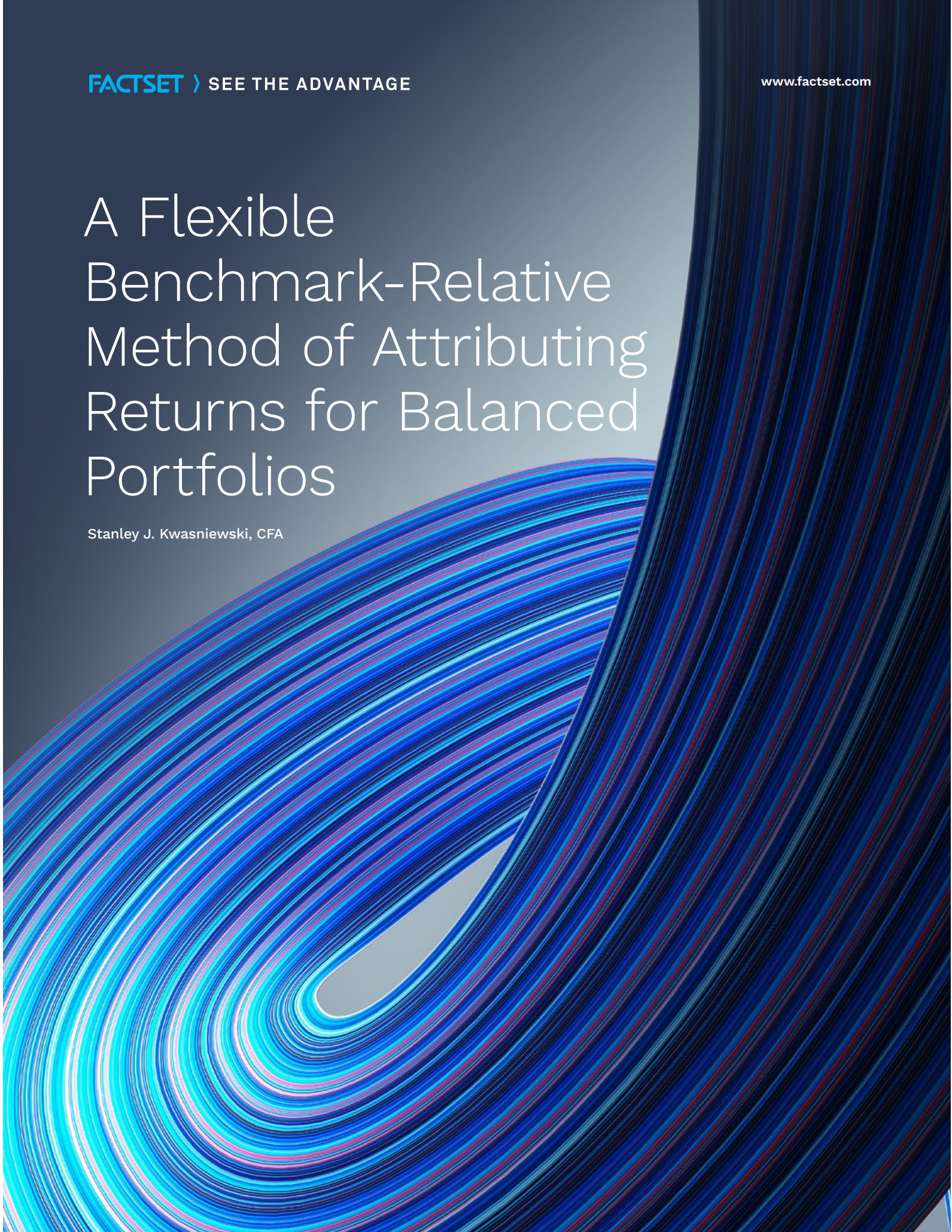


# A Flexible Benchmark-Relative Method of Attributing Returns for Balanced Portfolios

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## Introduction

The attribution of returns for balanced portfolios shares the same purpose as the attribution of returns for equity or fixed income portfolios; the goal of all three is to explain the portfolio's benchmark-relative performance over a period of time using attribution factors that sum to explain the variation in portfolio and benchmark returns according to the portfolio manager's investment strategy and decisions. One challenge with attributing the returns of balanced portfolios is that they can involve multiple investment managers who make autonomous decisions but collectively form the balanced portfolio's management team. Another challenge is that the asset classes that comprise balanced strategies are managed using different investment processes. An attribution model used for balanced portfolios should quantify the benchmark-relative value added by each team involved in the investment process, using relevant attribution factors consistent with the investment decisions. If a team approach isn't used, the attribution model should still quantify the benchmark-relative value added by each investment decision made during the investment process.

The teams commonly involved in the investment process for balanced portfolios are the asset allocation team, the equity team, the fixed income team, and the currency management team. The asset allocation team typically makes the first set of investment decisions. For example, the asset allocation team may decide that the asset mix in the portfolio should be 65% equities, 30% fixed income, and 5% cash versus a benchmark with 60% equities and 40% fixed income. From there, 65% of the funds in the portfolio are given to the equity team to manage and 30% of the funds are given to the fixed income team. Any remaining currency exposures are given to the currency team to manage. In some cases, the management of individual asset classes is outsourced to a different investment management firm altogether. Although cross-manager communication in balanced mandates can be limited, it is still possible to quantify the benchmark-relative value delivered by each separate management team.

## Model Background

FactSet's Balanced Attribution model is designed to explain the arithmetic difference between a balanced portfolio and benchmark total return using additive attribution effects. The model is a synthesis of FactSet's Top Down and Fixed Income Performance attribution models. Details of both models are available in whitepapers<sup>1</sup>.

Neither the Top Down nor the Fixed Income model on its own completely explains balanced portfolio benchmark-relative performance in a manner fully consistent with a typical balanced investment process. For example, the Top Down model does not include attribution effects such as shift and twist, which are commonly used to analyze the performance of fixed income portfolios. The Fixed Income model includes these, but it does not calculate attribution effects relative to the different asset classes in the portfolio. Neither model has a separate asset class effect. FactSet's Balanced Attribution model improves upon these shortcomings in the following ways:

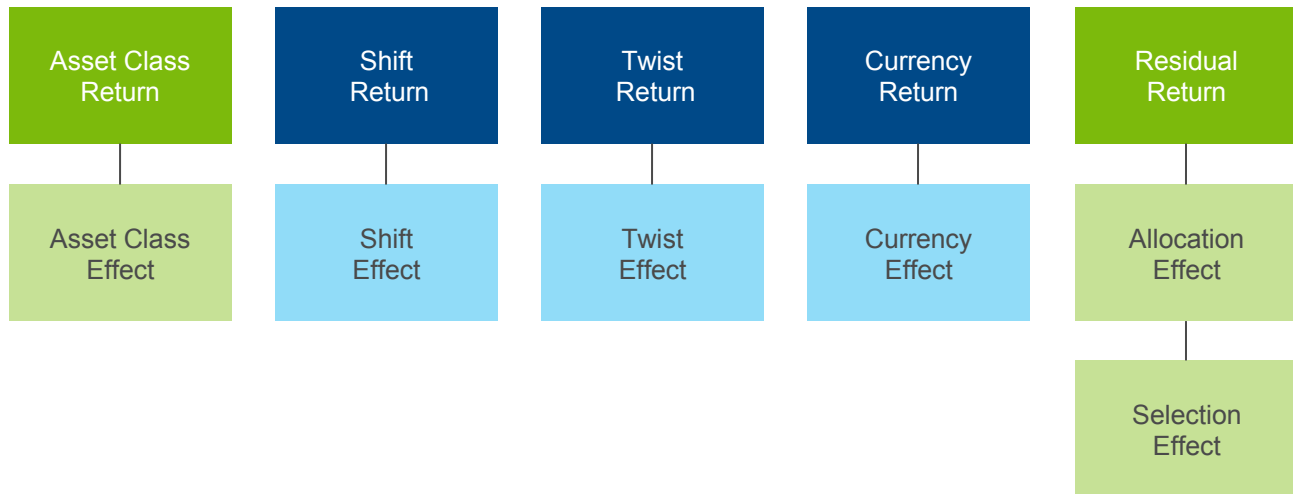
- The model assumes that asset class allocation is the first investment decision for a balanced portfolio and captures its impact in a standalone attribution effect
- The model quantifies the benchmark-relative value added by investment decisions within each asset class above and beyond the relative value added by the initial asset class allocation decision(s)
- The model calculates asset class-specific attribution effects relative to each individual asset class
- The model quantifies additional relative value added within each asset class using attribution factors that are relevant to the management of that specific asset class (e.g., shift and twist effects are used to help explain what happened within the fixed income asset class, but they are not used within equities or cash)

The result is an attribution model capable of explaining the sources of benchmark-relative performance for balanced portfolios in a manner consistent with the investment decisions that were employed.

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<sup>1</sup> Christian Levecq, An Exposure-based Attribution Model for Balanced Portfolios, *Journal of Performance Measurement*, Summer 2004, pp. 14-22. and Stanley J. Kwasniewski, CFA, A Flexible Benchmark-Relative Method of Attributing Returns for Fixed Income Portfolios, FactSet whitepaper.

## Model Overview



## Return Decomposition

FactSet’s balanced attribution model is built on the concept fundamental to FactSet’s Fixed Income attribution model: security-level total returns can be decomposed into additive subcomponent returns. Each subcomponent return corresponds to an investment decision and is subsequently used to calculate the attribution effect that quantifies the impact of that particular investment decision. The return decomposition for equities and cash is:

$$\text{Total Return} = \text{Currency Return} + \text{Residual Return}$$

This return decomposition can be extended to fixed income securities:

$$\text{Total Return} = \text{Shift Return} + \text{Twist Return} + \text{Currency Return} + \text{Residual Return}$$

It is also possible to further decompose residual return for fixed income securities into additional subcomponents:

$$\text{Total Return} = \text{Shift Return} + \text{Twist Return} + \text{Carry Return} + \text{Spread Return} + \text{Income Return} + \text{Inflation Return} + \text{Currency Return} + \text{Residual Return}$$

Details of these subcomponent return calculations can be found in the FactSet white paper A Flexible Benchmark-Relative Method of Attributing Returns for Fixed Income Portfolios. The following table summarizes the relevant subcomponent returns for each of the three main asset classes typically seen in balanced portfolios:

Asset Class	Relevant Subcomponent Returns
Equity	Currency & Residual Returns
Fixed Income	Shift, Twist, Carry, Spread, Income, Inflation, Currency & Residual Returns
Cash	Currency & Residual Returns

Since fixed income is the only asset class for which duration, curve, time, spread, income, and inflation management are relevant investment decisions, it is the only asset class for which shift, twist, carry, spread, income, and inflation returns are calculated. These subcomponent returns will naturally be zero for equities and cash.

### Basic Example

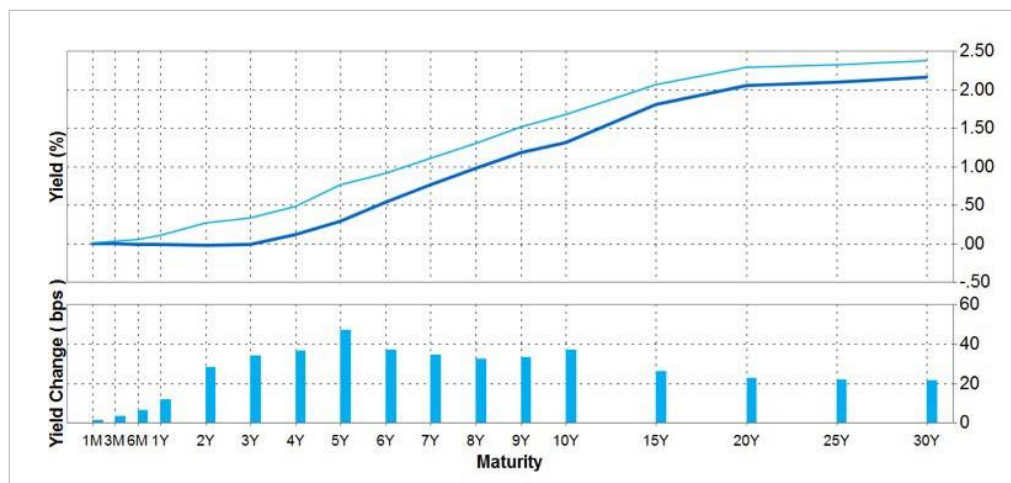
This example illustrates a basic return decomposition for a sample balanced portfolio over the course of one month. The portfolio represents a balanced strategy managed for a European investor where the reporting currency is Euros. The equity portion of the portfolio is exposed to large-cap stocks in developed European countries. The fixed income portion of the portfolio is exposed to government bonds also in developed European countries.

The portfolio's currency exposures were left unhedged:

**Contribution to Return**  
Euro

Asset Class	Average Weight	Shift Point Yield Change	Shift Return	Twist Return	Currency Return	Residual Return	Total Return
<b>Total</b>	<b>100.00</b>	<b>.41</b>	<b>-.83</b>	<b>.16</b>	<b>-1.38</b>	<b>3.65</b>	<b>1.59</b>
<b>Equity</b>	<b>60.85</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>-2.26</b>	<b>4.92</b>	<b>2.67</b>
Austria	.27	--	--	--	--	1.44	1.44
Belgium	1.10	--	--	--	--	.16	.16
Denmark	1.13	--	--	--	-.00	8.09	8.09
Finland	.76	--	--	--	--	3.76	3.76
France	8.76	--	--	--	--	2.72	2.72
Germany	7.82	--	--	--	--	1.75	1.75
Greece	.01	--	--	--	--	17.96	17.96
Ireland	.24	--	--	--	--	1.24	1.24
Italy	2.14	--	--	--	--	5.47	5.47
Netherlands	2.38	--	--	--	--	4.93	4.93
Norway	.88	--	--	--	-1.26	4.89	3.64
Portugal	.17	--	--	--	--	7.13	7.13
Spain	2.92	--	--	--	--	4.23	4.23
Sweden	3.00	--	--	--	-.70	5.72	5.02
Switzerland	7.68	--	--	--	-2.39	7.41	5.02
United Kingdom	21.56	--	--	--	-5.29	6.17	.88
<b>Fixed Income</b>	<b>37.08</b>	<b>.41</b>	<b>-2.23</b>	<b>.42</b>	<b>--</b>	<b>1.77</b>	<b>-.04</b>
Austria	1.51	.41	-2.50	.47	--	.73	-1.29
Belgium	1.85	.41	-2.45	.46	--	.39	-1.60
Finland	.50	.41	-2.39	.40	--	.07	-1.92
France	7.83	.41	-2.42	.47	--	.51	-1.44
Germany	6.46	.41	-2.07	.39	--	.14	-1.55
Ireland	1.85	.41	-2.08	.31	--	3.69	1.92
Italy	10.04	.41	-2.32	.45	--	3.39	1.52
Netherlands	1.68	.41	-2.14	.40	--	.03	-1.71
Spain	5.36	.41	-1.91	.38	--	3.41	1.88
<b>[Cash]</b>	<b>2.07</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>.01</b>	<b>.01</b>

The Euro government yield curve changed in the following way over the same period of time:



The overall total return of the portfolio in EUR was 1.59%. The return decomposition shows that equities, fixed income, cash, and currency returned 4.92%, -0.04%, 0.01%, and -1.38%, respectively.

Residual and total returns for Euro-denominated securities were identical for equities and cash but different for fixed income. This discrepancy is because fixed income was the only asset class in the portfolio for which shift and twist subcomponent returns were relevant and calculated. Shift return shows that -2.23% of the -0.04% fixed income asset class total return came from the portfolio's overall duration, while twist return shows that 0.42% of the -0.04% fixed income asset class total return came from the portfolio's overall yield curve positioning.

### Expanded Example

It is possible to continue with the example above and further decompose the fixed income asset class returns into additional subcomponents:

Contribution to Return												
Euro												
Asset Class	Average Weight	Shift Point Yield Change	Shift Return	Twist Return	Port. Carry Return	Port. Spread Return	Port. Income Return	Port. Inflation Return	Currency Return	Residual Return	Total Return	
<b>Total</b>	<b>100.00</b>	<b>.41</b>	<b>-.83</b>	<b>.16</b>	<b>-.04</b>	<b>.54</b>	<b>.19</b>	<b>--</b>	<b>-1.38</b>	<b>2.95</b>	<b>1.59</b>	
<b>Equity</b>	<b>60.85</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>.14</b>	<b>--</b>	<b>-2.26</b>	<b>4.79</b>	<b>2.67</b>	
Austria	.27	--	--	--	--	--	--	--	--	1.44	1.44	
Belgium	1.10	--	--	--	--	--	.07	--	--	.09	.16	
Denmark	1.13	--	--	--	--	--	--	--	-.00	8.09	8.09	
Finland	.76	--	--	--	--	--	--	--	--	3.76	3.76	
France	8.76	--	--	--	--	--	.04	--	--	2.68	2.72	
Germany	7.82	--	--	--	--	--	.35	--	--	1.40	1.75	
Greece	.01	--	--	--	--	--	--	--	--	17.96	17.96	
Ireland	.24	--	--	--	--	--	--	--	--	1.24	1.24	
Italy	2.14	--	--	--	--	--	--	--	--	5.47	5.47	
Netherlands	2.38	--	--	--	--	--	--	--	--	4.93	4.93	
Norway	.88	--	--	--	--	--	--	--	-1.26	4.89	3.64	
Portugal	.17	--	--	--	--	--	--	--	--	7.13	7.13	
Spain	2.92	--	--	--	--	--	1.09	--	--	3.15	4.23	
Sweden	3.00	--	--	--	--	--	--	--	-.70	5.72	5.02	
Switzerland	7.68	--	--	--	--	--	.01	--	-2.39	7.41	5.02	
United Kingdom	21.56	--	--	--	--	--	.09	--	-5.29	6.08	.88	
<b>Fixed Income</b>	<b>37.08</b>	<b>.41</b>	<b>-2.23</b>	<b>.42</b>	<b>-.11</b>	<b>1.45</b>	<b>.30</b>	<b>--</b>	<b>--</b>	<b>.13</b>	<b>-.04</b>	
Austria	1.51	.41	-2.50	.47	-.14	.47	.28	--	--	.12	-1.29	
Belgium	1.85	.41	-2.45	.46	-.16	.11	.30	--	--	.14	-1.60	
Finland	.50	.41	-2.39	.40	-.14	-.18	.24	--	--	.14	-1.92	
France	7.83	.41	-2.42	.47	-.16	.25	.27	--	--	.15	-1.44	
Germany	6.46	.41	-2.07	.39	-.14	-.06	.22	--	--	.11	-1.55	
Ireland	1.85	.41	-2.08	.31	-.05	3.31	.38	--	--	.05	1.92	
Italy	10.04	.41	-2.32	.45	-.08	2.97	.34	--	--	.15	1.52	
Netherlands	1.68	.41	-2.14	.40	-.13	-.19	.24	--	--	.10	-1.71	
Spain	5.36	.41	-1.91	.38	-.02	2.98	.36	--	--	.09	1.88	
<b>[Cash]</b>	<b>2.07</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>.01</b>	<b>.01</b>	

Carry return shows that -0.11% of the -0.04% fixed income asset class total return came from the passage of time. Spread return shows that 1.45% of the -0.04% fixed income asset class total return came from movements in spreads. Income return shows that 0.30% of the -0.04% fixed income asset class total return came from accrued interest and coupon payments. Inflation return shows that 0% of the -0.04% fixed income asset class total return came from the inflation adjustment from inflation linked bonds. Including these additional subcomponent returns lowers the overall residual return for the fixed income asset class from 1.77% to 0.13%.



## Basic Balanced Attribution Model Calculations

FactSet's basic balanced attribution model uses the following factors to quantify benchmark-relative performance:

*Total Effect = Asset Class Effect + Shift Effect + Twist Effect + Allocation Effect + Selection Effect + Currency Effect*

Return Component	Formula	Investment Decision Measured
<b>Asset Class Effect</b>	$(P_{wt} - B_{wt}) * (B_{AssetClassRet} - B_{TotRet})$	Asset class allocation
<b>Shift Effect</b>	$(P_{wt} - P_{pwt}) * (B_{ShftRet} - B_{AssetClassShftRet}) + P_{wt} * (P_{ShftRet} - B_{ShftRet})$	Duration
<b>Twist Effect</b>	$(P_{wt} - P_{pwt}) * (B_{TwstRet} - B_{AssetClassTwstRet}) + P_{wt} * (P_{TwstRet} - B_{TwstRet})$	Curve positioning
<b>Allocation Effect</b>	$(P_{wt} - P_{pwt}) * (B_{Resret} - B_{AssetClassResRet})$	Group allocation
<b>Selection Effect</b>	$(P_{wt} - P_{pwt}) * (B_{SecResRet} - B_{GroupResRet})$	Security selection
<b>Currency Effect</b>	$(P_{wt} * P_{CurrRet}) - (B_{wt} * B_{CurrRet})$	Currency management
<b>Total Effect</b>	Asset Class + Shift + Twist + Allocation + Selection + Currency Effects	All

## Primary Investment Decision: Asset Allocation Team

### Asset Class Effect

FactSet's Balanced Attribution model assumes the primary investment decision is the allocation of the balanced portfolio's assets into asset classes. These asset class allocation decisions are often made by an asset allocation team. The asset class effect quantifies the impact of these decisions. It is calculated as follows:

$$(P_{wt} - B_{wt}) * (B_{AssetClassRet} - B_{TotRet})$$

where:

- $P_{wt}$  = Portfolio Asset Class Weight
- $B_{wt}$  = Benchmark Asset Class Weight
- $B_{AssetClassRet}$  = Benchmark Asset Class Local Currency Total Return
- $B_{TotRet}$  = Benchmark Local Currency Total Return

The relative value added from all subsequent attribution effects is captured above and beyond the relative value quantified in the asset class effect in FactSet's Balanced Attribution model.

## Investment Decisions: Equity Team

Once the asset allocation decisions are made, a portion of the balanced portfolio's assets is given to the equity team to manage. The team generally adds additional benchmark-relative value by way of group allocation and stock selection. The additional value added by those two investment decisions is measured using asset allocation and security selection effects.

### Allocation Effect

Allocation effect quantifies the portion of benchmark-relative return that can be attributed to group allocation decisions within the equity asset class, above and beyond the relative value added by the initial asset class allocation decision(s). The calculation uses the top down concept of proportional weights and adjusts for the impact of the asset class allocation decision(s) made by the asset allocators earlier in the investment process. Allocation effect uses residual returns and is calculated relative to the equity asset class and not the overall benchmark total to ensure that the equity team is being measured against the performance of only the equity asset class:

$$(P_{wt} - P_{pwt}) * (B_{ResRet} - B_{AssetClassResRet})$$

where:

- $P_{wt}$  = Portfolio Weight
- $P_{pwt}$  = Portfolio Proportional Weight
- $B_{ResRet}$  = Benchmark Group Residual Return
- $B_{AssetClassResRet}$  = Benchmark Asset Class Residual Return

### Selection Effect

Selection Effect quantifies the portion of benchmark-relative return that can be attributed to security selection decisions within the equity asset class, above and beyond the relative value added by the initial asset class allocation and group allocation decisions. The calculation uses the top down concept of proportional weights and adjusts for the impact of the asset class and group allocation decisions made earlier in the investment process. Selection effect uses residual returns and is calculated relative to the lowest level of grouping within the equity asset class:

$$(P_{wt} - P_{pwt}) * (B_{SecResRet} - B_{GroupResRet})$$

where:

- $P_{wt}$  = Portfolio Weight
- $P_{pwt}$  = Portfolio Proportional Weight
- $B_{SecResRet}$  = Benchmark Security Residual Return
- $B_{GroupResRet}$  = Benchmark Lowest Grouping Level Residual Return

### Investment Decisions: Fixed Income Team

Another portion of the balanced portfolio's assets is given to the fixed income team to manage. This team generally adds additional benchmark-relative value by way of duration management, curve positioning, group allocation, and bond selection. The additional relative value added by those four investment decisions is measured using shift, twist, group allocation, and security selection effects.

### Shift Effect

Shift effect quantifies the portion of benchmark-relative return that can be attributed to the portfolio's duration bet. It can be thought of as an allocation calculation combined with a selection calculation using portfolio and benchmark shift returns. The calculation uses the top down concept of proportional weights and adjusts for the impact of the asset class allocation decision(s) made by the asset allocators earlier in the investment process. The effect explains the remaining difference in shift returns between the portfolio and benchmark by quantifying whether the fixed income portfolio manager allocated the fixed income assets to groups that had superior shift returns and whether the portfolio manager selected fixed income assets within each group that produced superior shift returns. Shift effect uses shift returns and is calculated relative to the fixed income asset class:

$$(P_{wt} - P_{pwt}) * (B_{ShftRet} - B_{AssetClassShftRet}) + P_{wt} * (P_{ShftRet} - B_{ShftRet})$$

where:

- $P_{wt}$  = Portfolio Weight
- $P_{pwt}$  = Portfolio Proportional Weight
- $B_{ShftRet}$  = Benchmark Shift Return
- $B_{AssetClassShftRet}$  = Benchmark Asset Class Shift Return
- $P_{ShftRet}$  = Portfolio Shift Return

### Twist Effect

The same concept that was used to capture shift effect is extended to twist effect. Twist effect quantifies the portion of benchmark-relative return that can be attributed to the portfolio's yield curve positioning bet. It is calculated as:

$$(P_{wt} - P_{pwt}) * (B_{TwstRet} - B_{AssetClassTwstRet}) + P_{wt} * (P_{TwstRet} - B_{TwstRet})$$

where:

- $P_{wt}$  = Portfolio Weight
- $P_{pwt}$  = Portfolio Proportional Weight
- $B_{TwstRet}$  = Benchmark Twist Return
- $B_{AssetClassTwstRet}$  = Benchmark Asset Class Twist Return
- $P_{TwstRet}$  = Portfolio Twist Return

### Allocation and Selection Effects

The fixed income team, much like the equity team, adds relative value through group allocation and security selection. The calculations used to quantify the impact of group allocation and security selection for the fixed income team are identical to those used for the equity team. The only difference is that the residual return inputs into the calculations are adjusted for the impact of duration and curve positioning.

### Investment Decisions: Currency Team

Currency exposures are given to the currency team to manage. This team generally adds benchmark-relative value by way of currency hedging. The benchmark-relative value added by this investment decision is measured using a currency effect. It is calculated as:

$$(P_{wt} * P_{CurRet}) - (B_{wt} * B_{CurRet})$$

where:

- $P_{wt}$  = Portfolio Weight
- $P_{CurRet}$  = Portfolio Currency Return
- $B_{wt}$  = Benchmark Weight
- $B_{CurRet}$  = Benchmark Currency Return

All attribution effects are calculated daily, summed upward, and combined over time using a compounding algorithm (see Appendix).

### Example

This example illustrates a basic balanced attribution for the sample balanced portfolio relative to its benchmark over the course of a month. The portfolio had the following bets relative to its benchmark during this period of time:

- The asset allocation team over-weighted equities, under-weighted fixed income, and had a modest allocation to cash.
- The equity team kept sector exposures relatively neutral and sought to deliver relative value primarily through stock selection.
- The fixed income team positioned the portfolio to be short duration, primarily from reducing its exposure to the long part of the Euro yield curve. The team also anticipated a rally in the Italian and Spanish government bond markets and positioned the fixed income assets in the portfolio accordingly.
- The currency team decided to leave the portfolio's currency exposures unhedged.

The total effect from the balanced attribution analysis shows that the portfolio outperformed the benchmark by 0.46% over the month.

The asset allocation team added 0.58% of relative value by way of their decisions to over-weight equities and cash in favor of fixed income. The ~10% over-weight in equities added 0.28% of relative value, while the ~12% underweight in fixed income added 0.35% of relative value. The ~2% allocation to cash detracted 0.05% of relative value.

Balanced Attribution												
Euro												
Asset Class	Portfolio		Benchmark		Balanced Attribution							Total Effect
	Port. Average Weight	Port. Total Return	Bench. Average Weight	Bench. Total Return	Asset Class Effect	Shift Effect	Twist Effect	Allocation Effect	Selection Effect	Currency Effect		
<b>Total</b>	<b>100.00</b>	<b>1.59</b>	<b>100.00</b>	<b>1.14</b>	<b>.58</b>	<b>.09</b>	<b>-.04</b>	<b>.15</b>	<b>-.07</b>	<b>-.26</b>	<b>.46</b>	
<b>Equity</b>	<b>60.85</b>	<b>2.67</b>	<b>50.95</b>	<b>2.83</b>	<b>.28</b>	<b>--</b>	<b>--</b>	<b>-.03</b>	<b>-.04</b>	<b>-.14</b>	<b>.07</b>	
Consumer Discretionary	5.61	2.49	4.61	2.52	--	--	--	-0.00	-0.00	-0.01	-0.01	
Consumer Staples	8.84	2.44	7.29	2.47	--	--	--	0.00	-0.00	-0.01	-0.01	
Energy	6.62	1.08	5.36	1.64	--	--	--	-0.00	-0.03	-0.02	-0.05	
Financials	12.01	5.71	10.71	5.84	--	--	--	-0.02	-0.00	0.03	0.01	
Health Care	7.37	3.37	6.09	3.41	--	--	--	0.00	-0.00	-0.01	-0.01	
Industrials	6.77	2.12	5.67	2.32	--	--	--	0.00	-0.01	-0.00	-0.01	
Information Technology	1.81	4.72	1.54	4.44	--	--	--	-0.00	0.01	0.00	0.01	
Materials	5.90	-.20	4.84	-.22	--	--	--	-0.00	0.00	-0.01	-0.01	
Telecommunication Services	3.39	3.48	2.78	3.48	--	--	--	0.00	0.00	-0.00	-0.00	
Utilities	2.53	-2.27	2.06	-2.32	--	--	--	-0.00	0.00	-0.00	-0.01	
<b>Fixed Income</b>	<b>37.08</b>	<b>-.04</b>	<b>49.05</b>	<b>-.57</b>	<b>.35</b>	<b>.09</b>	<b>-.04</b>	<b>.18</b>	<b>-.03</b>	<b>-.14</b>	<b>.41</b>	
Austria	1.51	-1.29	2.09	-1.34	--	0.00	-0.00	0.00	-0.00	0.00	0.01	
Belgium	1.85	-1.60	2.75	-1.69	--	0.01	-0.00	0.00	-0.00	0.01	0.02	
Finland	.50	-1.92	.67	-1.99	--	0.00	-0.00	0.00	0.00	0.00	0.00	
France	7.83	-1.44	11.74	-1.50	--	0.02	-0.01	0.01	-0.01	0.05	0.07	
Germany	6.46	-1.55	12.35	-1.70	--	0.02	-0.01	0.04	-0.00	0.14	0.19	
Ireland	1.85	1.92	.85	1.92	--	0.01	-0.00	0.03	-0.00	-0.06	-0.03	
Italy	10.04	1.52	10.00	1.55	--	0.01	-0.01	0.06	-0.01	-0.12	-0.07	
Netherlands	1.68	-1.71	3.33	-1.91	--	0.01	-0.00	0.01	-0.00	0.04	0.06	
Spain	5.36	1.88	5.27	1.85	--	0.01	-0.00	0.03	-0.00	-0.07	-0.03	
<b>[Cash]</b>	<b>2.07</b>	<b>.01</b>	<b>--</b>	<b>--</b>	<b>-.05</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>0.02</b>	<b>-0.02</b>	

The equity team lost 0.07% in relative value. Its proportional under-allocation to the Financial sector cost 0.02% in relative value because the Financial sector was the best performing equity sector, beating the equity benchmark total by ~3%. The team's stock selection within the Energy sector cost 0.03% in relative value because the Energy stocks in the portfolio failed to outperform the passive Energy stocks in the benchmark by 0.47%.

Balanced Attribution												
Euro												
Asset Class	Portfolio		Benchmark		Balanced Attribution							
	Port. Average Weight	Port. Residual Return	Bench. Average Weight	Bench. Residual Return	Asset Class Effect	Shift Effect	Twist Effect	Allocation Effect	Selection Effect	Currency Effect	Total Effect	
<b>Total</b>	<b>100.00</b>	<b>3.67</b>	<b>100.00</b>	<b>3.23</b>	<b>.58</b>	<b>.09</b>	<b>-.04</b>	<b>.15</b>	<b>-.07</b>	<b>-.26</b>	<b>.46</b>	
<b>Equity</b>	<b>60.85</b>	<b>5.02</b>	<b>50.95</b>	<b>5.14</b>	<b>.28</b>	<b>--</b>	<b>--</b>	<b>-.03</b>	<b>-.04</b>	<b>-.14</b>	<b>.07</b>	
Consumer Discretionary	5.61	4.13	4.61	4.15	--	--	--	-0.00	-0.00	-0.01	-0.01	
Consumer Staples	8.84	5.26	7.29	5.28	--	--	--	.00	-0.00	-0.01	-0.01	
Energy	6.62	4.58	5.36	5.05	--	--	--	-0.00	-0.03	-0.02	-0.05	
Financials	12.01	8.17	10.71	8.20	--	--	--	-.02	-0.00	.03	.01	
Health Care	7.37	5.56	6.09	5.59	--	--	--	.00	-0.00	-0.01	-0.01	
Industrials	6.77	3.65	5.67	3.81	--	--	--	.00	-0.01	-0.00	-0.01	
Information Technology	1.81	5.50	1.54	5.20	--	--	--	-0.00	.01	.00	.01	
Materials	5.90	2.43	4.84	2.40	--	--	--	-0.00	.00	-0.01	-0.01	
Telecommunication Services	3.39	5.95	2.78	5.95	--	--	--	.00	.00	-0.00	-0.00	
Utilities	2.53	-.40	2.06	-.46	--	--	--	-0.00	.00	-0.00	-0.01	
<b>Fixed Income</b>	<b>37.08</b>	<b>1.73</b>	<b>49.05</b>	<b>1.32</b>	<b>.35</b>	<b>.09</b>	<b>-.04</b>	<b>.18</b>	<b>-.03</b>	<b>-.14</b>	<b>.41</b>	
Austria	1.51	.66	2.09	.69	--	.00	-0.00	.00	-0.00	.00	.01	
Belgium	1.85	.32	2.75	.38	--	.01	-0.00	.00	-0.00	.01	.02	
Finland	.50	.01	.67	.00	--	.00	-0.00	.00	.00	.00	.00	
France	7.83	.44	11.74	.50	--	.02	-0.01	.01	-0.01	.05	.07	
Germany	6.46	.06	12.35	.10	--	.02	-0.01	.04	-0.00	.14	.19	
Ireland	1.85	3.67	.85	3.67	--	.01	-0.00	.03	-0.00	-.06	-.03	
Italy	10.04	3.37	10.00	3.48	--	.01	-0.01	.06	-0.01	-.12	-.07	
Netherlands	1.68	-.07	3.33	-.07	--	.01	-0.00	.01	-0.00	.04	.06	
Spain	5.36	3.41	5.27	3.47	--	.01	-0.00	.03	-0.00	-.07	-.03	
<b>[Cash]</b>	<b>2.07</b>	<b>.01</b>	<b>--</b>	<b>--</b>	<b>-.05</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>.02</b>	<b>-.02</b>	

The fixed income team added 0.20% of relative value primarily through its duration and market allocation bets. The fixed income assets in the portfolio were less sensitive to changes in interest rates during a period of time in which rates rose on average, producing 0.09% of relative value. The portfolio was less sensitive to the long part of the yield curve, which rose significantly less than average, causing a relative loss of 0.04%. Country allocation produced 0.18% in relative value, with the Italy and Spain bets delivering a combined 0.09% of relative value. Bond selection within each country detracted a total of 0.03% of relative value.

<b>Balanced Attribution</b>																	
Euro																	
Asset Class	Portfolio						Benchmark					Balanced Attribution					
	Port. Average Effective Duration	Port. Average Weight	Port. Shift Return	Port. Twist Return	Port. Residual Return	Bench. Average Effective Duration	Bench. Average Weight	Bench. Shift Return	Bench. Twist Return	Bench. Residual Return	Asset Class Effect	Shift Effect	Twist Effect	Allocation Effect	Selection Effect	Currency Effect	Total Effect
<b>Total</b>	<b>5.16</b>	<b>100.00</b>	<b>-0.84</b>	<b>.16</b>	<b>3.67</b>	<b>6.02</b>	<b>100.00</b>	<b>-1.22</b>	<b>.26</b>	<b>3.23</b>	<b>.58</b>	<b>.09</b>	<b>-0.04</b>	<b>.15</b>	<b>-0.07</b>	<b>-0.26</b>	<b>.46</b>
<b>Equity</b>	--	<b>60.85</b>	--	--	<b>5.02</b>	--	<b>50.95</b>	--	--	<b>5.14</b>	<b>.28</b>	--	--	<b>-0.03</b>	<b>-0.04</b>	<b>-0.14</b>	<b>.07</b>
Consumer Discretionary	--	5.61	--	--	4.13	--	4.61	--	--	4.15	--	--	--	-0.00	-0.00	-0.01	-0.01
Consumer Staples	--	8.84	--	--	5.26	--	7.29	--	--	5.28	--	--	--	-0.00	-0.00	-0.01	-0.01
Energy	--	6.62	--	--	4.58	--	5.36	--	--	5.05	--	--	--	-0.00	-0.03	-0.02	-0.05
Financials	--	12.01	--	--	8.17	--	10.71	--	--	8.20	--	--	--	-0.02	-0.00	0.03	0.01
Health Care	--	7.37	--	--	5.56	--	6.09	--	--	5.59	--	--	--	-0.00	-0.00	-0.01	-0.01
Industrials	--	6.77	--	--	3.65	--	5.67	--	--	3.81	--	--	--	0.00	-0.01	-0.00	-0.01
Information Technology	--	1.81	--	--	5.50	--	1.54	--	--	5.20	--	--	--	-0.00	0.01	0.00	0.01
Materials	--	5.90	--	--	2.43	--	4.84	--	--	2.40	--	--	--	-0.00	-0.00	-0.01	-0.01
Telecommunication Services	--	3.39	--	--	5.95	--	2.78	--	--	5.95	--	--	--	0.00	0.00	-0.00	-0.00
Utilities	--	2.53	--	--	-0.40	--	2.06	--	--	-0.46	--	--	--	-0.00	0.00	-0.00	-0.01
<b>Fixed Income</b>	<b>5.45</b>	<b>37.08</b>	<b>-2.23</b>	<b>.42</b>	<b>1.73</b>	<b>6.02</b>	<b>49.05</b>	<b>-2.47</b>	<b>.52</b>	<b>1.32</b>	<b>.35</b>	<b>.09</b>	<b>-0.04</b>	<b>.18</b>	<b>-0.03</b>	<b>-0.14</b>	<b>.41</b>
Austria	6.09	1.51	-2.50	.47	6.6	6.54	2.09	-2.68	.69	--	--	.00	-0.00	0.00	-0.00	0.00	0.01
Belgium	5.98	1.85	-2.45	.46	3.2	6.66	2.75	-2.72	.57	.38	--	.01	-0.00	0.00	-0.00	0.01	0.02
Finland	5.82	.50	-2.39	.40	6.10	6.7	-2.50	.45	0.00	--	--	.00	-0.00	0.00	0.00	0.00	0.00
France	5.91	7.83	-2.42	.47	4.4	6.49	11.74	-2.66	.57	.50	--	.02	-0.01	0.01	-0.01	0.05	0.07
Germany	5.07	6.46	-2.07	.39	0.6	5.90	12.35	-2.41	.52	.10	--	.02	-0.01	0.04	-0.00	0.14	0.19
Ireland	5.03	1.85	-2.08	.31	3.67	5.04	85	-2.09	.31	3.67	--	.01	-0.00	0.03	-0.00	-0.06	-0.03
Italy	5.66	10.04	-2.32	.45	3.37	5.97	10.00	-2.44	.50	3.48	--	.01	-0.01	0.06	-0.01	-0.12	-0.07
Netherlands	5.22	1.68	-2.14	.40	-0.07	6.12	3.33	-2.51	.54	-0.07	--	.01	-0.00	0.01	-0.00	0.04	0.06
Spain	4.63	5.36	-1.91	.38	3.41	4.89	5.27	-2.02	.42	3.47	--	.01	-0.00	0.03	-0.00	-0.07	-0.03
<b>[Cash]</b>	--	2.07	--	--	.01	--	--	--	--	--	-0.05	--	--	--	--	0.02	-0.02

The currency team lost 0.26% in relative value by deciding to leave the portfolio's currency exposures unhedged. Outside of Euros, the portfolio had currency exposure to British Pounds, Danish Krone, Norwegian Krone, Swedish Krona, and Swiss Francs. Each of these currencies depreciated relative to the Euro over the reporting period.

<b>Balanced Attribution</b>					
Euro					
Currency	Portfolio		Benchmark		Balanced Attribution
	Port. Average Weight	Port. Currency Return	Bench. Average Weight	Bench. Currency Return	Currency Effect
<b>Total</b>	<b>100.00</b>	<b>-1.38</b>	<b>100.00</b>	<b>-1.13</b>	<b>-0.26</b>
<b>British Pounds</b>	21.56	-5.29	17.42	-5.29	-0.18
<b>Danish Krone</b>	1.13	-0.00	.93	-0.00	-0.00
<b>Euro</b>	65.74	--	71.61	--	-0.07
<b>Norwegian Krone</b>	.88	-1.26	.72	-1.26	-0.00
<b>Swedish Krona</b>	3.00	-0.70	2.45	-0.70	-0.00
<b>Swiss Franc</b>	7.68	-2.39	6.87	-2.40	-0.01

In summary, the balanced attribution quantifies the relative value added by each of the four teams who helped manage this portfolio:

<b>Investment Team</b>	<b>Relative Value</b>
Asset allocators	+58bps
Equity team	-7bps
Fixed income team	+20bps
Currency team	-26bps
Total	+46bps (difference from rounding)

Balanced attribution lets us dive into exactly how relative value was added from each of these teams, using attribution effects that are relevant to their specific set of investment decisions and, where appropriate, calculating the attribution effects relative to the asset class managed.



## Expanded Balanced Attribution Model Calculations

### Carry Effect

Carry effect quantifies the portion of benchmark-relative return that can be attributed to the portfolio's ability to optimize return delivered from the passage of time. It can be thought of as an allocation calculation combined with a selection calculation using portfolio and benchmark carry returns. The calculation uses the top down concept of proportional weights and adjusts for the impact of the asset class allocation decision(s) made by the asset allocators earlier in the investment process. The effect explains the remaining difference in carry returns between the portfolio and benchmark by quantifying whether the fixed income portfolio manager allocated the fixed income assets to groups that had superior carry returns and whether the portfolio manager selected fixed income assets within each group that produced superior carry returns. Carry effect uses carry returns and is calculated relative to the fixed income asset class:

$$(P_{wt} - P_{pwt}) * (B_{CarryRet} - B_{AssetClassCarryRet}) + P_{wt} * (P_{CarryRet} - B_{CarryRet})$$

where:

- $P_{wt}$  = Portfolio Weight
- $P_{pwt}$  = Portfolio Proportional Weight
- $B_{CarryRet}$  = Benchmark Carry Return
- $B_{AssetClassCarryRet}$  = Benchmark Asset Class Carry Return
- $P_{CarryRet}$  = Portfolio Carry Return

### Spread Effect

Spread effect quantifies the portion of benchmark-relative return that can be attributed to the portfolio's ability to manage spreads. It can be thought of as an allocation calculation combined with a selection calculation using portfolio and benchmark spread returns. The calculation uses the top down concept of proportional weights and adjusts for the impact of the asset class allocation decision(s) made by the asset allocators earlier in the investment process. The effect explains the remaining difference in spread returns between the portfolio and benchmark by quantifying whether the fixed income portfolio manager allocated the fixed income assets to groups that had superior spread returns and whether the portfolio manager selected fixed income assets within each group that produced superior spread returns. Spread effect uses spread returns and is calculated relative to the fixed income asset class:

$$(P_{wt} - P_{pwt}) * (B_{SpreadRet} - B_{AssetClassSpreadRet}) + P_{wt} * (P_{SpreadRet} - B_{SpreadRet})$$

where:

- $P_{wt}$  = Portfolio Weight
- $P_{pwt}$  = Portfolio Proportional Weight
- $B_{SpreadRet}$  = Benchmark Spread Return
- $B_{AssetClassSpreadRet}$  = Benchmark Asset Class Spread Return
- $P_{SpreadRet}$  = Portfolio Spread Return

## Income Effect

Income effect quantifies the portion of benchmark-relative return that can be attributed to the portfolio's ability to manage income. It can be thought of as an allocation calculation combined with a selection calculation using portfolio and benchmark income returns. The calculation uses the top down concept of proportional weights and adjusts for the impact of the asset class allocation decision(s) made by the asset allocators earlier in the investment process. The effect explains the remaining difference in income returns between the portfolio and benchmark by quantifying whether the fixed income portfolio manager allocated the fixed income assets to groups that had superior income returns and whether the portfolio manager selected fixed income assets within each group that produced superior income returns. Income effect uses income returns and is calculated relative to the fixed income asset class:

$$(P_{wt} - P_{pwt}) * (B_{IncRet} - B_{AssetClassIncRet}) + P_{wt} * (P_{IncRet} - B_{IncRet})$$

where:

- $P_{wt}$  = Portfolio Weight
- $P_{pwt}$  = Portfolio Proportional Weight
- $B_{IncRet}$  = Benchmark Income Return
- $B_{AssetClassIncRet}$  = Benchmark Asset Class Income Return
- $P_{IncRet}$  = Portfolio Income Return

## Inflation Effect

Inflation effect quantifies the portion of benchmark-relative return that can be attributed to the portfolio's ability to manage inflation. It can be thought of as an allocation calculation combined with a selection calculation using portfolio and benchmark inflation returns. The calculation uses the top down concept of proportional weights and adjusts for the impact of the asset class allocation decision(s) made by the asset allocators earlier in the investment process. The effect explains the remaining difference in inflation returns between the portfolio and benchmark by quantifying whether the fixed income portfolio manager allocated the fixed income assets to groups that had superior inflation returns and whether the portfolio manager selected fixed income assets within each group that produced superior inflation returns. Inflation effect uses inflation returns and is calculated relative to the fixed income asset class:

$$(P_{wt} - P_{pwt}) * (B_{InflRet} - B_{AssetClassInflRet}) + P_{wt} * (P_{InflRet} - B_{InflRet})$$

where:

- $P_{wt}$  = Portfolio Weight
- $P_{pwt}$  = Portfolio Proportional Weight
- $B_{InflRet}$  = Benchmark Inflation Return
- $B_{AssetClassInflRet}$  = Benchmark Asset Class Inflation Return
- $P_{InflRet}$  = Portfolio Inflation Return

All attribution effects are calculated daily, summed upward, and combined over time using a compounding algorithm (see Appendix).

**Example**

This example illustrates an expanded balanced attribution for the demo balanced portfolio over the same month:

The total effect from the balanced attribution analysis once again shows that the portfolio outperformed the benchmark by 0.46% over the month. The expanded balanced attribution provides additional insight into how relative value was added by the fixed income team.

Balanced Attribution											
Euro											
Asset Class	Portfolio		Benchmark		Balanced Attribution						
	Port. Average Weight	Port. Residual Return	Bench. Average Weight	Bench. Residual Return	Asset Class Effect	Shift Effect	Twist Effect	Allocation Effect	Selection Effect	Currency Effect	Total Effect
<b>Total</b>	<b>100.00</b>	<b>3.67</b>	<b>100.00</b>	<b>3.23</b>	<b>.58</b>	<b>.09</b>	<b>-.04</b>	<b>.15</b>	<b>-.07</b>	<b>-.26</b>	<b>.46</b>
<b>Equity</b>	<b>60.85</b>	<b>6.02</b>	<b>60.95</b>	<b>5.14</b>	<b>.28</b>	<b>--</b>	<b>--</b>	<b>-.03</b>	<b>-.04</b>	<b>-.14</b>	<b>.07</b>
Consumer Discretionary	5.61	4.13	4.61	4.15	--	--	--	-.00	-.00	-.01	-.01
Consumer Staples	8.84	5.26	7.29	5.28	--	--	--	.00	-.00	-.01	-.01
Energy	6.62	4.58	5.36	5.05	--	--	--	-.00	-.03	-.02	-.05
Financials	12.01	8.17	10.71	8.20	--	--	--	-.02	-.00	.03	.01
Health Care	7.37	5.56	6.09	5.59	--	--	--	.00	-.00	-.01	-.01
Industrials	6.77	3.65	5.67	3.81	--	--	--	.00	-.01	-.00	-.01
Information Technology	1.81	5.50	1.54	5.20	--	--	--	-.00	.01	.00	.01
Materials	5.90	2.43	4.84	2.40	--	--	--	-.00	.00	-.01	-.01
Telecommunication Services	3.39	5.95	2.78	5.95	--	--	--	.00	.00	-.00	-.00
Utilities	2.53	-.40	2.06	-.46	--	--	--	-.00	.00	-.00	-.01
<b>Fixed Income</b>	<b>37.08</b>	<b>1.73</b>	<b>49.05</b>	<b>1.32</b>	<b>.35</b>	<b>.09</b>	<b>-.04</b>	<b>.18</b>	<b>-.03</b>	<b>-.14</b>	<b>.41</b>
Austria	1.51	.66	2.09	.69	--	.00	-.00	.00	-.00	.00	.01
Belgium	1.85	.32	2.75	.38	--	.01	-.00	.00	-.00	.01	.02
Finland	.50	.01	.67	.00	--	.00	-.00	.00	.00	.00	.00
France	7.83	.44	11.74	.50	--	.02	-.01	.01	-.01	.05	.07
Germany	6.46	.06	12.35	.10	--	.02	-.01	.04	-.00	.14	.19
Ireland	1.85	3.67	.85	3.67	--	.01	-.00	.03	-.00	-.06	-.03
Italy	10.04	3.37	10.00	3.48	--	.01	-.01	.06	-.01	-.12	-.07
Netherlands	1.68	-.07	3.33	-.07	--	.01	-.00	.01	-.00	.04	.06
Spain	5.36	3.41	5.27	3.47	--	.01	-.00	.03	-.00	-.07	-.03
<b>[Cash]</b>	<b>2.07</b>	<b>.01</b>	<b>--</b>	<b>--</b>	<b>-.05</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>.02</b>	<b>-.02</b>

The basic balanced attribution shows that the fixed income team added 0.15% of relative value by way of asset allocation and security selection. The expanded balanced attribution includes carry, spread, income, and inflation effects that provide greater insight into where the 0.15% of relative value came from:

Effect	Relative Value
Carry Effect	0bps
Spread Effect	15bps
Income Effect	0bps
Inflation Effect	0bps
Allocation Effect	0bps
Selection Effect	-1bps
<b>Total</b>	<b>14bps</b>

The additional relative value added came almost exclusively from spread management. The fixed income team's time management, income management, inflation management, and bond selection decisions did not materially add additional relative value.

## Summary

FactSet's Balanced Attribution model explains the benchmark-relative total return of a balanced portfolio by quantifying the relative value added by each investment decision that is typically seen in a balanced portfolio's investment process. The model assumes that asset class allocation is the first decision in the investment process and measures its impact before calculating the additional

relative value added from other investment decisions. The relative value added from other investment decisions is calculated relative to each respective asset class using only attribution factors relevant to the management of the asset class. The model has optional attribution effects available for fixed income assets that can be used to explain their relative value using relevant attribution factors based on the investment process. The model can be used in both single and multi-manager situations.

## Appendix

Attribution effects are combined over time using one of two compounding algorithms:

- residual free – portfolio cumulative
- residual free – benchmark cumulative

The details of these compounding and smoothing algorithms are outside of the scope of this paper. Transaction-based returns can be calculated using one of four methodologies:

- daily valuation
- cash flows at start of day
- purchase at start of day
- cash flows at middle of day (resembles “Mid-Point Dietz”)

The details of these transaction based return methodologies are outside of the scope of this paper.

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