



Sector Delta Methodology

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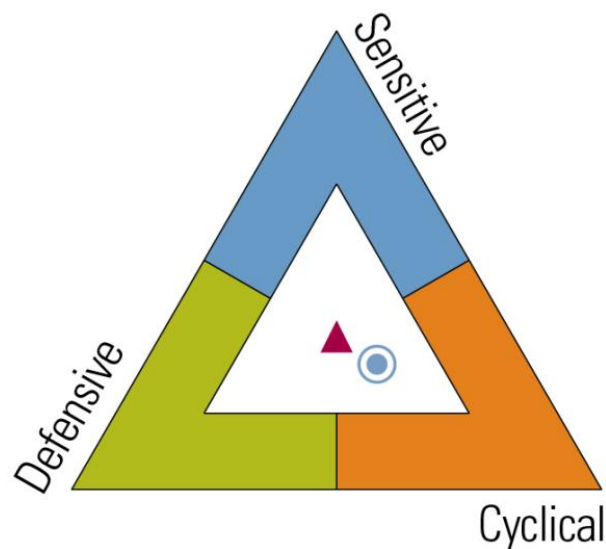
Introduction

The Sector Delta is an equilateral triangle that depicts a portfolio's super sector allocation, relative to a benchmark, on a two dimensional space. As shown in Figure 1, the Sector Delta is divided into four parts of equal area representing the following classification of portfolios:

- ▶ Diversified
- ▶ Defensive
- ▶ Sensitive
- ▶ Cyclical

The Sector Delta can be used to represent a fund's allocation at a single point in time or over a historical period. This document describes the following methods:

- Determine the Super Sector Allocation
- Rescale the Super Sector Allocation
- Classify the Portfolio (the Sector Delta icon)
- Draw the Sector Delta (the plot point)
- Longer-Term Analysis (historic three-year average)



Methodology

Determine the Super Sector Allocation

Pull the sector breakdown for the fund or index. The eleven Morningstar sectors roll-up to the super sectors as follows:

% Defensive	=	% Consumer Defensive + % Healthcare + % Utilities
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% Sensitive	=	% Communication Services + % Energy + % Industrials + % Technology
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% Cyclical	=	% Basic Materials + % Consumer Cyclical + % Financial Services + % Real Estate
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Rescale the Super Sector Allocation

Before plotting a portfolio's super sector allocation on the Sector Delta, we rescale the super sector allocation so that the allocation of the benchmark maps into a rescaled allocation of 1/3 in each of the three super sectors.

Let:

p_D	=	fraction of the benchmark in Defensive Economy
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p_S	=	fraction of the benchmark in Sensitive Economy
-------	---	--

p_C	=	fraction of the benchmark in Cyclical Economy
-------	---	---

Note that $p_D + p_S + p_C = 1$.

Let:

q_D	=	fraction of the benchmark in Defensive Economy
-------	---	--

q_S	=	fraction of the benchmark in Sensitive Economy
-------	---	--

q_C	=	fraction of the benchmark in Cyclical Economy
-------	---	---

Note that $q_D + q_S + q_C = 1$.

The benchmark portfolio data should be from the same date as the fund portfolio. The Morningstar US Market Index is the default benchmark for domestic equity funds. The MSCI EAFE is the default benchmark for international equity funds. Alternatively, certain tools and programs may be designed to accommodate user-defined benchmarks if Morningstar has the portfolio data. When using indexes that don't have data from the same date as the fund, products should use the closest available index portfolio date without exceeding 3 months in either direction.



Methodology (continued)

Let:

\hat{p}_D	=	the rescaled fraction of the portfolio in Defensive Economy
\hat{p}_S	=	the rescaled fraction of the portfolio in Sensitive Economy
\hat{p}_C	=	the rescaled fraction of the portfolio in Cyclical Economy

The rescaling is done as follows:

If $p_D > \frac{q_D}{q_S} p_S$ and $p_C \geq \frac{q_C}{q_S} p_S$,

$$[1] \quad \hat{p}_D = p_D + \frac{\frac{1}{3} - q_D}{q_S} p_S$$

$$[2] \quad \hat{p}_S = \frac{1}{3q_S} p_S$$

$$[3] \quad \hat{p}_C = p_C + \frac{\frac{1}{3} - q_C}{q_S} p_S$$

Else, if $p_D \geq \frac{q_D}{q_C} p_C$ and $p_S > \frac{q_S}{q_C} p_C$,

$$[1] \quad \hat{p}_D = p_D + \frac{\frac{1}{3} - q_D}{q_C} p_C$$

$$[2] \quad \hat{p}_S = p_S + \frac{\frac{1}{3} - q_S}{q_C} p_C$$

$$[3] \quad \hat{p}_C = \frac{1}{3q_C} p_C$$



Methodology (continued)

Else,

$$[1] \quad \hat{p}_D = \frac{1}{3q_D} p_D$$

$$[2] \quad \hat{p}_S = p_S + \frac{\frac{1}{3} - q_S}{q_D} p_D$$

$$[3] \quad \hat{p}_C = p_C + \frac{\frac{1}{3} - q_C}{q_D} p_D$$

Classify the Portfolio (the Sector Delta icon)

A portfolio can be classified among the four areas of the Sector Delta as follows:

Diversified	=	If $\hat{p}_D \geq \frac{1}{6}$ and $\hat{p}_S \geq \frac{1}{6}$ and $\hat{p}_C \geq \frac{1}{6}$
Defensive	=	If $\hat{p}_D \geq \hat{p}_C$ and $\hat{p}_D \geq \hat{p}_S$
Sensitive	=	If $\hat{p}_S \geq \hat{p}_D$ and $\hat{p}_S \geq \hat{p}_C$
Cyclical	=	If $\hat{p}_C \geq \hat{p}_D$ and $\hat{p}_C \geq \hat{p}_S$

Sector Delta icons can be assigned based on these assignments. These icons represent the portfolio at a single point in time.

Draw the Sector Delta (the plot point)

We draw the Sector Delta as an equilateral triangle in x-y coordinate space with the length of each side equal to 1. The x-y coordinates of the corners of the triangle are (0,0), $(\frac{1}{2}, \frac{\sqrt{3}}{2})$, and (1,0). The x-y coordinates for the fund are given by:

$$x = \frac{\hat{p}_S}{2} + \hat{p}_C$$

$$y = \frac{\sqrt{3}}{2} \hat{p}_S$$

Methodology (continued)

The rescaled allocation maps into an x-y coordinate pair. This x-y coordinate pair is the basis for plotting the fund's orientation as a single dot within the Sector Delta.

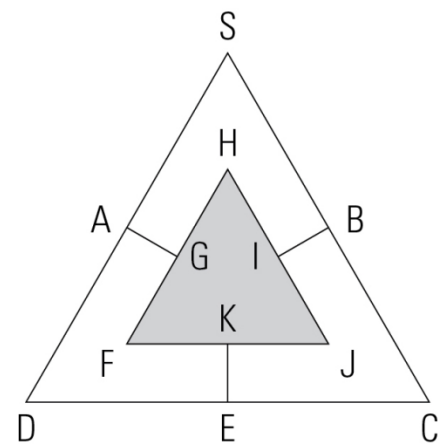
$$(1) \quad (\hat{p}_D, \hat{p}_S, \hat{p}_C) \rightarrow (x, y)$$

As shown in Figure 2, the Diversified area is the triangle with the following corners:

$$F: \quad \left(\frac{2}{3}, \frac{1}{6}, \frac{1}{6}\right) \rightarrow \left(\frac{1}{4}, \frac{\sqrt{3}}{2}\right)$$

$$H: \quad \left(\frac{1}{6}, \frac{2}{3}, \frac{1}{6}\right) \rightarrow \left(\frac{1}{2}, \frac{\sqrt{3}}{3}\right)$$

$$J: \quad \left(\frac{1}{6}, \frac{1}{6}, \frac{2}{3}\right) \rightarrow \left(\frac{3}{4}, \frac{\sqrt{3}}{12}\right)$$



The Defensive area is the arrowhead shaped figure with the corners:

$$D: \quad (1,0,0) \rightarrow (0,0)$$

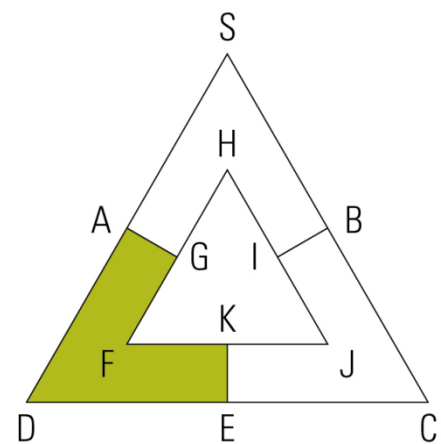
$$E: \quad \left(\frac{1}{2}, 0, \frac{1}{2}\right) \rightarrow \left(\frac{1}{2}, 0\right)$$

$$K: \quad \left(\frac{5}{12}, \frac{1}{6}, \frac{5}{12}\right) \rightarrow \left(\frac{1}{2}, \frac{\sqrt{3}}{12}\right)$$

$$F: \quad \left(\frac{2}{3}, \frac{1}{6}, \frac{1}{6}\right) \rightarrow \left(\frac{1}{4}, \frac{\sqrt{3}}{12}\right)$$

$$G: \quad \left(\frac{5}{12}, \frac{5}{12}, \frac{1}{6}\right) \rightarrow \left(\frac{3}{8}, \frac{5\sqrt{3}}{24}\right)$$

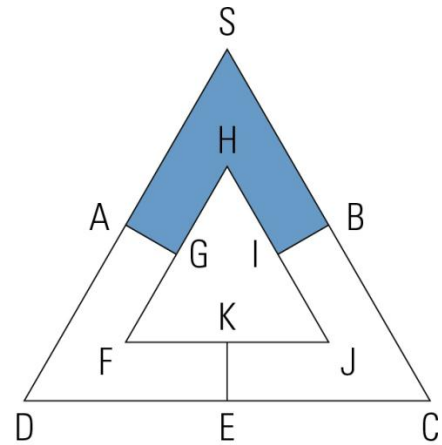
$$A: \quad \left(\frac{1}{2}, \frac{1}{2}, 0\right) \rightarrow \left(\frac{1}{4}, \frac{\sqrt{3}}{4}\right)$$



Methodology (continued)

The Service Oriented area is the arrowhead shaped figure with the following corners:

S: $(0,1,0) \rightarrow \left(\frac{1}{2}, \frac{\sqrt{3}}{2}\right)$
 A: $\left(\frac{1}{2}, \frac{1}{2}, 0\right) \rightarrow \left(\frac{1}{4}, \frac{\sqrt{3}}{4}\right)$
 G: $\left(\frac{5}{12}, \frac{5}{12}, \frac{1}{6}\right) \rightarrow \left(\frac{3}{8}, \frac{5\sqrt{3}}{24}\right)$
 H: $\left(\frac{1}{6}, \frac{2}{3}, \frac{1}{6}\right) \rightarrow \left(\frac{1}{2}, \frac{\sqrt{3}}{3}\right)$
 I: $\left(\frac{1}{6}, \frac{5}{12}, \frac{5}{12}\right) \rightarrow \left(\frac{5}{8}, \frac{5\sqrt{3}}{24}\right)$
 B: $\left(0, \frac{1}{2}, \frac{1}{2}\right) \rightarrow \left(\frac{3}{4}, \frac{\sqrt{3}}{4}\right)$



The Cyclical area is the arrowhead shaped figure with the following corners:

C: $(0,0,1) \rightarrow (1,0)$
 E: $\left(\frac{1}{2}, 0, \frac{1}{2}\right) \rightarrow \left(\frac{1}{2}, 0\right)$
 K: $\left(\frac{5}{12}, \frac{1}{6}, \frac{5}{12}\right) \rightarrow \left(\frac{1}{2}, \frac{\sqrt{3}}{12}\right)$
 J: $\left(\frac{1}{6}, \frac{1}{6}, \frac{2}{3}\right) \rightarrow \left(\frac{3}{4}, \frac{\sqrt{3}}{12}\right)$
 I: $\left(\frac{1}{6}, \frac{5}{12}, \frac{5}{12}\right) \rightarrow \left(\frac{5}{8}, \frac{5\sqrt{3}}{24}\right)$
 B: $\left(0, \frac{1}{2}, \frac{1}{2}\right) \rightarrow \left(\frac{3}{4}, \frac{\sqrt{3}}{4}\right)$

