fi})}$$

where

$TDiv_i$	=	tax-adjusted dividend per share at time i
Div_i	=	actual dividend per share at time i
t_{Si}	=	maximum state tax rate at time i
t_{Fi}	=	maximum federal tax rate at time i

For municipal bond funds, Morningstar uses $TDiv_i$ in place of dividends per share to calculate D_i for use in equation [1].

Cumulative Value

If there were no loads or redemption fees, the cumulative value of $1 over a period of T months would be:

[3] $$V_u = \prod_{t=1}^{T} \left(1 + TR_t\right)$$

where

V_u	=	cumulative value, unadjusted for loads and redemption fees
TR_t	=	total return for month t

If there are loads or redemption fees,

[4] $$V = (1-F)(1-R)\,V_u - D(1-F)\,\frac{\min(P_0, P_T)}{P_0}$$

where

V	=	cumulative value, adjusted for loads and redemption fees
F	=	front load
D	=	deferred load
R	=	redemption fee
P_0	=	beginning of period NAV per share
P_T	=	end of period NAV per share

Morningstar Risk-Adjusted Return

The Morningstar Risk-Adjusted Return (MRAR) measure has the following characteristics:

- no particular distribution of excess returns is assumed
- risk is penalized in all cases
- the theoretical foundation is acceptable to sophisticated investors and investment analysts.

MRAR is motivated by expected utility theory, according to which an investor ranks alternative portfolios using the mathematical expectation of a function (called the utility function) of the ending value of each portfolio.

Let W be the ending value of a portfolio being considered and u(.) be the investor's utility function. The expected utility of the portfolio is E[u(W)].

To be meaningful, the utility function must satisfy two conditions. First, it must always be positively sloped; i.e., $u'(.)>0$. That is, more expected wealth is always better than less expected wealth. Second it must imply risk aversion, i.e., that the investor prefers a riskless portfolio with a known end-of-period value to a risky portfolio that is expected, but not certain, to have the same end-of-period value. This means:

[5] $$u(E[W])>E[u(W)]$$

From probability theory, it follows that this can be true only if u(.) is everywhere a concave function; i.e. $u''(.)<0$.

The shape of the utility function describes the investor's attitude toward risk. The degree of risk aversion can be measured by the coefficient of relative risk aversion, RRA:

[6] $$RRA(W) = -\frac{Wu''(W)}{u'(W)}$$

A form of the utility function that is especially useful in portfolio theory is constant relative risk aversion. RRA(.) being a constant implies that u(.) can be written as:

[7] $$u(W)=\begin{cases}-\dfrac{W^{-\gamma}}{\gamma} & \gamma>-1,\ \gamma\neq 0\\ \ln(W) & \gamma=0\end{cases}$$

where γ is a parameter that describes the degree of risk aversion, specifically, RRA(.) = $\gamma+1$.

Constant relative risk aversion also implies that the investor's beginning-of-period wealth has no effect on the ranking of portfolios. To see this, let:

W_0	=	beginning of period wealth
TR	=	total return on the portfolio being evaluated so that $W = W_0 (1+TR)$

Hence:

[8] $$u(W_0(1+TR))=\begin{cases}W_0^{-\gamma}\,u(1+TR) & \gamma>-1,\ \gamma\neq 0\\ \ln(W_0)+u(1+TR) & \gamma=0\end{cases}$$

The value of W_0 does not affect the curvature of utility as a function of TR, and so it does not affect how the investor ranks portfolios.

Instead of holding a risky portfolio, the investor could buy a risk-free asset. Let R_b be the return on the risk-free asset. In comparing risky portfolios to the risk-free asset, we assume that the investor initially has all wealth invested in the risk-free asset and beginning-of-period wealth is such that end-of-period wealth, so invested, will be $1.

Hence:

[9] $$W_0 = \frac{1}{1+R_b}$$

and

[10] $$u(W_0(1+TR)) = u\left(\frac{1+TR}{1+R_b}\right) = u(1+r_G) = \begin{cases} -\dfrac{(1+r_G)^{-\gamma}}{\gamma} & \gamma > -1,\ \gamma \neq 0 \\ \ln(1+r_G) & \gamma = 0 \end{cases}$$

where

[11] $$r_G = \text{the geometric excess return} = \frac{1+TR}{1+R_b} - 1$$

The certainty equivalent geometric excess return of a risky investment is the guaranteed geometric excess return that the investor would accept as a substitute for the uncertain geometric excess return of that investment. Letting $r_G^{CE}(\gamma)$ denote the certainty equivalent geometric excess return for a given value of γ, this means that:

[12] $$u(1+r_G^{CE}(\gamma)) = E[u(1+r_G)]$$

Hence:

[13] $$r_G^{CE} = \begin{cases} \left(E[(1+r_G)^{-\gamma}]\right)^{-\frac{1}{\gamma}} & \gamma > -1,\ \gamma \neq 0 \\ e^{E[\ln(1+r_G)]} & \gamma = 0 \end{cases} - 1$$

MRAR(γ) is defined as the annualized value of r_G^{CE} using the time series average of $(1+r_G)^{-\gamma}$ as an estimate of $E[(1+r_G)^{-\gamma}]$. With $\gamma \neq 0$, we have:

[14] $$MRAR(\gamma) = \left[\frac{1}{T} \sum_{t=1}^{T} (1+r_{Gt})^{-\gamma} \right]^{-\frac{12}{\gamma}} - 1$$

where

r_{Gt}	=	the geometric excess return in month t $= \frac{1+TR_t}{1+R_{bt}} - 1$
R_{bt}	=	return on risk-free asset in month t

When γ=0, MRAR is the annualized geometric mean of r_G:

[15] $$MRAR(0) = \left[\prod_{t=1}^{T} (1+r_{Gt}) \right]^{\frac{12}{T}} - 1$$

A rating system based solely on performance would rank funds on their geometric mean return, or equivalently, MRAR(0). A rating system that provides a heavier penalty for risk requires that $\gamma > 0$.

Morningstar's U.S. fund analysts have concluded that $\gamma = 2$ results in fund rankings that are consistent with the risk tolerances of typical retail investors. Hence, Morningstar uses a γ equal to 2 in the calculation of its star ratings.

Because MRAR is expressed as an annualized return, it can be decomposed into a return component, MRAR(0), and a risk component, MRAR(0)–MRAR(2).

To calculate MRAR when there are loads and redemption fees, monthly total returns must be adjusted. Let:

[16] $$a = \left(\frac{V}{V_u} \right)^{\frac{1}{T}}$$

[17] $$ATR_t = a(1 + TR_t) - 1$$

where

a	=	the adjustment factor
V	=	cumulative value adjusted for loads and redemption fees
V_u	=	cumulative value not adjusted for loads and redemption fees
ATR_t	=	the adjusted total return for month t
TR_t	=	the total return for month t

See "Measuring Performance," page 8, for the formulas for V and V_u, and TR. To incorporate loads and fees into the calculation of MRAR, ATR_t is used in place of TR_t.

The following items are needed to calculate the new Morningstar Rating for funds:

- A list of fund categories and rules for assigning funds to these categories (see "Fund Categories," page 5)
- A triangular matrix with the categories as labels for both the rows and columns. Each element of the matrix contains a measure of the similarity of the two categories between zero (highly dissimilar) and one (identical)
- A database of funds. For each fund, the database should contain:
  - The front load, back load, and redemption fee
  - A monthly time-series record containing:
    - Category
    - NAV per share
    - Total return

Each fund is placed in the category indicated in the most recent monthly record. For each category, Morningstar calculates a three-year star rating for all member funds that have at least 36 continuous months of total return data, up to and including the evaluation month. In extreme cases where the funds in a category vary widely in their risk factor exposures (i.e., it is a "convenience category") a star rating would have little value and is not assigned. For example, in the United States, ratings are not assigned to funds in the Bear Market category.

To assign three-year ratings to funds in a given category, Morningstar calculates the load-adjusted MRAR(2) of total returns for the 36 months ending in the evaluation month. The funds are ranked using MRAR(2), and the funds with the highest scores receive the most stars.

The distribution of stars among the funds depends on the number of funds evaluated within the category. Let:

n	=	the total number of distinct portfolios being evaluated
n_1	=	the number of distinct portfolios that receive one star
n_2	=	the number of distinct portfolios that receive two stars
n_3	=	the number of distinct portfolios that receive three stars
n_4	=	the number of distinct portfolios that receive four stars
n_5	=	the number of distinct portfolios that receive five stars

Morningstar sets n_1 through n_5 so that:

n_1	=	10% of n
n_2	=	22.5% of n
n_3	=	35% of n
n_4	=	22.5% of n
n_5	=	10% of n

Where several funds are merely different share classes of the same underlying portfolio, each share class is counted as a fraction of a fund when calculating n_1, n_2 etc.; but each share class is assigned a separate star rating. For example, if the same portfolio can be bought in the form of five share classes, each share class is counted as one-fifth of a fund.

To accommodate fractional fund counts, star ratings are assigned as follows:

1) Sort all funds, including fractional funds, in the category by MRAR in descending order.
2) Count off funds until n_5 is reached but not exceeded. These funds receive five stars.
3) Continue counting off funds until the total number reaches but does not exceed n_5+n_4. The additional funds receive four stars.
4) Continue counting off funds until the total number reaches but does not exceed $n_5+n_4+n_3$. The additional funds receive three stars.
5) Continue counting off funds until the total number reaches but does not exceed $n_5+n_4+n_3+n_2$. The additional funds receive two stars.
6) The remaining funds receive one star.

If the data are available, five-year ratings are assigned using 60 months of data and 10-year ratings are assigned using 120 months of data. An overall star rating for each fund is based on the weighted average of the number of stars assigned to it in the three-year, five-year, and 10-year rating periods. If the fund in question has been in its current category over its entire evaluation period, the weights are:

Months of Total Returns	Overall (Weighted) Morningstar Rating
36–59	100% three-year rating
60–119	60% five-year rating
	40% three-year rating
120 or more	50% 10-year rating
	30% five-year rating
	20% three-year rating

While the long-term overall star rating formula seems to give the most weight to the 10-year period, the most recent three-year period actually has the greatest impact because it is included in all three rating periods.

If the fund has changed categories over time, a matrix is used to measure the similarity between the current category and the fund's historical categories. (For months that do not contain a category record, the category is assumed to equal that of the closest month that contains a category record.) The weights given above are then modified based on the fund's average degree of similarity to the current category for the months contained in the rating period.

In the following formulas, s denotes the number of months back in time with s=1 meaning the current month, s=2 meaning the previous month, etc. Let:

D_s	=	the degree of similarity between the fund's category in month 1 and the fund's category in month s.

For the diversified U.S. stock fund categories, Morningstar uses the following matrix to measure D_s:

Large Value	1.00								
Large Blend	0.50	1.00							
Large Growth	0.00	0.50	1.00						
Mid-cap Value	0.50	0.25	0.00	1.00					
Mid-cap Blend	0.25	0.50	0.25	0.50	1.00				
Mid-cap Growth	0.00	0.25	0.50	0.00	0.50	1.00			
Small Value	0.00	0.00	0.00	0.50	0.25	0.00	1.00		
Small Blend	0.00	0.00	0.00	0.25	0.50	0.25	0.50	1.00	
Small Growth	0.00	0.00	0.00	0.00	0.25	0.50	0.00	0.50	1.00

Morningstar uses the following table to measure the degree of similarity between other pairs of categories. If a category pair is not listed, the degree of similarity is zero.

Across Broad Asset Classes		
Large Value	World Stock	0.50
Large Blend	World Stock	0.50
Large Growth	World Stock	0.50
Mid-Cap Value	World Stock	0.50
Mid-Cap Blend	World Stock	0.50
Mid-Cap Growth	World Stock	0.50
Small Value	World Stock	0.50
Small Blend	World Stock	0.50
Small Growth	World Stock	0.50
Conservative Allocation	World Allocation	0.25
Moderate Allocation	World Allocation	0.25
Conservative Allocation	Multisector Bond	0.25

Domestic Equity		
Large Value	Moderate Allocation	0.25
Large Blend	Moderate Allocation	0.25
Large Growth	Moderate Allocation	0.25
Mid-Cap Value	Moderate Allocation	0.25
Mid-Cap Blend	Moderate Allocation	0.25
Mid-Cap Growth	Moderate Allocation	0.25
Small Value	Moderate Allocation	0.25
Small Blend	Moderate Allocation	0.25
Small Growth	Moderate Allocation	0.25
Moderate Allocation	Conservative Allocation	0.50
Specialty-Technology	Specialty-Communications	0.25
Target-Date 2000-2014	Conservative Allocation	0.50
Target-Date 2015-2029	Moderate Allocation	0.50
Target-Date 2030+	Moderate Allocation	0.50

International Equity

Foreign Large Value	World Stock	0.50
Foreign Large Blend	World Stock	0.50
Foreign Large Growth	World Stock	0.50
Foreign Small/Mid Value	World Stock	0.50
Foreign Small/Mid Growth	World Stock	0.50
Foreign Large Value	Foreign Large Bend	0.50
Foreign Large Blend	Foreign Large Growth	0.50
Foreign Small/Mid Value	Foreign Small/Mid Growth	0.25
Foreign Small/Mid Value	Foreign Large Value	0.25
Foreign Small/Mid Value	Foreign Large Blend	0.25
Foreign Small/Mid Growth	Foreign Large Blend	0.25
Foreign Small/Mid Growth	Foreign Large Growth	0.25

Taxable Bond

Long Government	Intermediate Government	0.50
Intermediate Government	Short Government	0.50
Long-Term Bond	Intermediate-Term Bond	0.50
Intermediate-Term Bond	Short-Term Bond	0.50
Short-Term Bond	Ultrashort Bond	0.50
Inflation-Protected Bond	Long Government	0.50
Inflation-Protected Bond	Intermediate Government	0.50

Municipal Bond

Muni National Long	Muni National Interm	0.50
Muni National Interm	Muni National Short	0.50
High Yield Muni	Muni National Long	0.50
High Yield Muni	Muni National Interm	0.50
High Yield Muni	Muni National Short	0.50
Muni Single State Long	Muni Single State Interm	0.50
Muni Single State Interm	Muni Single State Short	0.50
Muni New York Long	Muni New York Int/Sh	0.50
Muni California Long	Muni California Int/Sh	0.50

The average degree of similarity for the three-year period is:

[18] $$\bar{D}_3 = \frac{\sum_{s=1}^{36} D_s}{36}$$

The average degree of similarity for the five-year period is:

[19] $$\bar{D}_5 = \frac{\sum_{s=1}^{60} D_s}{60}$$

The average degree of similarity for the 10-year period is:

[20] $$\bar{D}_{10} = \frac{\sum_{s=1}^{120} D_s}{120}$$

When there are five years of data available, the three-year and five-year ratings are combined with the following weights:

[21] $$W_5 = \frac{0.60\bar{D}_5}{0.40\bar{D}_3 + 0.60\bar{D}_5}$$

[22] $$W_3 = \frac{0.40\bar{D}_3}{0.40\bar{D}_3 + 0.60\bar{D}_5}$$

When there are 10 years of data available, the three-year, five-year, and 10-year ratings are combined with the following weights:

[23] $$W_{10} = \frac{0.50\bar{D}_{10}}{0.20\bar{D}_3 + 0.30\bar{D}_5 + 0.50\bar{D}_{10}}$$

[24] $$W_5 = \frac{0.30\bar{D}_5}{0.20\bar{D}_3 + 0.30\bar{D}_5 + 0.50\bar{D}_{10}}$$

[25] $$W_3 = \frac{0.20\bar{D}_3}{0.20\bar{D}_3 + 0.30\bar{D}_5 + 0.50\bar{D}_{10}}$$

Notes

1 It is important to distinguish between a fund's Style Box™ placement – based on the fund's characteristics at a single point in time – and the category to which it is assigned; the latter measure is based on the fund's long-term or "normal" style profile.

Version History

Version	Date	Description
1.2	13 June 2006	Updated to reflect revised fund categories and to remove the function that rounded variables n_1-n_5 (the rating breakpoints) to integers. Changed the logic for assigning ratings to look for all funds up to but not exceeding each breakpoint, instead of all funds reaching or just exceeding each breakpoint.
1.1	1 October 2003	Updated to include revised fund categories
1.0	22 April 2002	Original publication