# Distributional Characteristics of Emerging Market Returns and Asset Allocation

*Analyzing returns that cannot be summarized by a normal distribution.*

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Research on emerging equity markets has suggested a number of empirical regularities: high volatility, low correlations with developed markets and within the emerging markets, high long-horizon returns, and predictability above and beyond what is found in developed market returns. It is also well-known that emerging markets are more likely to experience shocks induced by regulatory changes, exchange rate devaluations, and political crises. Indeed, this lesson was learned the hard way by many investors in December 1994 when the Mexican stock market began a plunge that would reduce equity value in U.S. dollars by 80% over the next three months.[1]

While emerging markets are seen as different enough that they are often considered as a stand-alone asset class in global portfolio management, the standard tools of portfolio analysis are often applied to these markets. A number of authors plug emerging market returns into the standard Markowitz [1959] framework and argue that the combination of high expected returns and low correlations pushes the efficient frontier outward. Indeed, many argue that the primary benefit of emerging market investment is its diversification potential.

We argue that the standard mean-variance analysis is somewhat problematical with respect to emerging markets. In this analysis, investors care about expected returns, variances, and covariances, but emerging market returns cannot be completely characterized by these measures alone. We show that there is significant skewness and kurtosis in these returns.

It is reasonable to assume that investors have a preference over skewness (investors prefer positively skewed distributions to negatively skewed distributions). Hence, at a minimum, investors need to keep track of asset skewness and coskewness (how an asset contributes to the skewness of the overall portfolio).[2]

There are additional complications, however. It is not just that skewness and kurtosis are present in emerging market returns — the skewness and kurtosis change through time. For emerging markets, there could be drastic changes in the characteristics of the asset returns. Bekaert and Harvey [1995, 1997a, 1997b] argue that this transformation is expected in markets that move from a state of segmentation (a market effectively closed to outside investors) to a state of integration (a market accessible by outsiders, and domestic investors able to diversify their portfolios outside the country).

Bekaert and Harvey also argue that the fundamental sources of risk change when this transformation occurs. In the segmented market, the sources of risk are focused on the local economy. In the integrated market, risk is measured with respect to the world economy.

This transformation may also affect skewness and kurtosis. For example, the integration process may cause discrete price hikes, when the marginal investor changes from local to foreign, inducing (temporarily) positive skewness and kurtosis in returns. Yet when integration brings about stock market development that leads to more companies seeking a stock market listing and eventually a more diversified index, skewness and kurtosis may decrease. That is, a cross-sectional central limit theorem may apply, turning non-normal individual returns into normal index returns.

We begin by detailing the distributional characteristics of emerging market returns. Then we explore how these distributional characteristics change through time. We contrast the behavior of emerging market returns in the 1980s and the 1990s. Next, we go beyond the documentation of skewness and kurtosis to explore the fundamental characteristics of each economy in an attempt to explain the cross-sectional patterns in the deviations from normality. The results have implications for asset allocation in emerging markets.

## NON-NORMALITY OF EMERGING MARKET RETURNS

### The Indexes

There are three main index providers for emerging market returns: the International Finance Corporation (IFC), Morgan Stanley Capital International (MSCI), and ING-Barings Emerging Markets indexes (BEMI). Both IFC and MSCI use value-weighted indexes, while BEMI uses an adjusted market weight that reflects the available liquidity to international investors.

Both MSCI and IFC present two types of indexes: global and investable (or "free"). The former considers a representative subset of stocks within each country, while the latter reflects only those securities that are available to foreign investors. BEMI is by construction an investable index.

Bekaert, Erb, Harvey, and Viskanta [1997] provide a comprehensive analysis of the differences among the three emerging market index vendors. They find that, aside from a few exceptions, there are broad similarities among the indexes. For example, the average correlation between the MSCI and IFC global indexes is 95%, and the average volatility difference (tracking error) is less than 1%. The BEMI indexes are on average correlated 96% and 95% with the MSCI and IFC investable indexes, respectively.

An analysis of tracking error suggests that MSCI and IFC are most similar. The BEMI indexes have some differences that are related to their liquidity criteria for inclusion and weighting of individual securities.[3]

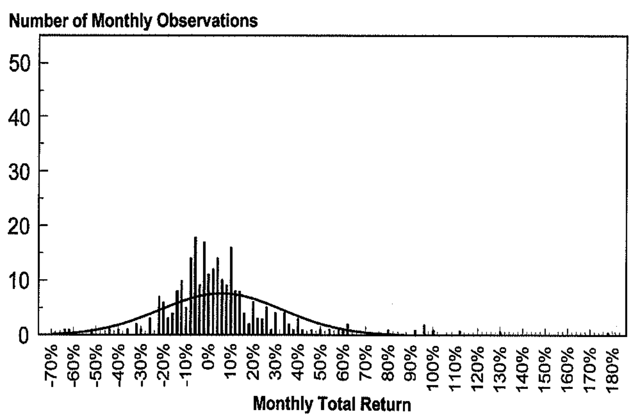
Part of the interest in studying emerging markets comes from the impact that capital market liberalizations have on the returns.[4] Hence, we study markets before and after they are accessible by international investors. We study the emerging market returns provided by the IFC, because these data have the longest history and span both segmented and integrated economic regimes in many emerging markets.

### Non-Normality of Returns

A preliminary analysis of the data suggests that many of the emerging market returns are highly non-normal. Exhibit 1 presents histograms of the monthly U.S. dollar returns for Argentina and the U.S. The curve in the Argentina panel represents the normal distribution. It is clear that many observa-

**EXHIBIT 1**
**DISTRIBUTION OF RETURNS**

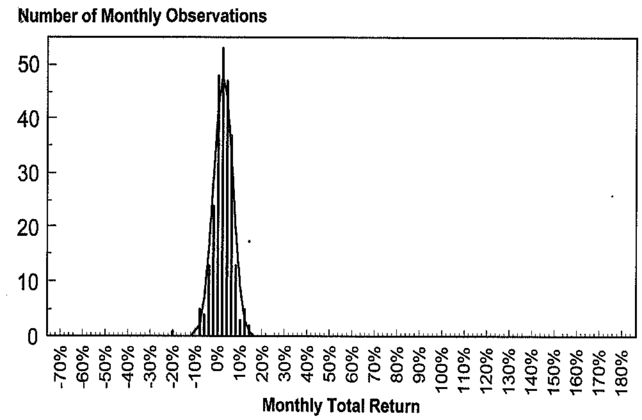
**ARGENTINA**




Monthly U.S. $ returns: January 1976-March 1997.

Source: International Finance Corp. Global Indexes.

**UNITED STATES**




Monthly U.S. $ total returns: January 1976-March 1997.

Source: Morgan Stanley Capital International.

tions lie outside what would be predicted by the normal distribution. There is some evidence of skewness and excess kurtosis in the Argentinean returns. The data for the U.S. more closely approximate the normal distribution.[5]

It turns out that Argentina is not the only emerging market to exhibit non-normality. Exhibit 2 presents some summary statistics for the emerging market returns. Over the April 1987-March 1997 period, seventeen of twenty countries exhibited positive skewness in the returns, and nineteen of twenty countries had excess kurtosis. The standard tests of normality, such as the Bera-Jarque or the Kolmogorov-Smirnov test, reject the hypothesis of normality in more than half the countries at the 95% level of confidence.[6]

The second panel of Exhibit 2 examines both developed and emerging market index returns. Summary statistics are presented for the MSCI-All Countries world and the MSCI world index. These indexes reflect mainly the returns in developed countries. The first index includes all the emerging markets that MSCI tracks, while the second has a low concentration of emerging markets. Also presented are results based on the IFC global capitalization-weighted and IFC global equally weighted indexes.

Over the April 1987-March 1997 period, both the MSCI indexes exhibit negative skewness that contrasts with the positive skewness found in most of the IFC indexes. The MSCI indexes exhibit excess kurtosis that is stronger than that in the IFC indexes. Although only three emerging markets have negative skewness, the capitalization-weighted index gives these countries significant weight. The skewness of the equally weighted IFC index is positive.

One might suspect that the averaging of a number of non-normal variables would lead to an index with a normal distribution. Obviously, twenty markets does not suffice for operation of the central limit theorem. The IFC composite exhibits positive skewness and a level of kurtosis more than double the level expected from a normal distribution. We can reject the hypothesis of normality for the IFC composite global index return.[7]

The negative skewness in both the developed and emerging market index returns could be a result of the inclusion of October 1987. The final panel in Exhibit 2 examines the most recent five-year period. Interestingly, the MSCI returns continue to exhibit negative skewness (although smaller). The excess kurtosis in the MSCI returns disappears in the sample that does not include the crash observation. The IFC returns by contrast show positive skewness and excess kurtosis in the most recent period.

**EXHIBIT 2**
**SUMMARY STATISTICS**

| Country | Arith. Return (%) | Geometric Return (%) | Std. Dev. (%) | Skewness | Kurtosis | First-Order Autocorrelation | AC World | World | Corr. with: IFCG-CW | IFCG-EW |
|---|---|---|---|---|---|---|---|---|---|---|
| Time Period: April 1987–March 1997 | | | | | | | | | | |
| Argentina | 56.8 | 27.2 | 87.9 | 3.32 | 20.22 | −0.08 | 0.01 | 0.00 | 0.06 | 0.38 |
| Brazil | 42.6 | 22.1 | 63.9 | 0.25 | 1.09 | −0.08 | 0.23 | 0.20 | 0.35 | 0.40 |
| Chile | 32.2 | 28.2 | 27.6 | 0.28 | −0.07 | 0.29 | 0.19 | 0.16 | 0.48 | 0.46 |
| Colombia | 32.7 | 28.0 | 31.5 | 1.63 | 4.14 | 0.45 | 0.05 | 0.04 | 0.12 | 0.31 |
| Greece | 21.6 | 14.0 | 41.2 | 1.76 | 6.33 | 0.13 | 0.15 | 0.15 | 0.14 | 0.45 |
| India | 11.7 | 6.3 | 33.8 | 0.72 | 1.11 | 0.15 | −0.09 | −0.11 | 0.16 | 0.31 |
| Jordan | 5.9 | 4.6 | 15.9 | 0.17 | 1.53 | −0.05 | 0.21 | 0.21 | 0.11 | 0.11 |
| Malaysia | 17.3 | 13.9 | 25.2 | −0.86 | 2.79 | −0.03 | 0.57 | 0.54 | 0.55 | 0.49 |
| Mexico | 29.2 | 17.2 | 45.4 | −1.01 | 5.41 | 0.34 | 0.37 | 0.34 | 0.59 | 0.56 |
| Nigeria | 32.6 | 18.1 | 52.3 | 1.49 | 19.64 | −0.02 | 0.05 | 0.05 | −0.06 | 0.19 |
| Pakistan | 14.7 | 11.1 | 27.4 | 1.23 | 4.27 | 0.26 | 0.06 | 0.04 | 0.17 | 0.32 |
| Philippines | 23.4 | 17.7 | 34.1 | 0.67 | 3.69 | 0.21 | 0.34 | 0.32 | 0.36 | 0.43 |
| Portugal | 15.7 | 9.0 | 39.2 | 2.35 | 12.91 | 0.26 | 0.34 | 0.34 | 0.93 | 0.48 |
| South Korea | 6.6 | 2.8 | 28.0 | 0.59 | 0.42 | −0.02 | 0.29 | 0.27 | 0.33 | 0.19 |
| Taiwan | 30.4 | 17.2 | 52.4 | 0.59 | 1.45 | 0.05 | 0.29 | 0.25 | 0.81 | 0.44 |
| Thailand | 20.5 | 15.0 | 32.7 | −0.19 | 1.81 | 0.09 | 0.42 | 0.39 | 0.54 | 0.56 |
| Turkey | 41.9 | 19.7 | 70.5 | 0.97 | 1.04 | 0.15 | 0.06 | 0.05 | 0.28 | 0.49 |
| Venezuela | 23.9 | 12.9 | 46.9 | 0.25 | 2.23 | 0.12 | −0.11 | −0.10 | −0.15 | 0.13 |
| Zimbabwe | 25.4 | 21.0 | 29.3 | 0.02 | 1.25 | 0.29 | 0.07 | 0.06 | 0.05 | 0.20 |
| MSCI AC World | 9.6 | 8.6 | 13.9 | −0.75 | 3.08 | −0.03 | 1.00 | 1.00 | 0.45 | 0.43 |
| MSCI World | 9.1 | 8.1 | 14.1 | −0.69 | 2.86 | −0.04 | 1.00 | 1.00 | 0.39 | 0.39 |
| IFCG-CW | 15.9 | 13.2 | 23.0 | −0.46 | 1.88 | 0.18 | 0.45 | 0.39 | 1.00 | 0.71 |
| IFCG-EW | 25.3 | 23.8 | 16.1 | 0.09 | 0.84 | 0.30 | 0.43 | 0.39 | 0.71 | 1.00 |
| Time Period: April 1991–March 1997 | | | | | | | | | | |
| MSCI AC World | 12.7 | 12.2 | 9.4 | −0.23 | −0.40 | −0.15 | 1.00 | 0.99 | 0.47 | 0.46 |
| MSCI World | 12.5 | 12.0 | 9.5 | −0.28 | −0.31 | −0.18 | 0.99 | 1.00 | 0.38 | 0.38 |
| IFCG-CW | 9.9 | 8.6 | 16.4 | 0.81 | 3.34 | 0.37 | 0.47 | 0.38 | 1.00 | 0.85 |
| IFCG-EW | 16.8 | 15.5 | 15.4 | 0.44 | 0.75 | 0.38 | 0.46 | 0.38 | 0.85 | 1.00 |

Total returns: International Finance Corporation Global Indexes in U.S. dollars.

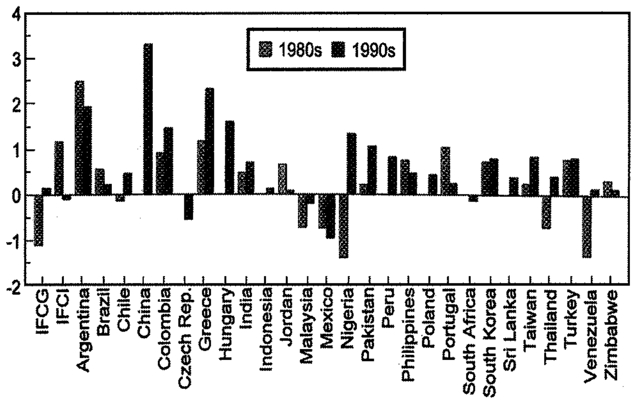
MSCI = Morgan Stanley Capital International, AC = All Country, IFCG = IFC Global Composite, CW = Cap-weighted, EW = equal-weighted.

## TIME-VARYING RETURN CHARACTERISTICS

### Time Variation in Skewness and Kurtosis

Exhibit 3 details the skewness of the emerging market returns over the entire sample. For nine of twenty countries, the data begin in January 1976, but the IFC data base was created in 1980 and backfilled. The first bar of each pair represents the skewness in the 1980s, and the second bar represents the skewness in

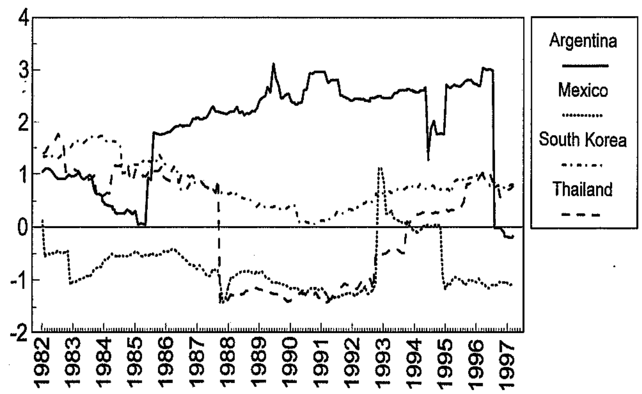
**EXHIBIT 3**
**SKEWNESS IN THE 1980s AND 1990s**




Monthly U.S. $ total returns through March 1997.

Source: International Finance Corp. Global Indexes.

**EXHIBIT 5**
**SKEWNESS THROUGH TIME — SELECTED COUNTRIES**




Five-year trailing skewness. Monthly U.S. $ total returns.

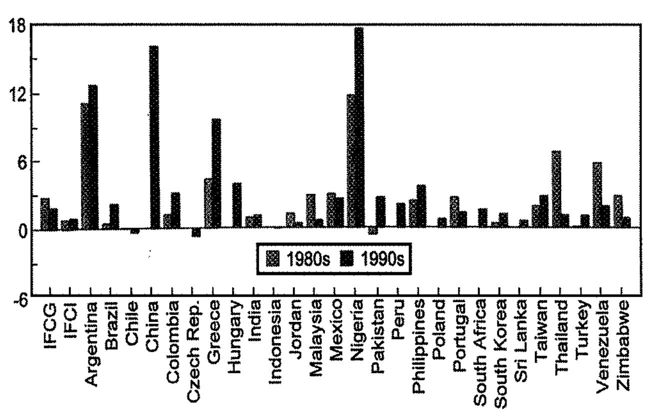
Source: International Finance Corp. Global Indexes.

the 1990s. We split the sample between the 1980s and 1990s because Bekaert [1995] details that many of the capital market liberalizations occur in the early 1990s. Remarkably, more countries have positive skewness in the 1990s than in the 1980s.

Exhibit 4 replicates this analysis for excess kurtosis. All but a single country has excess kurtosis in the 1990s. For many of the countries, the degree of kurtosis has been reduced in the 1990s compared to the 1980s.

Exhibits 5 and 6 explore the time series patterns in the skewness and kurtosis. We consider a subsample of four countries: Argentina, Mexico, South Korea, and Thailand, and graph rolling five-year skewness and kurtosis. As with the analysis in Exhibit 2, we need to be careful because it is difficult to estimate these higher moments with only sixty observations.[8]

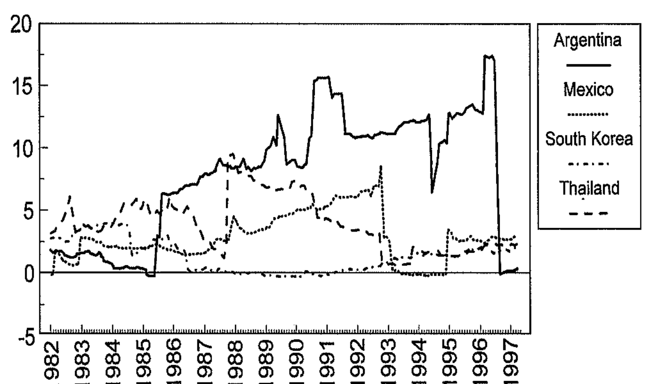
**EXHIBIT 4**
**EXCESS KURTOSIS IN THE 1980s AND 1990s**




Monthly U.S. $ total returns through March 1997.

Source: International Finance Corp. Global Indexes.

**EXHIBIT 6**
**EXCESS KURTOSIS THROUGH TIME — SELECTED COUNTRIES**




Five-year trailing kurtosis. Monthly U.S. $ total returns.

Source: International Finance Corp. Global Indexes.

Argentina presents an interesting case. There appears to be a positive trend in skewness through time until September 1996 when the skewness shifts downward toward zero. The jump downward is due to a single observation, the 96% return realized in August 1991. When this observation is dropped from the rolling skewness calculation, the skewness dramatically decreases. Interestingly, when the observation enters the data in August 1991, there is no noticeable impact.

Mexico is interesting because for much of the sample the skewness is negative. While there is a big jump upward following some large positive returns in 1992, during 1993 and 1994 skewness declines again. In December 1994 (the Mexican peso crisis), there is a big decrease — but the trend to lower skewness was clearly established earlier. The current skewness is at a pre-1992 level.

Korea's skewness declines from 1984 through 1990, and then increases throughout the 1990s. Thailand has positive skewness until late 1987. This period coincides with the world market crash in October 1987 and a number of capital market liberalizations that were initiated in Thailand. In the post-1987 period, the skewness has steadily increased in Thailand.

The excess kurtosis in Argentina (in Exhibit 6) has a similar pattern to the skewness. There is a distinct upward trend in kurtosis beginning in 1985 and a drop in 1996. For Mexico, kurtosis declines dramatically at the end of 1992. This is also a period where the volatility of the Mexican stock market substantially declined. There is a jump in kurtosis in December 1994. The pattern in excess kurtosis in Korea mimics the skewness. Kurtosis declines throughout the 1980s and begins to increase in the 1990s. There is a steady decline in the excess kurtosis from 1988 onward in Thailand.

**Are the 1990s Different From the 1980s?**

Exhibit 7 presents Chow tests of whether the 1980s are different from the 1990s. Bekaert [1995] details that many emerging markets underwent regulatory changes that opened these markets up to foreign investment. Bekaert and Harvey [1995] offer evidence that the degree of integration of many emerging markets with world markets changed in the 1990s.

The idea of the Chow test is to estimate, say, the mean in the 1980s and in the 1990s, and test whether the value is significantly different across the two periods.[9] The tests indicate significant differences in a number of the measures of distribution. We find little evidence that the mean returns are significantly different (nine of nineteen are higher in the 1990s).

There is substantial evidence that the volatility changed in the 1990s. In fourteen of nineteen countries, volatility decreased. In nine of nineteen countries, there is a significant shift in the volatility as detected by the Chow test at the 5% level. This evidence is consistent with the results presented in Bekaert and Harvey [1997a, 1997b], who argue that capital market integration is associated with lower volatility.

There is also evidence that the skewness in the returns changed in the 1990s. As noted earlier, the skewness is higher in fourteen of nineteen countries in the 1990s, but it is difficult to measure skewness precisely over short samples. The Chow tests indicate a significant shift in skewness in only four of nineteen countries at the 10% level of significance. Even countries like Argentina, with dramatic increases in skewness for much of the 1990s, as graphed in Exhibit 5, do not pass the test of statistical significance.

The evidence on kurtosis is similar to that of skewness. In ten of nineteen countries, the excess kurtosis is higher in the 1990s. The Chow tests indicate that kurtosis is significantly different in only three of nineteen countries, however.

The final test presented is a joint test of whether the distribution shifted in the 1990s. This joint test simultaneously considers the mean, variance, skewness, and kurtosis. In ten of nineteen countries, we can reject the hypothesis that the distribution is the same at the 5% level. The strongest rejections are found in Pakistan, Colombia, and Mexico. In two additional countries, we can reject the hypothesis at approximately the 10% level.

The evidence suggests that the distribution of emerging market returns is not normal, and that the distribution has changed through time, but the evidence is statistically weak because of the small number of observations available. Interestingly, there is no strong evidence that the non-normalities found in many emerging market returns are becoming less prominent in the 1990s. It is possible that this represents a temporary phenomenon caused by the integration process that many markets have recently undergone.

**EXHIBIT 7**
**BEHAVIOR OF EMERGING MARKET RETURNS IN THE 1980s AND 1990s**

| | Observations in | | Tests Whether Differences Exist in Decades | | | | |
|---|---|---|---|---|---|---|---|
| Country | 1980s | 1990s | Mean | Variance | Skewness | Kurtosis | Joint |
| Argentina | 120 | 87 | 0.8528 | 0.0413 | 0.6482 | 0.7866 | 0.1697 |
| Brazil | 120 | 87 | 0.9103 | 0.5574 | 0.5371 | 0.1453 | 0.5342 |
| Chile | 120 | 87 | 0.3403 | 0.0103 | 0.0486 | 0.4933 | 0.0222 |
| Colombia | 60 | 87 | 0.6581 | 0.0096 | 0.1882 | 0.1743 | 0.0000 |
| Greece | 120 | 87 | 0.4471 | 0.6682 | 0.0867 | 0.1178 | 0.3474 |
| India | 120 | 87 | 0.7246 | 0.0068 | 0.5652 | 0.8832 | 0.0449 |
| Jordan | 120 | 87 | 0.7883 | 0.1060 | 0.1693 | 0.2935 | 0.0378 |
| Malaysia | 60 | 87 | 0.9673 | 0.3758 | 0.4532 | 0.1745 | 0.6163 |
| Mexico | 120 | 87 | 0.8663 | 0.0096 | 0.7083 | 0.7376 | 0.0005 |
| Nigeria | 60 | 87 | 0.1026 | 0.2774 | 0.2487 | 0.4344 | 0.0496 |
| Pakistan | 60 | 87 | 0.7684 | 0.0001 | 0.0297 | 0.0015 | 0.0000 |
| Philippines | 60 | 87 | 0.0061 | 0.2946 | 0.7422 | 0.4022 | 0.0857 |
| Portugal | 47 | 87 | 0.0343 | 0.0027 | 0.2167 | 0.4705 | 0.0296 |
| South Korea | 120 | 87 | 0.0290 | 0.4046 | 0.8529 | 0.3924 | 0.2972 |
| Taiwan | 60 | 87 | 0.0350 | 0.3504 | 0.3535 | 0.5411 | 0.0321 |
| Thailand | 120 | 87 | 0.2505 | 0.0385 | 0.2846 | 0.0658 | 0.0023 |
| Turkey | 36 | 87 | 0.1105 | 0.0508 | 0.8598 | 0.2307 | 0.3509 |
| Venezuela | 60 | 87 | 0.2141 | 0.1896 | 0.0924 | 0.1025 | 0.1031 |
| Zimbabwe | 120 | 87 | 0.8459 | 0.4411 | 0.7669 | 0.2187 | 0.4154 |
| IFCG | 60 | 87 | 0.0624 | 0.2252 | 0.0687 | 0.6577 | 0.0134 |
| MSCI AC World | 24 | 87 | 0.2005 | 0.5971 | 0.2737 | 0.7564 | 0.3676 |
| MSCI World | 120 | 87 | 0.0974 | 0.4099 | 0.3770 | 0.2115 | 0.2103 |

Probability values are reported. Values of 0.500 indicate significant differences at the 5% level of significance.

## EXPLAINING THE DEVIATIONS FROM NORMALITY

### Fundamental Characteristics of Emerging Market Returns

Our first task has been to detail that emerging market returns deviate from the standard distributional assumptions and that the distributional characteristics change over time. The next task is to try to explain what forces determine the cross-sectional differences in distributional characteristics.

Exhibit 8 details a number of fundamental characteristics of emerging countries. Our method is to examine country characteristics in March 1987 and explore whether they are correlated with realized skewness and kurtosis over the April 1987-March 1997 period. These characteristics include country risk ratings explored in Harlow [1993], Erb, Harvey, and Viskanta [1996], and Diamonte, Liew, and Stevens [1996].

We also consider a number of macroeconomic characteristics such as inflation and trade-to-GDP. The development of the stock market is proxied by the market capitalization-to-GDP ratio. We examine but do not report one demographic variable, average age growth, which is explored in Erb, Harvey, and Viskanta [1997].

Finally, there are a number of financial variables. We consider the market capitalization, the volatility, and the beta versus the MSCI world index. We also report three fundamental ratios: earnings-to-price, book value-to-price, and dividend yield.

Note that a number of these variables are correlated with the market integration process. In particular, market capitalization-to-GDP as well as the world market beta are linked to capital market integration. Trade-to-GDP is often linked to economic integration.

Finally, credit ratings are often associated with both types of integration.

### Cross-Sectional Patterns in Skewness and Kurtosis

The rank-order correlations of the country attributes with skewness and kurtosis are reported in the second section of Exhibit 8. Exhibits 9 and 10 graph the cross-sectional relation between selected attributes and realized skewness and kurtosis, as well as report $R^2$s.

Skewness is negatively related to most of the ICRG ratings. These results, however, are particularly sensitive to one observation: Argentina. When Argentina is excluded, the relation between the ratings and skewness is weaker. Lower market capitalization greatly increases the chance of positive skewness in the returns. A negative correlation is also found between the skewness and GDP growth. Skewness is strongly

**EXHIBIT 8**
**SKEWNESS, KURTOSIS, AND COUNTRY ATTRIBUTES**

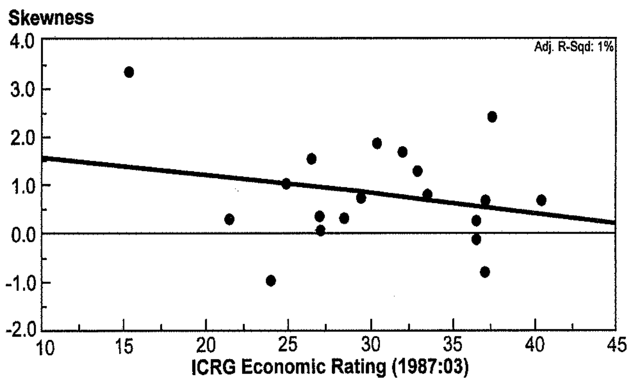
| Attributes | SKEW | KURT | IICCR | EMCRR | ICRGC | ICRGP | ICRGF | ICRGE | MKTCAP | INFLATE | RGDP | VOL | BETA | EP | BP | DY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Argentina | 3.3 | 20.2 | 24.8 | 29.0 | 43.0 | 59.0 | 11.0 | 15.5 | 1,214 | 211 | 0.3 | 92 | 0.52 | 12.5 | 3.57 | 1.0 |
| Brazil | 0.2 | 1.1 | 35.5 | 35.0 | 54.0 | 64.0 | 22.0 | 21.5 | 6,555 | 127 | 3.7 | 58 | −0.26 | 26.1 | 2.86 | 7.2 |
| Chile | 0.3 | −0.1 | 26.0 | 21.0 | 51.0 | 47.0 | 28.0 | 27.0 | 2,219 | 25 | 3.4 | 33 | 0.41 | 23.9 | 1.45 | 6.1 |
| Colombia | 1.6 | 4.1 | 39.8 | 42.0 | 59.5 | 58.0 | 29.0 | 32.0 | 677 | 23 | 4.1 | 23 | 0.24 | 18.1 | 1.22 | 6.7 |
| Greece | 1.8 | 6.3 | 46.9 | 60.0 | 59.0 | 60.0 | 27.0 | 30.5 | 824 | 18 | 1.9 | 30 | 0.45 | 11.4 | 0.88 | 3.0 |
| India | 0.7 | 1.1 | 50.6 | 69.0 | 56.5 | 50.0 | 29.0 | 33.5 | 5,373 | 8 | 4.5 | 24 | 0.01 | 9.8 | 0.53 | 3.6 |
| Jordan | 0.2 | 1.5 | 37.3 | 53.0 | 53.0 | 44.0 | 25.0 | 36.5 | 1,240 | 6 | 6.9 | 17 | −0.07 | 8.3 | 0.72 | 2.7 |
| Malaysia | −0.9 | 2.8 | 57.0 | 65.0 | 63.0 | 63.0 | 26.0 | 37.0 | 11,969 | 4 | 5.5 | 29 | −0.08 | 2.4 | 0.48 | 2.8 |
| Mexico | −1.0 | 5.4 | 28.7 | 31.0 | 54.0 | 62.0 | 22.0 | 24.0 | 5,611 | 55 | 3.7 | 47 | 0.29 | 6.2 | 0.75 | 2.0 |
| Nigeria | 1.5 | 19.6 | 22.0 | 27.0 | 42.0 | 42.0 | 15.0 | 26.5 | 576 | 15 | −0.6 | 46 | 1.75 | 22.4 | 0.42 | 1.9 |
| Pakistan | 1.2 | 4.3 | 30.4 | 50.0 | 48.5 | 41.0 | 23.0 | 33.0 | 643 | 7 | 6.5 | 12 | −0.04 | 13.8 | 0.80 | 5.8 |
| Philippines | 0.7 | 3.7 | 22.1 | 25.0 | 47.0 | 44.0 | 20.0 | 29.5 | 1,495 | 15 | 1.8 | 34 | 0.13 | | | 7.6 |
| Portugal | 2.4 | 12.9 | 54.3 | 71.0 | 72.5 | 70.0 | 37.0 | 37.5 | 1,591 | 20 | 2.8 | 40 | 1.13 | 6.9 | 0.31 | 1.7 |
| South Korea | 0.6 | 0.4 | 59.9 | 73.0 | 65.5 | 60.0 | 34.0 | 37.0 | 6,490 | 10 | 7.7 | 29 | 0.48 | 7.1 | 0.55 | 0.2 |
| Taiwan | 0.6 | 1.4 | 74.5 | 68.0 | 81.0 | 77.0 | 44.0 | 40.5 | 7,267 | 5 | 8.6 | 22 | 0.10 | 7.0 | 0.39 | 1.3 |
| Thailand | −0.2 | 1.8 | 53.6 | 62.0 | 60.5 | 55.0 | 29.0 | 36.5 | 2,004 | 7 | 6.4 | 18 | 0.05 | 8.2 | 0.78 | 5.0 |
| Turkey | 1.0 | 1.0 | 39.7 | 54.0 | 53.0 | 55.0 | 26.0 | 25.0 | 487 | 48 | 4.1 | | | | | |
| Venezuela | 0.2 | 2.2 | 36.9 | 31.0 | 56.5 | 63.0 | 21.0 | 28.5 | 1,298 | 14 | 0.7 | 47 | −0.03 | 7.6 | 0.38 | 0.8 |
| Zimbabwe | 0.0 | 1.2 | 22.8 | 34.0 | 47.0 | 44.0 | 23.0 | 27.0 | 200 | 13 | 3.0 | 42 | 0.61 | 29.2 | 0.75 | 11.2 |
| Rank Correlations: All Countries | | | | | | | | | | | | | | | | |
| Skewness | 1.00 | 0.69 | −0.11 | 0.00 | −0.11 | 0.04 | −0.14 | −0.24 | −0.51 | 0.44 | −0.41 | 0.38 | 0.47 | 0.11 | 0.39 | −0.20 |
| Kurtosis | 0.69 | 1.00 | −0.31 | −0.24 | −0.31 | −0.01 | −0.47 | −0.39 | −0.30 | 0.47 | −0.63 | 0.61 | 0.72 | 0.04 | 0.29 | −0.37 |
| Rank Correlations: Ex-Argentina | | | | | | | | | | | | | | | | |
| Skewness | 1.00 | 0.52 | 0.05 | 0.19 | 0.11 | −0.01 | 0.20 | 0.13 | −0.54 | −0.12 | −0.27 | −0.12 | 0.51 | 0.15 | −0.10 | −0.07 |
| Kurtosis | 0.52 | 1.00 | −0.21 | −0.12 | −0.15 | −0.08 | −0.25 | −0.07 | −0.27 | −0.09 | −0.56 | 0.28 | 0.84 | 0.07 | −0.30 | −0.28 |

Legend:

| | |
|---|---|
| SKEW | Skewness IFCG U.S.$ country returns (1987:04-1997:03). |
| KURT | Kurtosis IFCG U.S.$ country returns (1987:04-1997:03). |
| IICCR | *Institutional Investor* country credit rating (1987:03). |
| EMCRR | *Euromoney* country risk rating (1986:09). |
| ICRGC | Political Risk Services: International Country Risk Guide — Composite (1987:03). |
| ICRGP | Political Risk Services: International Country Risk Guide — Political (1987:03). |
| ICRGF | Political Risk Services: International Country Risk Guide — Financial (1987:03). |
| ICRGE | Political Risk Services: International Country Risk Guide — Economic (1987:03). |
| MKTCAP | IFC Global Market Capitalization (millions of U.S.$, 1987:03). |
| INFLATE | Trailing annual CPI inflation, IMF (1978-1987) in percent. |
| RGDP | Trailing annual real GDP growth, IMF (1978-1987) in percent. |
| VOL | Annualized volatility, monthly IFCG U.S.$ returns (1981:01-1987:03) in percent. |
| BETA | Beta versus MSCI World, monthly IFCG U.S.$ returns (1981:01-1987:03). |
| EP | IFC Global earnings/price ratio (1987:03). |
| BP | IFC Global book/price ratio (1987:03). |
| DY | IFC Global dividend yield (1987:03) in percent. |

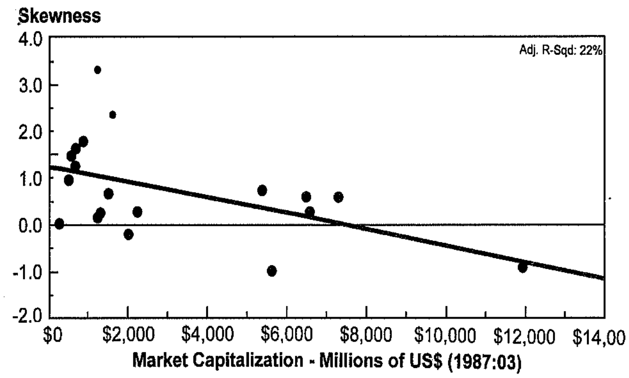
**EXHIBIT 9**
**CROSS-SECTIONAL DETERMINANTS OF SKEWNESS**

### SKEWNESS AND ICRG ECONOMIC RATING



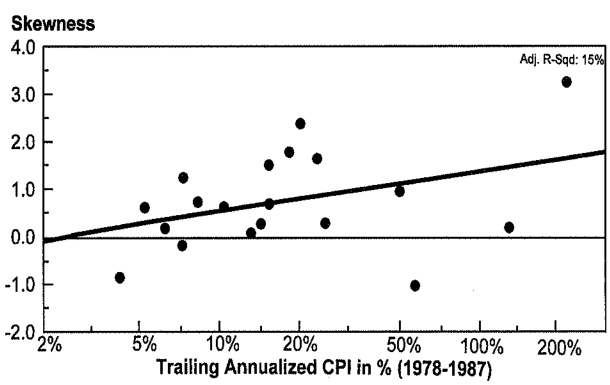

Skewness: IFCG monthly U.S. $ total returns (1987:04–1997:03).

### SKEWNESS AND MARKET CAPITALIZATION



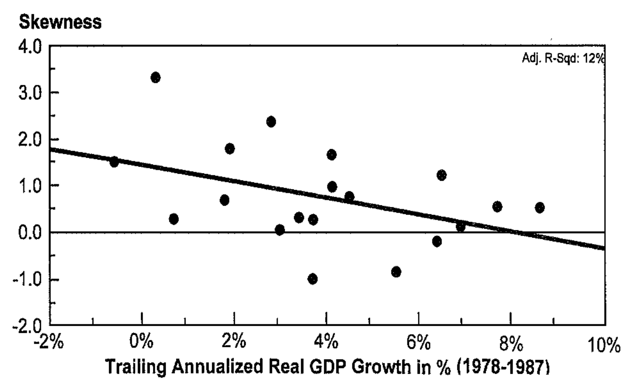

Skewness: IFCG monthly U.S. $ total returns (1987:04–1997:03).

### SKEWNESS AND INFLATION



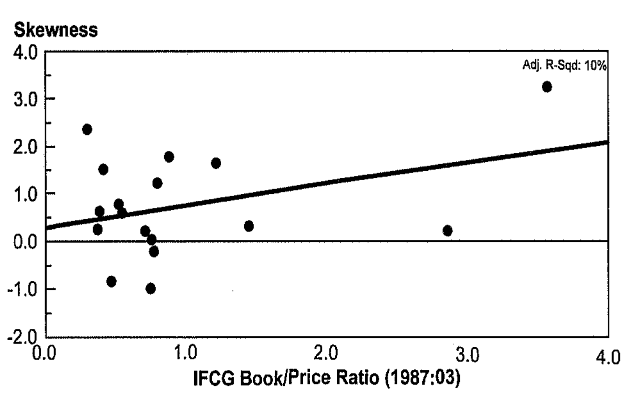

Skewness: IFCG monthly U.S. $ total returns (1987:04–1997:03).

### SKEWNESS AND GDP GROWTH



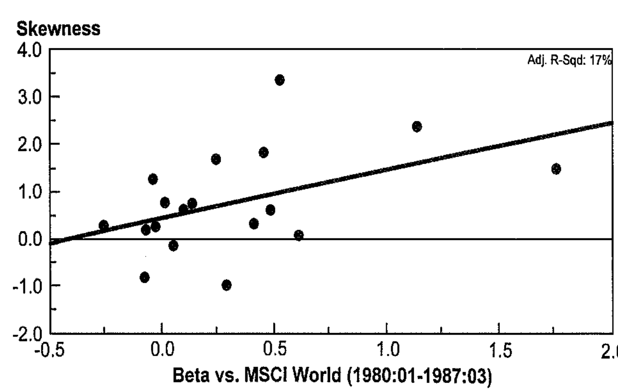

Skewness: IFCG monthly U.S. $ total returns (1987:04–1997:03).

### SKEWNESS AND BOOK/PRICE




Skewness: IFCG monthly U.S. $ total returns (1987:04–1997:03).

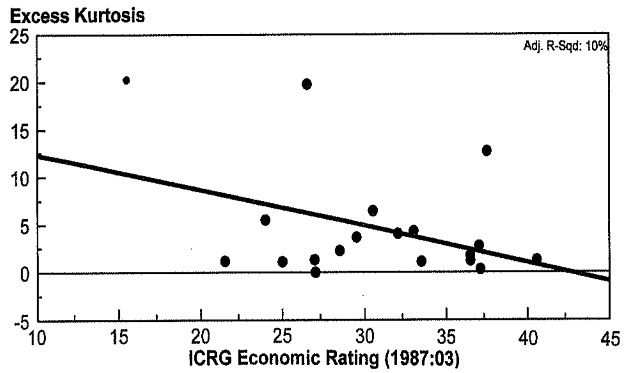
### SKEWNESS AND BETA




Skewness: IFCG monthly U.S. $ total returns (1987:04–1997:03).

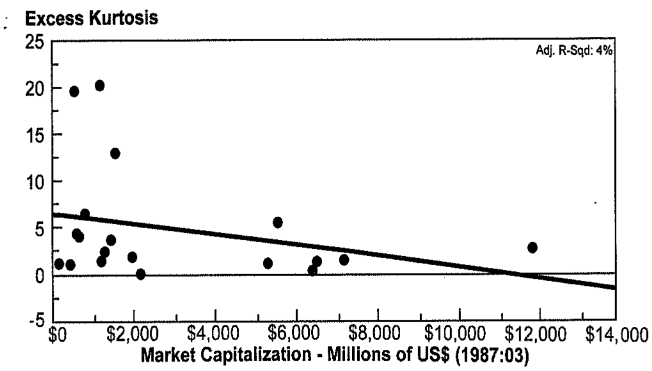
## EXHIBIT 10
## CROSS-SECTIONAL DETERMINANTS OF KURTOSIS

### KURTOSIS AND ICRG ECONOMIC RATING



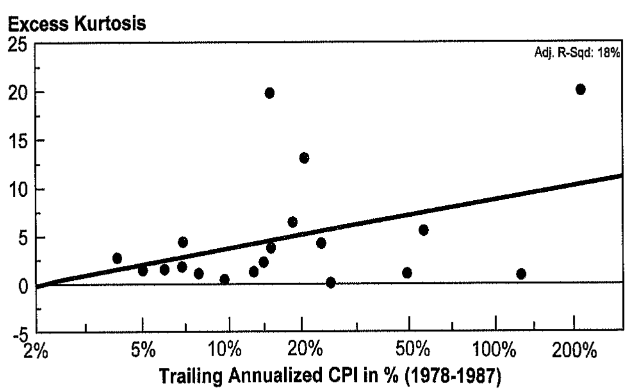

Excess kurtosis: IFCG monthly U.S. $ total returns (1987:04–1997:03).

### KURTOSIS AND MARKET CAPITALIZATION



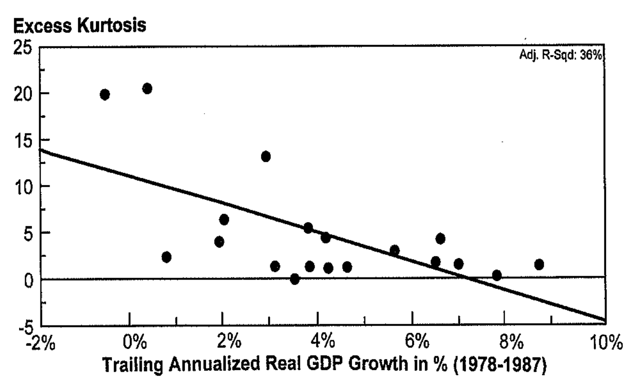

Excess kurtosis: IFCG monthly U.S. $ total returns (1987:04–1997:03).

### KURTOSIS AND INFLATION



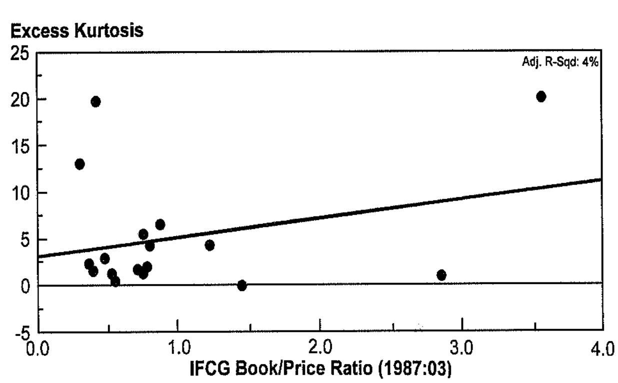

Excess kurtosis: IFCG monthly U.S. $ total returns (1987:04–1997:03).

### KURTOSIS AND GDP GROWTH



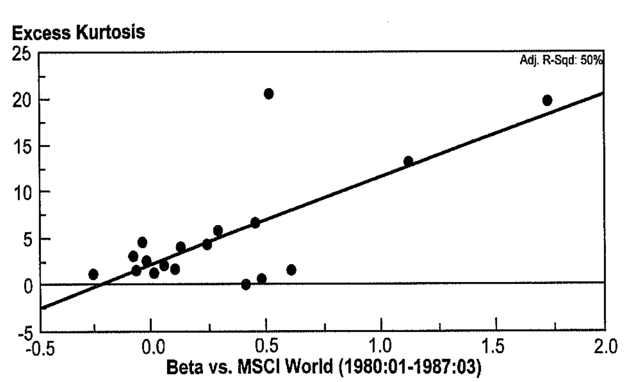

Excess kurtosis: IFCG monthly U.S. $ total returns (1987:04–1997:03).

### KURTOSIS AND BOOK/PRICE




Excess kurtosis: IFCG monthly U.S. $ total returns (1987:04–1997:03).

### KURTOSIS AND BETA




Excess kurtosis: IFCG monthly U.S. $ total returns (1987:04–1997:03).

positively related to inflation, book-to-price and the beta versus the MSCI world index.

The country characteristics have some success in explaining the cross-section of kurtosis. Both Exhibit 8 and Exhibit 10 document a negative relation between kurtosis and the ICRG country ratings, market capitalization, and GDP growth. These kurtosis results are less sensitive to the exclusion of Argentina. Similar to the analysis of skewness, positive correlations are found with inflation, book-to-price, and beta.

## HIGHER MOMENTS AND ASSET ALLOCATION

### Portfolio Analysis

We examine two trading strategies for skewness and kurtosis. Countries are sorted into tritiles on the basis of five-year trailing skewness and kurtosis. We hold these portfolios for one year and then rebalance on December 31. The results are presented in Exhibit 11.

The skewness trading strategy shows mixed results. Over the January 1990 through March 1997 period, the low-skewness portfolio has higher realized returns than the high-skewness portfolio. This is consistent with investors valuing skewness. That is, investors are willing to pay a premium (accept lower expected returns) for assets that contribute positive skewness.

Unexpectedly, the realized skewness of the low-skewness portfolio is higher than the realized skewness of the portfolio formed on the basis of high trailing skewness. This suggests that there is some reversion in skewness that the portfolio exercise is not picking up. There is also some sensitivity to when the portfolios are formed.[10] A heteroscedasticity-consistent test of whether the high-skewness portfolio returns are significantly different from the low-skewness portfolio fails to find evidence that the portfolio returns are different.

The second panel in Exhibit 11 reports the results based on kurtosis. In this case, the high- minus low-kurtosis strategy produces positive returns. These positive returns are not sensitive to the rebalancing period. In addition, the realized kurtosis of the portfolios is consistent with the way the portfolio is formed; i.e., the realized kurtosis of the high-kurtosis portfolio is higher than the low-kurtosis portfolio. A heteroscedasticity-consistent test provides only weak evidence that there is a real difference between these two portfolios' returns.

**EXHIBIT 11**
**HIGHER-MOMENT PORTFOLIO SIMULATIONS**

| | Low | High | High – Low | IFCG-EW | IFCG-CW | MSCI ACW |
|---|---|---|---|---|---|---|
| Skewness Portfolios | | | | | | |
| Annualized Return | 28.5% | 22.1% | –6.4% | 19.7% | 6.8% | 8.1% |
| Annualized Volatility | 18.7% | 19.6% | 19.6% | 15.2% | 19.5% | 13.0% |
| Skewness | 0.98 | 0.56 | 0.29 | 0.35 | 0.14 | –0.22 |
| Kurtosis | 2.83 | 0.46 | 0.56 | 0.56 | 1.87 | 0.86 |

Portfolios formed based on trailing sixty-month skewness (high = high skewness).

| | Low | High | High – Low | IFCG-EW | IFCG-CW | MSCI ACW |
|---|---|---|---|---|---|---|
| Kurtosis Portfolios | | | | | | |
| Annualized Return | 22.0% | 26.7% | 4.6% | 19.7% | 6.8% | 8.1% |
| Annualized Volatility | 19.6% | 19.7% | 23.2% | 15.2% | 19.5% | 13.0% |
| Skewness | 0.68 | 0.85 | 0.50 | 0.35 | 0.14 | –0.22 |
| Kurtosis | 0.89 | 2.67 | 0.92 | 0.56 | 1.87 | 0.86 |

Portfolios formed based on trailing sixty-month kurtosis (high = high kurtosis).

Portfolio construction:
IFC monthly U.S. $ returns: 1990:01-1997:03.
Countries equal-weighted, rebalanced annually.
IFCG = IFC Composite Global, EW = equal-weighted, CW = capitalization-weighted.
MSCI ACW = MSCI All-Country World.

## Asset Allocation

To analyze the impact of skewness and kurtosis on asset allocation, we undertake an exercise as follows. We assume that investors have constant relative risk aversion. In addition, we use data from April 1992 through March 1997 to determine the expected excess return on the world index divided by the variance (the reward-to-risk ratio). We set this as our level of risk aversion.

We solve the investor's optimization using three potential assets: risk-free, MSCI world index (developed markets), and emerging market index. Our innovation is the following. We assume that the world return is normally distributed, but we also assume that the emerging market portfolio is characterized by a mixture of normals. This allows us to match the skewness and the kurtosis that we observe in the emerging markets portfolio. We get exact solutions for the nonlinear first-order conditions from the optimization for a discretized process. That is, we discretize the distribution of returns using quadrature methods. We have found that even coarse grids give high accuracy. (More details are presented in the appendix.)

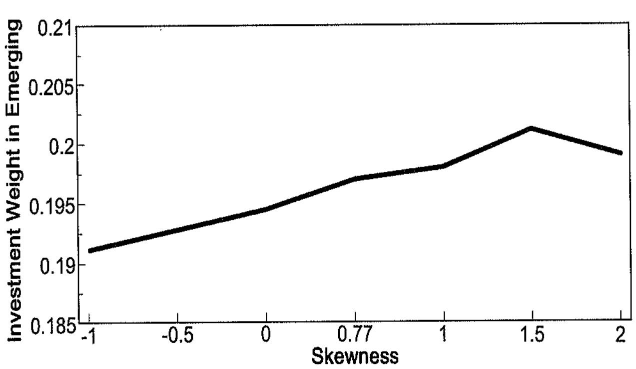
We further set the expected annual return on the world index to be 11% and the anticipated emerging market return to be 13%; the risk-free rate is set equal to the mean U.S. Treasury bill rate for our sample. The annual standard deviations for the world and emerging market portfolios are determined by the data to be 9.5% and 16.4%. Finally, we use the data to estimate the correlation between the two portfolios to be 33%.[11]

Exhibit 12 presents the weights in the emerging market portfolio if the level of kurtosis in the emerging markets is 5.77 (the level of kurtosis in the data), and we vary the level of skewness from −1.0 to 2.0. Generally, we see that the emerging markets' allocation increases as skewness increases up to the level of 1.5.

In Exhibit 13, we set the level of skewness to be 0.778 (the skewness observed in the data), and vary the level of kurtosis from 3.0 (what is expected under a normal distribution) to 10.5. We see that as the level of kurtosis rises beyond 5 the portfolio weight for the emerging markets increases.

Our exercise implies that skewness and kurtosis impact the asset allocation. In our example, the emerging markets portfolio weights could vary by 1.5%, which is potentially economically important, given that this represents over 10% of the emerging market alloca-

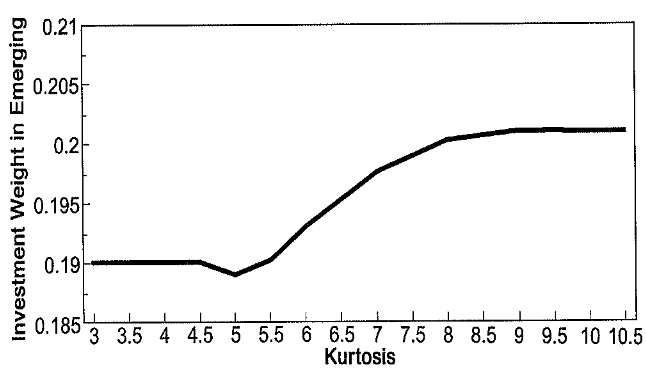
**EXHIBIT 12**
**IMPACT OF SKEWNESS IN EMERGING MARKET RETURNS ON OPTIMAL INVESTMENT WEIGHTS**




Mean World = 11%; Mean Emerging = 13%; Standard Deviation World = 9.5%; Standard Deviation Emerging = 16.4%; Correlation = 33%; Kurtosis Emerging = 5.77; Risk Aversion = 9.8567.

World return assumed to be normally distributed. Emerging market returns are assumed to follow a mixture of normals. Mean returns assumed. Standard deviations and correlations from April 1992-March 1997.

**EXHIBIT 13**
**IMPACT OF KURTOSIS IN EMERGING MARKET RETURNS ON OPTIMAL INVESTMENT WEIGHTS**




Mean World = 11%; Mean Emerging = 13%; Standard Deviation World = 9.5%; Standard Deviation Emerging = 16.4%; Correlation = 33%; Skewness Emerging = 0.778; Risk Aversion = 9.8567.

World return assumed to be normally distributed. Emerging market returns are assumed to follow a mixture of normals. Mean returns assumed. Standard deviations and correlations from April 1992-March 1997.

tion. In addition, we have looked only at the IFC composite portfolio. Departures from this portfolio may result in investment portfolios that have lower correlations and additional skewness and kurtosis, which could make the level and variation in the asset allocation to emerging markets more substantial. For example, if we assume that our portfolio has 13% correlation with the world index, and all other parameters remain the same, the same variation in skewness causes a 5.5% shift in the weight toward emerging markets.

## CONCLUSIONS

Emerging markets are playing an increasingly important role in international portfolios. Our research suggests that it could be a mistake to treat these markets like other developed markets. Aside from the well-known higher volatility, the returns of these markets exhibit substantial deviations from normality.

We detail these departures from normality, and show how skewness and kurtosis in these markets has evolved from the 1980s to the 1990s. We also find that some well-known country characteristics, such as market size, price-to-book value, and the size of the trade sector, have limited success in explaining why different countries have different skewness and kurtosis.

Finally, we investigate the economic implications of skewness and kurtosis. When we are faced with non-normal returns, the usual mean-variance framework breaks down. For example, it is reasonable to assume that investors prefer positively skewed returns to negatively skewed returns. Unfortunately, a Markowitz optimization is not able to take this into account.

For a representative investor, we examine how asset allocation decisions are impacted in the presence of skewness and kurtosis. Our portfolio simulation shows that investment weights are increased toward the asset with positive skewness, holding kurtosis constant. We also find that investment weights in emerging markets increase as kurtosis increases (holding skewness positive and constant).

As more markets open up to foreign investors, we will continue to face the problem of analyzing returns that cannot be summarized by a normal distribution. Optimal portfolio selection in the presence of non-normality is likely to become more important in the future.

## APPENDIX
## SOLVING THE ASSET ALLOCATION PROBLEM

### ASSET ALLOCATION SETUP

We solve the asset allocation problem with three assets: a world portfolio, an emerging markets portfolio, and a risk-free asset. We assume that the world portfolio returns are normally distributed. We allow the emerging market returns to be non-normal.

The asset allocation problem is a standard one where we maximize:

$$\max_{\alpha_w, \alpha_e} E[U(\tilde{W})]$$

where $\alpha_w$ and $\alpha_e$ are the investment proportions placed in the world and emerging market portfolios, respectively. We maximize the expected utility, E[U], of wealth, which is uncertain, and denoted by $\tilde{W}$.

There are two constraints in the problem. The first is that the sum of the investment weights for the two risky assets and the risk-free asset must be unity. The second defines next period's wealth in terms of the asset returns. Both constraints are reflected in:

$$\tilde{W} = W_0 \times$$

$$[(1 - \alpha_w - \alpha_e)(1 + r_f) + \alpha_w(1 + r_w) + \alpha_e(1 + r_e)]$$

where $r_w$ and $r_e$ denote the world and emerging market returns, respectively. The risk-free rate is denoted by $r_f$ and the initial wealth by $W_0$.

The final ingredient is the form of the utility function. We assume a utility function with constant relative risk aversion (CRRA):

$$U(\tilde{W}) = \frac{\tilde{W}^{1-\gamma}}{1 - \gamma}$$

where $\gamma$ is the coefficient of relative risk aversion.

Setting the first-order conditions equal to zero produces two equations:

$$E\left[\tilde{W}^{-\gamma}[r_w - r_f]\right] = 0$$

$$E\left[\tilde{W}^{-\gamma}[r_e - r_f]\right] = 0$$

Each of these conditions includes expectations. We need to use the joint density of ($r_w$, $r_e$) to solve for these expectations.

In the usual mean-variance Markowitz optimization, means, variances, and covariances of asset returns are used to determine the efficient portfolios. The price of risk determines the particular portfolio that is optimal (the tangency portfolio). Our problem is analogous, but a CRRA investor generally cares about higher-order moments, and the first-order conditions stated above are non-linear. When returns are multivariate normal, a mean-variance solution results, with the price of risk closely related to the coefficient of relative risk aversion. Since the emerging market return is assumed to be non-normal, this solution is incorrect in our case, and we solve the first-order conditions using a discrete approximation.

Denote the joint density of $(r_w, r_e)$ as $f(r_w, r_e)$. We can rewrite the first-order conditions as:

$$\int_{-\infty}^{\infty}\int_{-\infty}^{\infty} \tilde{W}^{-\gamma}[r_i - r_f]f(r_w, r_e)dr_w dr_e = 0; i = w, e$$

We approximate this by:

$$\sum_{s=1}^{N} P_s W_s^{-\gamma}[r_{i,s} - r_f] = 0$$

where $P_s$ is the state probabilities. There are N possible $(r_{w,s}, r_{e,s})$ states.

The approximation of the continuous density by a discrete one uses a technique known as quadrature. We start with a discrete approximation to a univariate density, and then use the product rule to get the bivariate density.

For a univariate density, $f(r_w)$, Gaussian quadrature chooses a set of abscissa of $(r_{w,s})_{s=1}^{N}$ and associated probabilities $(\pi_{w,s})_{s=1}^{N}$ so that the approximation is exact for integrating polynomials of degrees less than $2N - 1$. This implies:

$$\int_{-\infty}^{\infty} x^Z f(x)dx = \sum_{s=1}^{N} \pi_s x_s^Z$$

for $Z \leq 2N - 1$.

With the discrete state space, the first-order conditions can now be solved exactly. Wealth in every state depends on the asset weights, $\alpha_w$ and $\alpha_e$, and the state-specific asset returns. Hence, the first-order conditions constitute a system of two non-linear equations in two unknowns, which can be solved using a non-linear equation solver.

### DISTRIBUTIONAL ASSUMPTIONS

We assume that the world market return, $r_w$, follows a normal distribution. We assume that the emerging market return, $r_e$, follows a mixture of normal distributions. The mixture assumption allows for non-zero skewness and kurtosis.

Suppose that the returns, $r_w$ and $r_e$, have zero means. $r_w$ is assumed to be an independently normally distributed random variable. The emerging market asset, $r_e$, will have probability p of being $r_w$ and probability $1 - p$ of being another independently normal $r_v$. We let:

$$r_e = \begin{cases} c(m_w + \tilde{r}_w) & \text{with prob. } p \\ c(m_v + \tilde{r}_v) & \text{with prob. } 1 - p \end{cases}$$

where $m_w$, $m_v$, and c are constants. That is, the emerging market return is just a combination of two normally distributed variables.

Let $Var_w$, $Var_e$, and $Var_v$ denote the variances of $r_w$, $r_e$, and $r_v$. Let $Skew_e$ and $Kur_e$ represent the skewness and kurtosis of $r_e$. Finally, $Cov_{e,w}$ represents the covariance between $r_w$ and $r_e$. We use these five moments to determine $m_w$, $m_v$, $Var_v$, c, and p.

These parameters can be solved for from a system of five non-linear equations:

$$0 = pm_w + (1 - p)m_v$$

$$Var_e = c^2[p(m_w^2 + Var_w) + (1 - p)(m_v^2 + Var_v)]$$

$$Var_e^{3/2}Skew_e = c^3[p(m_w^3 + 3Var_w m_w) + (1 - p)(m_v^3 + 3Var_v m_v)]$$

$$Var_v^2 Kur_e = c^4[p(m_w^4 + 6m_w^2 Var_w + 3Var_w^2) + (1 - p)(m_v^4 + 6m_v^2 Var_v + 3Var_v^2)]$$

$$Cov_{e,w} = pVar_w c$$

This system may have more than one solution. Different solutions then imply distributions for the emerging market returns that are identical up to the first four moments and its covariance with the world return, but that may differ in terms of higher-order moments. The optimal allocation of CRRA investors may be sensitive to these higher-order moments, but our simulations indicate that this is the case only for investors with very high risk aversion.

So, we start from two independent normal variables and embed the correlation of the two risky assets in the mixture process. Hence, the different states $(N \times N)$ for $r_e$ are given by mixing all possible combinations of the states for $r_w$ and $r_v$.

## ENDNOTES

This article has benefited from the comments of Jarrod Wilcox and of participants at the Society of Quantitative Analysts Seminar in New York, May 1997.

[1]Harvey [1995], Bekaert and Harvey [1995], and Errunza [1997] provide research on emerging markets.

[2]See Kraus and Litzenberger [1977] and Harvey and Siddique [1997].

[3]Bekaert, Erb, Harvey, and Viskanta [1997] report that over the January 1989-March 1996 period, the correlation between the IFCI and the MSCI EMF indexes is 91.8%. Over the April 1991-March 1996 period, the correlation is 97.2%. The correlation between the EMG (EMF) and the MSCI World-All Countries is 41% (49%).

[4]See Bekaert and Harvey [1995, 1997a, 1997b] and Bekaert, Harvey, and Lumsdaine [1997].

[5]Histograms of all IFC countries and MSCI countries are available for viewing at http://www.duke.edu/~charvey/Country_risk.

[6]See Bekaert and Harvey [1997a] for the distribution of the statistic for the Kolmogorov-Smirnov test. A test statistic based on the generalized method of moments appears to have low power compared to the Bera-Jarque and the Kolmogorov-Smirnov tests.

[7]The Bera-Jarque test rejects the hypothesis of normality. While the Kolmogorov-Smirnov test does not provide a rejection, it is very close to rejection at the 5% level. (See Bekaert and Harvey [1997a].)

[8]Graphs for all IFC countries are available for viewing at http://www.duke.edu/~charvey/Country_risk.

[9]Technically, we conduct the Chow tests in a method of moments framework. Inference on higher-order moments with the short samples considered here is somewhat problematical. Monte Carlo analysis suggests that the test may over- or underreject in small samples depending on the moment considered and the distribution of the returns. The joint test always overrejects in small samples, so results for countries with fewer than 120 observations in the eighties should be interpreted with caution.

[10]If the portfolios are formed in the first quarter, the high-minus low-skewness return spread is 3.8%. When they are formed in the second quarter, the spread is –1.8%. In the third quarter, the spread is –3.3%.

[11]To match the sample correlation between the normally distributed random variable and the mixture of normals variable and the skewness and kurtosis of the latter, a system of non-linear equations must be solved. There is more than one solution to the system. We examine a number of different solutions and find that the weights for the emerging markets are substantially the same (to three decimal places).

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