INVESTING IN EMERGING MARKETS: A BLACK SWAN PERSPECTIVE

Emerging markets are populated by "black swans." These large, unpredictable swings have a massive impact on long-term performance and are concentrated in a negligible proportion of days. In light of this, the author recommends that investors in emerging markets avoid engaging in futile market timing and follow instead a passive approach.

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Investors considering their best strategy for investing in emerging markets are often trapped between two widely opposed views: One view advocates ignoring the wild swings in these markets and holding a properly diversified portfolio for the long term; the other advocates taking advantage of the high volatility in these markets and jumping frequently in and out of them, or from one to another, attempting to capture outsized short-term returns. The black swan perspective sides with the former view.

What investors should do when investing in emerging markets can be considered from many different perspectives and not all of them point in the same direction. The black swan perspective ultimately advocates a passive approach and is based on the following ideas. First, it is an empirical fact that an extremely small number of days has a massive impact on long-term performance. Second, although being invested in the good days and not invested in the bad days would yield extraordinary returns, investors are extremely unlikely to get the timing right. And third, because attempts to time the market have a negligible chance of succeeding and largely result in transaction costs, investors are best off simply holding a properly diversified portfolio for the long term.

Curiously, this recommendation is the same one that would be advocated by believers in market efficiency. However, the black swan perspective assumes neither market efficiency nor normally distributed returns. On the contrary, it argues that returns distributions have very fat tails and are therefore very far from normal. It also argues that mistakenly assuming normality would lead investors to underestimate risk substantially.

This article draws from results reported in an earlier article that quantified the impact of black swans on the long-term performance of emerging equity markets.[2] It further extends that article by considering in more detail what investors should do when investing in these markets. Interestingly, the investment advice discussed below has much in common with

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basic advice for a healthy life, such as exercising or eating right: First, a long-term gain can only be obtained as a result of some short-term pain; second, what should be done is quite clear but the actual implementation is far from effortless; and third, discipline and patience are an essential part of the process.

The article is organized as follows. First, we define a black swan and relate it to the financial concept of outliers. Then, we discuss the evidence reported in our previous work and some of its implications. Following this, we provide some further thoughts on investing in emerging markets and then conclude with an assessment.

What is a black swan?

Investors looking for a formal definition of a *black swan* will be disappointed; there is simply no such thing. But perhaps this should not be entirely surprising; the concept of outlier, widely used in finance and inevitably intertwined with the concept of black swan, has an ambiguous definition at best.

Taleb defines a *black swan* as an event with three attributes: 1) It is an outlier, lying outside the realm of regular expectations because nothing in the past can convincingly point to its occurrence; 2) it carries an extreme impact; and 3) despite being an outlier, plausible explanations for its occurrence can be found after the fact, thus making it appear as if it were explainable and predictable.[3] In short, then, a black swan has three characteristics: rarity, extreme impact, and retrospective predictability.

Note that this definition of black swan is rather informal and amounts to suggesting that, much like a financial bubble, we will recognize one only after the fact. Note also that this definition does not necessarily have a financial connotation; in fact, Taleb uses the events of September 11, 2001, as his first example.

To illustrate the definition of a black swan from a financial perspective, consider Black Monday. Between inception on May 26, 1896 and October 16, 1987, the Dow Jones Industrial Average had only twice in its whole history fallen by more than 10% in one day. This happened on back-to-back days in the midst of the crash of 1929: On October 28, 1929 and October 29, 1929 the Dow fell 12.8% and 11.7%, respectively. But nothing in over ninety years of history of the Dow indicated the possibility of a 22.6% fall like that observed on October 19, 1987. And yet, the unexpected and inconceivable did happen. Black Monday was an extremely rare event; it did have a very significant impact on investors' portfolios; and many and varied stories were advanced to explain it after the fact. In short, Black Monday was a black swan.

Events do not have to be so dramatic to have a substantial impact on long-term performance. The discussion below focuses on "large" daily swings (outliers) as defined below. What is the impact of these outliers on the long-term performance of emerging markets? How likely are investors to predict these outliers? Are market-timing strategies valuable in emerging markets? These are some of the questions addressed in the remainder of this article.

A BLACK SWAN HAS THREE CHARACTERISTICS: RARITY, EXTREME IMPACT, AND RETROSPECTIVE PREDICTABILITY.

Evidence

In a previous work we quantified the impact of black swans on the long-term performance of developed equity markets and finds that outliers have a massive impact on long-term performance.[4] Using a database of over 160,000 daily returns from fifteen developed equity markets, we found that, on average across all fifteen markets, missing the ten best days resulted in a portfolio 50.8% less valuable than a passive investment; and avoiding the ten worst days resulted in a portfolio 150.4% more valuable than a passive investment. Given that ten days represent less than 0.1% of the days considered in the average market in the sample, this evidence suggests that the odds against successful market timing are staggering.

In another work, we further expanded the inquiry by assessing the impact of black swans on the long-term performance of emerging equity markets.[5] The main results of that article are discussed in the remainder of this section. Exhibit 1

EXHIBIT 1 Data

This exhibit describes the data, including the markets in the sample; the index representing each market; the numbers of years and days in the sample of each market; and the first day in each market (Start). P10, P20, and P100 are the proportions that 10, 20, and 100 days represent relative to the total number of days in the sample of each market. All indices are in local currency and account for capital gains but not for dividends. All data is through December 31, 2007.

Market	Index	Years	Days	P10	P20	P100	Start
Argentina	Buenos Aires SE General	31	7,697	0.13%	0.26%	1.30%	12/30/1976
Brazil	Bovespa	36	9,090	0.11%	0.22%	1.10%	12/31/1971
Chile	Santiago SE General	33	8,229	0.12%	0.24%	1.22%	01/02/1975
India	Bombay SE Sensitive	28	6,224	0.16%	0.32%	1.61%	12/22/1979
Indonesia	Jakarta SE Composite	24	5,886	0.17%	0.34%	1.70%	12/30/1983
Israel	Tel Aviv SE Mishtamin-100	20	4,868	0.21%	0.41%	2.05%	12/31/1987
Korea	Kospi	46	13,009	0.08%	0.15%	0.77%	01/04/1962
Malaysia	KLSE Composite	28	6,930	0.14%	0.29%	1.44%	12/31/1979
Mexico	IPC	23	5,750	0.17%	0.35%	1.74%	12/31/1984
Peru	Lima SE General	26	6,464	0.15%	0.31%	1.55%	12/31/1981
Philippines	Manila SE Composite	22	5,446	0.18%	0.37%	1.84%	12/31/1985
South Africa	FTSE/JSE All-Share	21	5,319	0.19%	0.38%	1.88%	12/30/1986
Sri Lanka	Colombo SE All-Share	23	5,605	0.18%	0.36%	1.78%	12/31/1984
Taiwan	Taiwan SE Cap-Weighted	41	11,523	0.09%	0.17%	0.87%	01/05/1967
Thailand	Thailand SET General	32	7,956	0.13%	0.25%	1.26%	12/31/1975
Turkey	Istanbul SE IMKB-100	20	4,983	0.20%	0.40%	2.01%	12/31/1987
Average		28	7,186	0.15%	0.30%	1.51%	

EXHIBIT 2 Summary Statistics

This exhibit shows, for the indexes and sample periods in Exhibit 1, summary statistics for the series of daily returns, including minimum (Min) and maximum (Max) return; arithmetic (AM) and geometric (GM) mean return; standard deviation (SD); coefficients of skewness (Skw) and kurtosis (Krt); and coefficients of standardized skewness (SSkw) and standardized kurtosis (SKrt).

Market	Min	Max	AM	GM	SD	Skw	Krt	SSkw	SKrt
Argentina	–43.96%	45.41%	0.35%	0.30%	3.03%	1.4	23.2	51.8	416.0
Brazil	–46.03%	36.06%	0.38%	0.34%	2.83%	0.5	17.4	17.8	338.8
Chile	–11.58%	15.79%	0.14%	0.13%	1.12%	1.6	23.3	59.5	430.8
India	–12.76%	13.14%	0.10%	0.08%	1.69%	0.1	5.1	4.1	82.0
Indonesia	–20.17%	49.65%	0.07%	0.06%	1.69%	5.5	153.2	172.8	2399.6
Israel	–10.64%	10.91%	0.09%	0.07%	1.52%	–0.2	4.1	–5.4	57.9
Korea	–51.16%	51.24%	0.07%	0.05%	1.97%	0.0	115.4	–1.7	2687.9
Malaysia	–21.46%	23.14%	0.04%	0.03%	1.49%	0.5	34.7	15.4	590.3
Mexico	–18.32%	26.60%	0.17%	0.15%	1.88%	0.0	18.0	0.3	278.4
Peru	–9.32%	17.85%	0.36%	0.34%	1.79%	1.3	8.0	42.7	130.8
Philippines	–13.19%	17.56%	0.08%	0.06%	1.75%	0.7	11.3	21.0	170.6
South Africa	–11.86%	7.54%	0.06%	0.05%	1.15%	–0.9	10.1	–27.7	149.9
Sri Lanka	–12.98%	20.07%	0.06%	0.06%	1.14%	1.5	39.8	45.4	608.9
Taiwan	–7.88%	9.38%	0.05%	0.04%	1.53%	–0.1	2.9	–3.7	63.1
Thailand	–14.84%	12.02%	0.04%	0.03%	1.47%	0.2	9.0	8.5	163.8
Turkey	–18.11%	35.60%	0.22%	0.18%	2.96%	0.4	7.3	12.8	105.1
Average	–20.27%	24.50%	0.14%	0.12%	1.81%	0.8	30.2	25.9	542.1

EXHIBIT 3 Outliers—Expected and Observed

This exhibit shows, for the indexes and sample periods in Exhibit 1, the expected (Exp) and observed (Obs) number of daily returns three standard deviations (SD) below and above the arithmetic mean return (AM); the ratio between the number of these observed and expected returns; and the total number of expected (TE) and observed (TO) returns more than three SDs away from the mean. "Exp" figures are rounded to the nearest integer.

	Lower Tail				Upper Tail						
Market	AM–3·SD	Exp	Obs	Ratio	AM+3·SD	Exp	Obs	Ratio	TE	TO	Ratio
Argentina	–8.76%	10	29	2.8	9.45%	10	80	7.7	21	109	5.2
Brazil	–8.09%	12	44	3.6	8.86%	12	77	6.3	25	121	4.9
Chile	–3.22%	11	48	4.3	3.50%	11	98	8.8	22	146	6.6
India	–4.99%	8	40	4.8	5.18%	8	46	5.5	17	86	5.1
Indonesia	–4.99%	8	31	3.9	5.14%	8	50	6.3	16	81	5.1
Israel	–4.47%	7	30	4.6	4.64%	7	31	4.7	13	61	4.6
Korea	–5.83%	18	99	5.6	5.97%	18	106	6.0	35	205	5.8
Malaysia	–4.43%	9	54	5.8	4.51%	9	46	4.9	19	100	5.3
Mexico	–5.48%	8	41	5.3	5.82%	8	38	4.9	16	79	5.1
Peru	–5.00%	9	28	3.2	5.71%	9	107	12.3	17	135	7.7
Philippines	–5.18%	7	40	5.4	5.34%	7	44	6.0	15	84	5.7
South Africa	–3.39%	7	50	7.0	3.51%	7	26	3.6	14	76	5.3
Sri Lanka	–3.36%	8	44	5.8	3.49%	8	46	6.1	15	90	5.9
Taiwan	–4.54%	16	105	6.8	4.64%	16	84	5.4	31	189	6.1
Thailand	–4.38%	11	62	5.8	4.46%	11	81	7.5	21	143	6.7
Turkey	–8.65%	7	33	4.9	9.10%	7	38	5.6	13	71	5.3
Average	–5.30%	10	49	5.0	5.58%	10	62	6.4	19	111	5.7

describes the sample, which consists of sixteen emerging markets and over 110,000 daily returns. Exhibit 2 shows summary statistics for the distributions of daily returns of the sixteen markets in the sample. The coefficients of standardized kurtosis in the last column of this exhibit suggest that the departures from normality are massive.[6]

Exhibit 3 addresses the issue of non-normality from a different perspective. It compares the number of outliers expected under normality with those actually observed, defining outliers as those returns more than three standard deviations away from the mean return. To illustrate the interpretation of the figures in this exhibit, consider Argentina. The lower end of the interval three standard deviations around the mean is -8.76%; and although 10 returns lower than this magnitude were expected, 29 such returns were observed. The upper end of the same interval is 9.45%; and although 10 returns higher than this magnitude were expected, 80 were observed. That yields a total of 109 observed outliers, over five times as many as the 21 expected.[7]

Exhibit 3 shows that not just in Argentina but in all of the markets the number of outliers observed was far larger than the number of those expected under normality; across all markets, an average of 111 outliers were observed, over five times as many as the 19 expected. The evidence from these sixteen markets suggests that assuming normally distributed returns would have led investors to underestimate substantially the risk of investing in emerging markets.

Exhibit 4 evaluates the impact of outliers on long-term performance. Panel A shows the terminal wealth resulting from passively investing one unit of local currency between the beginning and the end of each market's sample period. It also shows the terminal wealth resulting from not being invested during each market's best and worst ten, twenty, and one hundred days. Some markets were subject to high inflation during the period considered, which is reflected in very large

EXHIBIT 4 Terminal Values

Panel A of this exhibit shows, for the indexes and sample periods in Exhibit 1, the terminal value of 1 unit of local currency (TV1) invested on the date indicated in the "Start" column in Exhibit 1 and held passively through December 31, 2007, not including dividends; such terminal value without being invested during the best 10, 20, and 100 days (–B10, –B20, and –B100); and such terminal value without being invested during the worst 10, 20, and 100 days (–W10, –W20, and –W100). Panel B shows the percent changes of these last six terminal values with respect to TV1. Panel C shows the mean annual compound return in all the scenarios considered. The "m" and "b" after some numbers denotes millions and billions.

Panel A: Terminal values

Market	TV1	–Best10	–Best20	–Best100	–Worst10	–Worst20	–Worst100
Argentina	10.6b	915.8m	165.7m	30,646	71.6b	212.2b	104,340.7b
Brazil	32,839.9b	3,994.7b	1,138.3b	691.6m	215,512.2b	618,813.1b	376,653,683.9b
Chile	61,201	20,920	10,902	340	129,934	219,495	2.8m
India	171	65	32	1	439	882	41,02
Indonesia	32	6	2	0	108	231	7,679
Israel	38	18	10	1	88	160	3,734
Korea	629	65	17	0	11,670	41,417	19.1m
Malaysia	7	2	1	0	28	58	2,110
Mexico	7,314	2,128	1,008	17	34,695	82,847	4.5m
Peru	3.3b	1.1b	439.7m	1.7m	7.6b	14.4b	420.3b
Philippines	28	8	4	0	76	159	7,500
South Africa	16	9	6	1	39	69	961
Sri Lanka	25	10	5	0	60	103	1,282
Taiwan	92	47	25	0	186	365	30,614
Thailand	10	4	2	0	26	55	2,678
Turkey	8,252	1,750	617	1	37,313	109,682	55.9m

Panel B: Variation in Terminal Values

Argentina	–91.4%	–98.4%	–100.0%	574.9%	1900.3%	983653.5%
Brazil	–87.8%	–96.5%	–100.0%	556.3%	1784.3%	1146839.4%
Chile	–65.8%	–82.2%	–99.4%	112.3%	258.6%	4519.6%
India	–61.9%	–81.4%	–99.6%	156.7%	416.3%	23913.8%
Indonesia	–82.7%	–92.6%	–99.8%	235.6%	618.9%	23843.9
Israel	–51.5%	–72.7%	–98.6%	133.4%	323.2%	9786.5%
Korea	–89.7%	–97.3%	–100.0%	1754.7%	6482.2%	3035588.7
Malaysia	–72.8%	–86.4%	–99.5%	292.9%	728.7%	29913.7%
Mexico	–70.9%	–86.2%	–99.8%	374.4%	1032.7%	61324.3%
Peru	–67.7%	–86.7%	–99.9%	129.8%	337.6%	12651.3%
Philippines	–71.1%	–86.5%	–99.7%	176.7%	474.5%	27068.6%
South Africa	–42.4%	–62.6%	–96.1%	145.0%	331.6%	5890.3%
Sri Lanka	–62.5%	–79.0%	–98.5%	137.5%	304.5%	4943.7
Taiwan	–49.2%	–73.2%	–99.5%	102.7%	296.6%	33183.5%
Thailand	–62.2%	–82.8%	–99.7%	158.7%	441.1%	26141.7%
Turkey	–78.8%	–92.5%	–100.0%	352.2%	1229.1%	677499.3%
Average	**–69.3%**	**–84.8%**	**–99.4%**	**337.1%**	**1060.0%**	**381672.6%**

terminal values in nominal (and local currency) terms.

Panel B shows the impact on terminal wealth of not being invested during the best and worst ten, twenty, and one hundred days in each market. On average across all sixteen markets, missing the best ten, twenty, and one hundred days resulted in a reduction in terminal wealth, relative to a passive investment, of 69.3%,

EXHIBIT 4 Terminal Values (Continued)

Panel C: Mean Annual Compound Returns

Market	TV1	–Best10	–Best20	–Best100	–Worst10	–Worst20	–Worst100
Argentina	110.6%	94.6%	84.1%	39.5%	124.0%	131.9%	183.3%
Brazil	137.4%	123.9%	116.2%	76.0%	150.1%	157.6%	207.8%
Chile	39.7%	35.2%	32.5%	19.3%	42.9%	45.2%	56.9%
India	20.2%	16.1%	13.1%	–1.5%	24.3%	27.4%	46.1%
Indonesia	15.5%	7.4%	3.7%	–11.6%	21.5%	25.4%	45.2%
Israel	19.9%	15.7%	12.4%	–3.2%	25.1%	28.9%	50.9%
Korea	15.0%	9.5%	6.4%	–6.4%	22.6%	26.0%	44.0%
Malaysia	7.2%	2.3%	–0.2%	–11.4%	12.6%	15.6%	31.4%
Mexico	47.2%	39.5%	35.1%	13.0%	57.5%	63.6%	94.6%
Peru	132.3%	122.4%	115.0%	73.5%	139.9%	145.9%	179.9%
Philippines	16.3%	9.9%	6.2%	–11.4%	21.8%	25.9%	50.0%
South Africa	14.1%	11.2%	8.9%	–2.2%	19.1%	22.4%	38.7%
Sri Lanka	15.1%	10.3%	7.6%	–4.2%	19.5%	22.3%	36.5%
Taiwan	11.7%	9.8%	8.1%	–1.9%	13.6%	15.5%	28.7%
Thailand	7.5%	4.3%	1.8%	–10.2%	10.8%	13.4%	28.0%
Turkey	57.0%	45.3%	37.9%	0.1%	69.3%	78.7%	144.0%
Average	41.7%	34.8%	30.5%	9.8%	48.4%	52.8%	79.1%

84.8%, and 99.4%, respectively. Avoiding the worst ten, twenty, and one hundred days, in turn, resulted in an increase in terminal wealth of 337.1%, 1,060.0%, and 381,672.6%, respectively, again relative to a passive investment. Obviously, a very small number of days has a massive impact on the long-term performance of emerging equity markets.

Finally, panel C shows the mean annual compound returns for all markets of a passive investment, as well as those resulting from not being invested during the best and worst ten, twenty, and one hundred days. Note that on average missing the ten best days (0.15% of the days considered in the average market) resulted in a decrease of almost seven percentage points in mean annual compound returns from 41.7% to 34.8%. Avoiding the worst 10 days, in turn, resulted in an increase of almost 7 percentage points in mean annual compound returns from 41.7% to 48.4%. Furthermore, missing the best one hundred days (1.51% of the days considered in the average market) resulted in a decrease of almost thirty-two percentage points in mean annual compound returns from 41.7% to just 9.8%; and avoiding the worst one hundred days resulted in an increase of over thirty-seven percentage points in mean annual compound returns from 41.7% to 79.1%.

As these figures show, in all cases a very small number of days accounts for the bulk of returns delivered by emerging equity markets. Investors in these markets do not obtain their long-term returns smoothly and steadily over time but largely as a result of booms and busts. A negligible proportion of days determines a massive creation or destruction of wealth. Being invested on the good days and not invested on the bad days is the key to long-term performance, but the odds of successfully and consistently predicting the days to be in and out of the markets are, unfortunately, close to negligible.

Some further thoughts

As mentioned above, sound investment advice has much in common with basic advice for a healthy life, like exercising or eating right; we all agree that the long-term goal is desirable but the getting there is the problem. Many people cannot bear the short-term pain of exercising and eating right, even when they

would like to achieve the long-term goal of being healthy and looking good. Many people know what they have to do to be healthy and look good, but they do not have the discipline and perseverance to do what is needed. Many people try shortcuts, such as miracle diets or magic fitness gadgets, knowing deep inside that that is just not the way to achieve their long-term goal.

ULTIMATELY, BLACK SWANS RENDER MARKET-TIMING STRATEGIES A GOOSE CHASE.

Investing, particularly in emerging markets, is much the same: All investors aim for the desirable goal of high (risk-adjusted) returns, but the getting there is the problem. Many investors cannot bear the pain of short-term losses; many do not have the patience and discipline to stick with their portfolios in bad times; many try shortcuts, such as magic investment strategies that presumably yield high returns with little risk, knowing deep inside that if such strategies existed we would all be sipping margaritas in some remote island. Too bad that we are not.

A basic recommendation from financial theory is that the higher the exposure to risk, the longer must be the investment horizon. An obvious corollary, particularly relevant for investing in emerging markets, is that a risky investment requires a long investment horizon, which in turn requires patience and discipline to hold the investment through thick and thin. It is here that many investors fail. When volatility kicks in, as sooner or later it always does in emerging markets, some investors fly for safety and park their capital in cash, but usually do so after suffering substantial losses. To make matters worse, very often these investors miss the market rebound and further sadden the return of their portfolios.

At the end of the day, a short-term investor should simply stay away from investing in emerging markets. A short-term investment horizon requires protecting a portfolio rather than seeking upside potential. This, in turn, requires a high exposure to bonds, a low exposure to stocks, and little or no exposure to emerging markets. Those who do not have the ability or the possibility to bear short-term losses should invest conservatively and stay away from emerging markets. These markets offer high rewards to long-term investors, but they do so in exchange for some short-term pain.

The large swings in these markets may tempt many investors to engage in market-timing strategies in order to capture outsized short-term returns. But they would be relying on luck, not on a sound financial strategy. Black swans in emerging markets render market timing an entertaining, but potentially very expensive, activity. Those with an inclination for gambling may find better odds in Vegas than in emerging markets.

An assessment

Black swans do exist, both in nature and in financial markets. Those in nature may be just a curiosity for most people; those in financial markets, however, have critical implications for the behavior of investors. Ultimately, black swans render market-timing strategies a goose chase.

Investors trapped between the widely opposing views that advocate either a passive approach or an active approach should remember that black swans not only do exist but also that they have a massive impact on long-term performance. The evidence discussed in this article, based on sixteen emerging equity markets and over 110,000 daily returns, clearly confirms it. On average across all sixteen markets, missing the best ten days (0.15% of the days considered in the average market) resulted in a portfolio 69.3% less valuable than a passive investment; and avoiding the worst ten days resulted in a portfolio 337.1% more valuable than a passive investment.

Some investors may question the wisdom of remaining invested in the current environment in which markets are displaying nearly all-time high volatility and seem to go nowhere but down. But hindsight is 20-20. If only we had known a few months ago what was coming, of course it would have been best to realize gains and move into cash. But this is, precisely, the nature of black swans: They are unpredictable, and we know that one hit us only after it did.

True, some pundits had been arguing that after the spectacular run of the

2003–2007 period (37.5% annualized as measured by the MSCI Emerging Markets index), emerging markets were bound for a correction. But nobody predicted *when* exactly it would happen. In fact, many pundits had been expecting a correction after the 2003–2005 run, and yet again after the 2005–2006 run. Investors that listened and cashed in gave up the 32.6% return of 2006 and/or the 39.8% return of 2007. The right times to be in and out of the market can be perfectly determined after the fact but hardly ever beforehand.

Investors that are keen on market-timing strategies should probably stay away from emerging markets. Much the same goes for investors that do not have the ability or the possibility of bearing short-term losses. A long-term view and the discipline to remain passively invested during good times and bad times are essential for successfully investing in emerging markets. ■

NOTES

[1] Gabriela Giannattasio provided valuable research assistance. The views expressed herein and any errors that may remain are entirely my own.

[2] J. Estrada, "Black Swans in Emerging Markets," *Journal of Investing* (forthcoming).

[3] N. Taleb, *The Black Swan. The Impact of the Highly Improbable* (Random House, 2007).

[4] J. Estrada, "Black Swans and Market Timing: How Not To Generate Alpha," *Journal of Investing* (Fall 2008): 20–34. J. Estrada, "Black Swans, Market Timing, and the Dow," Applied Financial Economics Letters, forthcoming; evaluates the impact of black swans on the US Dow Jones Industrials Average index in more detail.

[5] Estrada, op. cit. note 2.

[6] Under normality, the coefficients of standardized skewness and kurtosis are asymptotically distributed as $N(0, 6/T)$ and $N(0, 24/T)$, where T is the number of observations in the sample. Hence, values of these coefficients outside the range (–1.96, 1.96) indicate, at the 5% level of significance, significant departures from normality.

[7] The number of returns expected outside the interval considered must be split equally between the upper and the lower tails of the distribution. For clarity, throughout Exhibit 3 all expected and observed figures have been rounded to the nearest integer; for this reason, the sum of the values in the two "Exp" columns may not add up exactly to the values in the "TE" column.