Portfolio performance analysis—comprising both performance measurement and attribution—is an indispensable tool for the investment manager. Appropriate performance analytics give managers direct insight into and an objective evaluation of the effectiveness of their investment processes. Perhaps more importantly, performance analytics also provide a concise illustration to the client that explains what the manager did to add value.

Managers of U.S.-only portfolios that accept these basic tenets are very likely already to have in place a methodology and system for analyzing performance. This article addresses the following question: Given a robust and operational platform for U.S.-only performance analysis, what is required to extend that platform to global portfolios, maintaining an equivalent level of analytic effectiveness?

A simplistic answer to this question seems obvious: Get some exchange-rate data, calculate the currency effect, and generate a new report that shows results by country and region. Indeed, for many vendors of performance software, that is the answer that is implemented. Such an approach, however, is likely to compromise the quality of the resultant analysis in two critical aspects:

**Accuracy.** Performance generated by observable manager actions or market effects will be unattributed or misattributed to other effects.

**Congruence.** The analysis will measure something other than the effectiveness of the global investment process; it will not explain what the manager did.

What, then, are the additional elements we must consider to preserve the quality of our performance analytics in a global context?

### Measuring Currency Effects

Most obviously, we must measure a currency effect—the movement in foreign-exchange (FX) rates that forces the base-currency return to differ from a security’s local-currency return. Let’s look at a simple example, the basic data for which is contained in table 1.

#### TABLE 1: CURRENCY EFFECTS CALCULATION INPUTS

<table>
<thead>
<tr>
<th>Asset</th>
<th>FX</th>
<th>Local Market Value (Beginning)</th>
<th>FX Rate</th>
<th>Base Market Value (Beginning)</th>
<th>Weight (%)</th>
<th>Local Market Value (End)</th>
<th>FX Rate</th>
<th>Base Market Value (End)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABC</td>
<td>EUR</td>
<td>400</td>
<td>0.69701</td>
<td>$573.88</td>
<td>68.12%</td>
<td>414</td>
<td>0.69847</td>
<td>$592.72</td>
</tr>
<tr>
<td>XYZ</td>
<td>JPY</td>
<td>25,000</td>
<td>93.07000</td>
<td>$268.62</td>
<td>31.88%</td>
<td>24,667</td>
<td>92.23237</td>
<td>$267.44</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>$842.50</td>
<td></td>
<td></td>
<td>100.00%</td>
<td>$860.17</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### TABLE 2: CURRENCY EFFECTS AS AN UNDIFFERENTIATED QUANTITY

<table>
<thead>
<tr>
<th>Asset</th>
<th>Local Return</th>
<th>Currency Effect</th>
<th>Base</th>
<th>Local Return</th>
<th>Currency Effect</th>
<th>Base</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABC</td>
<td>3.500%</td>
<td>-0.217%</td>
<td>3.283%</td>
<td>2.384%</td>
<td>-0.148%</td>
<td>2.236%</td>
</tr>
<tr>
<td>XYZ</td>
<td>-1.332%</td>
<td>0.896%</td>
<td>-0.436%</td>
<td>-0.425%</td>
<td>0.286%</td>
<td>-0.139%</td>
</tr>
<tr>
<td>Total</td>
<td>-1.959%</td>
<td>0.387%</td>
<td>-0.453%</td>
<td>0.287%</td>
<td>0.138%</td>
<td>0.306%</td>
</tr>
</tbody>
</table>

The simplest solution for calculating currency effects would be to take the difference between the two, as shown in table 2.

However, the label “Currency Effects” is somewhat misleading in this approach; more accurately we should call it “Everything Except Local Return,” because it ignores the fundamental causes that have generated this result. Nonetheless, this approach may be sufficient for analyzing portions of the complete investment process, where currency allocation and management are completely external to the analytic context.

Furthermore, the implementation of even a simple approach such as this one should be approached with wariness and attention to detail; it is no empty homily to note that therein lie the devils that will impair accuracy and utility. For example, it is important that the currency effect of a holding be calculated from the market value in the local currency to which it is exposed, not neces-
sarily the same as the one in which it is priced. American Depositary Receipts—which move in USD terms when the home currency moves, independently of local market price—thus are commonly mishandled in the performance analyses made by USD-based performance systems. It is a certainty that many USD-based portfolios billed as “domestic only” experience significant—though unrecognized—currency effects.

**Differentiating FX-only Performance—A House of Sticks**

Slightly more sophisticated is an approach that acknowledges that local and currency returns are multiplicative, and that there is an “interaction” or “cross-product” effect between them. The cross-product effect arises from the fact that base currency returns do not derive arithmetically from the sum of local currency returns and FX rate changes but multiplicatively from their product:

\[
R_b = \left[ (1 + R_L) \times (1 + R_{FX}) \right] - 1 = R_L + R_{FX} + R_L R_{FX}
\]

Table 3 restates currency effects using such a methodology.

Here the “Currency Effects” of the prior method are decomposed into pure FX (i.e., performance obtained solely from FX rate movement \(R_{FX}\)) and the cross-product of FX and local currency security returns \(R_L R_{FX}\). Although the cross-product effects are relatively small in this example, they are cumulative and can become significant over multiple periods.

The Karnosky-Singer Methodology—A House of Bricks

To fully expose the sources of return from cross-currency investments, however, a yet more-sophisticated methodology is required. This stems from the fact that FX returns are fundamentally dependent on differences between short-term interest rates in the base and local markets, and as such can be effectively hedged *ex ante*. In its most simple form, this relationship is stated in an arbitrage-free context as:

\[
\frac{S_{LB}}{F_{LB}} = \frac{1 + R_L}{1 + R_b}
\]

Where:
- \(S_{LB}\) is the spot FX rate, local per base unit
- \(F_{LB}\) is the one-period forward FX rate, local per base unit
- \(R_L\) is the one-period interest rate in the local currency
- \(R_b\) is the one-period interest rate in the base currency

In tables 4 and 5, we complete our example by making use of this relationship, separating the effects of hedgeable from nonhedgeable performance. Note that we now require additional input data points for deposit rates: 0.465 percent, 0.180 percent, and 0.350 percent for EUR, JPY, and USD, respectively. (Alternatively, forward FX contract quotes could have been used with a slightly different formulation of the currency arbitrage relationship.)

The theory for this framework was developed in a classic 1994 monograph by Karnosky and Singer, and has since

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**Table 3: Separating Foreign Exchange from Cross-Product Performance**

<table>
<thead>
<tr>
<th>Asset</th>
<th>FX</th>
<th>Cross Prod</th>
<th>Total</th>
<th>FX</th>
<th>Cross Prod</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABC</td>
<td>-0.210%</td>
<td>-0.007%</td>
<td>-0.217%</td>
<td>-0.143%</td>
<td>-0.005%</td>
<td>-0.148%</td>
</tr>
<tr>
<td>XYZ</td>
<td>0.908%</td>
<td>-0.012%</td>
<td>0.896%</td>
<td>0.290%</td>
<td>-0.004%</td>
<td>0.286%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>0.147%</td>
<td>-0.009%</td>
<td>0.138%</td>
</tr>
</tbody>
</table>

**Table 4: Hedgeable and Nonhedgeable Returns**

<table>
<thead>
<tr>
<th>Asset</th>
<th>Local</th>
<th>Hedgeable Currency Effects</th>
<th>Nonhedgeable Currency Effects</th>
<th>Base</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FX</td>
<td>Cross</td>
<td>Total</td>
<td>FX</td>
</tr>
<tr>
<td>ABC</td>
<td>3.500%</td>
<td>-0.114%</td>
<td>-0.004%</td>
<td>-0.118%</td>
</tr>
<tr>
<td>XYZ</td>
<td>-1.332%</td>
<td>0.170%</td>
<td>-0.002%</td>
<td>0.167%</td>
</tr>
</tbody>
</table>

**Table 5: Hedgeable and Nonhedgeable Contributions**

<table>
<thead>
<tr>
<th>Asset</th>
<th>Local</th>
<th>Hedgeable Currency Effects</th>
<th>Nonhedgeable Currency Effects</th>
<th>Base</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FX</td>
<td>Cross</td>
<td>Total</td>
<td>FX</td>
</tr>
<tr>
<td>ABC</td>
<td>2.384%</td>
<td>-0.078%</td>
<td>-0.003%</td>
<td>-0.081%</td>
</tr>
<tr>
<td>XYZ</td>
<td>-0.425%</td>
<td>0.054%</td>
<td>-0.001%</td>
<td>0.053%</td>
</tr>
<tr>
<td>Total</td>
<td>1.959%</td>
<td>-0.024%</td>
<td>-0.003%</td>
<td>-0.027%</td>
</tr>
</tbody>
</table>
been extended in a multitude of papers by other authors. Its actual implementation is usually more complex than in this example, particularly when extending over multiple periods, multiple hedging currencies (beyond merely portfolio base currency), and using separate bid and ask quotes for greater accuracy. Several performance software vendors offer Karnosky-Singer as a standard attribution methodology option.

To managers just beginning to contemplate a global investment scope, or for whom currency management and performance measurement is a more casual affair, this approach may seem overly detailed and complex. It is important, however, to reiterate a point from Karnosky and Singer’s original exposition: These sources of return exist in a global portfolio, whether or not the manager actively recognizes and manages them. They are consequences of market structure and pricing that inexorably influence expected and realized returns. Even managers who do not explicitly include active currency allocation or hedging as elements of their investment process are nonetheless experiencing performance that is a direct effect of these causes. To fail to measure and attribute these effects in a performance analysis will produce ambiguous or misleading results.

Performance Attribution

A robust performance measurement methodology separates and quantifies the individual, mechanical sources of return at the position, segment, portfolio, and aggregate levels. We define performance attribution as the subsequent analysis that attributes (i.e., establishes a direct and quantified cause-and-effect linkage for) investment performance to management decisions—what the manager did while following (or deviating from) the defined investment process.

Once again, a simplistic approach to global performance attribution would be to graft country, currency, and region segmentation onto an existing methodology and measure the same attribution effects (e.g., allocation and selection) as with the USD-only attribution. And once again, one can find many real-world examples of attribution methodologies and implemented systems that adopt this approach and no more.

Let us then look at some additional aspects of performance attribution that a global manager should consider while designing and implementing a methodology. A particularly malicious devil lying in the details appears when attempting to assign securities to country and currency segments. True multinationals with significant exposure to multiple local economies and ambiguous domicile are not rare. Furthermore, securities for which the pricing currency, income payment currency, and accounting currency do not all match exist as well. Researching and assigning these exposures correctly is an ongoing and sometimes costly effort.

Because attribution is often an analysis of relative performance, a major concern—and one that is much more complex for global than USD-only managers—is benchmark selection. Factors that need to be considered when selecting a benchmark include:

Hedged vs. unhedged. Index returns often are available as either fully exposed to local currency movements, or periodically hedged in currency forward/futures markets.

Gross vs. net of withholding. Some countries withholds taxes on dividends and/or coupons paid, which can only be recovered by filing at a later date. An index return may be calculated either including this withheld income as of the ex-date, or not.

Free vs. restricted. Some countries restrict the securities and/or the quantities that can be held by foreign investors. The weight of securities in an index return calculation can either ignore this restriction, or modify weights accordingly.

Market capitalization vs. gross domestic product (GDP) weight. Constituent weights in an index can either be base-currency market capitalization, or they can be adjusted to give countries within the index a weight that corresponds to their relative GDP instead.

Multi-country vs. single-country. Many countries maintain and publish their own equity or fixed-income indexes. A single index provider that publishes multi-country indexes can be selected, or an index may be pieced together by the performance system from multiple single-country indexes.

Each of these choices should be made in the full light of the circumstances (domicile, tax exposure, etc.) and objectives of the individual client and portfolio. As such, it is quite likely that a single benchmark choice will fail to suffice for a given manager and analytic methodology.

Additionally, we find that, for global portfolios, more care must be taken in the definition of attribution calculations for out-of-benchmark holdings and segments than is usually the case for domestic portfolios. While USD-only managers may routinely invest in securities outside the benchmark, these nonetheless almost always reside in segments (e.g., industries) that are covered by the benchmark. A global manager venturing into a country that is not covered by the benchmark, however, may be surprised with some
nonsensical results if this eventuality is not considered and dealt with ahead of time.

Finally—and most importantly—the fundamental structure and definition of the attribution model should be reconsidered to ensure congruence with the investment process. It is quite rare among global investment managers (among successful ones, anyway) to observe an investment process that is identical to the domestic-only one. The principal purpose of a performance attribution methodology (and its system implementation) is to accurately measure the impact and effectiveness of the investment process on the generation of added value to the portfolio. By this definition, different processes demand different attributions.

Devils in the Data
To conclude our devils-in-the-details theme, let’s talk about data. Any manager who has experienced a performance system implementation knows that the greatest portion of the required time and effort—by far—is spent acquiring, structuring, populating, and cleansing the data required to drive it. The same maxim applies to global performance systems; in fact, the shear quantity and variety of data types, sources, and levels of quality guarantee its veracity manifold. Here are some flashpoints that the prudent implementer of such a system should be on the lookout for:

Closing spot FX rates. These need to be obtained from a reliable source with a consistent methodology. The time of day at which these are captured should be consistent and not vary by currency or market.

Deposit and/or FX forward rates. If implementing the Karnosky-Singer methodology or some variant of it, one or both of these also will be required. The same issues apply as with spot rates; furthermore, these data points typically lie on constant-horizon curves, a structure that will need to be accommodated in the data design.

Security pricing. Coverage is an obvious concern when looking for pricing data sources, but global investments require attention to other issues as well. Many securities are traded on multiple exchanges, and closing price is likely to be more reliable on some of these than others. Last trade can be subject to manipulation on some smaller exchanges, and another quote type may be necessary. Of course, there is no getting around the fact that exchanges around the globe all close at different times, so the methodology should explicitly state its end-of-period definition.

Corporate actions, terms, and conditions. These are more difficult to obtain and more complex than for U.S. securities. Equity dividends in many countries frequently are structured as special dividends, rights, or warrants, making determination of total return an art form. Bond accruals and conditions can be structured in unique and unfamiliar ways.

Benchmark data. Expensive and difficult to work with in any context, benchmark data is even more so for global indexes. Constituent membership changes can be frequent and immediately effective without prior warning. Individual security weights within the index are not always published or transparent.

Corporate fundamentals. For attribution methodologies that segment along corporate fundamental dimensions (e.g., leverage, earnings growth), this data also may be problematic and difficult to work with. The menagerie of different accounting standards country-to-country virtually guarantees that comparability across borders is suspect.

Conclusions
The effectiveness of any performance analysis is critically dependent upon its accuracy and congruence with the investment process. The robustness of these factors, in turn, is dependent upon the critical thinking and attention to detail applied to the development of the performance methodology and its system implementation. Many elements of a global investment mandate and process go well beyond those of a domestic-only portfolio. Underestimating the impact of these elements on performance by simply applying a few patches to an existing system is usually a mistake, one that can be painful and expensive to correct. It is vital to the effectiveness of the performance analysis that these elements be considered fully in the design, from its initial conception.

Acknowledgments
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References