



Morningstar Style Box™ Methodology

Morningstar Methodology Paper
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Document Version History

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Introduction

The Morningstar Style Box™ was introduced in 1992 to help investors and advisors determine the investment style of a fund. Different investment styles often have different levels of risk and lead to differences in returns. Therefore, it is crucial that investors understand style and have a tool to measure their style exposure. The Morningstar Style Box provides an intuitive visual representation of style that helps investors build better portfolios and monitor them more precisely.

Morningstar classifies funds as being large-cap, mid-cap, or small-cap based on the market capitalization of the fund's stock holdings; and as value, blend, or growth based on the value-growth orientation of the stock holdings. The nine possible combinations of these characteristics correspond to the nine squares of the Morningstar Style Box—size is displayed along the vertical axis and style is displayed along the horizontal axis.

Morningstar's original Style Box model for equity funds used the median market capitalization of the underlying stocks to determine a fund's average size. The original model measured value-growth orientation based on two price ratios (price-to-earnings and price-to-book for U.S. equity funds and price-to-book and price-to-cash flow for non-U.S. equity funds). In the original model, all non-U.S. stocks and funds were measured against a single set of breakpoints.

The current, enhanced Style Box model uses 10 factors—five for value and five for growth—to measure a stock's value-growth orientation. The multi-factor approach produces more accurate and stable stock and fund style assignments. To measure size, the enhanced model uses flexible rather than static breakpoints between large-, mid-, and small-cap stocks. The current methodology also measures stocks in the context of a geographic style zone, rather than grouping all non-U.S. stocks together.

The enhanced methodology starts at the stock level and therefore fosters a shared analytical framework that can also be applied to fund research, portfolio assembly, and market monitoring. In the United States, Morningstar introduced the enhanced 10-factor model for U.S. stocks and U.S. equity funds in May 2002 and for non-U.S. stocks and global funds in March 2004. Outside of the United States, the 10-factor model was introduced in various markets starting in March 2004. Morningstar applies the same methodology to all types of equity managed products, such as open-end mutual funds, closed-end funds, separate accounts, etc.

Morningstar places all global stocks within one of seven style zones:

| | |
|-------------|--|
| Style Zones | United States |
| | Latin America |
| | Canada |
| | Europe* |
| | Japan |
| | Asia ex-Japan |
| | Australia/New Zealand |
| | * Stocks from African countries are scored with European stocks. |

Within each style zone, stocks are assigned to the rows of the Style Box as follows:

| | |
|-----------|---|
| Large-cap | Stocks within the top 70% of the cumulative capitalization of each style zone |
| Mid-cap | 70%-90% of the cumulative capitalization of each style zone |
| Small-cap | 90-100% of the cumulative capitalization of each style zone |

The Morningstar Style Box uses 10 factors for style:

| Value Score Components and Weights | Growth Score Components and Weights |
|------------------------------------|--|
| Forward Looking | Forward Looking |
| 1. Price-to-Projected Earnings* | 1. Long-Term Projected Earnings Growth |
| Historical-based measures: | Historical-based measures: |
| 2. Price-to-Book* | 2. Book Value Growth |
| 3. Price-to-Sales* | 3. Sales Growth |
| 4. Price-to-Cash Flow* | 4. Cash Flow Growth |
| 5. Dividend Yield | 5. Historical Earnings Growth |

* The calculations are done with the yield form of these variables (i.e. with price in the denominator of the fraction).

This paper explains the theories and methodology behind the 10-factor Morningstar Style Box. The first section explains how size and style scores are calculated for each stock. The second section explains how stock style is used to determine the style placement for a mutual fund or other portfolio.

Driving Principles

The Morningstar Style Box is applicable in all equity markets. A geographic framework ensures that stocks are compared to their closest peers and that style assignments are relevant to local investors everywhere. World equity markets are divided up into seven style zones: United States, Latin America, Canada, Europe, Japan, Asia ex-Japan, and Australia/New Zealand.

The first premise of this model is that stock size breakpoints should be flexible and responsive to changing market conditions. Instead of using fixed dollar breakpoints to classify securities as large-cap, mid-cap, or small-cap, the model bases that distinction on each stock's position in the cumulative capitalization of its style zone. Large-cap stocks are those that together account for the top 70% of the capitalization of each style zone; mid-cap stocks represent the next 20%; and small-caps represent the balance.

The second premise of this model is that a stock's value-growth orientation should be relative to a peer group ("scoring group"), as defined by the style zone of the stock and its capitalization (e.g. Latin America large-cap). A Japanese small-cap stock performs quite differently than a European large-cap stock and the two should not be scored relative to each other. Therefore, two stocks may have similar financial ratios and growth prospects, but they may be given different value-growth assignments if they are in different scoring groups.

The third premise of this model is that a stock's value orientation and growth orientation are distinct measures. As such, they are estimated using related but separate variables. Once estimated (Overall Value and Overall Growth scores), they are combined into a single net value-core-growth ("VCG") score.

- ▶ A high Overall Value score indicates that a stock's price is relatively low, given the anticipated per-share earnings, book value, revenues, cash flow, and dividends that the stock provides to investors. A high price relative to these measures indicates that a stock's value orientation is weak, but it does not necessarily mean that the stock is growth-oriented.

- ▶ A high Overall Growth score indicates that a stock’s per-share earnings, book value, revenues, and cash flow are expected to grow quickly relative to other stocks in the same scoring group. A weak growth orientation does not necessarily mean that a stock has a strong value orientation.

- ▶ It follows that an individual stock may have any combination of strong or weak growth and value characteristics. Where one set of characteristics is dominant, the stock can be classified accordingly. Where the stock’s growth and value characteristics are similar in strength, the stock will be given a “core” style assignment.
(A note on terminology: For stocks, the central column of the Style Box represents the “core” style. For funds, both value and growth managers often hold core stocks for diversification or other reasons; therefore, the central column of the Style Box for funds represents the “blend” style.)

The fourth premise of this model is that historical measures alone can rarely fully capture a stock’s value-growth orientation. Investors and institutions trade based on historical measures as well as future expectations. Therefore, Morningstar includes both historical and forward-looking financial measures in the model to ensure that all information available to active fund managers is considered. The forward-looking measures are primarily based on third-party analysts’ earnings estimates. When forward-looking data is available, it contributes to 50% of the stock’s style assignment.

The fifth and last premise of this model is that once a stock’s size and value-growth orientation is determined, these scores can also be used for fund research, portfolio assembly, and market monitoring. Morningstar assigns X- and Y-coordinates for style and size that form the building blocks for this unified framework for holdings-based analysis. This integrated system can help investors and advisors understand the style positioning of funds and construct well-diversified portfolios that are consistent with the investor’s return expectations and risk tolerances. Also, in the United States, investors can monitor the performance of their U.S. portfolios with Morningstar’s style-based market indexes, which offer broad coverage of the U.S. market and are based on the same structural foundation as the Style Box.

Data

Terminology and Notation

The following variables relate to company earnings per share:

| | | |
|----------|---|---|
| e_1 | = | forecasted earnings per share (EPS) for the current fiscal year |
| e_0 | = | EPS for the most recently reported fiscal year |
| e_{-1} | = | EPS for the fiscal year prior to e_0 |
| e_{-2} | = | EPS for the fiscal year prior to e_{-1} |
| e_{-3} | = | EPS for the fiscal year prior to e_{-2} |
| e_{-4} | = | EPS for the fiscal year prior to e_{-3} |

The same notation is used for book value per share, revenue per share, cash flow per share, and dividends per share except that “b,” “r,” “c” or “d,” respectively, are substituted for “e” in the example above.

When the data is available, the model uses earnings per share from continuing operations instead of net EPS. The model uses cash flow from operations instead of total cash flow. For non-U.S. stocks, the data is as originally reported (AOR). For U.S. stocks, the data is restated. Restated cash flow is limited to three years (c_0 , c_{-1} , and c_{-2}). All financial statement data is from fiscal year-end reports—quarterly reports are not used.

The following variables relate to the yield factors that are used in determining a stock’s value orientation:

| | | |
|---------|---|---|
| p | = | current stock price per share, from the most recent month-end |
| e_1/p | = | projected earnings yield (uses third party estimates for e_1 , where available) |
| b_1/p | = | book value yield (projected based on historical data) |
| r_1/p | = | revenue yield (projected based on historical data) |
| c_1/p | = | cash flow yield (projected based on historical data) |
| d_1/p | = | dividend yield (projected based on historical data) |

For the purpose of determining stock value orientation, Morningstar may also use an additional growth measure. When a third party estimate of e_1 is not available, Morningstar calculates a projection for e_1 based on historical growth rates up through the most recent year, e_0 .

$g(e_1)$ = forecasted growth in EPS for the current fiscal year, based on historical growth rates and using e_0 as the end point for growth. Used to calculate e_1 to determine a stock's value orientation.

The same notation is used to forecast growth for book value, revenue, cash flow, and dividends except that “b,” “r,” “c” or “d,” respectively, are substituted for “e” in the example above.

For the purposes of determining stock growth orientation, a different growth measure is used:

$g'(e)$ = historical average growth rate of EPS, based on historical growth rates and using e_0 or e_{-1} as the end point for growth. Used to determine a stock's growth orientation.

The same notation is used for historical average growth rates in book value per share, revenue per share, and cash flow per share except that “b,” “r” or “c,” respectively, are substituted for “e” in the example above. Because dividends are commonly associated with value-oriented stocks, dividend growth is not one of the five growth factors.

In addition, for earnings growth only, the following notation applies:

$g(e_3)$ = third-party long-term earnings growth forecast (mean for U.S. stocks and median for non-U.S. stocks)

Stock capitalization (“cap”) and company size are treated as synonymous in this document.

Frequency

An individual stock shows continuous short-term variation as its price and other attributes change. To capture the effects of such changes, Morningstar recalculates each stock's Style Box assignment at the end of every month.

The Morningstar Equity Sample

Stock Style Box assignments are based on information drawn from Morningstar's equity sample. The equity sample includes over 20,000 stocks from 70 different countries.

The following security types are excluded from the original scoring groups.

- ▶ American Depositary Receipts (ADRs)
- ▶ American Depositary Shares (ADSs)
- ▶ fixed-dividend shares
- ▶ convertible notes, warrants and rights
- ▶ tracking stocks
- ▶ preferred shares (unless it is the most commonly held share)
- ▶ mutual funds

VCG Style Assignments & Capitalization Effects

VCG (value-core-growth) style assignments can appear inconsistent where stocks are in different scoring groups but are otherwise similar. For instance, if European mid-cap stocks have an average price-earnings ratio (p/e) of 20 and European large-cap stocks have an average p/e of 16, a European mid-cap stock with a p/e of 18 might be considered strongly value-oriented, whereas a large-cap stock with the same p/e might be considered to have a weak value orientation.

For the same reason, stocks that are "borderline" in their size group, and vary from month to month between the large-cap and mid-cap groups, for example, may experience variation in their VCG assignments. This variation may be due to the use of different comparison groups in successive months, not to variation in value or growth characteristics.

Stocks may therefore experience changes in their month-to-month VCG style assignment for two separate reasons:

- ▶ Their fundamental characteristics vary from month to month.
- ▶ Their size group varies from month to month, thus changing the scoring group on which Morningstar bases their VCG style assignment.

Assigning Stocks to Scoring Groups

Stocks are first divided into seven style zones based on their country of domicile.

- ▶ United States
- ▶ Latin America
- ▶ Canada
- ▶ Europe
- ▶ Japan
- ▶ Asia ex-Japan
- ▶ Australia/New Zealand

Then, capitalization assignments are determined as follows:

- 1) For all stocks in a style zone, convert the market cap of each stock into a common currency. Order the stocks in each style zone in descending order by size, and calculate cumulative capitalization as a percentage of total sample capitalization as each stock is added to the list.
- 2) The stock that causes cumulative capitalization to equal or exceed 40% of the style zone's total cap is the final one assigned to the giant-cap group.
- 3) The largest of the remaining stocks are assigned to the large-cap group until cumulative capitalization equals or exceeds 70% of the total capitalization of the style zone.
- 4) The largest of the remaining stocks are assigned to the mid-cap group until cumulative capitalization equals or exceeds 90% of the total capitalization of the style zone.
- 5) The largest of the remaining stocks are assigned to the small-cap group until cumulative capitalization equals or exceeds 97% of the total capitalization of the style zone.
- 6) The remaining stocks are assigned to the micro-cap group.

Within each style zone, giant-cap and large-cap stocks are combined together for VCG style scoring. Micro-cap stock style assignments are based on the small-cap scores for that style zone (10 factor scores, value threshold, and growth threshold).

Therefore, there are 21 scoring groups, based on each combination of the seven style zones and the three size groups (large, mid, or small).

Measuring Stock Value Orientation

Basic Process

A stock's value orientation reflects the price investors are willing to pay for a share of some combination of the stock's prospective earnings, book value, revenue, cash flow, and dividends. Morningstar measures a stock's value orientation in relation to its scoring group (groups based on style zone and size).

Value orientation is determined using the following three steps:

- 1) Calculate up to five prospective yields (e_1/p , b_1/p , r_1/p , c_1/p and d_1/p : as many as are available) for each stock.
- 2) Calculate a float-weighted percentile score (0-100) for each available yield factor for each stock within each scoring group.
- 3) Calculate the Overall Value score (0-100) for each stock. This is a weighted average of the individual percentile scores for each of the five value factors. The weights for this average are described below. The weighted average score represents the strength of the stock's value orientation.

Details of each of these steps are provided below.

Calculating Prospective Yields

As many as possible of e_1/p , b_1/p , r_1/p , c_1/p and d_1/p are calculated for each stock. Because p is known, the method used to forecast e_1 , b_1 , etc. is key.

If a positive third-party forecast of e_1 , b_1 , r_1 , c_1 or d_1 is available, it is used to calculate the prospective yield. (At the time of writing, Morningstar only uses third-party forecasts for e_1). If e_1 , b_1 , r_1 , c_1 or d_1 is forecasted to be negative by a third party, or if e_0 , b_0 , r_0 , c_0 or d_0 is negative and no third party forecast is available, prospective yield on that factor is excluded for that stock. If no third party forecast is available and e_0 , b_0 , r_0 , c_0 or d_0 is positive, then forecasted values are calculated.

In summary, when:

| e_1 | e_0 | Then |
|-------|-------|---|
| >0 | any | Use third-party estimate for e_1 . |
| <0 | any | Don't calculate this factor. |
| NA | >0 | Calculate internal estimate for e_1 . |
| NA | <0 | Don't calculate this factor. |

Internal estimates for e_1 are based on the following straightforward relationship between prospective and current EPS:

$$[1] \quad e_1 = e_0 \times (1 + g(e_1))$$

Because e_0 is known, only the growth rate $g(e_1)$ must be calculated to provide a forecast of e_1 . The growth rate $g(e_1)$ is calculated from historical earnings data.

First calculate as many as possible of four periodic growth rates:

$$[2] \quad g(e)_{-4} = \left(\frac{e_0}{e_{-4}}\right)^{\frac{1}{4}} - 1$$

$$[3] \quad g(e)_{-3} = \left(\frac{e_0}{e_{-3}}\right)^{\frac{1}{3}} - 1$$

$$[4] \quad g(e)_{-2} = \left(\frac{e_0}{e_{-2}}\right)^{\frac{1}{2}} - 1$$

$$[5] \quad g(e)_{-1} = \left(\frac{e_0}{e_{-1}}\right) - 1$$

If e_{-1} , e_{-2} , e_{-3} or e_{-4} is negative, no periodic growth rate is calculated using that data point. A minimum of one periodic growth rate must be available to determine $g(e_1)$.

Because this growth rate is used to estimate the current year EPS, e_0 must be positive and e_0 serves as the numerator for calculating growth. This growth rate can sometimes be different than the historical earnings growth rate used to determine growth orientation, because that growth rate will use e_{-1} as the numerator when e_0 is negative.

When all available growth rates have been calculated, average the results:

$$[6] \quad g(e_1) = \text{Average}[g(e)_{-4}, g(e)_{-3}, g(e)_{-2}, g(e)_{-1}]$$

Prospective book value, revenue, cash flow, and dividend yields are calculated in the same way.

Thus,

- ▶ Estimated earnings growth $g(e_1)$ and forecasted earnings e_1 are calculated only for stocks where e_0 is a positive number.
- ▶ In calculating $g(e_1)$, recent growth rates are included in more of the averaged terms than are older growth rates; recent growth rates are therefore weighted more heavily than are older growth rates.

If only forecasted dividend yield, or no information, is available for a given stock, the stock is eliminated from the scoring group and is not scored in any way.

Calculating Percentile Scores For Each Value Factor

When one or more of e_1/p , b_1/p , r_1/p and c_1/p values have been calculated, with or without d_1/p , each stock is assigned a float-weighted percentile score for each relevant factor. The percentile scores are calculated within each stock's scoring group.

To calculate an earnings yield score (0-100) for each stock in a scoring group:

- 1) Rank all stocks in the scoring group by e_1/p yields in ascending order.
- 2) Determine the total float capitalization of all stocks in the group. Float is defined as the number of shares issued and outstanding, less any shares owned by insiders, 5% owners, and Rule 144 shares.
- 3) Starting with the lowest observations, trim all stocks that sum up to 5% of float. Then, trim 5% of the float from the highest observations. When a stock "straddles" the 5th percentile point or 95th percentile point, remove it from the sample.
- 4) Calculate the float-weighted average e_1/p for the remaining stocks.
- 5) Add the trimmed stocks back to the sample. Calculate the ratio of each stock's e_1/p to the float-weighted average e_1/p .
- 6) Assign each stock to an e/p "bucket" as follows:
 - a) If the stock's e_1/p is equal to or less than 0.75 times the float-weighted average e_1/p ("the lower value cutoff"), the stock is assigned to the low e/p bucket.
 - b) Or, if the stock's e_1/p is equal to or less than the float-weighted average e_1/p , the stock is assigned to the mid-minus e/p bucket.
 - c) Or, if the stock's e_1/p is equal to or less than 1.25 ("the upper value cutoff") times the float-weighted average e_1/p , the stock is assigned to the mid-plus e/p bucket.
 - d) Or, the stock is assigned to the high e/p bucket.

When each stock has been assigned to an e/p bucket, it is then scaled relative to other stocks in the same bucket. The low e/p bucket is used as an example here:

- 1) Order the stocks within the low e/p bucket by their raw e_1/p scores, from lowest to highest.
- 2) Within the low e/p bucket, assign each stock a value equal to the cumulative float represented by that stock and all stocks with a lower e_1/p . Thus, the stocks in the low e/p bucket have values ranging from 0.00+ (the stock with the lowest e_1/p in the low e/p bucket) to 100 (the stock with the highest e_1/p in the low e/p bucket).
- 3) Where two or more stocks have the same e_1/p , they are assigned a value that represents the cumulative float of all stocks with a lower e_1/p plus one-half of the total float of the stocks that share the same e_1/p .
- 4) Re-scale the scores in the low e/p bucket between 0.00+ and 33.33.

Repeat the four steps immediately above for each of the mid-minus, mid-plus and high e/p buckets; and re-scale the values as follows:

| Bucket | Minimum Score | Maximum Score |
|---------------|---------------|---------------|
| Low e/p | 0.00+ | 33.33 |
| Mid-minus e/p | 33.34 | 50.00 |
| Mid-plus e/p | 50.01 | 66.66 |
| High e/p | 66.67 | 100.00 |

All of the steps in this section are then repeated for each of b_1/p , r_1/p , c_1/p and d_1/p . For stocks that do not pay dividends, 0% dividend yield is considered a valid data point and is given a dividend yield score.

Repeat all of the steps above for each scoring group.

Percentile scores for micro-cap stocks are assigned based on the small-cap scoring group for the respective style zone. For each micro-cap stock, find the small-cap stock that has the closest earnings yield. Copy the percentile score from the small-cap reference stock and assign it to the micro-cap stock. Repeat for all the remaining value factors.

Calculating Overall Value Scores

When all of the five value factors have been scored from 0-100, a weighted average Overall Value score is calculated for each stock. If available, e/p scores are assigned a weight of 50% in the Overall Value score; each of the other value factors is assigned an equal share of the remaining weight (either 50% or, if e/p is unavailable, 100%).

For example, if all five value factors are available, the weights are:

| Scores | e/p | b/p | r/p | c/p | d/p | Overall Value |
|---------|-----|-------|-------|-------|-------|---------------|
| | 50% | 12.5% | 12.5% | 12.5% | 12.5% | |
| Stock A | 41 | 78 | 73 | 88 | 81 | 61 |

Or, for example, if b/p is missing, the weights are:

| Scores | e/p | b/p | r/p | c/p | d/p |
|--------|-----|-----|-------|-------|-------|
| | 50% | -- | 16.7% | 16.7% | 16.7% |

Or, for example, if e/p and b/p are both missing, the weights are:

| Scores | e/p | b/p | r/p | c/p | d/p |
|--------|-----|-----|-------|-------|-------|
| | -- | -- | 33.3% | 33.3% | 33.3% |

If only forecasted dividend yield, or no information, is available for a given stock, the stock is not given an Overall Value score or a net VCG style score.

Measuring Stock Growth Orientation

Basic Process

A stock's growth orientation reflects the rates at which its earnings, book value, revenue, and cash flow are expected to grow. Dividend growth rates are not used in determining stock growth orientation. Morningstar measures a stock's growth orientation in relation to its scoring group (groups based on style zone and size).

Growth orientation is determined using the following three steps:

- 1) Calculate up to four average growth rates $g'(e)$, $g'(b)$, $g'(r)$ and $g'(c)$ for each stock, using the process described in the next section. Collect third-party estimates for long-term projected earnings growth rate, $g(e_5)$.
- 2) Calculate a float-weighted percentile score (0-100) for each available growth rate for each stock within each scoring group.
- 3) Calculate the Overall Growth score (0-100) for each stock. This is a weighted average of the individual percentile scores for each of the five growth factors. The weighting scheme is described below. The weighted average score represents the strength of the stock's growth orientation.

Details of each of these steps are provided below.

Calculating Stock Growth Rates

As many as possible of $g'(e)$, $g'(b)$, $g'(r)$ and $g'(c)$ are calculated for each stock. The example historical growth rate calculation below uses $g'(e)$, but the process is identical for $g'(b)$, $g'(r)$ and $g'(c)$. In addition, if $g(e_5)$ is available from a third party and if the estimate is greater than 0, it is used as a fifth growth rate indicator.

If e_0 and e_{-1} are both negative, then $g'(e)$ is not calculated. If e_0 or e_{-1} is positive, then $g'(e)$ is calculated as follows.

First calculate as many as possible of four periodic growth rates:

$$[7] \quad g'(e)_{-4} = \left(\frac{e_n}{e_{-4}} \right)^{\frac{1}{n+4}} - 1$$

$$[8] \quad g'(e)_{-3} = \left(\frac{e_n}{e_{-3}} \right)^{\frac{1}{n+3}} - 1$$

$$[9] \quad g'(e)_{-2} = \left(\frac{e_n}{e_{-2}}\right)^{\frac{1}{n+2}} - 1$$

$$[10] \quad g'(e)_{-1} = \left(\frac{e_n}{e_{-1}}\right)^{\frac{1}{n+1}} - 1$$

where:

n = the most recent period (0 or -1) in which EPS is positive

If e_{-1} , e_{-2} , e_{-3} or e_{-4} is negative, no periodic growth rate is calculated using that data point. A minimum of two periodic growth rates must be available to determine $g'(e)$. If $n=0$, up to four rates are calculated; and if $n=-1$, up to three growth rates are calculated.

When all available growth rates have been calculated, average the results:

$$[11] \quad g'(e) = \text{Average}[g'(e)_{-4}, g'(e)_{-3}, g'(e)_{-2}, g'(e)_{-1}]$$

If $n=0$ and if the stock was missing a third party forecast for e_1 , $g'(e)$ will be the same as the growth rate used in the calculation of the stock's value orientation, $g(e_1)$.

Book value, revenue, and cash flow growth rates are calculated in the same way.

If growth information for at least one factor is unavailable for a given stock, the stock is eliminated from the scoring group and is not scored in any way.

Calculating Percentile Scores For Each Growth Factor

As with the value factors, percentile scores are assigned to each of the five growth factors. The percentile scores are calculated within each stock's scoring group.

To calculate an earnings growth rate score (0-100) for each stock within a scoring group:

- 1) Rank all stocks in the scoring group by their $g'(e)$ growth rates in ascending order.
- 2) Determine the total float capitalization of all stocks in the group.
- 3) Starting with the lowest observations, trim all stocks that sum up to 5% of float. Then, trim 5% of the float from the highest observations. When a stock "straddles" the 5th percentile point or 95th percentile point, remove it from the sample.
- 4) Calculate the share-weighted average growth rate for the remaining stocks. See Appendix A for a description of the share-weighted average.
- 5) Add the trimmed stocks back to the sample. Calculate the ratio of each stock's $g'(e)$ to the share-weighted average $g'(e)$.
- 6) Assign each stock to a $g'(e)$ "bucket" as follows:
 - a) If the stock's $g'(e)$ is equal to or less than 0.75 times the share-weighted average $g'(e)$ ("the lower growth cutoff"), the stock is assigned to the low $g'(e)$ bucket.
 - b) Or, if the stock's $g'(e)$ is equal to or less than the share-weighted average $g'(e)$, the stock is assigned to the mid-minus $g'(e)$ bucket.
 - c) Or, if the stock's $g'(e)$ is equal to or less than 1.25 times the share-weighted average $g'(e)$ ("the upper growth cutoff"), the stock is assigned to the mid-plus bucket.
 - d) Or, the stock is assigned to the high $g'(e)$ bucket.

When each stock has been assigned to a $g'(e)$ bucket, it is then scaled relative to other stocks in the same bucket. The low $g'(e)$ bucket is used as an example here:

- 1) Order the stocks within each bucket by raw $g'(e)$ score, from lowest to highest.
- 2) Within the low $g'(e)$ bucket, assign each stock a value equal to the cumulative float represented by that stock and all stocks with a lower $g'(e)$. Thus, the stocks in the low $g'(e)$ bucket have values ranging from 0.00+ (the stock with the lowest $g'(e)$ in the low $g'(e)$ bucket) to 100 (the stock with the highest $g'(e)$ in the low $g'(e)$ bucket).
- 3) Where two or more stocks have the same $g'(e)$, they are assigned a value which represents the cumulative float of all stocks with a lower $g'(e)$, plus one-half of the total float of the stocks that share the same $g'(e)$.
- 4) Re-scale the scores in the low $g'(e)$ bucket between 0.00+ and 33.33.

Repeat the four steps immediately above for each of the mid-minus, mid-plus and high $g'(e)$ buckets; and re-scale the values as follows:

| Bucket | Minimum Score | Maximum Score |
|-------------------|---------------|---------------|
| Low $g'(e)$ | 0.00+ | 33.33 |
| Mid-minus $g'(e)$ | 33.34 | 50.00 |
| Mid-plus $g'(e)$ | 50.01 | 66.66 |
| High $g'(e)$ | 66.67 | 100.00 |

All of the steps in this section are then repeated for the other four growth orientation factors. Repeat all of the steps above for each scoring group.

Percentile scores for micro-cap stocks are assigned based on the small-cap scoring group for the respective style zone. The procedure is described in the section on value factor scores.

Calculating Overall Growth Scores

When all of the five growth factors have been scored from 0-100, a weighted average Overall Growth score is calculated for each stock. If available, $g(e_5)$ scores are assigned a weight of 50% in the Overall Growth score; each of the other growth factors is assigned an equal share of the remaining weight (either 50% or, if $g(e_5)$ is unavailable, 100%).

For example, if all five growth factors are available, the weights are:

| Scores | $g(e_5)$ | $g'(b)$ | $g'(c)$ | $g'(r)$ | $g'(e)$ |
|--------|----------|---------|---------|---------|---------|
| | 50% | 12.5% | 12.5% | 12.5% | 12.5% |

If no growth rates are available for a given stock, the stock is not given an Overall Growth score or a net VCG style score.

Determining the Stock's Net Value-Core-Growth Score

Each stock now has an Overall Value score and an Overall Growth score; both of these range from 0 to 100. Morningstar calculates a net value-core-growth (VCG) score for each stock by subtracting the stock's Overall Value score from its Overall Growth score. The result can range from 100 (for low-yield, extremely growth-oriented stocks) to -100 (high-yield, low-growth stocks).

Morningstar classifies a stock as growth-oriented if its net value-core-growth score equals or exceeds the "growth threshold" (normally about 10 to 30 for large-cap stocks). Morningstar classifies a stock as value-oriented if its net VCG style score equals or falls below the "value threshold" (normally about -5 to -20 for large-cap stocks). And, the stock is given a style assignment of "core" if its net VCG score lies between the two thresholds. Morningstar classifies micro-cap stocks using the threshold values from the small-cap scoring group in the respective style zone.

Calculating Threshold Levels

Value-oriented, growth-oriented, and core stocks are each assumed, over time, to account for one-third of the total capitalization of each scoring group. The value and growth thresholds for each scoring group are recalculated monthly using a three-step process:

- 1) Within each scoring group, calculate the preliminary value and growth thresholds that would result in each stock type representing exactly one-third of the total capitalization at the current month-end. (For the U.S. scoring groups, use one-third of the total float capitalization).
- 2) Repeat Step 1 for the periods ending six, 12, 18, 24, and 30 months ago.
- 3) Calculate the simple average of the six preliminary value thresholds.
Calculate the simple average of the six preliminary growth thresholds.

The two simple averages calculated in Step 3 are used as the current value and growth thresholds for each scoring group.

Assigning Coordinates and Style Boxes to Stocks

Raw X and Y Coordinates for Stocks

Morningstar uses a system of X and Y coordinates to determine a stock's placement on the Morningstar Style Box. These coordinates also serve as the building blocks for determining the style of a fund or portfolio.

Each stock is assigned a raw X score, which represents its placement along the horizontal axis of the Morningstar Style Box. Morningstar scales the net VCG score of each stock so that core stocks have raw X scores ranging from 100 to 200. Hence,

$$[12] \quad \text{raw } X = 100 \times \left[1 + \frac{g - v - s_1(\text{cap})}{s_2(\text{cap}) - s_1(\text{cap})} \right]$$

where:

| | | |
|-------------------|---|--|
| g | = | the stock's Overall Growth score (based on the five growth factors) |
| v | = | the stock's Overall Value score (based on the five value factors) |
| $s_1(\text{cap})$ | = | the threshold between value and core stocks for the stock's respective scoring group (the "value threshold") |
| $s_2(\text{cap})$ | = | the threshold between core and growth stocks for the stock's respective scoring group (the "growth threshold") |

Value and growth thresholds—the dividing points between value, core and growth stocks—are calculated separately for each scoring group.

Each stock is next assigned a raw Y score, which represents its placement along the vertical axis of the Morningstar Style Box. Morningstar uses the natural logarithm of market capitalization to measure stock size. This number is scaled so that each mid-cap stock has a raw Y size score between 100 and 200. Hence, given a stock with a market capitalization of “cap,”

$$[13] \quad raw\ Y = 100 \times \left[1 + \frac{\ln(cap) - \ln(cap_1)}{\ln(cap_2) - \ln(cap_1)} \right]$$

where

cap₂ = the market capitalization that corresponds to the breakpoint between large-cap and mid-cap stocks for the stock's respective style zone

cap₁ = the market capitalization that corresponds to the breakpoint between mid-cap and small-cap stocks for the stock's respective style zone

Raw Y is unbounded for large-cap and small-cap stocks.

When all stocks have been assigned value-growth orientation (raw X) and size (raw Y) scores, Morningstar determines the stock's Style Box placement.

| | | | |
|---------|-------------------|--------|-------------------|
| Small | Raw Y < 100 | Value | Raw X < 100 |
| Mid-cap | 100 ≤ Raw Y ≤ 200 | Core | 100 ≤ Raw X ≤ 200 |
| Large | 200 < Raw Y | Growth | 200 < Raw X |

Note: See Rescaling section for the differences between raw X and Y and rescaled X and Y for stocks.

Assigning Coordinates and Style Boxes to Funds

Frequency

Morningstar calculates each fund's Style Box assignment upon receipt of a new portfolio of holdings. Morningstar uses stock scores from the same date as the fund portfolio date in order to determine the fund's Style Box assignment.

Raw X and Y Coordinates for Funds

The Style Box assignment for a fund or portfolio is based on the asset-weighted average of the raw X and raw Y scores for the underlying stocks.

Let:

$raw \bar{X}$ = the asset-weighted average of the raw X scores of the stocks in a fund

$raw \bar{Y}$ = the asset-weighted average of the raw Y scores of the stocks in a fund

X_i = the raw X score for stock "i"

Y_i = the raw Y score for stock "i"

N = the number of stocks in the fund

w_i = the fraction of the fund's stock assets held in an individual stock "i"

so that:

$$[14] \quad raw \bar{X} = \sum_{i=1}^N w_i X_i$$

$$[15] \quad raw \bar{Y} = \sum_{i=1}^N w_i Y_i$$

This method of assigning fund style involves blending stock raw X and raw Y scores that were generated in different style zones or size groups. These style and size scores may correspond to different net VCG style scores or market caps, but they can be blended together into the fund-level score, because they represent each stock's relative size and style.

The center column of the Style Box for funds (“blend”) is a little different than the center column for stocks (“core”). Few or no funds contain only stocks with extreme value-growth orientation scores, and both value and growth managers often hold core stocks for diversification or other reasons. As a result, funds show less variation than stocks do on the x-axis; that is, funds tend to cluster nearer the middle of the x-axis.

It follows that the threshold points between value, blend and growth funds are closer to the center of the x-axis than are the threshold points between value, core and growth stocks. Therefore, the value and growth areas are expanded toward the center for funds, and the remaining “blend fund” area is narrower than the “core stock” area.

Let γ denote the ratio of the width of the blend fund area to the width of the core stock area. Then,

$$[5] \quad \text{value-blend breakpoint} = 150 \times \left(1 - \frac{\gamma}{3}\right)$$

$$[6] \quad \text{blend-growth breakpoint} = 150 \times \left(1 + \frac{\gamma}{3}\right)$$

Currently Morningstar sets $\gamma = 0.5$ so that a fund is considered to be value if $\text{raw } \bar{X} < 125$, growth if $\text{raw } \bar{X} > 175$, and blend if $125 \leq \text{raw } \bar{X} \leq 175$ (in contrast to core stocks which have raw X scores between 100 and 200).

A fund’s Style Box assignment is based on its raw X and Y coordinates.

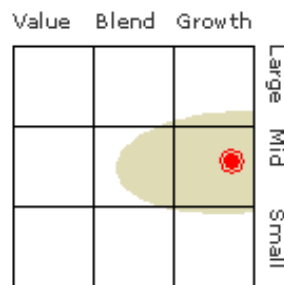
| | | | |
|---------|-------------------|--------|-------------------|
| Small | Raw Y < 100 | Value | Raw X < 125 |
| Mid-cap | 100 ≤ Raw Y ≤ 200 | Blend | 125 ≤ Raw X ≤ 175 |
| Large | 200 < Raw Y | Growth | 175 < Raw X |

Note: See Rescaling section for the differences between raw X and Y and rescaled X and Y for funds.

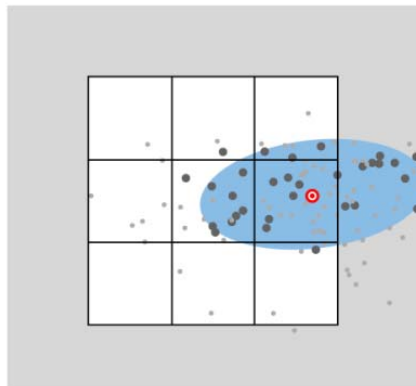
Morningstar Ownership ZoneSM

The style and size scores for stocks and funds are the building blocks for the Morningstar Ownership ZoneSM. A portfolio's Ownership Zone is derived by plotting each stock in the fund's portfolio within the proprietary Morningstar Style Box. The shaded area represents the center 75% of the fund's assets, and it provides an intuitive visual representation of the area of the market in which the fund invests. A “centroid” plot in the middle of the Ownership Zone represents the weighted average of all the fund's holdings.

The Ownership Zone can be illustrated on the familiar nine-square grid of the Morningstar Style Box.



The Style Box can also be expanded to a 25-square grid. This version of the Ownership Zone often includes individual plot points for each stock. This provides investors with more detail and allows them to better differentiate between giant-cap, micro-cap, deep value and high growth stocks.



The Ownership Zone helps investors visually evaluate the investment style of a fund or a portfolio. It can also be helpful for monitoring style drift, a fund's tendency to change its style over time.

Rescaling

In order to graphically distribute the X and Y coordinates evenly across the width and height of the Style Box grid, Morningstar established a system of rescaling for stocks and funds (see Appendix B for exact rules).

- ▶ Rescaling is for graphical presentation only. All in-house calculations (e.g. fund Style Box, Morningstar Category™) use raw scores.
- ▶ Rescaling does not change the style assignment for a stock or fund.
- ▶ The same rescaling rules can be used for stocks and funds.

Each raw value for style and size (raw X and Y) is rescaled onto a grid that runs from -100 to 400 (rescaled X and Y). For example, during one month, the raw Y scores for stocks ranged from -555 to 397 (the smallest numbers represent the micro-cap universe). These Y scores were squeezed and stretched and redistributed between -100 and 400.

The breakpoints for the rescaled values are as follows:

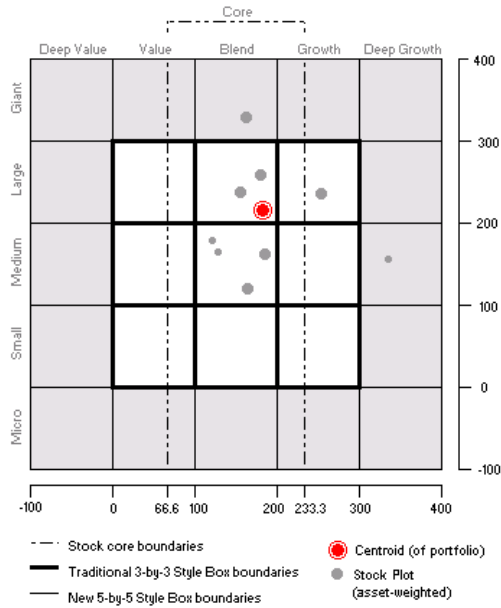
Stock Scores

| | | | |
|---------|------------------------|--------|-----------------------|
| Small | Rescaled Y < 100 | Value | Rescaled X < 67 |
| Mid-cap | 100 ≤ Rescaled Y ≤ 200 | Core | 67 ≤ Rescaled X ≤ 233 |
| Large | 200 < Rescaled Y | Growth | 233 < Rescaled X |

Fund Scores

| | | | |
|---------|------------------------|--------|------------------------|
| Small | Rescaled Y < 100 | Value | Rescaled X < 100 |
| Mid-cap | 100 ≤ Rescaled Y ≤ 200 | Blend | 100 ≤ Rescaled X ≤ 200 |
| Large | 200 < Rescaled Y | Growth | 200 < Rescaled X |

The rescaled X and Y scores can be plotted on the Morningstar Style Box. Each square of the Style Box grid represents 100 rescaled units.



As with the raw scores, the size of the center column for stocks (“core”) is wider than the center column for funds (“blend”).

Rescaling does not change the style assignment for a stock or a fund. Raw X scores of 100 and 200 (the raw boundaries for core stocks) get rescaled to 67 and 233, respectively. Raw X scores of 125 and 175 (the raw boundaries for blend funds) get rescaled to 100 and 200, respectively.

Long-Term Style Trend: The Morningstar Category™

While the Morningstar Style Box represents a snapshot in time for a fund or portfolio, Morningstar also performs holdings-based analysis of long-term style trends. The Morningstar Category™ reflects the primary investment focus of the portfolio over the past three years. Categories for equity funds can be based on style, country/regional exposure (e.g. Japan Stock), or economic sector focus (e.g. Specialty Technology).

In the United States, Morningstar uses 14 style-based categories. Nine of these categories are for diversified U.S. equity funds, and the category names correspond to the nine squares of the Style Box (Large Value, Mid-Cap Blend, etc.). The remaining five style-based categories are used for diversified non-U.S. equity funds (Foreign Large Value, Foreign Small/Mid Growth, etc.). Some of Morningstar's international operations also classify funds based on style.

Morningstar reviews category assignments semi-annually, incorporating all portfolio data over the prior three years up through the most recent quarter-end. The process is partially quantitative: a program calculates the three-year averages for various statistics and makes a recommendation about the appropriate category for the portfolio. The process is also qualitative: Morningstar's fund analyst team will review the suggestions from the quantitative program and, based on their unique knowledge of the funds, will make a recommendation about whether the changes should be overruled or upheld. These results are then communicated to the fund company.

Funds are assigned to style-based categories based on their three-year average raw X and raw Y scores. The three-year average is the simple average of three 12-month averages, using the portfolio files that were received over that period.

An example of the three-year average calculation is below:

| Year 1 (April 2003-March 2004) | | | Year 2 (April 2002-March 2003) | | | Year 3 (April 2001-March 2002) | | |
|-----------------------------------|------------|------------|-----------------------------------|------------|------------|-----------------------------------|------------|------------|
| Date | Raw X | Raw Y | Date | Raw X | Raw Y | Date | Raw X | Raw Y |
| 5/31/03 | 105 | 297 | 6/30/02 | 110 | 296 | 5/31/01 | 106 | 295 |
| 7/31/03 | 116 | 290 | 9/30/02 | 118 | 289 | 9/30/01 | 111 | 287 |
| 9/30/03 | 132 | 284 | 12/31/02 | 117 | 295 | 12/31/01 | 121 | 279 |
| 1/31/04 | 134 | 286 | | | | 3/31/02 | 124 | 286 |
| Average | 122 | 289 | Average | 115 | 293 | Average | 116 | 287 |

Three-year average Raw X = $(122 + 115 + 116)/3 = 117$

Three-year average Raw Y = $(289 + 293 + 287)/3 = 290$

Style-specific category assignments are based on the fund's three-year average raw X and raw Y, using the same raw breakpoints for value, blend, and growth that are used for the fund Style Box.

| | | | |
|---------|----------------------------------|--------|----------------------------------|
| Small | Raw Y < 100 | Value | Raw X < 125 |
| Mid-cap | $100 \leq \text{Raw Y} \leq 200$ | Blend | $125 \leq \text{Raw X} \leq 175$ |
| Large | $200 < \text{Raw Y}$ | Growth | $175 < \text{Raw X}$ |

When there are fewer funds in certain investment styles, Morningstar may only support two categories across the value-growth spectrum. For example, in the United States, there are two categories for smaller foreign style funds: Foreign Small/Mid Value and Foreign Small/Mid Growth. In these cases, funds with three-year average raw X scores < 150 are placed in the value category and funds with three-year average raw X scores ≥ 150 are placed in the growth category.

Some Morningstar operations may use some discretion or buffering mechanisms during the Morningstar Category review process. These methods ensure that a fund does not undergo a category change unless it has exhibited a strong and sustained shift into a new investment style. That is, a fund may not necessarily experience a category change if the three-year average has landed just over a breakpoint by a small amount. (These buffering mechanisms are for category placement only and do not apply to Style Box assignments.)

Conclusion

The Morningstar Style Box has become the industry standard for categorizing and tracking managed investment portfolios. It describes securities in terms of their relative size and value-growth orientation in an intuitive, visual tool. It is based on a robust methodology that includes forward-looking and historical components and 10 different factors to measure value-growth orientation.

Because different investment styles often offer different return and risk patterns, it is important for individuals to understand the investment style of a stock, fund or portfolio. This understanding can help investors and advisors construct portfolios that are consistent with the investor's return expectations and risk tolerances.

The Morningstar Style Box lays the groundwork for better portfolio assembly and monitoring and is a useful tool for individual and professional investors. It provides a logical, completely integrated system and philosophy for analyzing stocks, funds, and portfolios.

Appendix A: Share-Weighted Average

Morningstar calculates five value and five growth factors for each stock and then scores each factor from 0 to 100. The scores are similar to percentile ranks, but the scoring is constrained based on quartiles (called “buckets”) for each scoring group. Bucket assignment is based on the stock’s value for that factor relative to a trimmed scoring group average.

The scoring group average for the five value factors is float-weighted. The scoring group average for the five growth factors is share-weighted, as described below. There are two calculations for share-weighted average: one for long-term projected earnings growth and one for the four historical growth rates. Because these calculations often reach across different countries within a style zone, all financial statement data must first be converted into a common currency.

The same methods are also used to calculate the growth rate factors at the fund level (using shares currently held by the fund, rather than shares outstanding for the company).

Share-Weighted Average for Long-Term Projected Earnings Growth Rate

$$\text{Share Weighted Average} = \frac{\sum_{j=1}^m (1 + g(e_s)) \times e_{0j} \times \text{shares}_{0j}}{\sum_{j=1}^n e_{0j} \times \text{shares}_{0j}} - 1$$

where

| | | |
|----------------------|---|--|
| $g(e_s)$ | = | third-party long-term earnings growth forecast |
| e_{0j} | = | EPS for the most recently reported fiscal year for stock j |
| shares_{0j} | = | shares outstanding for the most recent fiscal year-end for stock j |
| m | = | the number of stocks in the group with long-term earnings forecasts >0 and with $e_{0j} > 0$ |

Share-Weighted Average for the Four Historical Growth Rates

The example below uses earnings, but the procedure is the same for book value, revenue, or cash flow growth.

Step 1: Calculate a 4-year earnings growth rate

$$[1] \quad egr(0,-4) = \left[\frac{earn(0)}{earn(-4)} \right]^{\frac{1}{4}} - 1$$

where

$egr(0,i)$ = portfolio earnings growth rate from year i to year 0

$$earn(i) = \sum_{j=1}^n shares_{ij} \times e_{ij}$$

$shares_{ij}$ = shares outstanding for fiscal year-end i for stock j

e_{ij} = earnings per share (EPS) for fiscal year-end i for stock j

n = the number of stocks in the peer group that were not trimmed and for which e_0 and e_i are greater than 0

Step 2: Calculate a 3-year earnings growth rate

$$[2] \quad egr(0,-3) = \left[\frac{earn(0)}{earn(-3)} \right]^{\frac{1}{3}} - 1$$

Step 3: Calculate a 2-year earnings growth rate

$$[3] \quad egr(0,-2) = \left[\frac{earn(0)}{earn(-2)} \right]^{\frac{1}{2}} - 1$$

Step 4: Calculate a 1-year earnings growth rate

$$[4] \quad egr(0,-1) = \left[\frac{earn(0)}{earn(-1)} \right] - 1$$

Step 5: Calculate the historical share-weighted average for this growth factor

$$[5] \quad = Average[egr(0,-4), egr(0,-3), egr(0,-2), egr(0,-1)]$$

Appendix B: Rescaling Rules

In order to graphically distribute the raw X and Y coordinates evenly across the width and height of the Style Box grid, Morningstar established a system of rescaling for stocks and funds. The following rescaling rules are applied to the raw X and Y coordinates for both stocks and funds. Rescaling does not change the style assignment for a stock or fund.

Parameters for Y

There are different rules for rescaling Y scores, based on the style zone and size of each stock. First, six parameters must be defined for each style zone.

The four parameters y_0 , y_1 , y_2 , and y_3 are the raw Y scores for the smallest stocks in the small, mid, large, and giant capitalization groups, respectively, for each style zone. The parameter y_{bot} defines the lower boundary of the micro cap group (although it is not necessarily the raw Y score of the smallest stock in the micro cap group). The parameter y_{top} defines the top boundary of the giant cap group (although it is not necessarily the raw Y score of the largest stock in the giant cap group).

First, determine y_0 and y_3 for each style zone. Then, calculate y_{bot} and y_{top} .

| | | |
|------------------------|---|---|
| y_0 | = | The raw Y score for the smallest stock that falls into the small capitalization group. This is the raw Y score for the first stock that meets or exceeds the top 97% of cumulative market cap in each style zone. y_0 changes every month. See below for derivation. |
| y_1 | = | This is always 100. |
| y_2 | = | This is always 200. |
| y_3 | = | The raw Y score for the smallest stock that falls into the giant capitalization group. This is the raw Y score for the first stock that meets or exceeds the top 40% of cumulative market cap in each style zone. y_3 changes every month. See below for derivation. |
| β_{micro} | = | The ratio of the slope of rescaled Y for small-cap stocks to the slope of rescaled Y for micro-cap stocks. Currently, this is set to 2 and does not change every month. |
| y_{bot} | = | $y_0 - \beta_{\text{micro}} * (y_1 - y_0)$ |
| y_{top} | = | $2y_3 - y_2$ |

Finding y_0 and y_3

The most straightforward way to find y_0 and y_3 for each style zone is to insert the monthly capitalization breakpoints into the equation for raw Y.

$$[1] \quad \text{raw } Y = 100 \times \left[1 + \frac{\ln(\text{cap}) - \ln(\text{cap}_1)}{\ln(\text{cap}_2) - \ln(\text{cap}_1)} \right]$$

Example for the United States:

| | Breakpoint | \$USD million | ln | Raw Y | |
|------------------|-------------------------------------|---------------|-------|-------|----------------|
| cap ₃ | between giant- and large-cap stocks | 49,250 | 10.80 | 298 | y ₃ |
| cap ₂ | between large- and mid-cap stocks | 8,435 | 9.04 | 200 | y ₂ |
| cap ₁ | between mid- and small-cap stocks | 1,391 | 7.24 | 100 | y ₁ |
| cap ₀ | between small- and micro-cap stocks | 361 | 5.89 | 25 | y ₀ |

Example:

$$y_3 = y_{\text{score}}(\text{Giant}) = 100 \times \left[1 + \frac{\ln(49,250) - \ln(1,391)}{\ln(8,435) - \ln(1,391)} \right] = 298$$

For funds, use an average of the style zone values for y_0 , y_3 , y_{bot} , and y_{top} .

Rescaling Y

Once these six parameters are defined for each style zone, the raw y values can be rescaled according to the calculations below.

| Raw Y | Rescaled Y |
|---|--|
| raw Y < y _{bot} | -100 |
| y _{bot} ≤ raw Y ≤ y ₀ | $100 \times \left(\frac{y - y_0}{y_0 - y_{\text{bot}}} \right)$ |
| y ₀ ≤ raw Y ≤ y ₁ | $100 \times \left(\frac{y - y_0}{y_1 - y_0} \right)$ |
| y ₁ ≤ raw Y ≤ y ₂ | $100 \times \left(1 + \frac{y - y_1}{y_2 - y_1} \right)$ |
| y ₂ ≤ raw Y ≤ y _{top} | $100 \times \left(2 + \frac{y - y_2}{y_3 - y_2} \right)$ |
| y _{top} < raw Y | 400 |

Parameters for X

While some of the parameters for Y change every month, the parameters for X are constant for all style zones.

$$x_{\text{bot}} = -50$$

$$x_0 = 50$$

$$x_1 = 125$$

$$x_2 = 175$$

$$x_3 = 250$$

$$x_{\text{top}} = 350$$

Rescaling X

The raw X values can be rescaled according to the calculations below.

| Raw X | Rescaled X |
|---|--|
| $\text{raw X} < x_{\text{bot}}$ | -100 |
| $x_{\text{bot}} \leq \text{raw X} \leq x_0$ | $100 \times \left(\frac{x - x_0}{x_0 - x_{\text{bot}}} \right)$ |
| $x_0 \leq \text{raw X} \leq x_1$ | $100 \times \left(\frac{x - x_0}{x_1 - x_0} \right)$ |
| $x_1 \leq \text{raw X} \leq x_2$ | $100 \times \left(1 + \frac{x - x_1}{x_2 - x_1} \right)$ |
| $x_2 \leq \text{raw X} \leq x_3$ | $100 \times \left(2 + \frac{x - x_2}{x_3 - x_2} \right)$ |
| $x_3 \leq \text{raw X} \leq x_{\text{top}}$ | $100 \times \left(3 + \frac{x - x_3}{x_{\text{top}} - x_3} \right)$ |
| $x_{\text{top}} < \text{raw X}$ | 400 |

Limiting Rescaled Scores to the Nine-Square Style Box

The nine-square Style Box grid is scaled from 0 to 300. When stocks or funds are displayed on this grid, any rescaled X or Y values that are below 0 or above 300 should be trimmed to 0 and 300, respectively.

Appendix C: Major Countries in Each Style Zone

The following major economies map to the seven style zones:

| | | | | |
|----------------------|---|-----------|-------------|----------------|
| United States | United States | | | |
| Latin America | Argentina | Mexico | | |
| | Brazil | Peru | | |
| | Chile | Venezuela | | |
| | Colombia | | | |
| Canada | Canada | | | |
| Europe | Austria | France | Luxembourg | Slovakia |
| | Belgium | Germany | Macedonia | Slovenia |
| | Croatia | Greece | Netherlands | Spain |
| | Cyprus | Hungary | Norway | Sweden |
| | Czech Republic | Ireland | Poland | Switzerland |
| | Denmark | Italy | Portugal | Turkey |
| | Estonia | Latvia | Romania | United Kingdom |
| | Finland | Lithuania | Russia | |
| | African stocks are scored with the European stocks. They represent only 2% of the total capitalization of the style zone. | | | |
| Japan | Japan | | | |
| Asia ex-Japan | Bahrain | Israel | Pakistan | Taiwan |
| | China | Jordan | Philippines | Thailand |
| | Hong Kong | Kuwait | Singapore | |
| | India | Lebanon | South Korea | |
| | Indonesia | Malaysia | Sri Lanka | |
| | | | | |
| Australia/NZ | Australia | | | |
| | New Zealand | | | |