Diversification with Correlations and Return Gaps

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Editor's Note: This article is an updated version of Statman and Scheid (2008).

Think of two assets, say U.S. stocks and international stocks. Suppose that we tell you that the correlation between their returns is 0.88. What is your estimate of the typical annual return gap between them? The return gap is the difference between the returns of the two assets, without regard to which asset has the high return and which has the low return.

Here are four questions:

1. Would you say that the typical annual return gap:
   a. Is higher than 6 percentage points?
   b. Is between 3 and 6 percentage points?
   c. Is between 1 and 3 percentage points?
   d. Is lower than 1 percentage point?

2. Would you say that the correlation between the returns of U.S. and international stocks is, on average, higher in down months—when the returns of both U.S. and international stocks are negative, than in up months—when the returns of both are positive?
   a. Yes
   b. No

3. Would you say that the benefits of diversification between U.S. and international stocks are, on average, smaller in down months than in up months?
   a. Yes
   b. No

4. Would you say that the standard deviations of the returns of U.S. and international stocks affect the benefits of diversification, beyond the effect of the correlation between the returns?
   a. Yes
   b. No

Here are our answers:

1. The typical annual return gap is higher than 6 percentage points.
2. Yes, the correlation between the returns of U.S. and international stocks is, on average, higher in down months than in up months.
3. No, the benefits of diversification between U.S. and international stocks are, on average, larger in down months than in up months.
4. Yes, the standard deviations of the returns of U.S. and international stocks affect the benefits of diversification, beyond the effect of the correlation between the returns.

Correlations

We commonly use correlations between the returns of assets as measures of the benefits of diversification, but correlations are not good measures of the benefits of diversification, for two reasons. First, we tend to misperceive correlations. The benefits of diversification indeed disappear when correlations reach 1.0, but we tend to misperceive correlations of 0.9 as leaving little diversification benefit. In truth, 0.9 correlations and even 0.99 correlations provide substantial diversification benefits. Second, the benefits of diversification depend not only on the correlations between the returns of assets but also on the standard deviations of the returns of assets. The benefits of diversification are small when correlations are high, but the benefits of diversification are large when standard deviations are high.

Return Gaps

Return gaps are better measures of the benefits of diversification than correlations because they account for the effects of both correlations and standard deviations and because they provide intuitive measures of the benefits of diversification. Return gaps are gaps between the returns of pairs of assets, whether U.S. stocks and international stocks or between portfolios composed of many assets. Return gaps and the benefits of diversification are indeed small when correlations are high but they are large when standard deviations are high.

Investors who consider diversification ask: "By how much will I lag or lead a diversified portfolio if I fail to diversify?" Return gaps answer this question. Compare three investors considering portfolios composed of U.S. and international stocks: One invests his entire portfolio in U.S. stocks, another invests it all in international stocks, and the third diversifies her portfolio between the two, say in equal proportions.

Imagine that we are at December 31, 2007, contemplating the yet unknown 2008 returns. We find, at the end of 2008, that the return on U.S. stocks was a 37-percent loss and the return on international stocks was a 43-percent loss. The return gap in 2008 was 6 percentage points. The investor who concentrated his portfolio in U.S. stocks

is at the top of the gap, the investor who concentrated his portfolio in international stocks is at the bottom of the gap, and the investor who diversified her portfolio equally between the U.S. and international stocks is inside the gap, with a 40-percent loss.

The benefits of diversification are all about falling inside the gap. Diversified investors give up the hope of having an entire portfolio at the top of the gap, but they gain the freedom from fear of having an entire portfolio at the bottom of the gap. The top of the gap does not necessarily provide a positive return. The entire gap can be in the region of losses, as in 2008. Diversification does not eliminate the risk of losses, it only mitigates it. Only the risk-free rate eliminates losses, and that rate is low. A 40-percent loss is a terrible loss, but it is not as terrible as a 43-percent loss.

Return Gaps, Correlations, and Standard Deviations

Table 1 shows the return gaps between U.S. and international stocks during each of the 13 years from 2000 through 2012. Return gaps are substantial, ranging from a high of 11.06 percentage points in 2006 to a low of 1.89 percentage points in 2012. The mean annual return gap is 7.84 percentage points and the median annual return gap is 6.86 percentage points.

We can estimate the return gap between two assets from the standard deviations of their returns and their correlation (Statman and Scheid 2008).

$$\text{Estimated Return Gap} = 2\sigma\sqrt{\frac{(1-\rho)}{2}}$$

Each asset has an expected return and standard deviation of returns, and each pair of assets has a correlation between returns. We use the mean standard deviation of the returns of the two assets as our measure of the mean standard deviation, σ, and we use the correlation between the returns of the two assets as our measure of correlation, ρ. We see in the equation that estimated return gaps and the associated benefits of diversification are low when correlations are high, but return gaps are high when standard deviations are high.

TABLE 1: ANNUAL RETURN GAP OF U.S. STOCKS (S&P 500 INDEX) AND INTERNATIONAL STOCKS (MSCI EAFE INDEX), 2000–2012

Year	U.S. Stocks Return	International Stocks Return	Return Gap
2000	–9.10%	–13.96%	4.85%
2001	–11.89%	–21.21%	9.32%
2002	–22.10%	–15.66%	6.45%
2003	28.69%	39.17%	10.48%
2004	10.88%	20.70%	9.82%
2005	4.91%	14.02%	9.10%
2006	15.80%	26.86%	11.06%
2007	5.49%	11.63%	6.14%
2008	–37.00%	–43.06%	6.06%
2009	26.46%	32.46%	6.00%
2010	15.06%	8.21%	6.86%
2011	2.11%	–11.73%	13.85%
2012	16.00%	17.90%	1.89%
		Average:	7.84%
		Median:	6.86%
		Max:	13.85%
		Min:	1.89%

TABLE 2: ESTIMATED ANNUAL RETURN GAPS FOR VARYING COMBINATIONS OF CORRELATIONS AND STANDARD DEVIATIONS

	Standard Deviation			
Correlation	10.00%	15.00%	17.08%	20.00%
0.99	1.41%	2.12%	2.42%	2.83%
0.90	4.47%	6.71%	7.64%	8.94%
0.88	4.91%	7.36%	8.39%	9.82%
0.80	6.32%	9.49%	10.80%	12.65%
0.50	10.00%	15.00%	17.08%	20.00%
0.00	14.14%	21.21%	24.15%	28.28%

Estimated annual return gap = 2 * Standard deviation * [(1-correlation)/2] ^ (1/2)
Annual standard deviation = mean of annual standard deviations of the two assets.

Table 2 shows examples of the relation between correlations, standard deviations, and estimated return gaps. The correlation between the returns of U.S. and international stocks was 0.88 during the period from January 2000 through December 2012, and the mean annualized standard deviation was 17.08 percent. The estimated annual return gap is 8.39 percent. The estimated return gap would have been 2.42 percent if the correlation were 0.99, implying that substantial diversification benefits remain even when correlations are exceedingly high.

It is easy to confuse return gaps with covariances because both combine correlation with standard deviations. But the two are different not only in functional form but also in the direction of the relation between the variables. In particular, while both return gaps and covariances are high when standard deviations are high, covariances are low when correlations are low, but return

TABLE 3: CORRELATIONS, ESTIMATED ANNUAL RETURN GAPS, AND THE RANGE OF ROLLING 12-MONTH REALIZED RETURN GAPS, JANUARY 2000–DECEMBER 2012

	S&P 500	T–Bills	LT Treas.	Corp. Bonds	Russell 2000	EAFE	REIT	Commodi–ties	Gold
S&P 500		–0.08	–0.27	0.03	0.83	0.88	0.64	0.31	0.04
		12.14%	21.78%	18.36%	10.80%	8.39%	16.17%	23.62%	23.19%
		0.4–53.5%	0.1–62.8%	0.2–45.8%	0.1–37.5%	0.2–23%	0.1–49.1%	0–89.1%	0.1–56.1%
T–Bills			0.01	–0.05	–0.07	–0.07	–0.01	0.03	–0.06
			8.40%	7.98%	15.95%	13.73%	16.19%	17.26%	13.14%
			0–30.8%	0.1–36%	0–63.9%	0.4–57.2%	0.2–98.8%	0–72.8%	0–53.7%
LT Treas.				0.78	–0.28	–0.23	–0.11	–0.12	0.13
				7.26%	26.11%	23.18%	25.02%	26.64%	18.98%
				0–28.1%	0–71.1%	0.5–68.9%	0.4–107.3%	0.5–72.3%	0–64.1%
Corp. Bonds					0.01	0.13	0.17	–0.02	0.11
					22.32%	18.86%	20.95%	24.71%	18.57%
					0–58.3%	1.6–51.8%	0–79.1%	0–75.2%	0.1–64.3%
Russell 2000						0.80	0.69	0.31	0.10
						12.57%	17.15%	26.75%	26.03%
						0.1–26.8%	0.1–52.2%	0.3–92.2%	0.5–59.2%
EAFE							0.63	0.43	0.18
							17.40%	22.60%	22.82%
							0–50.1%	0–86.1%	0.1–53.2%
REIT								0.206	0.102
								29.22%	26.55%
								0.1–92.5%	0.2–77.2%
Com-mod-ities									0.29
									24.78%
									0.2–67%
Gold									

Note: The top number in each cell is the correlation between a pair of assets, the middle number is the estimated annual return gap, and the bottom number is the range of realized 12–month return gaps.

gaps and the benefits of diversification are high when correlations are low.

Nine Asset Classes

Consider nine asset classes during the 13-year period from January 2000 through December 2012. The benefits of diversification varied greatly among asset pairs, but they were substantial. Table 3 shows that the smallest annual return gap estimated from correlations and standard deviations was the 7.26-percent gap between corporate bonds and long-term Treasuries. The largest was the 29.22-percent gap between commodities and real estate investment trusts (REITs).

Relatively high correlations are indeed associated with relatively small benefits of diversification, but standard deviations also play a role in determining these benefits. For example, the correlation between the returns of gold and those of corporate bonds was 0.11, almost identical to the 0.10 correlation between the returns of gold and those of the Russell 2000 index. But the benefits of diversification were quite different. The estimated return gap in the first pair is 18.57 percent whereas it is 26.03 percent in the second.

Realized return gaps might be higher than estimated return gaps, or lower. The estimated annual return gap between U.S. and international stocks is 8.39 percent, but realized 12-month return gaps ranged from a low of 0.2 percent during the 12 months ending in October 2001 to 23 percent during the 12 months ending in March 2004. The wide range of realized return gaps tells us that the benefits of diversification

extend beyond those indicated by estimated return gaps. Diversification provides additional benefits, by removing the uncertainty associated with the magnitude of future return gaps, given that we do not know these return gaps in foresight.

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Return Gaps in Up and Down Markets

Correlations between the returns of U.S. and international stocks are higher in down markets, when both returns are negative, than in up markets, when both are positive. Thus diversification seems to offer smaller benefits in down markets, precisely when the benefits of diversification would have been most welcome.

Observation of return gaps, however, indicates that diversification provided greater benefits in down markets than in up markets. Table 4 shows that the returns of both U.S. and international stocks were negative in 52 months during January 2000 through December 2012. The returns of both were positive in 79 months. The correlation between the returns of U.S. and international stocks in down months was 0.83, higher than the 0.69 correlation in up months. But the benefits of diversification were greater in down months than in up months. The mean realized monthly return gap was 1.83 percent in down months, but it was only 1.70 percent in up months. This is because the mean monthly standard deviation of the returns of U.S. and international stocks was 3.72 percent in down months, higher than the 2.72 percent in up months.

Conclusion

The intuition underlying the benefits of diversification was known long before Harry Markowitz was born, expressed in sayings such as, "Don't put all your eggs in one basket." The eggs intuition is the intuition of return gaps. Investors who place all their eggs in one basket will find themselves at the top of the return gap, with all their eggs intact, or at the bottom of the gap, with all their eggs smashed. Investors who spread their eggs among baskets will find themselves inside the gap, with smashed eggs in unlucky baskets and intact eggs in lucky baskets. Markowitz's contribution centers on the mathematical formalization of diversification. In particular, Markowitz showed the importance of correlations in the determination of the benefits of diversification.

It is unfortunate that we have gained the mathematical language of diversification, including the language of correlation, but lost the intuition of diversification. Correlations are the common measures of the benefits of diversification, but they are not good measures. This is because correlations do not provide intuitive measures of the benefits of diversification and because the benefits of diversification also depend on standard deviations. Return gaps are better measures. They are intuitive measures of the benefits of diversification, reflecting the effects of both correlations and standard deviations. I&W

TABLE 4: CORRELATIONS, STANDARD DEVIATIONS AND RETURN GAPS IN U.S. AND INTERNATIONAL UP AND DOWN MONTHS, JANUARY 2000 TO DECEMBER 2012

	Up Months	Down Months
Number of Months	79	52
Correlation	0.69	0.83
Mean Standard Deviation (Monthly)	2.72%	3.72%
Mean Return Gap (Monthly)	1.70%	1.83%
Median Return Gap (Monthly)	1.36%	1.55%

Note: Up months are months where the returns of both U.S. and International stocks were positive. Down months are months where the returns of both U.S. and International stocks were negative.

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Reference

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