

### A Decision-Based Approach to Risk-Adjusted Performance Attribution

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### Intro

Why and how this method is developed

- Bridging the gap between the drivers of investment returns (Risk) and the decision-making process (Attribution)
- Evaluate the role of risk in interpreting attribution results







### Decision level

Classic Brinson-Fachler models a 2-step investment process, over a single period (e.g., a day):





Decision level

#### Example:

	Return			Attribution
	(bps)			Effect (bps)
Benchmark	109.64	N		
<b>Notional Allocation</b>	118.31	$\Box >$	Allocation	8.68
Portfolio	131.38	V	Selection	13.06
Excess	21.74		Total	21.74





Segment level

Allocation effect: 
$$A_i \coloneqq (w_i - \overline{w}_i) \cdot (\overline{r}_i - \overline{r})$$
  
Selection effect:  $S_i \coloneqq w_i \cdot (r_i - \overline{r}_i)$ 

$$\sum_{i} A_i + \sum_{i} S_i = A + S = r_{XS}$$



5



#### Segment level

	V	Veights (%)		Re	eturns (bps)				Attribu	tion Effects (k	ops)
Sector	Benchmark	Portfolio	Excess	Benchmark	Portfolio	Excess		Sector	Allocation	Selection	Total
Energy	7.34	1.94	-5.40	17.80	22.56	4.77		Energy	4.96	0.09	5.05
Materials	9.31	20.60	11.29	146.30	77.67	-68.63		Materials	4.14	-14.14	-10.00
Industrials	11.43	25.47	14.04	95.57	199.58	104.01		Industrials	-1.97	26.49	24.52
Consumer Disc	10.45	2.13	-8.32	122.63	115.68	-6.95	N	Consumer Disc	-1.08	-0.15	-1.23
<b>Consumer Staples</b>	6.88	1.85	-5.03	48.05	82.87	34.83		Consumer Staples	3.10	0.64	3.74
Health Care	2.95	3.77	0.82	-0.57	-175.76	-175.18	$\neg$	Health Care	-0.90	-6.60	-7.51
Financials	27.84	25.09	-2.75	231.64	201.73	-29.91		Financials	-3.35	-7.50	-10.85
Information Tech	5.07	3.79	-1.28	137.89	175 <mark>.</mark> 52	37.63		Information Tech	-0.36	1.43	1.07
Telecom Services	8.07	8.07	0.00	-29.53	129.12	158.64		<b>Telecom Services</b>	0.00	12.81	12.81
Utilities	10.67	7.29	-3.38	-13.03	-13.03	0.00		Utilities	4.15	0.00	4.15
Total	100.00	100.00	0.00	109.64	131.38	21.74		Total	8.68	13.06	21.74

#### **Observations:**

- Top contributor: Industrials Selection
- Top detractor: Materials Selection
- Passive allocation for Telecom Services
- Passive selection for Utilities





### Short-term risk

- We need a definition of risk representing a single period, reflecting the decision made by the manager
- A portfolio return is decomposed into contributions from all securities:

$$r = \sum_{s} w_{s} \cdot r_{s}$$

This gives the *short-term volatility*:

$$\sigma \coloneqq \sqrt{\sum_{s,x} w_s \cdot w_x \cdot cov_{s,x}}$$







### Short-term risk

• Turning the short-term volatility to a ratio of risk premium per unit of risk results in the short-term Sharpe ratio:



### Short-term risk

Portfolio: σ, sr

• Benchmark:  $\bar{\sigma}, \bar{sr}$ 

• Notional Allocation:  $\sigma_{NA}$ ,  $sr_{NA}$ 

• Segments:  $\sigma_i, sr_i = \overline{\sigma}_i, \overline{sr}_i$ Portfolio Benchmark Risk-free rate (bps) 1.262

	Short-term Volatility (bps)	Short-term Sharpe Ratio
Benchmark	192.96	0.562
Notional Allocation	200.17	0.585
Portfolio	224.75	0.579

	Shor	t-term Volat	ility (bps)	) Short-term Sharpe Rat			
Sector	Benchmark	Portfolio	Excess	Benchmark	Portfolio	Excess	
Energy	207.51	250.77	43.26	0.080	0.085	0.005	
Materials	225.18	211.77	-13.41	0.644	0.361	-0.283	
Industrials	220.99	337.11	116.11	0.427	0.588	0.162	
Consumer Disc	196.96	303.45	106.49	0.616	0.377	-0.239	
Consumer Staples	167.56	162.82	-4.75	0.279	0.501	0.222	
Health Care	164.44	194.18	29.74	-0.011	-0.912	-0.900	
Financials	230.86	233.59	2.73	0.998	0.858	-0.140	
Information Tech	264.92	292.03	27.12	0.516	0.597	0.081	
Telecom Services	156.63	198.28	41.66	-0.197	0.645	0.841	
Utilities	216.90	216.90	0.00	-0.066	-0.066	0.000	
Total	192.96	224.75	31.78	0.562	0.579	0.017	



Our proposed method combines the ideas of classic Brinson attribution and short-term risk

**Important:** Apply the method to the level on which the investment decisions are made

Levels:

- Overall
- Per decision
  - Per decision and per segment





## **Risk-adjusted attribution** Overall level

				51			
$r_{XS} = r - \bar{r}$				GT	•		
$= (r-f) - (\bar{r}-f)$				51	D 4	DI.	
$= \sigma \cdot sr - \overline{\sigma} \cdot \overline{sr}$					$r_{XS}^{RA}$	$r_{XS}^{RI}$	
$\int_{-\infty}^{\overline{\sigma} \cdot (sr - \overline{sr})}$	=:	$r_{XS}^{RA}$	<b>Risk-Adjusted</b>	sr			
$= \begin{cases} (\sigma - \overline{\sigma}) \cdot \overline{sr} \\ \bot \end{cases}$	=:	$r_{XS}^{RR}$	<b>Risk-Related</b>		Benchmark risk	$r_{XS}^{RR}$	
$\left( (\sigma - \overline{\sigma}) \cdot (sr - \overline{sr}) \right)$	=:	$r_{XS}^{RI}$	<b>Risk Interaction</b>		preimum		Volatili

Sharne ratio

ty risk  $\bar{\sigma}$  $\sigma$ 

11



## **Risk-adjusted attribution** Overall level

#### Example:

				35 Neturn
	Short-term	Short-term	Contribu	tion (bps)
	Volatility (bps)	Sharpe Ratio	Risk adjusted (RA)	3.34
Benchmark	192.96	0.562	Risk related (RR)	17.85
Portfolio	224.75	0.579	Risk interaction (RI)	0.55
			Total	21.74

#### Observation:

Excess return is mostly due to excess risk taken in the portfolio





Evenes Daturn

### **Risk-adjusted attribution** Decision level

We can decompose the allocation and selection effect in a similar way:





## **Risk-adjusted attribution** Decision level

#### Example:

	Short-term	Short-term		Attribu	tion Effects	(bps)
,	olatility (bps)	Sharpe Ratio		Allocation	Selection	Total
Benchmark	192.96	0.562	Risk adjusted (RA)	4.46	-1.16	3.30
Notional Allocati	on 200.17	0.585	Risk related (RR)	4.05	14.37	18.42
	200.17	0.505	Risk interaction (RI)	0.17	-0.14	0.02
Portiolio	224.75	0.579	Total	8.68	13.06	21.74

#### **Observations:**

- Allocation almost evenly due to risk-adjusted and risk-related outperformance
- Selection mainly attributable to excess risk





Let's stack up all analyses until now:

Brinso	n-Fachler	Risk-adjusted (Ov	ed (Overall) Risk-adjusted (Decision)					
Attribution		Excess	s Return	Attribution Effects (bps)				
	Effect (bps)	Contributi	Allocation Selection Tota					
Allocation	8.68	Risk adjusted (RA)	3.34	Risk adjusted (RA)	4.46	-1.16	3.30	
Selection	13.06	Risk related (RR)	17.85	Risk related (RR)	4.05	14.37	18.42	
	13.00	Risk interaction (RI)	0.55	Risk interaction (RI)	0.17	-0.14	0.02	
lotal	21.74	Total	21.74	Total	8.68	13.06	21.74	

#### The level of the analysis matters!





Segment level

 Portfolio risk premium contribution, split into the benchmark risk premium contribution and attribution effects



16



### Segment level - Selection

	Attribution Enects (bps)									
	Allocation				Selectio	on		Total		
Sector	RA	RR	RI	Total	RA	RR	RI	Total		
Energy				4.96	0.02	0.07	0.00	0.09	5.05	
Materials				4.14	-13.14	-1.78	0.78	-14.14	-10.00	
Industrials				-1.97	9.09	12.62	4.78	26.49	24.52	
Consumer Disc				-1.08	-1.00	1.40	-0.54	-0.15	-1.23	
Consumer Staples				3.10	0.69	-0.02	-0.02	0.64	3.74	
Health Care				-0.90	-5.58	-0.01	-1.01	-6.60	-7.51	
Financials				-3.35	-8.09	0.68	-0.10	-7.50	-10.85	
Information Tech				-0.36	0.81	0.53	0.08	1.43	1.07	
Telecom Services				0.00	10.64	-0.66	2.83	12.81	12.81	
Utilities				4.15	0.00	0.00	0.00	0.00	4.15	
Total	4.46	4.05	0.17	8.68	-6.57	12.82	6.81	13.06	21.74	

Attribution Effects (bps)

### Observations:

- Top contributor: Industrials Additional risk
- Top detractor: Materials Risk adjusted
- Passive selection for Utilities Passive risk tolerance





#### Segment level

	V	Veights (%)		Re	eturns (bps)				Attribu	tion Effects (k	ops)
Sector	Benchmark	Portfolio	Excess	Benchmark	Portfolio	Excess		Sector	Allocation	Selection	Total
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#### **Observations:**

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- Top detractor: Materials Selection
- Passive allocation for Telecom Services

Passive selection for Utilities





### Segment level - Allocation

				Attisut		(242)					
		Allocatio	on			Selectio	n		Total		
Sector	RA	RR	RI	Total	RA	RR	RI	Total			
Energy	4.75	0.12	0.09	4.96	0.02	0.07	0.00	0.09	5.05		
Materials	2.58	1.49	0.08	4.14	-13.14	-1.78	0.78	-14.14	-10.00		
Industrials	-3.22	1.28	-0.03	-1.97	9.09	12.62	4.78	26.49	24.52		
Consumer Disc	-1.55	0.49	-0.02	-1.08	-1.00	1.40	-0.54	-0.15	-1.23		
Consumer Staples	1.87	1.17	0.06	3.10	0.69	-0.02	-0.02	0.64	3.74		
Health Care	-0.60	-0.29	-0.02	-0.90	-5.58	-0.01	-1.01	-6.60	-7.51		
Financials	-2.84	-0.45	-0.06	-3.35	-8.09	0.68	-0.10	-7.50	-10.85		
Information Tech	-0.11	-0.25	-0.01	-0.36	0.81	0.53	0.08	1.43	1.07		
Telecom Services	0.00	0.00	0.00	0.00	10.64	-0.66	2.83	12.81	12.81		
Utilities	3.57	0.50	0.08	4.15	0.00	0.00	0.00	0.00	4.15		
Total	4.46	4.05	0.17	8.68	-6.57	12.82	6.81	13.06	21.74		
Obs	Observations:										

Attribution Effects (bps)

### Top contributor: Energy – Risk adjusted

- Top detractor: Financials Risk-adjusted
- Passive allocation for Telecom Services





### Takeaways

- Expand on classical attribution to show how risk affected the outcome of decisions
- Risk decomposition
  - Risk-adjusted outperformance
  - Incremental Risk
  - Interaction

Application of new attribution framework to various decision levels







### Variants

- Independent selection decision (separate interaction effect)
- Brinson-Hood-Beebower
- Multi-level

(Details in the article)







## **Questions?**









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