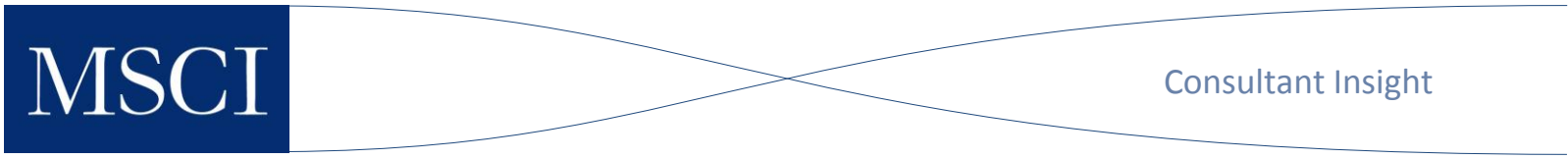

Manager Risk Contribution: *Attributing Risk in a Multi-Manager Portfolio*

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Introduction

Asset owners often allocate capital to asset classes or regional groups by investing in a roster of portfolio managers in each group. For example, equities are often broken down into groups of managers with the same geographic focus—such as US, International and Emerging Markets. In Miller (2013) we examined a sample Global Equity portfolio with benchmark misfit. In this paper, we examine the same Global Equity portfolio, but add another dimension of analysis. The result is a simple and intuitive framework for answering the following question: *given a portfolio of managers, how does the active risk of each manager relate to the active risk of the portfolio?*

When reviewing managers in isolation, investors measure the forecast active risk of each manager to their own benchmark as a basis for comparing managers. For example, the active risk of two portfolios using MSCI EAFE as their benchmark can be compared to see which portfolio is expected to show a wider distribution of benchmark-relative returns. This works even if the two portfolio managers are following different investment strategies as long as each is managing their portfolio to outperform MSCI EAFE. For simplicity, we will refer to the forecast active risk of a single manager as Manager Risk. This measure is always made relative to the manager's assigned benchmark, sometimes called the mandate benchmark.

Investors who own a portfolio of managers are frequently interested in measuring the contribution each manager makes to the active risk of the whole portfolio. We call this the Manager Risk Contribution.

In this Consultant Insight, we extend the analysis of the previous paper, Miller (2013). We introduced previously the misfit effect on a Global Equity portfolio as the return contribution due to differences between the manager benchmark and policy benchmark. In this paper, the same Global Equity portfolio is formed from the combination of five managers across three regions. We form an expression for Manager Risk Contribution in terms of the selection effect and misfit effect. We use this expression to calculate the Manager Risk Contribution for each of the managers.

The result is a decomposition which identifies the contribution to the active risk of the Global Equity portfolio from the following sources for each of the three regions: allocation, selection and benchmark misfit. For each manager *k* in each region *i*, we identify the manager risk contribution. Finally, we demonstrate that the traditional Brinson allocation effect can be added to the sum of manager risk contribution across region *i* to measure the risk contributed for the region as a whole.

We believe the results described are significant because they facilitate a *coherent* view of a manager's portfolio: the Manager Risk Contribution is a simple function of the Manager Risk. This should have meaningful implications for the reporting framework used by investors to attribute ex-post performance (return, risk and risk-adjusted return) as well as ex-ante risk. Moreover, though we discuss risk as the standard deviation of benchmark relative returns here, this framework is applicable to any convex risk measure such as expected shortfall. See Goldberg (2010) for more details on convex risk measures.

Manager Risk Contribution: An Example

Table 1 shows the Global Equity portfolio as a combination of three regions and five managers. In each of the International and Emerging Markets regions, there is a single manager responsible for all the investor's assets in the region. In the US, the investor has allocated capital to three managers[1]. The investor's policy benchmark for the US region is MSCI USA IMI. Each of the three US managers is measured against a benchmark other than MSCI USA IMI to illustrate the misfit that often exists between the policy and manager benchmarks. The benchmark and weight of each region and manager in the Global Equity portfolio is presented in Table 1. All of the analysis in this paper is based on portfolio holdings as of 12/31/2012.

Region	Policy Benchmark	Portfolio Weight (%)	Benchmark Weight (%)	Active Weight (%)	Manager	Manager Benchmark	Manager Weight (%)
US	MSCI USA IMI	50.12	46.12	4.00	US Mgr I	MSCI USA	20.00
					US Mgr II	MSCI USA IMI Value	50.00
					US Mgr III	MSCI USA IMI Value	30.00
Intl	MSCI World exUSA IMI	41.96	40.96	1.00	Intl Mgr	MSCI World exUSA IMI	100.00
EM	MSCI EM IMI	7.93	12.93	-5.00	EM Mgr	MSCI EM IMI	100.00
Equity	**MSCI ACWI IMI**	**100.00**	**100.00**	**0.00**			

Table 1: Capital and policy weights for a sample global equities portfolio. The asset owner allocates capital to each region by investing in one or more portfolio managers.

The previous paper described the benchmark misfit effect and extended the Brinson model to include a third term to measure the magnitude of misfit. Equation (1) presents the framework used to attribute the active return of a portfolio based on allocation, selection and the benchmark misfit effect.

Equation 1

$$R^A = \sum_i (w_i^P - w_i^B)(r_i^B - R^B) + \sum_i (w_i^P)(r_i^P - r_i^Q) + \sum_i (w_i^P)(r_i^Q - r_i^B)$$

The portfolio and benchmark weights in region *i* are given by w_i^P and w_i^B, respectively. The corresponding region returns are r_i^P and r_i^B. The overall benchmark return is given by R^B.

[1] We used the same assets for the analysis presented in both papers. The US region was formed by combining the three US managers we discuss here. Miller (2013) represented the combination of the three US managers as a single manager.

The first term in Equation (1) is known as the allocation effect, it is given by the product of the active weight, $(w_i^P - w_i^B)$, and the relative region return, $(r_i^B - R^B)$. Positive allocation effect is obtained either by overweighting outperforming regions, or by underweighting the underperformers.
The second term in Equation (1) is known as the selection effect, it is given by the product of the portfolio region weight and the active return for the manager in that region, $(r_i^P - r_i^Q)$. The return r_i^Q represents the return of the manager's benchmark, which may differ from the policy benchmark for the region. For net-long portfolios, positive selection effect is obtained when the manager outperforms his benchmark.

The third term in Equation (1) has been defined as the benchmark misfit effect, it is given by the product of the portfolio region weight and the misfit return: $(r_i^Q - r_i^B)$. This effect is positive when the manager's benchmark outperforms the policy benchmark in the region.

Extending this equation to measure the contribution from each manager within region *i* requires one additional term. We define $u_{i,k}^P$ as the weight of manager *k* within region *i*. Note that this term sums to 100% for each region. The sum of the contribution from each manager *k* is equal to the total contribution from selection and benchmark misfit for region *i*. Equation (2) expresses the allocation, selection and benchmark misfit effects in terms of a group of *K* managers for each region *i*.

Equation 2

$$R^A = \sum_i (w_i^P - w_i^B)(r_i^B - R^B) + \sum_i \sum_k (w_i^P)(u_{i,k}^P)(r_{i,k}^P - r_{i,k}^Q) + \sum_i \sum_k (w_i^P)(u_{i,k}^P)(r_{i,k}^Q - r_i^B).$$

Comparing Equations (1) and (2), we can see that selection effect has been re-written to measure the contribution from manager *k* for all the managers in region *i*. The benchmark misfit effect has also been re-written to measure the misfit return for each manager *k*.

The terms in Equation (2) correspond to familiar and well-understood concepts in the manager oversight investment process. It is common practice for investors to measure the weight of each region in the portfolio and benchmark, along with the weight of each manager in each region. They also measure the relative return and manager active return as part of standard performance reporting; the misfit return may not be a familiar concept, but it is easily identified as the active return of one benchmark relative to another. It is important to note that we have not defined any novel concepts to arrive at Equation (2). We are only recombining sources of active return.

To measure the contribution to the active return of the Global Equity portfolio for each manager *k* in region *i*, we sum the selection effect and benchmark misfit effect for that manager. The last step remaining is to decompose portfolio active risk along the same dimensions. Following Menchero (2011), we re-write Equation (2) as:

Equation 3

$$\sigma(R^A) = \sum_i (w_i^P - w_i^B)\sigma(r_i^B - R^B)\,\rho(r_i^B - R^B, R^A) + \sum_i \sum_k (w_i^P)(u_{i,k}^P)\sigma(r_{i,k}^P - r_{i,k}^Q)\rho(r_{i,k}^P - r_{i,k}^Q, R^A) + \sum_i \sum_k (w_i^P)(u_{i,k}^P)\sigma(r_{i,k}^Q - r_i^B)\rho(r_{i,k}^Q - r_i^B, R^A)$$

Equation (3) can now be applied to the Global Equity portfolio, a portfolio of three regional allocations and five portfolio managers.

Table 1 provides the measures of region and Manager Weight required by Equation (3). Table 2 provides the necessary volatility and correlation forecasts. Recall that Active refers to the manager's tilts against their own mandate, while Misfit refers to the mandate's tilts against the policy benchmark. All of the forecast volatility and correlation measures were made using the Barra Integrated Model (BIM 301L.)

Region	Relative Volatility	Relative Correlation	Manager	Active Volatility	Active Correlation	Benchmark Misfit Volatility	Benchmark Misfit Correlation
US	5.63	0.12	US Mgr I	0.59	-0.10	0.79	0.21
			US Mgr II	5.25	0.34	1.74	0.19
			US Mgr III	1.74	0.11	1.74	0.19
Intl	4.86	-0.05	Intl Mgr	3.66	0.72	0.00	0.00
EM	9.03	-0.18	EM Mgr	2.87	0.00	0.00	0.00

Table 2: Volatility and correlation forecasts associated with the relative, active and misfit returns for each region and manager:

The highlighted values highlight the inputs to our Manager Risk Contribution measurement that are being described here for the first time. All other measurements are the same as in the previous discussion of this portfolio.

We can see in Table 2 that each of the three US managers has a unique value for active volatility. US Manager I is a passive index tracker with a Manager Risk of just 59 basis points relative to MSCI USA. US Manager II is a concentrated active manager, and has a Manager Risk of 525 basis points relative to MSCI USA IMI Value. MSCI USA IMI Value is also the manager benchmark for US Manager III; it has a Manager Risk of 179 basis points. Each of these managers also has a distinct active correlation; the active return of each manager is forecast to have a correlation with the active return of the Global Equity portfolio between -0.10 (US Manager I) and 0.34 (US Manager II.)

The benchmark misfit volatility of US Manager I, 79 basis points, reflects the forecast active risk of MSCI USA relative to MSCI USA IMI. The forecast correlation of this benchmark misfit return with the active return of the Global Equity portfolio is 0.21. The benchmark misfit volatility and benchmark misfit correlation for US Manager II are the same as for US Manager III—due to the fact that these managers have the same benchmark, MSCI USA IMI Value. For the International and Emerging Markets regions, each of the weights, volatilities and correlations presented in Tables 1 and 2 in this Consultant Insight are the same as was presented in the previous paper.

We define the Manager Risk Contribution of manager *k* in region *i*, $c_{i,k}^{P}$, as the sum of manager *k's* Active Contribution and Benchmark Misfit Contribution, as shown in Equation (4):

Equation 4

$$c_{i,k}^{P} = (w_i^P)(u_{i,k}^P)\sigma(r_{i,k}^P - r_{i,k}^Q)\rho(r_{i,k}^P - r_{i,k}^Q, R^A) + (w_i^P)(u_{i,k}^P)\sigma(r_{i,k}^Q - r_i^B)\rho(r_{i,k}^Q - r_i^B, R^A)$$

In Table 3, we report the risk contributions from the allocation, selection and misfit effects from each region. In the US, the risk contribution is attributed to an active component and a benchmark misfit component for each of the three managers. Importantly, the active risk contribution is expressed as a function of the manager risk $\sigma(r_{i,k}^P - r_{i,k}^Q)$.The selection effect and misfit effect for each manager are added together and labeled as Manager Risk Contribution in Table 4.

Region	Relative Contribution	Manager	Active Contribution	Benchmark Misfit Contribution	Total Contribution
US	0.03	US Mgr I	-0.01	0.02	0.65
		US Mgr II	0.45	0.08	
		US Mgr III	0.03	0.05	
Intl	0.00	Intl Mgr	1.10	0.00	1.10
EM	0.08	EM Mgr	0.00	0.00	0.08
Equity	**0.10**		**1.57**	**0.15**	**1.82**

Table 3: Contribution to portfolio active risk for the global equity portfolio

Region	Relative Contribution	Manager	Manager Risk Contribution	Total Contribution
US	0.03	US Mgr I	0.01	0.65
		US Mgr II	0.53	
		US Mgr III	0.08	
Intl	0.00	Intl Mgr	1.10	1.10
EM	0.08	EM Mgr	0.00	0.08
Equity	**0.10**		**1.57**	**1.82**

Table 4: Relative Contribution, Manager Risk Contribution and Total Contribution for the global equity portfolio

Equation (4) is particularly useful when the investor wants to understand the Active Risk of the Global Equity portfolio as a sum of relative contributions and a single contribution term for each manager. We can confirm that the total risk contribution in the US (65 basis points) is the sum of the relative risk contribution (3 basis points) and the Manager Risk Contribution for the three US Managers (1 + 53 + 8 = 62 basis points.)

The two Insights on Manager Risk attribution have to this point focused on theoretically extending Brinson attribution to multiple sources of return and multiple managers in a shared mandate. Practically, the active risk decomposition is powerful. For example, two themes emerge from our stylized Global Equity portfolio shown in Table 4.

First, the US allocation consumes over 35% (65 basis points/182 basis points) of the active risk budget. The majority of this is generated not from the allocation decision, but rather the active decisions of US Manager II. This manager has a large proportion (50%) of the US allocation, a large Manager Risk, and active returns that are moderately correlated with the active returns of the Global Equity portfolio. All of these sources amplify Manager Risk Contribution. Importantly, in this case the asset owner can single out the amount of benchmark misfit (8 basis points) in US Manager II that could otherwise confound the monitoring function.

Second, the International Manager consumes over 60% (110 basis points / 182 basis points) of the active risk budget. This is due to the Manager's having over 40% of the capital allocation, a relatively high standalone active risk, and active returns that are highly correlated (0.72) with the active returns of the Global Equity portfolio. When Global Equities outperforms the policy benchmark, the International Manager will also tend to outperform its own benchmark, amplifying active risk.

Conclusion

Asset owners often measure Manager Risk (the active risk of each manager) and have difficulty relating it to the contribution each manager makes to the multi-manager portfolio. We believe it is important that the analysis of the multi-manager portfolio be coherent with the analysis of each manager in isolation.

In order to achieve this, we have defined and calculated Manager Risk Contribution as the product of Manager Weight, Manager Risk and the correlation of the manager's active return with the active return of the entire portfolio. This extends the familiar Brinson attribution framework to the multi-manager portfolio. Utilizing the X-Sigma-Rho risk attribution framework described in Menchero (2011), we measure the additive contribution from each manager as a function of Manager Weight, Manager Risk and active correlation with the Global Equity portfolio.

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[1] *As of September 30, 2012, as published by eVestment, Lipper and Bloomberg on January 31, 2013*

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