Karnosky Singer Attribution: A Worked Example

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Introduction

In 1994, Denis Karnosky and Brian Singer published the monograph *Global Asset Management and Performance Attribution*. It described a method for multicurrency performance attribution that had certain advantages. The principal advantage of the method was demonstrated in several examples that showed that the Karnosky-Singer (or "KS") model would reward optimal active portfolio "bets", while more traditional approaches to multicurrency attribution would reward non-optimal bets.

This document works through one of those examples with a view to helping performance analysts explain to their colleagues the strengths and weaknesses of the Karnosky Singer model. This example is on pp. 21-40 of Karnosky and Singer (1994).

The Karnosky Singer spreadsheet can help performance analysts understand the calculations discussed in this example. Apart from Table 4, all of the tables of numbers in this paper are reproduced in the example spreadsheet, including the Excel formulas used to calculate the numbers.

The Example

The example is a single-period country-level attribution on an equities portfolio that holds four different countries. In the monograph, the portfolio was managed from a US dollar perspective. To make the example more relevant to an Australian audience, I have adapted it so it is managed from an Australian dollar (AUD) perspective. The example was constructed before the inception of the Euro, so it uses Deutsche Marks instead of Euros.

The benchmark is fairly simple[1]:

Table 1
Benchmark information for the example

Country	Local CCY	Benchmark Weight	Local CCY Benchmark Return	Exchange Rate Return	Base CCY (AUD) Benchmark Return
Germany	DEM	25%	7.00%	1.00%	8.00%
UK	GBP	25%	10.50%	-3.00%	7.50%
Japan	JPY	25%	9.50%	-1.00%	8.50%
Australia	AUD	25%	8.40%	0.00%	8.40%
Total	**Blend**	**100%**	**8.85%**	**-0.75%**	**8.10%**

The countries are equally weighted in the benchmark. The benchmark weight applies both to the markets and the currencies (for example, the benchmark specifies 25% of the

[1] The calculations in this example use continuously compounding returns in order to simplify some of the arithmetic. For example, the German local currency benchmark return (7.0%) and the exchange rate return on DEM (1.0%) compound continuously using simple addition to exactly 8.0%. Normally, a performance analyst would compound returns geometrically. Using the same numbers, the results of geometric compounding would be (1.07x1.01) – 1=8.07%. Continuous compounding makes the examples easier to follow, but it does make implementation a bit more difficult, since "in the real world: performance analysts very rarely use continuously compounding returns.

physical assets will be in German equities, and 25% of the currency exposure will be in DEM). It is possible to specify more complicated benchmarks, where the weights are not the same for markets and currencies. KS can deal just as easily with the simple benchmarks and the more complicated ones.

The local currency benchmark return for each country is measured in that country's local currency (e.g. DEM for Germany, GBP for the UK, etc). It is also quite simple to use a weighted sum calculation to obtain a local currency benchmark return at the fund level. The interesting thing about this fund-level local currency benchmark return is that it is not in any particular currency: rather, it is in a blend of currencies, and hence not easily convertible.

Hence, it is also convenient to calculate base currency (which means AUD in this example) benchmark returns for each market and for the total fund. Note that the exchange rate conversion is additive rather than multiplicative simply because Karnosky and Singer chose to use continuously compounding returns in this example.

2 How Could We Have Maximized the Portfolio Return?

The returns that appear in Table 1 would of course only be knowable at the end of the period we wanted to analyze. If it were possible to know in advance how investment markets would perform, active funds management would certainly be a lot easier!

However, suppose we did know in advance the information in Table 1. Would that tell us how to beat the benchmark? Or, putting the question another way, what would be the combination of markets and currencies to best take advantage of the returns in Table 1?

In regard to market selection, we might decide to select the country with the highest local currency return (the UK). This is the approach adopted by "traditional" approaches to multicurrency attribution. Alternatively, we might decide to choose the country with the highest base currency return (Japan).

However, for reasons that will become apparent later, Karnosky Singer would not regard the UK or Japan as optimal market choices in this example.

Turning to currency, one might hope that the data in Table 1 was sufficient to determine an optimal currency strategy. Perhaps it would maximize returns if we tilted the portfolio toward the Deutsche Mark, since that currency appreciated against the base currency. Or would it be better to stay in Australian dollars since that is the base currency? Once again, the Karnosky Singer framework would not regard either of these choices as best.

Clearly, there is something about the Karnosky Singer approach that is non-obvious to the casual observer. To understand how the Karnosky Singer approach determines the attractiveness of different market and currency choices, it is necessary to consider how currency hedging works.

Currency Hedge Calculations

The exchange rates that are commonly reported in the press are "spot" exchange rates, i.e. the rates that would apply if you made a currency conversion today. However, for practical purposes in investment management, it is also very useful to lock-in exchange rates for future dates. For example, if I knew in advance that UK equities were going to have a local currency return of 10.5%, while Australian equities would only return 8.4%, it might seem attractive to invest heavily in UK equities. The difficulty with this is that investing in UK equities automatically entails having an exposure to British Pounds (GBP). The fund in this example has a base currency of Australian dollars, and hence the Australian dollar performance is what will matter in the long run. One choice would be to simply take a chance on the movement of GBP relative to AUD. As Table 1 shows, that bet would not pay off in this particular case, since GBP declined relative to AUD, making an unhedged investment in UK equities a poor choice. Table 1 shows that this choice had a base currency return of 7.50%, which was in fact 60 basis points below benchmark. The only way to take a "pure" bet on UK equities without simultaneously betting on GBP would be by using a Forward Rate Agreement (otherwise known as a currency hedge or simply a FRA) to lock-in a future exchange rate. We will consider this calculation in a moment.

Instead of investing unhedged in UK equities, suppose I decided on the basis of the information in Table 1 to invest unhedged in Japanese equities. This would clearly give a base currency return of 8.50%, comfortably above benchmark. Perhaps surprisingly, while it is true that this choice would give a base currency return better than benchmark, it would still not give the best possible base currency return. To understand why, we need to do some calculations on how to do currency hedging using FRAs.

Using FRAs to Expand the Opportunity Set

The investment opportunities we considered above all entailed betting simultaneously on an equity market and the associated currency. By using a FRA, it is possible to invest offshore, and lock-in a future exchange rate at which you can convert the funds back into base currency. Thus, one can separate the currency bet from the market bet (for example, one could invest in German equities, but hedge the currency exposure into AUD or any other currency).

FRAs are typically provided by banks. While the bank incorporates a fee into their pricing of the FRA, these fees are quite small relative to typical fluctuations in equities and currency markets. However, there is a much more important issue to consider: what will the forward rate be in comparison to the spot rate?

In brief, the forward rate will sometimes be higher than the spot rate, while at other times it will be lower. The principles that govern the determination of the forward rate arise from considering what the bank will need to do in order to provide a FRA at no financial risk to them.

Suppose that you invested in UK equities, and wanted to hedge the GBP exposure back into AUD on a particular forward date. Upon maturity, the bank will receive GBP, and you will return (say) $1 million AUD. The bank can achieve this without financial risk by following these three steps:

- The bank converts sufficient GBP into AUD so that, by the maturity date, there will be AUD $1 million available after receiving interest on the AUD amount;
- Upon maturity, the bank accepts the pre-agreed amount of GBP in exchange for the AUD $1 million;
- Because the risk-free interest rate available on AUD will most likely differ from the risk-free rate available on GBP, the bank needs to price the forward rate based on the difference between interest rates in the two markets. Specifically, if the bank earns more on AUD than it would have earned if they kept the cash in GBP, the fair value of the forward rate will be more favorable than the spot rate. However, if the bank earns a lower interest rate on AUD than it would have on GBP, it will have to recoup that loss of interest by pricing the forward rate less favorably than the spot rate.

It follows from this reasoning that the fair price for a FRA depends almost entirely on the different interest rates available in different in each currency.

In turn, it follows that the investment merits of any given offshore equity market will depend on the both on the local equity returns in that market, and also on the local cash returns in that market (since the only way to gain a "pure" exposure to an offshore equities market without simultaneously making a currency bet is by using a FRA to eliminate currency risk).

These basic economic facts are the motivation behind KS's distinctive analysis of market and currency returns. We will explore this in detail below.

Before then, there is a useful item of terminology. The cash rates used in KS are known technically as "Eurodeposit rates". In other words, they are the cash rates that are available to investors depositing funds from another currency. These rates are sometimes published in the financial press.

Doing the Hedge Calculations

In this section, we will calculate returns for every member of the opportunity set. There are 20 possible investments from which we can choose. These arise from considering the how the 4 different market returns — as well as the domestic cash return — can be hedged into each of the four currencies.

Because Eurodeposit rates are necessary for hedging calculations, the following table provides data about the Eurodeposit return in each country.

Table 2

Benchmark Eurodeposit rates and return premiums for each country

Country	FX Rate Return	Local CCY Benchmark Return	Local CCY Eurodeposit Return	Base CCY Eurodeposit Return	Local CCY Benchmark Return Premium
Germany	1.00%	7.00%	5.00%	6.00%	2.00%
UK	-3.00%	10.50%	11.25%	8.25%	-0.75%
Japan	-1.00%	9.50%	9.00%	8.00%	0.50%
Australia	0.00%	8.40%	7.50%	7.50%	0.90%
Total	-0.75%	8.85%	8.19%	7.44%	0.66%

This table also introduces the notion of a local currency return premium, which is the extent to which the local currency market return exceeds the local currency cash return. This is a key concept in KS, which we will discuss further.

To start with, consider what sort of base currency return we would obtain if we invested in German equities, and then hedged the currency exposure across into British pounds. There are three steps in calculating this return:

- We start with the local currency return for German equities (7.00%).
- We calculate the effect of hedging this DEM return across into GBP. In continuously compounding terms, this is a matter of adding the GBP Eurodeposit return (11.25%), and subtracting the DEM Eurodeposit return (5.0%). At this point in the calculation, we have a GBP return of 13.25%. This is consistent with the basic principle of hedging—the bank has gained a GBP cash return of 11.25% instead of a DEM cash return of 5.0%, and hence is able to provide a forward rate that is more favorable than the spot rate.
- Finally, we convert that GBP return of 13.25% back into base currency. This is simply a matter of adding the actual FX return of GBP, which was –3% (see Table 1). This results in a base currency return of 10.25%.

It so happens that this 10.25% return is the highest base currency return in the opportunity set. In other words, the asset allocation with the highest return would have been German equities hedged into British pounds.

Table 3 summarizes the base currency returns for the 20 different combinations of currency and market strategies.

Table 3

Base currency returns for each combination of market and currency

	Currency Strategy				
Market Strategy	Germany	8.00%	10.25%	10.00%	9.50%
	UK	5.25%	7.50%	7.25%	6.75%
	Japan	6.50%	8.75%	8.50%	8.00%
	Australia	6.90%	9.15%	8.90%	8.40%
	Australia Cash	6.00%	8.25%	8.00%	7.50%

Each of these returns was calculated using the three steps listed above. It is easy to see that step 2 will be self-canceling when the hedge is from DEM to DEM, or from GBP to GBP, etc. Hence, the calculation proceeds in the same way regardless of whether one is hedging or not, since the hedge calculation self-cancels in the cases when it should.

According to KS, the returns in Table 3 provide a clear ranking of the available strategies. For the sake of absolute clarity, the following table lists all of the possible strategies in descending order of base currency return.

Table 4

Ranked base currency benchmark returns for the opportunity set

Rank	Strategy	AUD Return
1	German equities hedged into GBP	7.00% + (11.25% – 5.00%) – 3.00% = 10.25%
2	German equities hedged into JPY	7.00% + (9.00% – 5.00%) – 1.00% = 10.00%
3	German equities hedged into AUD	7.00% + (7.50% – 5.00%) – 0.00% = 9.50%
4	Australian equities hedged into GBP	8.40% + (11.25% – 7.50%) – 3.00% = 9.15%
5	Australian equities hedged into JPY	8.40% + (9.00% – 7.50%) – 1.00% = 8.90%
6	Japanese equities hedged into GBP	9.50% + (11.25% – 9.00%) – 3.00% = 8.75%
7	Japanese equities in JPY (no hedge)	9.50% + (9.00% – 9.00%) – 1.00% = 8.50%
8	Australian equities in AUD (no hedge)	8.40% + (7.50% – 7.50%) + 0.00% = 8.40%
9	Australian cash hedged into GBP	7.50% + (11.25% – 7.50%) – 3.00% = 8.25%
=10	German equities in DEM (no hedge)	7.00% + (5.00% – 5.00%) + 1.00% = 8.00%
=10	Japanese equities hedged into AUD	9.50% + (7.50% – 9.00%) + 0.00% = 8.00%
=10	Australian cash hedged into JPY	7.50% + (9.00% – 7.50%) – 1.00% = 8.00%
=13	UK equities in GBP (no hedge)	10.50% + (11.25% – 11.25%) – 3.00% = 7.50%
=13	Australian cash (no hedge)	7.50% + (7.25% – 7.50%) + 0.00% = 7.50%
15	UK equities hedged into JPY	10.50% + (9.00% – 11.25%) – 1.00% = 7.25%
16	Australian equities hedged into DEM	8.40% + (5.00% – 7.50%) + 1.00% = 6.90%
17	UK equities hedged into AUD	10.50% + (7.50% – 11.25%) + 0.00% = 6.75%
18	Japanese equities hedged into DEM	9.50% + (5.00% – 9.00%) + 1.00% = 6.50%
19	Australian cash hedged into DEM	7.50% + (5.00% – 7.50%) + 1.00% = 6.00%
20	UK equities hedged into DEM	10.50% + (5.00% – 11.25%) + 1.00% = 5.25%

It is perfectly clear from this ranked table of opportunities that one would be sacrificing many of the opportunities that offered the highest returns if one only contemplated the possibility of unhedged investments. The six highest returns are for hedged investments. On the other side of the ledger, the bottom five returns are also for hedged investments. For both these reasons, currency hedging should play a very important part in any rigorous analysis of active multicurrency investment.

While the calculations behind currency hedging may seem unintuitive at first, they are by no means strictly in the realm of theory: FRAs are very widely available, and their pricing conforms to the calculations described above. The key insight in KS is that local currency market returns should not be taken at face value: they have to be considered in relation to the Eurodeposit rates that govern currency hedge calculations.

In fact, KS neatly solves the problems of multicurrency attribution through a single important insight: Eurodeposit returns determine the payoff from currency strategies.

Therefore:

- One can evaluate market strategies by "removing" the Eurodeposit returns from the market returns (in a continuously compounding framework, this consists simply of subtracting the Eurodeposit return from the local market return); and
- One can evaluate currency strategies by considering the relationship between Eurodeposit returns (which determine the fair value of a FRA), and the realized FX returns. Simply speaking, the most favorable currencies are those whose realized FX performance is better than the Eurodeposit returns would have led one to expect at the start of the analysis period.

In the next section, we provide the data for the example portfolio. Then, in the following sections, we see how KS attributes it in a way that takes account of currency hedge calculations.

The Example Portfolio

In this example, the fund manager took active decisions at three different levels:

- The market allocation was dramatically different from benchmark, with 60% of the assets in German equities (compared with a benchmark weight of 25% for Germany).
- The currency allocation was also very active, with 55% of the currency exposure in GBP (against a benchmark weight of 25%).
- Finally, there were some moderately active stock selections within each asset class. These added value in each asset class (resulting in a local portfolio return that exceeded the local benchmark return at the asset class level), except for German equities, which slightly under-performed benchmark.

Table 5 (on the following page) provides a summary of the portfolio's active positions.

At sector level, the "Portfolio Return Premium" reflects two components:

- The extent to which the equities return exceeded the Eurodeposit return in each sector; plus
- The extent to which active management added value in each sector.

Under continuous compounding, it has the same value whether calculated in base or local currency.

The total "Portfolio Return Premium" is a weighted sum of the sector-level portfolio return premiums, where the weights are portfolio sector weights.

Table 5
Active positions for the example portfolio

Sector	Market Portfolio Weight[2]	Portfolio Local Return	Currency Portfolio Weight	Portfolio Return Premium	Portfolio Base Return
Germany	60%	6.80%	10%	1.80%	7.80%
UK	10%	12.25%	55%	1.00%	9.25%
Japan	10%	10.50%	25%	1.50%	9.50%
Australia	15%	9.00%	10%	1.50%	9.00%
Domestic Cash	5%	8.00%	N/A	0.50%	8.00%
Total	**100%**	**8.11%**	**100%**	**1.58%**	**9.47%**

The portfolio base return at sector level is simply the portfolio local return compounded with the FX return. The total portfolio base return is the base currency Eurodeposit return, plus the total portfolio return premium. This entails the Eurodeposit returns (weighted by currency exposure) and the portfolio return premiums (weighted by market exposure). Hence, the total portfolio return in base currency was 9.47%, compared with a base currency benchmark return of 8.10% (see Table 1). This leaves a value-added of 137 basis points for the attribution to explain.

From a performance analyst's perspective, it is notable that we have calculated the base currency portfolio return using a calculation method based on the KS paradigm (specifically, the calculation used Eurodeposit returns and return premiums, which are the tools that KS uses for dissecting portfolio returns). This tends to confirm that the KS approach does neatly account for each component of the portfolio return. In case there are doubts about the correctness of this calculated base currency portfolio return, the accompanying spreadsheet calculates the portfolio return using the weighted sum method that is very familiar to performance analysts.

Stock Selection (and Interaction?)

The KS analysis of stock selection produces exactly the same results as a "naïve" multi-currency attribution. It is intuitive that the value added in each sector is proportional to the out-performance of the local currency portfolio sector return compared with the local currency benchmark sector return. In a standard Brinson attribution, one would either obtain a combined stock selection + interaction attribute (using portfolio weights), or separate stock selection and interaction attributes (stock selection uses the benchmark weight, and interaction uses portfolio weight minus benchmark weight).

So, for example, the combined stock selection + interaction attribute for Germany would be $60\% \times (6.80\% - 7.00\%) = -0.12\%$. On the other hand, if one calculated separate stock

[2] The "market portfolio weights" are the actual weights of the equities in each sector. The "currency portfolio weights" are the actual exposures to each currency. By using FRAs, these can in principle be managed quite separately with negligible implementation costs. So far as most performance analysts are concerned, it is unusual to encounter fund managers who construct their portfolios with large differences between the currency weights and the asset weights. However, this is essentially a matter of custom rather than due to any impediment in financial markets. There are some funds, for example, that hedge all of their foreign currency exposure back into local currency. The question of whether one can hope to systematically add value due to active currency management is part of the broader "active vs. passive" debate. This touches on wider issues such as the efficient markets hypothesis, and it is unlikely that this debate will be decisively resolved either way at any time in the foreseeable future.

selection and interaction attributes, the stock selection would be $25\% \times (6.80\% - 7.00\%) = -0.05\%$ and the interaction would be $(60\% - 25\%) \times (6.80\% - 7.00\%) = -0.07$.

Strictly speaking, in the KS calculation, the local currency benchmark and portfolio returns that one uses would be expressed as return premiums, rather than simply as returns. However, this makes no difference to the actual result, since it is simply a matter of subtracting the local currency Eurodeposit return from both the portfolio return and the benchmark return. Still, it is useful to know that this part of the calculation is based on return premiums, just like the asset allocation calculation.

The following table provides a summary of the combined stock selection + interaction, as well as separate stock selection and interaction, for each sector in the fund.

Table 6
Stock selection and interaction (separate and combined)

Sector	Combined Stock Selection + Interaction	"Pure" Stock Selection	"Pure" Interaction
Germany	-0.12%	-0.05%	-0.07%
UK	0.18%	0.44%	-0.26%
Japan	0.10%	0.25%	-0.15%
Australia	0.09%	0.15%	-0.06%
Domestic Cash	0.03%	0.00%	0.03%
Total	0.27%	0.79%	-0.52%

As an aside, these numbers do tend to illustrate why it is useful to at least have the capability of viewing interaction and stock selection as separate attributes. If you only knew that the total stock selection was 27 bps, you might draw the inference that the fund manager has displayed moderately good stock selection skills. If you knew that the stock selection (based on the assumption of a neutral asset allocation) was actually 79 bps, but two-thirds of this added value was dissipated because the asset allocators favored sectors where the firm's stock selection was relatively weak, you might think differently about how to manage the firm's investment process. For a further discussion of this topic, see Laker (2000).

Sector Allocation and Currency Allocation

Understanding the asset allocation and currency allocation of the portfolio is a straightforward two-step process:

- Understand the market tilts; then
- Understand the currency tilts.

This is easy to do in this example, since the benchmark weights appear in Table 1, and the portfolio exposures (both by sector and by currency) appear in Table 5. In a "real world" case, one would have to do some calculations to determine the separate exposures of the portfolio to markets and currencies.

Sector allocation in KS is calculated in exactly the same way as for a single-currency Brinson model — except that it uses local currency benchmark and portfolio returns that

have been converted to return premiums. This flows from the basic concept of KS that the component of market returns provided by the Eurodeposit rate determines the cost of hedging, rather than the market return.

To use Germany as an example, the benchmark weight for this sector was 25%, while the portfolio weight was 60%. The local currency benchmark return for Germany was 7.00%, while it was 8.85% for the overall portfolio (see Table 1). Hence, a naïve performance attribution would say that the overweight position in Germany was a poor decision, since that market's benchmark local return was below the overall benchmark local return. However, in KS, the benchmark return premium for Germany was 2.00%, while that for the overall portfolio was 0.66% (see Table 2). This highlights the fact that KS sometimes will regard as beneficial a bet that naïve attribution would regard as harmful. When you inspect the hedged returns in Table 3 and Table 4, it seems hard to deny that, if you accept the possibility of currency hedging, and your aim is to maximize base currency return, then you must also accept that naïve multicurrency attribution would give a perverse assessment of the overweight to Germany. Note especially that, for every column in Table 3 (i.e. for every currency), Germany is the row with the highest base currency benchmark return.

Hence, KS would measure the sector allocation for Germany as Sector Allocation = $(60\% - 25\%) \times (2.00\% - 0.66\%) = 0.47\%$.

In regard to currency allocation, the formula is also similar to the familiar Brinson asset allocation formula — except that in this case, the weights are currency weights, and the returns are base currency Eurodeposit returns. Once again, the rationale for this is that base currency Eurodeposit returns reflect the impact that Eurodeposit returns has on the cost of hedging (and expressing the Eurodeposit returns in terms of base currency also takes account of the actual exchange rate return over the analysis period). GBP was the currency that had the highest base currency Eurodeposit return. If you inspect Table 3, you will see that for every row (i.e. for every sector), GBP is the column with the highest base currency benchmark return. Once again, this shows that, once you accept the arithmetic of currency hedging and the desirability of maximizing base currency return, KS makes more sense than other approaches.

The benchmark weight for GBP was 25%, while the portfolio weight was 55%. The base currency Eurodeposit return for GBP was 8.25% while the overall benchmark was 7.44%. Therefore, the currency attribute for GBP was Currency Allocation = $(55\% - 25\%) \times (8.25\% - 7.44\%) = 0.24\%$

It is also worth noting that the base currency Eurodeposit return for Germany was 6.00%, the lowest of all the currencies. Once again, if you inspect Table 3, you will see that for every row (i.e. for every sector), DEM is the column with the lowest base currency benchmark return. The portfolio was 15% underweight DEM, and according to the KS model, this bet added 22 basis points to the portfolio return.

Summary of Attribution Results

Table 7 summarizes the attribution results from KS. These attributes exactly explain the base currency active return (i.e. the attribution is collectively exhaustive). However, on portfolios in the "real world", there are various issues that can give rise to residuals. Hence this method will not be as easy to implement in practice as in theory.

Table 7
Results from the KS attribution

	Stock Selection	Market Allocation	Currency Allocation	Total
Germany	-0.12%	0.47%	0.22%	0.56%
UK	0.18%	0.21%	0.24%	0.63%
Japan	0.10%	0.02%	0.00%	0.12%
Australia	0.09%	-0.02%	-0.01%	0.06%
Cash	0.03%	-0.03%	N/A	-0.01%
Total	**0.27%**	**0.65%**	**0.45%**	**1.37%**

Conclusion

The Karnosky Singer (KS) model has theoretical advantages that arise from insights about the relationship between interest (Eurodeposit) rates and exchange rates. By subtracting Eurodeposit rates from the returns used in the calculation of asset allocation attributes, KS obtains a "pure" measure of asset allocation that is unaffected by incidental currency exposures that could be hedged away if one wished to. This also has a beneficial effect on the attribution of currency effects, since these could easily be completely spurious if one took no account of the relationships between interest rates and currencies. Finally, in regard to stock selection, KS uses local currency returns (both benchmark and portfolio), and essentially uses the same approach as the traditional Brinson model does.

Karnosky and Singer argue that "naïve" attribution models that do not account for the relationship between interest rates and currency may very well give perverse indications about which bets have added value to the portfolio. The example presented in this document would tend to confirm that assertion.

It is worth noting that this document includes a fair deal of complexity, yet it only analyzes a simple single-period example. In the practical world of business, a KS implementation will have to deal with numerous problems that this document was able to safely ignore. Therefore, readers are urged to temper their enthusiasm for the KS model with some careful reflection about the practical difficulties that will emerge during an implementation. Furthermore, the theoretical foundations of KS will be difficult for some investors (or even portfolio managers!) to grasp, so education will be an important part of any successful KS implementation.

References

Karnosky, Denis S. and Brian D. Singer, *Global Asset Management and Performance Attribution,* The Research Foundation of the Institute of Chartered Financial Analysts, 1994.

Laker, D., "What is this Thing Called 'Interaction'?" *Journal of Performance Measurement,* Fall 2000.