

Correlation

IN FORMULATING our optimal asset allocation, estimating how different assets will perform relative to each other is as important as estimating future returns and risk. The fundamental premise of modern portfolio theory is that a high-risk asset can reduce portfolio risk if it has the right correlation to other assets.

We measure the extent to which returns between two asset categories are linked with the statistical measure of a correlation coefficient. Correlations vary between 1 and -1. Asset returns that move in perfect lock-step have a correlation of 1. Asset returns that have no connection have a correlation of 0. Returns that mirror each other but in opposite directions have a correlation of -1.

As in the process of formulating expected risk measures, we start with historical measures of correlation in formulating expected correlations and then make judgments about how future markets are likely to perform relative to each other.

One could devote a lifetime to studying the correlations among global capital market returns. This author maintains a 370-page notebook with more than 650 charts that show the various cross-correlations among capital market returns, comparative time series results, and relevant statistics. The charts and statistics don't tell the whole story, however, and we are well advised to keep in mind Keynes' admonition that statistics should be used to test propositions or hypotheses, not to formulate them. We can be easily fooled into believing correlations that have little or no basis or that are the unreliable statistic of a highly complex and unpredictable system of multiple interrelated factors.

Correlations among asset returns are affected by a wide range of factors including, but not limited to: varying economic and demographic growth rates; local monetary and fiscal policies; global trade conditions (and the effects which all of these factors have on relative currency values); cultural attributes affecting entrepreneurship, innovation, and productivity; local supply and demand conditions; investor preferences regarding liquidity and risk premia; and regulatory considerations.

Judgment is critical, therefore, in formulating projected correlations and particularly among international capital markets where the global integration of world economies and capital markets may make past correlations poor guides to the future. Consider, as a case in point, correlations between the world's two largest equity markets, the United States and Japan. Long-term correlations show a weak positive correlation (.24) between the two markets. From 1991 to 1999, the markets had a negative correlation – not surprising with the deflation and recession Japan experienced during this time. More recent correlations, however, show a strong positive correlation as the prospect of real growth has returned for Japan. What correlation should we use going forward? A negative correlation seems unlikely and could result in an over-allocation to Japanese equities. A strong positive correlation seems inappropriate in view of the number of factors that could lead to divergent returns. As we see in figure C.1, we have chosen a correlation between the near-term strong positive correlation and the long-term lower positive correlation.

Our sixteen asset categories have 120 unique cross-correlations. Based on historical returns, these 120 correlations fall into three categories: those showing strong or very strong correlations (greater than +/- .60), those showing moderate correlations (between +/- .40 and +/- .60), and those showing weak or negligible correlations (between 0 and +/- .40). Only twenty-four (24) of the long-term historical correlations are strong. Twenty-eight (28) fall in the moderate range, and the majority (68 of 120) fall into the weak or negligible category.

The strongest historical correlations (greater than .90) are among several fixed-income categories: U.S. government bonds versus corporate bonds; U.S. government bonds versus mortgage-backed bonds; and long-term government bonds versus intermediate-term government bonds. These strong correlations make sense since returns for each of the categories are dominated by the overall level of interest rates, which generally overwhelms the impact of ancillary return elements such as corporate credit spreads, yield curve spreads, or mortgage cash flow.



Equity returns among the U.S., UK, and euro area equity markets show relatively strong historical correlations (between .60 and .80 depending on the specific correlation). The strongest correlations between equity market returns are those between U.S. large-cap equities and U.S. small-cap equities, between U.S. large-cap equities and euro area equities, and between UK equities and euro area equities. Inflation-backed bonds show reasonably strong negative correlations to most equity categories, but these correlations must be taken with a grain of salt since inflation-backed bonds are such a new category and correlation data is not robust.

Projected correlations are based on history in cases where correlations are stable over time and are plausible – as in the case with the strong correlations among the fixed-income categories mentioned above. Although we may not know the factors driving market pricing and return performance in these cases, we can surmise that they are shared by the asset categories and largely determine their performance. Generally speaking, we find stable historical correlations only among assets of like type; in other words, between one fixed-income category and another or between one equity category and another, with fixed income correlations being the strongest.

Correlations between fixed-income categories and equity categories or between assets from different markets have lower and less stable correlations. One would expect this since multiple factors are at work in these cases, driving relative market performance. Historical correlations in these cases may range from weakly positive or negative over the long term to more strongly positive or negative over the short term. Projected correlations in these cases are based on judgment as to what the central tendency of the correlation is likely to be comparing the relative performance of the asset categories with others pairs of assets and keeping in mind the likely near-term direction of market movements.

The correlation between bond and stock returns is a classic case in point. The long-term correlation between returns on U.S. large-cap equities and returns on U.S. long-term government bonds is a weak 0.12. Bond returns are generally positive when stock returns are positive, but the correlation is not strong. In fact, over the past ten years, the correlation has been -0.38, as bonds produced positive returns during the stock market losses of the early 2000s and had two loss years during the late 1990s. However, such a strong divergence in returns seems unlikely to continue. Our projected correlation is .10, weakly positive in keeping with the long-term correlation, but modestly weaker than the long-term correlation.

PROJECTED ASSET RETURN CORRELATIONS

	1- U.S. large-cap	2- U.S. small-cap	3- UK equities	4- Euro equities	5- Japan equities	6- Emerging-market equities	7- Venture capital	8- Real estate	9a- U.S. long-term gov't. bonds	9b- U.S. intermediate gov't. bonds	10- Inflation protected bonds	11- U.S. corporate bonds	12- High-yield bonds	13- Mortgage-backed bonds	14- Foreign investment-grade bonds	15- Emerging-market sovereign debt
1	1.00	0.66	0.59	0.70	0.30	0.30	0.65	0.40	0.10	0.05	-0.05	0.20	0.55	0.10	0.00	0.25
2		1.00	0.48	0.50	0.26	0.55	0.30	0.64	0.00	-0.07	-0.15	0.10	0.65	-0.03	-0.04	0.56
3			1.00	0.76	0.45	0.53	0.57	0.30	0.02	-0.02	0.00	0.10	0.40	-0.10	0.16	0.50
4				1.00	0.42	0.40	0.50	0.20	0.23	0.08	0.05	0.20	0.52	-0.06	0.20	0.34
5					1.00	0.65	0.55	-0.09	-0.10	-0.20	-0.20	-0.16	0.15	-0.60	0.12	0.20
6						1.00	0.25	0.22	-0.13	-0.12	-0.10	-0.09	0.41	-0.40	-0.07	0.60
7							1.00	-0.10	-0.15	-0.20	-0.25	-0.28	0.15	-0.04	-0.26	0.20
8								1.00	0.16	0.20	0.20	0.59	0.12	0.00	0.60	
9a									1.00	0.90	0.25	0.93	0.35	0.85	0.20	0.20
9b										1.00	0.40	0.90	0.33	0.88	0.29	0.19
10											1.00	0.20	0.15	0.40	0.15	0.19
11												1.00	0.43	0.85	0.34	0.19
12													1.00	0.15	0.38	0.64
13														1.00	0.25	0.20
14															1.00	0.05
15																1.00

Figure C.1: Projected Asset Return Correlations Among Asset Classes

Source: Asset Allocation Advisor



We can be fooled into believing correlations that have little or no basis or that are the unreliable statistic of a highly complex and unpredictable system.

The fundamental premise of modern portfolio theory is that a high-risk asset can reduce portfolio risk if it has the right correlation to other assets.

The highest projected positive correlations are between:

U.S. long-term government bonds	U.S. corporate bonds	.93
U.S. long-term government bonds	U.S. intermediate-term government bonds	.90
U.S. intermediate-term government bonds	U.S. corporate bonds	.90
U.S. intermediate-term government bonds	Mortgage-backed bonds	.88
U.S. long-term government bonds	Mortgage-backed bonds	.85
U.S. corporate bonds	Mortgage-backed bonds	.85
UK equities	Euro area equities	.76
U.S. large-cap equities	Euro area equities	.70
U.S. large-cap equities	U.S. small-cap equities	.66
U.S. large-cap equities	Venture capital	.65
U.S. small-cap equities	High-yield bonds	.65
Japan equities	Emerging-market equities	.65

The highest projected negative correlations are between:

Japan equities	Mortgage-backed bonds	-.60
Emerging-market equities	Mortgage-backed bonds	-.40
Venture capital	U.S. corporate bonds	-.28
Venture capital	Foreign investment grade bonds	-.26
Venture capital	Inflation-protected bonds	-.25
Venture capital	U.S. intermediate-term government bonds	-.20
Japan equities	Inflation-protected bonds	-.20
Japan equities	U.S. intermediate-term government bonds	-.20

Projected correlations differ from long-term historical correlations in approximately 70% of the cases (83 of 120). In twenty-four (24) cases, projected correlations were increased, by an average of 0.05. In fifty-nine (59) cases, projected correlations were decreased, by an average of 0.13. Large negative correlations for the performance of U.S. TIPS against seven asset categories were significantly reduced because of the short history of the performance of this asset category. Other notable reductions included the correlation between large- and small-cap U.S. stocks where the historical trend shows a consistent decrease in the strong correlation between these two categories. Unfortunately, space does not permit discussion of all 120 of the correlations here.

