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MORGAN STANLEY RESEARCH
NORTH AMERICA

Morgan Stanley & Co. Incorporated

Martin Leibowitz
Martin.Leibowitz@morganstanley.com
+1 (1)212 761 7597

Anthony Bova
Anthony.Bova@morganstanley.com
+1 (1)212 761 3781

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Portfolio Strategy

The Endowment Model: Theory and More Experience

In a series of earlier papers based upon a 2003 return/covariance matrix, endowment-like allocations were shown to have risk characteristics that were basically the same as a traditional 60/40 structure: total volatilities between 10-11%, portfolio to US Equity (USE) volatility ratios of 60-70%, correlations with USE all above 90%, and correlation-based portfolio betas that ranged from 0.55-0.65. One advantage of diversification is the higher expected returns derived from the "beyond-equity" alphas of non-USE asset classes.

The endowment model does not fit the textbook definition of a diversification that lowers volatility. With USE acting as the overwhelmingly dominant single risk factor, endowment portfolios may theoretically be even more vulnerable to adverse tail events than implied by the standard volatility estimates.

Our last paper compared these theoretical results with actual returns over 2003-2007 and found that this 5-year data was extraordinarily supportive of the theoretical analysis. This paper now extends the historical study back 15 years to 1993-2007 and again finds that the endowment model has essentially the same risk characteristics as the traditional 60/40.

The largest discrepancy in the 1993-2007 experience was in the area of realized returns. Within each of the three 5-year subperiods the alpha returns increased with diversification, but the outperformance was so consistent and so far exceeded the expectations as to raise questions about its probability of persistence.

Conclusion: These results suggest that diversification should not be viewed as smoothing returns and lowering short-term volatility, but rather as a strategy for accumulating incremental returns and achieving more divergent outcomes — over the long-term!

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The Endowment Model: Theory and More Experience

Summary & Conclusions

The "endowment model" is characterized by diversification into a broad range of asset classes. In our previous Note, we examined the five-year performance from 2003-2007 of various portfolios ranging from a traditional 60/40 to a full diversified endowment-type and compared them with the theoretical expectations from a representative return/ covariance matrix.

The 2003-2007 experience confirmed the theoretical projection regarding risk characteristics, i.e., that traditional and diversified allocations all have very similar volatility levels, 90% or greater correlations with equity, and beta sensitivities to equity in the area of 0.60. However, even given this common risk structure, the diversified portfolios generated higher real returns than the traditional 60/40, both on a total and on a "beyond-equity" alpha basis. The theoretical model also projected higher alpha returns from diversification, but the realized alpha returns were far higher and far more consistent quarter by quarter than expected.

Given the strong performance of the endowment model over the 2003-2007 period, it was important to see how the model has fared over longer periods. This Note examines the 15-year period from 1993-2007 with a focus on both the three 5-year subperiods as well as the overall long-term results.

Theoretical Beta-Based Risks

Exhibit 1 lists the hypothetical portfolios that will be used throughout this Note. Portfolio B represents the traditional 60/40 portfolio. Portfolios B1, B2 and C2 have increasing degrees of diversification, moving towards the endowment model Portfolio C.

Exhibit 1
Sample Portfolio Allocations

	Diversification →				
	B	B1	B2	C2	C
US Equity	60%	40%	30%	20%	20%
US Bonds	40%	30%	25%	10%	20%
International Equity		20%	20%	20%	15%
Emerging Mkt Equity				5%	5%
Real Estate		10%	10%	10%	10%
Absolute Return			10%	20%	10%
Private Equity			5%	10%	10%
Venture Capital				5%	10%
Total	100%	100%	100%	100%	100%

Source: Morgan Stanley Research

Exhibit 2 summarizes the risk projections for US Equity (USE) and for the sample portfolios based on the theoretical return/covariance matrix used in our earlier studies [1-4]. It should be noted that this matrix was developed in 2003 and hence does not in any way reflect the actual experience of the subsequent 2003-2007 period.

Exhibit 2
Theoretical Risk Projections

		Diversification →				
	US Equity	B	B1	B2	C2	C
Volatility (σ)	16.50%	11.17%	10.65%	10.19%	10.76%	10.45%
Volatility/Equity Volatility	1.00	0.68	0.65	0.62	0.65	0.63
Correlation (ρ)	1.00	0.97	0.93	0.93	0.91	0.90
Beta to US Equity (β)	1.00	0.65	0.60	0.57	0.60	0.57
β-Based Volatility	16.50%	10.73%	9.90%	9.41%	9.83%	9.45%
β-Based Volatility As % of Total Volatility	100.0%	96.0%	93.0%	92.3%	91.4%	90.4%

Source: Morgan Stanley Research

Focusing on these theoretical risk projections, a number of common features can be observed across all the portfolios. The total volatilities all range between 10-11%, the ratios of portfolio volatility to USE volatility all lie within 60-70%, and the correlations with USE are all above 90%. The ratio of the portfolio to USE volatility and the correlation with USE can be multiplied to derive a portfolio beta, which can be seen to be around 0.60 for all portfolios. The product of this portfolio beta and USE volatility determines the beta-based volatilities of 9.4-10.7%. These beta-based volatilities represent over 90%

of the total portfolio volatilities, regardless of the level of diversification. Thus, all the sample portfolios are subject to similar domination by the beta volatility.

Historical Risk Characteristics

We now turn to the historical experience for the 1993-2007 period and the three 5-year subperiods. This data was based upon the quarterly index values from the sources listed in Exhibit 3. The index values were adjusted for the realized inflation to obtain empirical real returns that could be compared with the preceding theoretical real returns.

Exhibit 3

Index Sources: 2003-2007 Quarterly Returns

Asset Class	Index Used
US Equity	S&P 500
US Bonds	Lehman US Aggregrate Bond
International Equity	MSCI EAFE
Emerging Mkt Equity	MSCI Emerging
Real Estate	NCREIF Property
Absolute Return	HFR
Venture Capital	Cambridge Associates US Venture Capital
Private Equity	Cambridge Associates US Private Equity

Theoretical Data Based on Cambridge Associates Covariance Matrix

Source: Morgan Stanley Research

It can be seen that actual portfolio volatilities vary significantly depending on the period. The primary driver of the level of portfolio volatility is the magnitude of the equity volatility. The higher equity volatility in 1998-2002 led to higher portfolio volatilities, while lower portfolio volatilities occurred in 1993-1997 and 2003-2007 when equity volatility was much lower.

In 1993-1997 and 2003-2007, the portfolio volatilities were between 5-8%, much lower than the expectations of 10-11%. From 1998-2003, the portfolio volatilities were much higher than expectations, ranging from 11-14%. However, if we examine the full 15-year period, the volatilities were only slightly lower than expectations. Thus, it appears that over the long term, the volatilities of diversified portfolios (C and C2) are generally close to the theoretical projections, while the behavior in shorter periods can be quite different from projections.

Exhibit 4

Volatility Characteristics

	Theoretical	1993-1997	1998-2002	2003-2007	1993-2007
US Equity Volatility	16.50%	9.16%	21.71%	10.54%	15.08%
B	11.17%	6.87%	12.04%	6.79%	9.01%
B1	10.65%	5.58%	11.95%	7.21%	8.76%
B2	10.19%	5.04%	11.33%	6.90%	8.29%
C2	10.76%	5.09%	14.37%	7.49%	9.87%
C	10.45%	4.93%	14.35%	6.61%	9.52%

Source: Morgan Stanley Research

However, the key point is that diversification does not materially reduce the portfolio volatility within any of these periods. The traditional 60/40 Portfolio B had subperiod volatilities of 6.9%, 12.0% and 6.8%, while the highly diversified Portfolio C had corresponding subperiod volatilities of 4.9%, 14.4% and 6.6%. Thus, diversification appeared to have a relatively modest effect on volatility relative to a traditional allocation. Over the entire 15-year period, the traditional and diversified funds had similar volatilities of 9.0% and 9.5%, respectively.

The volatility effect can be further analyzed in terms of the ratio of portfolio volatility to USE volatility. As shown in Exhibit 5, this volatility ratio was generally quite stable across the different subperiods and also across the various allocations. For Portfolio C, this ratio ranged from 54-66%, in line with expectations of 63%. The accuracy and consistency of this ratio has important implications in explaining why the portfolio betas have remained consistent over these periods.

As shown in Exhibit 6, the other factor is the high and stable correlation (in most cases 90%+) that the portfolios have had with USE. As shown in Exhibit 2, the portfolio correlation to USE coincides with the percentage of total volatility represented by beta volatility. Thus, these high and stable correlations enable the beta volatility to account for a high proportion of the total volatility. This long-term relationship reinforces the fact that USE beta remains the dominant risk factor in virtually all institutional portfolios.

Exhibit 5

Ratio of Portfolio Volatility to USE Volatility

	Theoretical	1993-1997	1998-2002	2003-2007	1993-2007
US Equity Real Return	7.25%	17.23%	-2.89%	9.42%	7.59%
B	0.68	0.75	0.55	0.64	0.60
B1	0.65	0.61	0.55	0.68	0.58
B2	0.62	0.55	0.52	0.65	0.55
C2	0.65	0.56	0.66	0.71	0.65
C	0.63	0.54	0.66	0.63	0.63

Source: Morgan Stanley Research

Exhibit 6

Correlations with USE

	Theoretical	1993-1997	1998-2002	2003-2007	1993-2007
US Equity Real Return	7.25%	17.23%	-2.89%	9.42%	7.59%
B	0.97	0.81	0.89	0.94	0.89
B1	0.93	0.93	0.99	0.98	0.97
B2	0.93	0.89	0.98	0.98	0.96
C2	0.91	0.78	0.93	0.95	0.92
C	0.90	0.85	0.89	0.94	0.89

Source: Morgan Stanley Research

The basically stable beta across all levels of diversification is evident in Exhibit 7. Taking the endowment model Portfolio C as an example, the portfolio beta within the 1998-2002 and 2003-2007 subperiods was 0.59 versus a theoretical projection of 0.57. The strong equity markets from 1993-1997 led to a “lag” that resulted in a lower 0.46 beta for Portfolio C.

Exhibit 7

Portfolio Betas

	Theoretical	1993-1997	1998-2002	2003-2007	1993-2007
US Equity Real Return	7.25%	17.23%	-2.89%	9.42%	7.59%
B	0.65	0.61	0.49	0.61	0.53
B1	0.60	0.56	0.54	0.67	0.57
B2	0.57	0.49	0.51	0.64	0.53
C2	0.60	0.43	0.62	0.67	0.60
C	0.57	0.46	0.59	0.59	0.56

Source: Morgan Stanley Research

The key message from Exhibit 7 is that, over longer periods, the covariance-based beta estimate appears to be an appropriate indicator of overall portfolio risk. More generally, the 15-year experience appears to be quite consistent with the theoretical projections from the 2003 covariance matrix.

Alpha and Beta Returns

The preceding analysis has been focused on risk factors. However, the 2003 return/covariance matrix also provided expected real returns for each of the asset classes. As shown in Exhibit 8, these assumptions allow projected returns to be calculated for each of the portfolios. Moreover, by using the theoretical beta values, these projected real returns can be partitioned into a beta-component associated with US equity and a residual “alpha-component.” Exhibit 9 illustrates how Portfolio C’s return can be separated into alpha and beta returns.

Exhibit 8

Theoretical Return Projections

		Diversification →				
	US Equity	B	B1	B2	C2	C
Total Real Return	7.25%	5.85%	6.03%	6.15%	6.98%	7.08%
Beta	1.00	0.65	0.60	0.57	0.60	0.57
Beta-Based Return	7.25%	5.24%	4.95%	4.78%	4.93%	4.79%
Structural Alpha	0.00%	0.61%	1.08%	1.37%	2.05%	2.29%
Incremental Volatility over Beta-Based Volatility	1.00	1.04	1.08	1.08	1.09	1.11

Source: Morgan Stanley Research

Since the portfolios have similar beta values, their beta-based returns are all in the 4.8-5.2% range. The structural alphas are quite small for Portfolio B but increase with greater levels of diversification. It is these higher alpha returns that provide diversified portfolios with their return advantages over the traditional 60/40. However, it is interesting to note that these higher alpha returns lead to only minimal increases in portfolio volatility.

Exhibit 9

Portfolio C: Alpha and Beta Returns

Equity Real Return	7.25%
Risk-Free Rate	- 1.50%
Equity Risk Premium	5.75%
x Portfolio C Beta	x 0.57
Beta * Equity Risk Premium	3.29%
Risk-Free Rate	+ 1.50%
Beta-Based Return	4.79%
Structural Alpha (Passive)	+2.29%
Total Portfolio C Return	7.08%

Source: Morgan Stanley Research

Exhibit 10 shows the total portfolio returns realized over the different historical subperiods. There is significant variability in returns across the different periods. As with the portfolio volatility, the dominance of USE plays a major role in determining the portfolio returns. In periods when USE performed well, all the portfolios also did well. In contrast, the weak USE equity market from 1998-2002 drove down all the portfolios' returns. At the same time, it is worth noting that within each of the periods, the returns generally increased with greater levels of diversification (as predicted).

Exhibit 10

Total Portfolio Returns

	Theoretical	1993-1997	1998-2002	2003-2007	1993-2007
US Equity Real Return	7.25%	17.23%	-2.89%	9.42%	7.59%
B	5.85%	12.17%	0.93%	6.24%	6.35%
B1	6.03%	10.65%	0.82%	9.09%	6.76%
B2	6.15%	11.28%	1.48%	9.99%	7.49%
C2	6.98%	13.28%	2.82%	12.78%	9.52%
C	7.08%	13.21%	4.62%	11.46%	9.70%

Source: Morgan Stanley Research

In Exhibit 7, it was shown that the portfolio betas were quite similar, both across allocations and across different periods. However, the beta-based returns clearly depend on the realized USE returns within each period. Exhibit 11 depicts how the beta returns were driven by these USE returns. At the same time, it is quite striking how for the full 15-year period, all the beta returns fell into the 4.4-5.4% range, i.e., very close to the theoretical expectations.

Exhibit 11

Portfolio Beta Returns

	Theoretical	1993-1997	1998-2002	2003-2007	1993-2007
US Equity Real Return	7.25%	17.23%	-2.89%	9.42%	7.59%
B	5.26%	11.32%	-0.47%	5.66%	5.39%
B1	4.96%	10.61%	-0.70%	6.30%	5.30%
B2	4.79%	9.50%	-0.56%	5.98%	4.89%
C2	4.93%	8.60%	-1.06%	6.31%	4.53%
C	4.79%	8.99%	-0.91%	5.50%	4.44%

Source: Morgan Stanley Research

The differences in the total returns are explained, not by their beta exposure, but rather by their alpha returns. The argument for portfolio diversification can be examined by focusing on the realized alpha returns shown in Exhibit 12. For Portfolio C, the theoretical alpha return was 2.29%. In every sub-period, the actual alpha return was greater than this projection. Moreover, the alpha returns for Portfolio C were roughly stable across the three 5-year subperiods. The less diversified portfolios also had positive alphas, but these were smaller and more volatile than for the more diversified funds.

Exhibit 12

Realized Alpha Returns

	Theoretical	1993-1997	1998-2002	2003-2007	1993-2007
US Equity Real Return	0.00%	0.00%	0.00%	0.00%	0.00%
B	0.59%	0.86%	1.40%	0.58%	0.96%
B1	1.07%	0.04%	1.52%	2.79%	1.46%
B2	1.36%	1.78%	2.04%	4.01%	2.60%
C2	2.05%	4.68%	3.88%	6.47%	4.98%
C	2.29%	4.23%	5.53%	5.96%	5.26%

Source: Morgan Stanley Research

Conclusions

The risk estimates from a standard covariance matrix were remarkably accurate in projecting the risk characteristics over the last 15 years. Both the ratio of portfolio volatility to USE volatility and the portfolio correlation to USE have proved consistent, leading to stable betas over the 15-year history.

These theoretical and empirical results demonstrate that the risk characteristics of a traditional 60/40 fund and an endowment-type portfolio are fundamentally similar. Therefore, the true advantage gained by the typical diversification is not risk reduction. Rather, the primary benefit of the endowment model is the accumulation of alpha returns over time.

Finally, over recent history, endowment funds' alpha returns have been far greater and far more stable than projected, which in itself raises a number of intriguing questions.

References:

1) Leibowitz, Martin L. "The β-Plus Measure in Asset Allocation.'" *Journal of Portfolio Management*, Spring 2004
2) Leibowitz, Martin L. and Anthony Bova. "Allocation Betas.'" *Financial Analysts Journa*l, July/August 2005
3) Leibowitz, Martin L. and Anthony Bova. "Beta-Based Allocation: A Summary." *Portfolio Analysis Note*, November 30, 2005
4) Leibowitz, Martin L. and Anthony Bova. "Gathering Implicit Alphas in a Beta World." *Journal of Portfolio Management*, Spring 2007

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MORGAN STANLEY RESEARCH

The Americas
1585 Broadway
New York, NY 10036-8293
United States
Tel: +1 (1) 212 761 4000

Europe
20 Bank Street, Canary Wharf
London E14 4AD
United Kingdom
Tel: +44 (0) 20 7 425 8000

Japan
4-20-3 Ebisu, Shibuya-ku
Tokyo 150-6008
Japan
Tel: +81 (0) 3 5424 5000

Asia/Pacific
Three Exchange Square
Central
Hong Kong
Tel: +852 2848 5200