
Morningstar DirectSM

In-Depth Methodologies to
Performance Attribution

MORNINGSTAR[®]

Outline

- ▶ What is Attribution
- ▶ Classic Attribution
- ▶ Key Decisions in Morningstar Direct
- ▶ Interpretation of Attribution Results
- ▶ Special Situations
- ▶ Future Enhancements

What is Attribution?

What is Performance Attribution?

Definition

- ▶ Process of breaking down a portfolio's return into components that can be identified with types of decisions
 - ▶ Stock Selection
 - ▶ Sector and Industry Allocation
 - ▶ Regional and Country Allocation
 - ▶ Market Cap Allocation
 - ▶ P/E and other valuation measures
- ▶ Accomplished by using portfolio holdings

Classic Attribution

Classic Attribution

Brinson Three-Factor Models

- ▶ **Active Return** = **Weighting Effect** + **Selection Effect** + **Interaction**
- ▶ “Interaction”
 - ▶ Definition: the interaction between weighting and selection
 - ▶ Consideration: “interaction” does not represent a decision

Classic Attribution

Brinson and Fachler (1985) Weighting Effect

	Underperform	Outperform
Overweight	—	+
Underweight	+	—

$$(w_j^P - w_j^B) \bullet (R_j^B - R^B)$$

Key Decisions

Key Decision 1

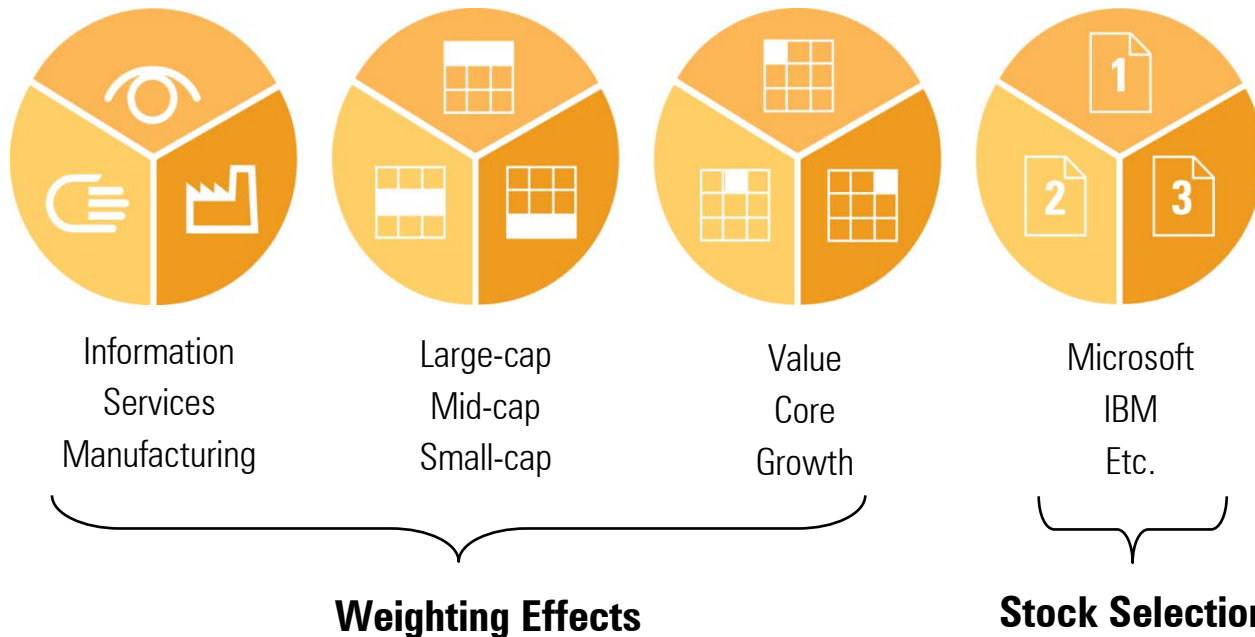
Investment Process: Top Down, Bottom Up, and Three Factor

- ▶ Two-Factor Top-Down Approach
 - ▶ Weighting decisions before security selection
- ▶ Two-Factor Bottom-Up Approach
 - ▶ Security selection before weighting decision
- ▶ Three-Factor Approach
 - ▶ Order agnostic

Key Decision 1

Investment Process: Top Down

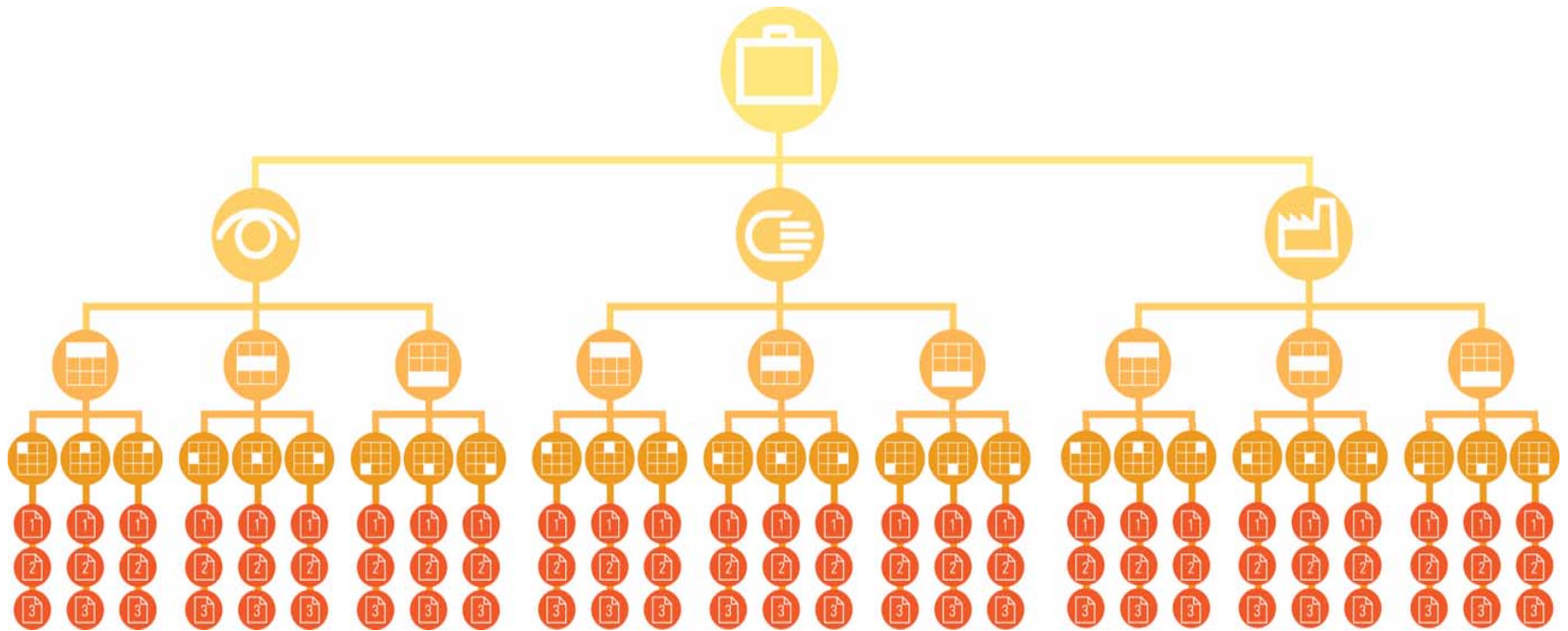
- ▶ Multiple Weighting Effects in Top-Down Approach
 - ▶ Example: weighting decision made on sector, size, & style



Key Decision 1

Investment Process: Top Down

- ▶ Hierarchical View of a U.S. Stock Portfolio



Key Decision 1

Investment Process: Top Down

▶ Multiple-Decision Attribution

	Portfolio Weight	Benchmark Weight
Asia	60%	30%
Information	20%	10%
Service	20%	10%
Manufacturing	20%	10%

- ▶ **Appearance:** the three sectors in Asia appear overweight compared to the benchmark (20% vs. 10%)
- ▶ **Fact:** the portfolio's sector allocation is simply mimicking the benchmark's allocation (1/3 in each sector)
- ▶ **Issue:** the portfolio's overweight in Asia makes each sector appear overweight → don't compare top level weights directly

Key Decision 1

Investment Process: Top Down

▶ Anchoring Process in Top-Down Attribution

	Portfolio Weight	Benchmark Weight
Asia	60%	30%
Information	20%	10%
Service	20%	10%
Manufacturing	20%	10%

A red bracket groups the three benchmark weights (10%, 10%, 10%) with a red "x 2" next to it, indicating a multiplier.

- ▶ **Issue:** the portfolio's overweight in Asia makes each sector appear overweight
- ▶ **Solution:** multiply benchmark sector weights by 2, since 2 is the ratio between 60% and 30%

Key Decision 1

Investment Process: Bottom Up

- ▶ Bottom-Up Approach
 - ▶ Security selection before weighting decision

Key Decision 1

Investment Process: Bottom Up

▶ Multiple-Decision Attribution

	Portfolio Weight	Benchmark Weight
Business Services	60%	30%
Stock 1	20%	10%
Stock 2	20%	10%
Stock 3	20%	10%


- ▶ **Appearance:** the three securities in Business Services Sector appear overweight compared to the benchmark (20% vs. 10%)
- ▶ **Fact:** the portfolio's security allocation is simply mimicking the benchmark's allocation (1/3 in each security)
- ▶ **Issue:** the portfolio's overweight in Business Services makes each security appear overweight → don't compare security weight directly

Key Decision 1

Investment Process: Bottom Up

▶ Anchoring Process in Bottom-Up Attribution

	Portfolio Weight	Benchmark Weight
Business Services	60%	30%
Stock 1	20%	10%
Stock 2	20%	10%
Stock 3	20%	10%



- ▶ **Issue:** the portfolio's overweight in the Business Services sector makes each security appear overweight
- ▶ **Solution:** multiple portfolio security weights by 0.5, since 0.5 is the ratio between 30% and 60%

Key Decision 1

Investment Process: Three Factor

- ▶ Three Factor Approach
 - ▶ Agnostic view on order of investment decision
 - ▶ Same anchoring process as the two-factor bottom-up approach

Key Decision 1

Investment Process: Three Factor

- ▶ Three Factor Approach
 - ▶ Agnostic view on the order of investment decision

Name	Attribution Effect			Active Return %
	Weighting %	Selection %	Interaction %	
Level <input type="checkbox"/> 1 <input type="checkbox"/> 2				
▶ Business Services	(0.03)	0.76	0.21	0.94
▶ Consumer Goods	0.15	0.77	(0.61)	0.31
▶ Consumer Services	0.04	0.02	0.00	0.07
▶ Energy	0.31	0.42	(0.18)	0.55
▶ Financial Services	0.02	0.08	(0.01)	0.09
▶ Hardware	0.07	0.26	0.31	0.63
▶ Healthcare	0.08	0.00	0.00	0.09
▶ Industrial Materials	0.06	0.49	0.36	0.91
▶ Media	(0.05)	(0.26)	0.13	(0.18)
▶ Software	(0.00)	0.11	0.00	0.11
▶ Telecommunication	0.00	0.28	(0.16)	0.11
▶ Utilities	0.10	(0.21)	0.16	0.05
▶ Unclassified	(0.00)	0.00	0.00	(0.00)
Attribution Total	0.77	2.72	0.20	3.68

Key Decision 1

Investment Process: Three Factor

▶ Three Factor Approach

- ▶ Interaction is at sector level only, since it is the interaction between weighting and selection effects.

Name	Attribution Effect			Active Return %
	Weighting %	Selection %	Interaction %	
Level <input type="checkbox"/> 1 <input type="checkbox"/> 2				
▶ Business Services	(0.03)	0.76	0.21	0.94
▶ Consumer Goods	0.15	0.77	(0.61)	0.31
▶ Consumer Services	0.04	0.02	0.00	0.07
▼ Energy	0.31	0.42	(0.18)	0.55
Anadarko Petroleu...		0.00		0.00
Apache Corporation		0.00		0.00
Atwood Oceanics, Inc.		(0.02)		(0.02)
Baker Hughes Inc.		0.01		0.01
BJ Services Company		(0.00)		(0.00)
Cabot Oil & Gas Co...		0.00		0.00

$$(w_j^P - w_j^B) \bullet (R_j^P - R_j^B)$$

Key Decision 1

Investment Process: Three Factor vs. Top Down

Name Level <input type="checkbox"/> 1 <input type="checkbox"/> 2	Attribution Effect			
	Weighting %	Selection %	Interaction %	Active Return %
▶ Business Services	(0.03)	0.76	0.21	0.94
▶ Consumer Goods	0.15	0.77	(0.61)	0.31
▶ Consumer Services	0.04	0.02	0.00	0.07
▶ Energy	0.31	0.42	(0.18)	0.55

Name Level <input type="checkbox"/> 1 <input type="checkbox"/> 2	Attribution Effect		
	Morningstar Sector Weighting %	Selection %	Active Return %
▶ Business Services	(0.03)	0.97	0.94
▶ Consumer Goods	0.15	0.16	0.31
▶ Consumer Services	0.04	0.03	0.07
▶ Energy	0.31	0.24	0.55

$$0.42 + (-0.18) = 0.24$$

Key Decision 1

Investment Process: Three Factor vs. Bottom Up

Name	Attribution Effect			
	Weighting %	Selection %	Interaction %	Active Return %
Level <input type="checkbox"/> 1 <input type="checkbox"/> 2				
▶ Business Services	(0.03)	0.76	0.21	0.94
▶ Consumer Goods	0.15	0.77	(0.61)	0.31
▶ Consumer Services	0.04	0.02	0.00	0.07
▶ Energy	0.31	0.42	(0.18)	0.55

$$0.31 + (-0.18) = 0.13$$

Name	Attribution Effect		
	Weighting %	Selection %	Active Return %
Level <input type="checkbox"/> 1 <input type="checkbox"/> 2			
▶ Business Services	0.18	0.76	0.94
▶ Consumer Goods	(0.47)	0.77	0.31
▶ Consumer Services	0.04	0.02	0.07
▶ Energy	0.13	0.42	0.55

Key Decision 2

Multi-Period Linking: Arithmetic vs. Geometric

▶ Arithmetic vs. Geometric

- ▶ Example: portfolio return = 12%, benchmark return = 10%

Arithmetic Method

- ▶ Active Return = $R_p - R_b = 12\% - 10\% = 2\%$
- ▶ Active Return = Wt Effect + Sel Effect

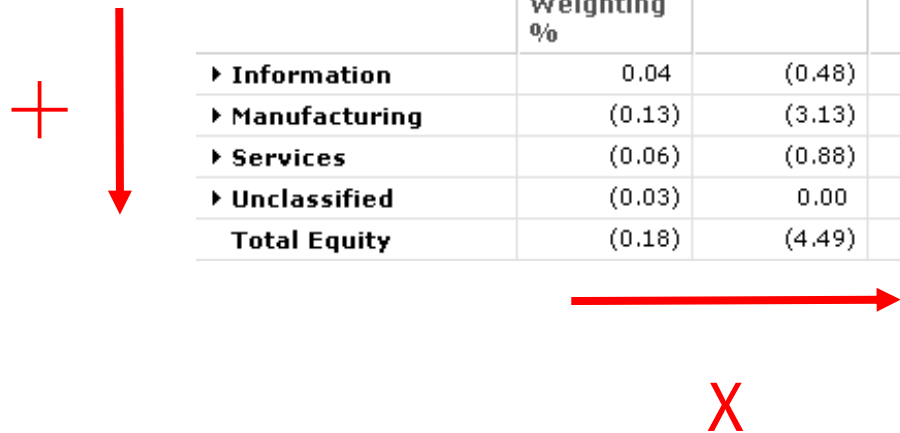
Geometric Method

- ▶ Active Return = $(1 + R_p) / (1 + R_b) - 1 =$
 $= 1.12 / 1.10 - 1 = 1.82\%$
- ▶ Active Return = $(1 + \text{Wt Effect}) \times (1 + \text{Sel Effect}) - 1$

Key Decision 2

Multi-Period Linking: Geometric Method

▶ Single Period



Name Level <input type="text" value="1"/> <input type="text" value="2"/>	Attribution Effect		
	Morningstar Super Sector Weighting %	Selection %	Active Return %
▶ Information	0.04	(0.48)	(0.44)
▶ Manufacturing	(0.13)	(3.13)	(3.25)
▶ Services	(0.06)	(0.88)	(0.94)
▶ Unclassified	(0.03)	0.00	(0.03)
Total Equity	(0.18)	(4.49)	(4.66)

Key Decision 2

Multi-Period Linking: Geometric Method

► Multi Period

Name		Attribution Effect			
Level	1	2	Morningstar Super Sector Weighting %	Selection %	Active Return %
► Information			0.04		
► Manufacturing			0.04		
► Services			0.00		
► Unclassified			(0.05)		
Total Equity			0.03		

Name		Attribution Effect			
Level	1	2	Morningstar Super Sector Weighting %	Selection %	Active Return %
► Information			(0.04)		
► Manufacturing			(0.39)		
► Services			(0.11)		
► Unclassified			0.01		
Total Equity			(0.53)		

Name		Attribution Effect			
Level	1	2	Morningstar Super Sector Weighting %	Selection %	Active Return %
► Information			0.05		
► Manufacturing			0.23		
► Services			0.04		
► Unclassified			0.01		
Total Equity			0.33		

Name		Attribution Effect			
Level	1	2	Morningstar Super Sector Weighting %	Selection %	Active Return %
► Information			0.04	(0.48)	(0.44)
► Manufacturing			(0.13)	(3.13)	(3.25)
► Services			(0.06)	(0.88)	(0.94)
► Unclassified			(0.03)	0.00	(0.03)
Total Equity			(0.18)	(4.49)	(4.66)

Oct

Nov

Dec

Oct – Dec

X

$$(1 + \text{Oct}) \times (1 + \text{Nov}) \times (1 + \text{Dec}) - 1$$

Key Decision 2

Multi-Period Linking: Geometric Method

► Characteristics

- Theoretically and mathematically sound
- Multi-period: **no** sector-level details because each sector in isolation does not represent a complete decision

Single Period

Name	Attribution Effect	
	Morningstar Super Sector Weighting %	Selection %
Level <input type="text" value="1"/> <input type="text" value="2"/>		
► Information	0.05	0.62
► Manufacturing	0.22	1.52
▼ Services	0.04	1.12
Abbott Laboratories		0.01
Abercrombie & Fitch Comp...		(0.00)
ACE, Ltd.		(0.02)
Aetna, Inc.		(0.04)
Affymetrix, Inc.		0.00
Aflac, Inc.		0.01
Alexander & Baldwin		0.00
Allergan, Inc.		0.08

Multi-Period

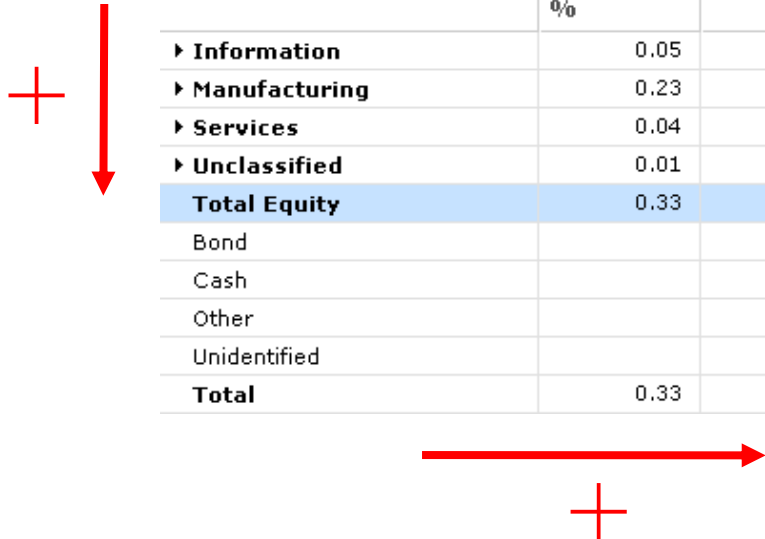
Name	Attribution Effect		
	Morningstar Super Sector Weighting %	Selection %	Active Return %
Level <input type="text" value="1"/> <input type="text" value="2"/>			
► Information		(0.61)	
► Manufacturing		(3.38)	
▼ Services		(1.11)	
Abbott Laboratories			
Abercrombie & Fitch Comp...			
ACE, Ltd.			
Aetna, Inc.			
Affymetrix, Inc.			
Aflac, Inc.			
Alexander & Baldwin			

Key Decision 2

Multi-Period Linking: Arithmetic Method

▶ Single Period

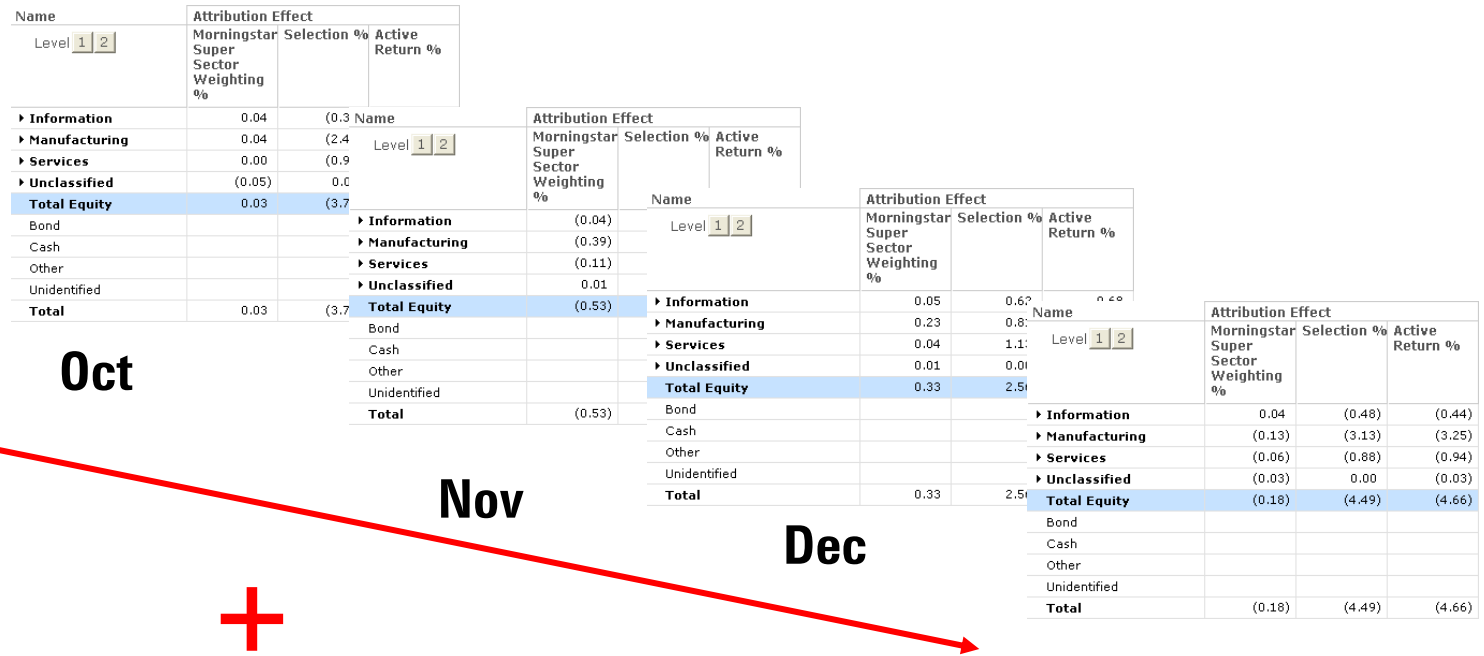
Name Level <input type="text" value="1"/> <input type="text" value="2"/>	Attribution Effect		
	Morningstar Super Sector Weighting %	Selection %	Active Return %
▶ Information	0.05	0.62	0.68
▶ Manufacturing	0.23	0.81	1.04
▶ Services	0.04	1.13	1.17
▶ Unclassified	0.01	0.00	0.01
Total Equity	0.33	2.56	2.89
Bond			
Cash			
Other			
Unidentified			
Total	0.33	2.56	2.89



Key Decision 2

Multi-Period Linking: Arithmetic Method

► Multi Period



"Smoothing" is required

Oct – Dec

Key Decision 2

Multi-Period Linking: Arithmetic Method

- ▶ Reason for smoothing: $\text{Excess Return} = \text{Active Return}$

Name Level <input type="checkbox"/> 1 <input type="checkbox"/> 2	Return %			Attribution Effect		
	Portfolio	Benchmark	+/-	Morningstar Super Sector Weighting %	Selection %	Active Return %
▶ Information	(23.46)	(21.41)	(2.05)	0.04	(0.48)	(0.44)
▶ Manufacturing	(30.34)	(20.84)	(9.50)	(0.13)	(3.13)	(3.25)
▶ Services	(25.63)	(23.54)	(2.08)	(0.06)	(0.88)	(0.94)
▶ Unclassified	(56.64)	(56.64)	0.00	(0.03)	0.00	(0.03)
▶ Missing Performance						
Total Equity	(26.73)	(22.06)	(4.66)	(0.18)	(4.49)	(4.66)

Key Decision 2

Multi-Period Linking: Arithmetic Method

- ▶ Without smoothing: Excess Return \neq Active Return
 - ▶ Excess Return October to December = -4.66%

	October	November	December	October - December
Portfolio	-20.51	-11.33	3.95	-26.73
Benchmark	-16.79	-7.32	1.06	-22.06
Excess Return				-4.66

- ▶ Active Return October to December = -4.83% w/o smoothing

	October		November		December		October - December		
	Attribution Effect	Weighting Selection	Attribution Effect	Weighting Selection	Attribution Effect	Weighting Selection	Attribution Effect	Weighting Selection	Active Ret
Information	0.04	-0.36	+ -0.04	-0.73	+ 0.05	0.62	= 0.05	+ -0.47	= -0.41
Manufacturing	0.04	-2.45	-0.39	-1.73	0.23	0.81	-0.13	-3.38	+ -3.51
Services	0.00	-0.94	-0.11	-1.00	0.04	1.13	-0.07	-0.82	+ -0.88
Unclassified	-0.05	0.00	0.01	0.00	0.01	0.00	-0.03	0.00	+ -0.03
Total Equity	0.03	-3.75	-0.53	-3.47	0.33	2.56	-0.18	-4.66	= -4.83

Key Decision 2

Multi-Period Linking: Arithmetic Method

- ▶ After smoothing: Excess Return = Active Return
 - ▶ Excess Return October to December = -4.66%

	October	November	December	October - December
Portfolio	-20.51	-11.33	3.95	-26.73
Benchmark	-16.79	-7.32	1.06	-22.06
Excess Return				-4.66

- ▶ Active Return

	Without Smoothing			With Smoothing		
	October - December Attribution Effect			October - December Attribution Effect		
	Weighting	Selection	Active Ret	Weighting	Selection	Active Ret
Information	0.05	-0.47	-0.41	0.04	-0.48	-0.44
Manufacturing	-0.13	-3.38	-3.51	-0.13	-3.13	-3.25
Services	-0.07	-0.82	-0.88	-0.06	-0.88	-0.94
Unclassified	-0.03	0.00	-0.03	-0.03	0.00	-0.03
Total Equity	-0.18	-4.66	-4.83	-0.18	-4.49	-4.66

Key Decision 2

Multi-Period Linking: Arithmetic Method

- ▶ Characteristics

- ▶ Simple, intuitive
- ▶ Multi-period: requires mathematical “smoothing”
- ▶ Multi-period: offers sector-level details

Key Decision 3

Inferring Forward or Backward In Time

- ▶ When portfolio holdings are not available:

- ▶ Example

Need

- ▶ Attribution analysis period from Apr 1 to Jun 30
→ *need Mar 31 portfolio holdings*

Have

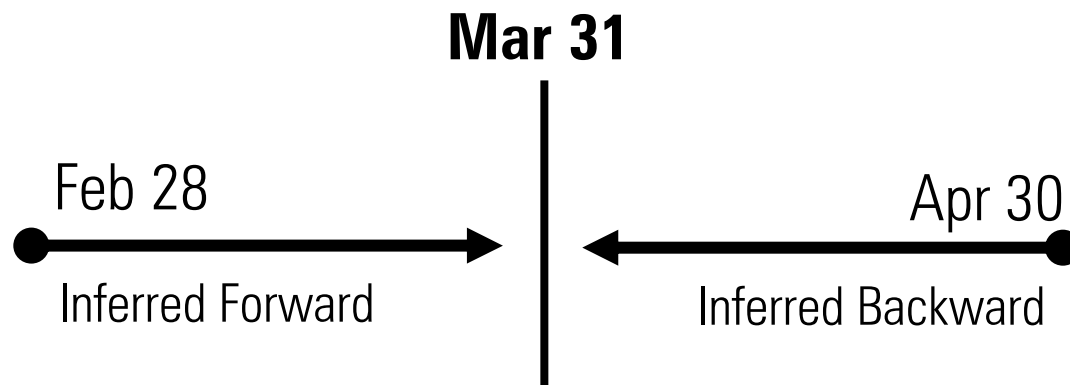
- ▶ Portfolio has holdings information on Feb 28 and Apr 30 but not Mar 31

Key Decision 3

Inferring Forward or Backward In Time

- ▶ Our solution

- ▶ Use buy-and-hold assumption to infer Mar 31 holdings data from nearby dates



Interpretation of Attribution Results

Interpretation of Attribution Results

► Top-Down Investment Process

	Underperform	Outperform
Overweight	—	+
Underweight	+	—

$$(w_j^P - w_j^B) \bullet (R_j^B - R^B)$$

Interpretation of Attribution Results

Top-Down: Total Equity Level

- ▶ Portfolio underperformed by 3.64%
 - ▶ Poor sector weighting decision → -0.56%
 - ▶ Poor security selection decision → -3.07%

Name Level 1 2	Rescaled Weights %			Return %			Attribution Effect		
	Portfolio	Benchmark	+/-	Portfolio	Benchmark	+/-	Morningstar Sector Weighting %	Selection %	Active Return %
▶ Business Services	7.29	4.67	2.61	(4.57)	(1.09)	(3.48)	(0.01)	(0.25)	(0.26)
▶ Consumer Goods	2.00	9.04	(7.03)	(2.85)	4.81	(7.65)	(0.40)	(0.15)	(0.55)
▶ Consumer Services	7.21	6.95	0.26	(2.21)	0.24	(2.45)	0.00	(0.18)	(0.17)
▶ Energy	18.65	16.36	2.29	(20.20)	(14.02)	(6.18)	(0.30)	(1.15)	(1.45)
▶ Financial Services	10.58	14.21	(3.64)	2.77	7.24	(4.47)	(0.29)	(0.47)	(0.77)
▶ Hardware	17.20	9.84	7.36	2.35	1.32	1.04	0.16	0.18	0.34
▶ Healthcare	12.03	11.95	0.08	5.39	5.10	0.29	0.00	0.04	0.04
▶ Industrial Materials	18.01	12.98	5.03	(5.74)	(0.65)	(5.09)	0.01	(0.92)	(0.91)
▶ Media	0.78	2.79	(2.01)	(13.75)	(2.05)	(11.70)	0.02	(0.09)	(0.07)
▶ Software	3.79	3.99	(0.19)	(5.18)	(3.53)	(1.65)	0.01	(0.06)	(0.06)
▶ Telecommunication	1.56	3.33	(1.77)	(2.91)	(5.89)	2.98	0.09	0.05	0.14
▶ Utilities	0.90	3.88	(2.98)	(11.59)	(5.59)	(6.00)	0.14	(0.05)	0.09
Total Equity	100.00	100.00	0.00	(4.46)	(0.82)	(3.64)	(0.56)	(3.07)	(3.64)



+ =

Interpretation of Attribution Results

Top-Down: Sector Level

- ▶ Poor sector weighting and security selection decisions in Energy

Name Level <input type="checkbox"/> 1 <input type="checkbox"/> 2	Rescaled Weights %			Return %			Attribution Effect		
	Portfolio	Benchmark	+/-	Portfolio	Benchmark	+/-	Morningstar Sector Weighting %	Selection %	Active Return %
▶ Business Services	7.29	4.67	2.61	(4.57)	(1.09)	(3.48)	(0.01)	(0.25)	(0.26)
▶ Consumer Goods	2.00	9.04	(7.03)	(2.85)	4.81	(7.65)	(0.40)	(0.15)	(0.55)
▶ Consumer Services	7.21	6.95	0.26	(2.21)	0.24	(2.45)	0.00	(0.18)	(0.17)
▶ Energy	18.65	16.36	2.29	(20.20)	(14.02)	(6.18)	(0.30)	(1.15)	(1.45)
▶ Financial Services	10.58	14.21	(3.64)	2.77	7.24	(4.47)	(0.29)	(0.47)	(0.77)
▶ Hardware	17.20	9.84	7.36	2.35	1.32	1.04	0.16	0.18	0.34
▶ Healthcare	12.03	11.95	0.08	5.39	5.10	0.29	0.00	0.04	0.04
▶ Industrial Materials	18.01	12.98	5.03	(5.74)	(0.65)	(5.09)	0.01	(0.92)	(0.91)
▶ Media	0.78	2.79	(2.01)	(13.75)	(2.05)	(11.70)	0.02	(0.09)	(0.07)
▶ Software	3.79	3.99	(0.19)	(5.18)	(3.53)	(1.65)	0.01	(0.06)	(0.06)
▶ Telecommunication	1.56	3.33	(1.77)	(2.91)	(5.89)	2.98	0.09	0.05	0.14
▶ Utilities	0.90	3.88	(2.98)	(11.59)	(5.59)	(6.00)	0.14	(0.05)	0.09
Total Equity	100.00	100.00	0.00	(4.46)	(0.82)	(3.64)	(0.56)	(3.07)	(3.64)



Interpretation of Attribution Results

Top-Down: Sector Weighting Effect

	Underperform	Outperform
Overweight	—	+
Underweight	+	—

- ▶ Poor sector weighting decision in Energy, resulting in -0.30%
 - ▶ Energy overweighted → 2.29%
 - ▶ Sector underperformed the total → -14.02% vs. -0.82%

Name Level 1 2	Rescaled Weights %			Return %			Attribution Effect		
	Portfolio	Benchmark	+/-	Portfolio	Benchmark	+/-	Morningstar Sector Weighting %	Selection %	Active Return %
▶ Business Services	7.29	4.67	2.61	(4.57)	(1.09)	(3.48)	(0.01)	(0.25)	(0.26)
▶ Consumer Goods	2.00	9.04	(7.03)	(2.85)	4.81	(7.65)	(0.40)	(0.15)	(0.55)
▶ Consumer Services	7.21	6.95	0.26	(2.21)	0.24	(2.45)	0.00	(0.18)	(0.17)
▶ Energy	18.65	16.36	2.29	(20.20)	(14.02)	(6.18)	(0.30)	(1.15)	(1.45)
▶ Financial Services	10.58	14.21	(3.64)	2.77	7.24	(4.47)	(0.29)	(0.47)	(0.77)
▶ Hardware	17.20	9.84	7.36	2.35	1.32	1.04	0.16	0.18	0.34
▶ Healthcare	12.03	11.95	0.08	5.39	5.10	0.29	0.00	0.04	0.04
▶ Industrial Materials	18.01	12.98	5.03	(5.74)	(0.65)	(5.09)	0.01	(0.92)	(0.91)
▶ Media	0.78	2.79	(2.01)	(13.75)	(2.05)	(11.70)	0.02	(0.09)	(0.07)
▶ Software	3.79	3.99	(0.19)	(5.18)	(3.53)	(1.65)	0.01	(0.06)	(0.06)
▶ Telecommunication	1.56	3.33	(1.77)	(2.91)	(5.89)	2.98	0.09	0.05	0.14
▶ Utilities	0.90	3.88	(2.98)	(11.59)	(5.59)	(6.00)	0.14	(0.05)	0.09
Total Equity	100.00	100.00	0.00	(4.46)	(0.82)	(3.64)	(0.56)	(3.07)	(3.64)



Interpretation of Attribution Results

Top-Down: Selection Effect

	Underperform	Outperform
Overweight	—	+
Underweight	+	—

- ▶ Holding Canadian Natural Resources was the worst decision → -0.33%
 - ▶ Security overweighted → 4.34% vs. 0%
 - ▶ Security underperformed the sector → -21.51% vs. -14.02%

Name Level 1 2	Rescaled Weights %			Return %			Attribution Effect		
	Portfolio	Benchmark	+/-	Portfolio	Benchmark	+/-	Morningstar Sector Weighting %	Selection %	Active Return %
▼ Energy	18.65	16.36	2.29	(20.20)	(14.02)	(6.18)	(0.30)	(1.15)	(1.45)
Anadarko Petroleum Corp.	0.00	0.31	(0.31)	(22.62)	(22.62)	0.00		0.03	0.03
Apache Corporation	1.55	0.42	1.14	(19.19)	(19.19)	0.00		(0.06)	(0.06)
Arch Coal, Inc.	1.38	0.00	1.38	(24.95)	(24.95)	0.00		(0.15)	(0.15)
Atwood Oceanics, Inc.	0.17	0.00	0.17	(26.15)	(26.15)	0.00		(0.02)	(0.02)
Baker Hughes Inc.	0.00	0.24	(0.24)	(4.90)	(4.90)	0.00		(0.03)	(0.03)
BJ Services Company	0.00	0.08	(0.08)	(7.95)	(7.95)	0.00		(0.01)	(0.01)
Cabot Oil & Gas Corporati...	0.00	0.06	(0.06)	(35.02)	(35.02)	0.00		0.01	0.01
Cameron International Co...	0.00	0.11	(0.11)	(13.71)	(13.71)	0.00		(0.00)	(0.00)
Canadian Natural Resourc...	4.43	0.00	4.43	(21.51)	(21.51)	0.00		(0.33)	(0.33)
Chesapeake Energy Corp.	0.56	0.28	0.27	(23.97)	(23.97)	0.00		(0.02)	(0.02)



Interpretation of Attribution Results

Top-Down: Selection Effect

	Underperform	Outperform
Overweight	—	+
Underweight	+	—

- ▶ ExxonMobil: what you don't own can also hurt → -0.25%
 - ▶ Security underweighted → 0% vs. 4.18%
 - ▶ Security outperformed the sector → -8.74% vs. -14.02%

Name Level <input type="checkbox"/> 1 <input type="checkbox"/> 2	Rescaled Weights %			Return %			Attribution Effect		
	Portfolio	Benchmark	+/-	Portfolio	Benchmark	+/-	Morningstar Sector Weighting %	Selection %	Active Return %
▼ Energy	18.65	16.36	2.29	(20.20)	(14.02)	(6.18)	(0.30)	(1.15)	(1.45)
Canadian Natural Resourc...	4.43	0.00	4.43	(21.51)	(21.51)	0.00		(0.33)	(0.33)
Chesapeake Energy Corp.	0.56	0.28	0.27	(23.97)	(23.97)	0.00		(0.02)	(0.02)
Chevron Corporation	0.00	1.84	(1.84)	(14.70)	(14.70)	0.00		0.01	0.01
ConocoPhillips	0.00	1.31	(1.31)	(13.02)	(13.02)	0.00		(0.01)	(0.01)
Consol Energy, Inc.	0.00	0.18	(0.18)	(33.80)	(33.80)	0.00		0.04	0.04
Denbury Resources, Inc.	0.77	0.00	0.77	(22.90)	(22.90)	0.00		(0.07)	(0.07)
Devon Energy Corporation	0.00	0.48	(0.48)	(21.03)	(21.03)	0.00		0.04	0.04
El Paso Corporation	0.00	0.14	(0.14)	(17.53)	(17.53)	0.00		0.01	0.01
Energy Transfer Equity, L.P.	0.08	0.00	0.08	2.52	2.52	0.00		0.01	0.01
ENSCO International, Inc.	0.00	0.10	(0.10)	(14.37)	(14.37)	0.00		0.00	0.00
Enterprise Products Partne...	0.06	0.00	0.06	2.51	2.51	0.00		0.01	0.01
EOG Resources	0.64	0.29	0.35	(23.29)	(23.29)	0.00		(0.03)	(0.03)
ExxonMobil Corporation	0.00	4.18	(4.18)	(8.74)	(8.74)	0.00		(0.25)	(0.25)
Halliburton Company	0.00	0.42	(0.42)	(15.55)	(15.55)	0.00		0.01	0.01
Hess Corporation	1.42	0.32	1.10	(19.64)	(19.64)	0.00		(0.06)	(0.06)



Interpretation of Attribution Results

Top-Down: Selection Effect

	Underperform	Outperform
Overweight	—	+
Underweight	+	—

- ▶ Challenge: why is Motorola a detractor in Hardware? → -0.01%
 - ▶ Overweight: 0.20% vs. 0.15%
 - ▶ Outperformance: 17.71% vs. 1.32%

Name Level <input type="text" value="1"/> <input type="text" value="2"/>	Rescaled Weights %			Return %			Attribution Effect		
	Portfolio	Benchmark	+/-	Portfolio	Benchmark	+/-	Morningstar Sector Weighting %	Selection %	Active Return %
▼ Hardware	17.20	9.84	7.36	2.35	1.32	1.04	0.16	0.18	0.34
Motorola, Inc.	0.20	0.15	0.05	17.71	17.71	0.00		(0.01)	(0.01)

Interpreting Attribution Results

Top-Down: Anchoring on Prior Decision

▶ Anchoring Process in Top-Down Attribution

	Portfolio Weight	Benchmark Weight
Asia	60%	30%
Information	20%	10%
Service	20%	10%
Manufacturing	20%	10%

A red bracket groups the three benchmark weights (10%, 10%, 10%) with a red "x 2" next to it, indicating that these weights are multiplied by 2 to match the portfolio weights.

- ▶ **Issue:** the portfolio's overweight in Asia makes each sector appear overweight
- ▶ **Solution:** multiply benchmark sector weights by 2, since 2 is the ratio between 60% and 30%

Interpretation of Attribution Results

Top-Down: Selection Effect

	Underperform	Outperform
Overweight	—	+
Underweight	+	—

▶ Correct interpretation

- ▶ Must anchor on prior decision
- ▶ Benchmark weight of 0.15% becomes 0.26% after anchoring
- ▶ Motorola is actually underweight → 0.20% vs. 0.25%

Name Level <input type="text" value="1"/> <input type="text" value="2"/>	Rescaled Weights %			Return %			Attribution Effect		
	Portfolio	Benchmark	+/-	Portfolio	Benchmark	+/-	Morningstar Sector Weighting %	Selection %	Active Return %
▼ Hardware	17.20	9.84	7.36	2.35	1.32	1.04	0.16	0.18	0.34
Motorola, Inc.	0.20	0.15	0.05	17.71	17.71	0.00		(0.01)	(0.01)

$$0.15 \times 17.20 / 9.84 = 0.25$$

Interpretation of Attribution Results

▶ Bottom-Up Investment Process

	Underperform	Outperform
Overweight	—	+
Underweight	+	—

$$(w_j^P - w_j^B) \bullet (R_j^P - R^B)$$

Interpretation of Attribution Results

Bottom-Up: Sector Weighting Effect

	Underperform	Outperform
Overweight	—	+
Underweight	+	—

- ▶ Good sector weighting decision in Consumer Goods, resulting in 0.17%
 - ▶ Consumer Goods underweighted → -7.15%
 - ▶ Sector underperformed the total → -3.24% vs. -0.82%

Name Level 1 2	Rescaled Weights %			Return %			Attribution Effect		
	Portfolio	Benchmark	+/-	Portfolio	Benchmark	+/-	Weighting %	Selection %	Active Return %
▶ Business Services	7.29	4.67	2.61	(4.57)	(1.09)	(3.48)	(0.10)	(0.16)	(0.26)
▶ Consumer Goods	1.89	9.04	(7.15)	(3.24)	4.81	(8.04)	0.17	(0.73)	(0.55)
▶ Consumer Services	7.21	6.95	0.26	(2.21)	0.24	(2.45)	(0.00)	(0.17)	(0.17)
▶ Energy	18.65	16.36	2.29	(20.20)	(14.02)	(6.18)	(0.44)	(1.01)	(1.45)
▶ Financial Services	10.58	14.21	(3.64)	2.77	7.24	(4.47)	(0.13)	(0.64)	(0.77)
▶ Hardware	17.20	9.84	7.36	2.35	1.32	1.04	0.23	0.10	0.34
▶ Healthcare	12.03	11.95	0.08	5.39	5.10	0.29	0.00	0.03	0.04
▶ Industrial Materials	18.01	12.98	5.03	(5.74)	(0.65)	(5.09)	(0.25)	(0.66)	(0.91)
▶ Media	0.78	2.79	(2.01)	(13.75)	(2.05)	(11.70)	0.26	(0.33)	(0.07)
▶ Software	3.79	3.99	(0.19)	(5.18)	(3.53)	(1.65)	0.01	(0.07)	(0.06)
▶ Telecommunication	1.56	3.33	(1.77)	(2.91)	(5.89)	2.98	0.04	0.10	0.14
▶ Utilities	0.90	3.88	(2.98)	(11.59)	(5.59)	(6.00)	0.32	(0.23)	0.09
▶ Unclassified	0.11	0.00	0.11	3.64	3.64	0.00	0.01	0.00	0.01
Total Equity	100.00	100.00	0.00	(4.46)	(0.82)	(3.64)	0.12	(3.76)	(3.64)



Interpretation of Attribution Results

Bottom-Up: Selection Effect

	Underperform	Outperform
Overweight	—	+
Underweight	+	—

- ▶ Challenge: why is PPL Corporation a detractor in Utilities? → -0.01%
 - ▶ Underweight: 0.07% vs. 0.17%
 - ▶ Underperformance: -10.16 vs. -5.59%

Name	Rescaled Weights %			Return %			Attribution Effect		
	Portfolio	Benchmark	+/-	Portfolio	Benchmark	+/-	Weighting %	Selection %	Active Return %
Level <input type="checkbox"/> 1 <input type="checkbox"/> 2									
▼ Utilities	0.90	3.88	(2.98)	(11.59)	(5.59)	(6.00)	0.32	(0.23)	0.09
PPL Corporation	0.07	0.17	(0.10)	(10.16)	(10.16)	0.00		(0.01)	(0.01)

Interpretation of Attribution Results

Bottom-Up: Selection Effect

▶ Anchoring Process in Bottom-Up Attribution

	Portfolio Weight	Benchmark Weight
Business Services	60%	30%
Stock 1	20%	10%
Stock 2	20%	10%
Stock 3	20%	10%

A red bracket groups the 20% portfolio weights for Stock 1, Stock 2, and Stock 3, with the text **x 0.5** next to it, indicating the adjustment factor.

- ▶ **Issue:** the portfolio's overweight in the Business Services sector makes each security appear overweight
- ▶ **Solution:** multiple portfolio security weights by 0.5, since 0.5 is the ratio between 30% and 60%

Interpretation of Attribution Results

Bottom-Up: Selection Effect

	Underperform	Outperform
Overweight	—	+
Underweight	+	—

▶ Correct interpretation of PPL Corporation

- ▶ Must anchor on prior hierarchy
- ▶ Portfolio weight of 0.07% becomes 0.30% after anchoring
- ▶ PPL is actually overweight → 0.30% vs. 0.17%

Name	Rescaled Weights %			Return %			Attribution Effect		
	Portfolio	Benchmark	+/-	Portfolio	Benchmark	+/-	Weighting %	Selection %	Active Return %
Level <input type="text" value="1"/> <input type="text" value="2"/>									
▼ Utilities	0.90	3.88	(2.98)	(11.59)	(5.59)	(6.00)	0.32	(0.23)	0.09
PPL Corporation	0.07	0.17	(0.10)	(10.16)	(10.16)	0.00		(0.01)	(0.01)

$$0.07 \times 3.88 / 0.90 = 0.30$$

Interpretation of Attribution Results

► Three-Factor Investment Process

	Underperform	Outperform
Overweight	—	+
Underweight	+	—

$$(w_j^P - w_j^B) \bullet (R_j^B - R^B)$$

Interpretation of Attribution Results

Three-Factor: Sector Weighting Effect

	Underperform	Outperform
Overweight	—	+
Underweight	+	—

- ▶ Good sector weighting decision in Consumer Goods, resulting in 0.15%
 - ▶ Consumer Goods underweighted → -8.53%
 - ▶ Sector underperformed the total → -0.66% vs. 1.06%

Name Level 1 2	Rescaled Weights %			Return %			Attribution Effect			
	Portfolio	Benchmark	+/-	Portfolio	Benchmark	+/-	Weighting %	Selection %	Interaction %	Active Return %
▶ Business Services	6.23	4.91	1.32	14.63	(0.93)	15.55	(0.03)	0.76	0.21	0.94
▶ Consumer Goods	2.23	10.76	(8.53)	6.52	(0.66)	7.19	0.15	0.77	(0.61)	0.31
▶ Consumer Services	8.87	7.74	1.12	5.01	4.70	0.31	0.04	0.02	0.00	0.07
▶ Energy	8.37	14.39	(6.03)	(1.09)	(4.02)	2.92	0.31	0.42	(0.18)	0.55
▶ Financial Services	11.42	13.33	(1.90)	0.38	(0.19)	0.57	0.02	0.08	(0.01)	0.09
▶ Hardware	19.59	8.97	10.62	4.59	1.71	2.88	0.07	0.26	0.31	0.63
▶ Healthcare	15.43	13.98	1.45	6.83	6.81	0.02	0.08	0.00	0.00	0.09
▶ Industrial Materials	19.96	11.44	8.51	6.06	1.82	4.24	0.06	0.49	0.36	0.91
▶ Media	1.32	2.58	(1.27)	(5.44)	4.68	(10.12)	(0.05)	(0.26)	0.13	(0.18)
▶ Software	3.92	3.88	0.04	3.73	0.92	2.81	(0.00)	0.11	0.00	0.11
▶ Telecommunication	1.56	3.82	(2.26)	8.21	0.99	7.22	0.00	0.28	(0.16)	0.11
▶ Utilities	1.05	4.18	(3.14)	(7.19)	(2.22)	(4.97)	0.10	(0.21)	0.16	0.05
▶ Unclassified	0.06	0.00	0.06	(2.79)	(2.79)	0.00	(0.00)	0.00	0.00	(0.00)
Attribution Total	100.00	100.00	0.00	4.74	1.06	3.68	0.77	2.72	0.20	3.68



Interpretation of Attribution Results

Three-Factor: Selection Effect

	Underperform	Outperform
Overweight	—	+
Underweight	+	—

- ▶ Poor security selection decision in Nike, resulting in -0.14%
 - ▶ Must anchor on prior hierarchy
 - ▶ Security overweighted → 4.87% vs. 0.27%
 - ▶ Security underperformed the sector → -3.76% vs. -0.66%

Name	Rescaled Weights %			Return %			Attribution Effect			
	Portfolio	Benchmark	+/-	Portfolio	Benchmark	+/-	Weighting %	Selection %	Interaction %	Active Return %
Level 1 2										
▼ Consumer Goods	2.23	10.76	(8.53)	6.52	(0.66)	7.19	0.15	0.77	(0.61)	0.31
Nike, Inc. B	1.01	0.27	0.74	(3.76)	(3.76)	0.00		(0.14)		(0.14)
Philip Morris Interna...	0.00	1.11	(1.11)	4.54	4.54	0.00		(0.06)		(0.06)
Lululemon Athletica,...	0.03	0.00	0.03	(19.25)	(19.25)	0.00		(0.03)		(0.03)
Colgate-Palmolive ...	0.00	0.42	(0.42)	5.33	5.33	0.00		(0.03)		(0.03)
Avon Products	0.00	0.11	(0.11)	13.89	13.89	0.00		(0.02)		(0.02)

$$1.01 \times 10.76 / 2.23 = 4.87$$

Interpretation of Attribution Results

Three-Factor: Interaction

	Underperform	Outperform
Overweight	—	+
Underweight	+	—

- ▶ Poor interaction of decisions in Consumer Goods, resulting in -0.61%
 - ▶ Consumer Goods underweighted → -8.53%
 - ▶ Sector active management outperformed passive → 7.19%

Name Level 1 2	Rescaled Weights %			Return %			Attribution Effect			
	Portfolio	Benchmark	+/-	Portfolio	Benchmark	+/-	Weighting %	Selection %	Interaction %	Active Return %
▶ Business Services	6.23	4.91	1.32	14.63	(0.93)	15.55	(0.03)	0.76	0.21	0.94
▶ Consumer Goods	2.23	10.76	(8.53)	6.52	(0.66)	7.19	0.15	0.77	(0.61)	0.31
▶ Consumer Services	8.87	7.74	1.12	5.01	4.70	0.31	0.04	0.02	0.00	0.07
▶ Energy	8.37	14.39	(6.03)	(1.09)	(4.02)	2.92	0.31	0.42	(0.18)	0.55
▶ Financial Services	11.42	13.33	(1.90)	0.38	(0.19)	0.57	0.02	0.08	(0.01)	0.09
▶ Hardware	19.59	8.97	10.62	4.59	1.71	2.88	0.07	0.26	0.31	0.63
▶ Healthcare	15.43	13.98	1.45	6.83	6.81	0.02	0.08	0.00	0.00	0.09
▶ Industrial Materials	19.96	11.44	8.51	6.06	1.82	4.24	0.06	0.49	0.36	0.91
▶ Media	1.32	2.58	(1.27)	(5.44)	4.68	(10.12)	(0.05)	(0.26)	0.13	(0.18)
▶ Software	3.92	3.88	0.04	3.73	0.92	2.81	(0.00)	0.11	0.00	0.11
▶ Telecommunication	1.56	3.82	(2.26)	8.21	0.99	7.22	0.00	0.28	(0.16)	0.11
▶ Utilities	1.05	4.18	(3.14)	(7.19)	(2.22)	(4.97)	0.10	(0.21)	0.16	0.05
▶ Unclassified	0.06	0.00	0.06	(2.79)	(2.79)	0.00	(0.00)	0.00	0.00	(0.00)
Attribution Total	100.00	100.00	0.00	4.74	1.06	3.68	0.77	2.72	0.20	3.68



Special Situation

Special Situation I

Short Positions

- ▶ Attribution analysis must be performed on the short positions separately from the long positions

Name	Rescaled Weights %			Return %			Attribution Effect			
	Portfolio	Benchmark	+/-	Portfolio	Benchmark	+/-	Long/Short Weighting %	Morningstar Super Sector Weighting %	Selection %	Active Return %
Level <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3										
▼ Long Equity	154.52	100.00	54.52	(6.65)	(6.17)	(0.48)	0.00	(0.60)	(0.14)	(0.74)
▶ Information	39.27	20.59	18.68	(9.37)	(10.93)	1.56		(0.35)	0.61	0.26
▶ Manufacturing	59.11	38.68	20.43	(7.26)	(7.64)	0.37		0.01	0.22	0.23
▶ Services	56.14	40.73	15.41	(4.10)	(2.36)	(1.74)		(0.26)	(0.97)	(1.23)
▶ Missing Performance										
▼ Short Equity	(54.52)	0.00	(54.52)	(8.15)	(6.17)	(1.98)	0.00	0.42	0.66	1.08
▶ Information	(19.15)	0.00	(19.15)	(13.85)	(10.93)	(2.92)		0.91	0.56	1.47
▶ Manufacturing	(16.20)	0.00	(16.20)	(6.10)	(7.64)	1.54		0.24	(0.25)	(0.01)
▶ Services	(19.17)	0.00	(19.17)	(4.18)	(2.36)	(1.82)		(0.73)	0.35	(0.38)
Total Equity	100.00	100.00	0.00	(5.83)	(6.17)	0.34	0.00	(0.18)	0.52	0.34

Special Situation II

Groups without Holdings

- ▶ Condition 1

- ▶ If neither the portfolio nor the benchmark has holdings in a particular group, this group is ignored during attribution analysis

Special Situation II

Groups without Holdings (continued)

► Condition 2

- If the portfolio does not have holdings in a particular group, then portfolio return = benchmark return
 - Attribution result reflects sector weighting decision
 - Attribution results are zero for subsequent decisions

	Weights %		Return %		Attribution Effect		
	Portfolio	Benchmark	Portfolio	Benchmark	Sector	Industry	
					Weighting %	Weighting %	Selection %
Industrial Materials	0.00	11.75	13.23	13.23	-0.98	0.00	0.00
Aerospace & Defense	0.00	1.55	2.83	2.83		0.00	0.00
Aircastle Ltd.	0.00	0.00	1.90	1.90			0.00
Alliant Techsystems, Inc.	0.00	0.02	3.59	3.59			0.00
Armor Holdings, Inc.	0.00	0.01	10.30	10.30			0.00

Special Situation II

Groups without Holdings (continued)

► Condition 3

- If the benchmark does not have holdings in a particular group and this group contains long positions, then benchmark return = portfolio return
 - Attribution result reflects sector weighting decision
 - Attribution results sum to zero for subsequent decisions

	Weights %		Return %		Attribution Effect	
	Portfolio	Benchmark	Portfolio	Benchmark	Weighting %	Selection %
Media	3.03	0.00	-1.45	-1.45	0.05	0.00
Comcast Corporation A	0.50	0.00	9.07	9.07		0.05
News Corporation Ltd. B	0.86	0.00	-4.82	-4.82		-0.03
Time Warner, Inc.	0.48	0.00	-3.24	-3.24		-0.01

Special Situation II

Groups without Holdings (continued)

► Condition 4

- If the benchmark does not have holdings in a particular group, and this group contains short positions, then benchmark return of short position = benchmark return of long position counterpart

	Weights %		Return %		Attribution Effect	
	Portfolio	Benchmark	Portfolio	Benchmark	Weighting %	Selection %
Long Equity						
Healthcare	21.53	11.99	-6.19	-5.01	0.03	-0.25
Affymetrix, Inc.	0.00	0.00	-13.31	-13.31		0.00
Alpharma, Inc.	0.00	0.00	1.74	1.74		0.00
Applied Biosystems Inc	0.00	0.04	-7.25	-7.25		0.00
Short Equity						
Healthcare	-10.37	0.00	-2.19	-5.01	-0.12	-0.29
Affymetrix, Inc.	-0.52	0.00	-13.31	-13.31		0.04
Alpharma, Inc.	-0.53	0.00	1.74	1.74		-0.04
Applied Biosystems Inc	-0.44	0.00	-7.25	-7.25		0.01

Future Enhancements

Future Enhancements

- ▶ 3.6.1 (March 2009)
 - ▶ Three Factor Model
 - ▶ Multi-Manager Attribution for Fund-of-Funds and Aggregates (Asset Level)
 - ▶ Two portfolios vs. One benchmark Output
 - ▶ Display “Reported” Return by Fund Manager vs. “Attribution” Return
 - ▶ Executive Summary
 - ▶ Attribution Holdings Data View of Portfolio and Benchmark Holding Dates
 - ▶ Export Data to Expand and Collapse Groupings
- ▶ Coming Soon
 - ▶ Chart and Reports
 - ▶ Batch Scheduling
 - ▶ Currency Attribution, Transaction-Based Attribution, Basic Fixed Income Attribution

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