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The Harvard Management Company and Inflation-Protected Bonds

In late February 2000, Jack Meyer, the President and CEO of the Harvard Management Company (HMC), Inc., was finishing a draft of the changes to the Harvard Policy Portfolio for which the management of HMC would be seeking approval at the Board meeting in March. The Policy Portfolio determined the long-run asset allocation policy of the Harvard endowment among different asset classes. Changes in the Policy Portfolio were rare and, whenever they occurred, were usually modest in size. However, the management of HMC believed that some recent developments in the capital markets required some significant changes in the Policy Portfolio. If approved, these changes would sharply reduce the allocation to U.S. equities and U.S. nominal bonds, and lead to Harvard making a significant investment in the new U.S. Treasury Inflation-Protected Securities (TIPS). TIPS, which were absent from the portfolio only 12 months ago, would now represent 7% of the total portfolio.

The Harvard Management Company

The Harvard Management Company (HMC) had been established in 1974. It was a separately incorporated, not-for-profit entity, wholly owned by Harvard University. Its portfolio included much of the University's endowment, pension assets, working capital, and certain other assets. In the second quarter of fiscal year 2000, it oversaw the management of more than \$19 billion in total assets, including approximately \$15.1 billion in endowment funds. Endowment income was an important source of income for the university. In fiscal year 1999, endowment income represented about 25% of the university total income, almost as much as tuition, which represented about 30% of income.¹ The fraction of the university budget financed by endowment income had been steadily increasing in the last ten years.

Like many other universities, Harvard pursued an active strategy to managing its endowment funds. However, unlike virtually all other universities, Harvard relied largely on internal management, provided by HMC, to achieve its investment goals. As of the end of fiscal year 1999, HMC managed 68% of endowment assets internally, and only 32% through outside asset managers. HMC had 180 employees, of whom 38 were investment professionals.

¹ The other main sources of income were gifts and grants.

HMC's investment strategy aimed at adding value by engaging professional investment managers who actively sought superior returns across a diverse array of asset classes relative to well-defined benchmarks. Over the last 10 years, this active strategy had produced a real (inflation adjusted) return of 11.3% per year after expenses. Over the same period, U.S. Treasury bills had returned 2.2% per year in real terms, US Treasury bonds had returned 5.2% per year and U.S. equities (as measured by the S&P 500) had returned 15.8% per year. In fiscal year 1999, the expenses generated by this active strategy (including performance fees) had been \$93.1 million, or about 49 basis points² of total assets under management. This strategy involved greater costs than a passive, or "indexed" strategy aimed at tracking the returns on market indexes (about 20 basis points), but it was cheaper than a typical active investment strategy (100 basis points or more).

Policy Portfolio

The Policy Portfolio served two important purposes within the corporation. First, it determined the long-run allocation of the endowment to different asset classes. The Board of the corporation determined the Policy Portfolio, but the management was permitted to make short-run tactical allocation adjustments within minimum and maximum guidelines without prior consultation with the Board. Second, it was a benchmark the corporation used to evaluate the performance of the active investment strategies pursued by its managers. A significant fraction of the compensation received by HMC managers was based on performance. The Board set the performance benchmarks (usually a well-known market index) for each asset class.

HMC considered 11 wide asset classes in the Policy Portfolio. These asset classes included categories familiar to most investors such as domestic equities or foreign bonds, plus an additional category known as "absolute return" asset class.³ **Exhibit 1** shows the Policy Portfolio and the benchmark for each asset class in March 1999, before they considered investing in TIPS.

The Policy Portfolio was designed to fulfill the growth goals of the endowment within a well-diversified portfolio. Harvard's long-term goal for the endowment was to distribute annually between 4% and 5% of the endowment to the schools within the university, while at the same time preserving the real value of the endowment and allowing for some real growth in the income distributions. Assuming that gifts to the endowment continued at their historical average rate of 1% of the endowment, achieving this preservation goal required an average real return on the endowment of at least 3% to 4% annually. But such a return would not allow for any long-term real growth in spending out of the endowment, and Harvard spending had been growing at 3% after inflation. A growth rate of 3% annually in real spending would require an investment real return goal between 6% and 7%.

The Policy Portfolio was the result of careful consideration of the risk and return characteristics of each asset class. To determine the relevance of an asset class for the portfolio, HMC typically considered three asset return characteristics: expected future real returns, the volatility of real returns, and the correlation of the real return on each asset class with the real return on all other asset classes. To estimate these characteristics, HMC used historical data on real returns as well as the assessment of experts. **Exhibit 2** shows twenty-year historical mean, standard deviation and correlation of real returns for the period 1989-1999.

² A basis point is 0.01%. That is, 100 basis points equal one percentage point.

³ An absolute return investment targets a specific return, usually without making directional bets on the market. The "absolute return" strategy included mostly investments in market neutral hedge funds. The Board had decided to create a specific asset category for them because they usually follow strategies that involve simultaneous investments in a variety of markets, so that it is very difficult to classify them in a particular asset class.

To analyze the portfolio implications of these capital market assumptions, HMC used a quantitative portfolio technique known as mean-variance analysis. Mean-variance analysis determines the optimal allocation to different asset classes that minimizes portfolio return variance given an expected portfolio return. The analysis can also incorporate portfolio constraints that investors might face, such as minimum and maximum positions. The output of this analysis is a set of portfolios, known as “efficient frontier,” that gives the minimum-variance portfolio for each expected return. Investors can then choose their preferred portfolio according to their tolerance for risk. The portfolio allocations resulting from applying this analysis to the capital market assumptions were useful to shape the Policy Portfolio recommendations.

The Policy Portfolio changed infrequently. Changes in the portfolio had to be approved by the Board. The Policy Portfolio changed only in response to (1) changes in the goals or risk tolerance of the university as an institution; (2) changes in capital market assumptions; (3) the appearance of a new asset class in the market. HMC believed that the issuance of inflation-protected bonds by the US Treasury in early 1997, and their performance during the last two years, suggested changes in the Policy Portfolio of the university based on (2) and (3).

Inflation-Protected Bonds⁴

U.S. Treasury Inflation-Protected Securities (TIPS) are bonds whose principal and coupons grow with the general level of prices as measured by the Consumer Price Index (CPI). These securities therefore give investors protection against the eroding effects of inflation on the value of money.

TIPS were first offered by the U.S. Treasury in January 1997. The first auction offered 10-year inflation-indexed notes. The size of the initial offering was approximately \$7 billion. **Exhibit 3** shows the ex-post real return on three-month U.S. Treasury bills (yield on T-bills at the beginning of the quarter minus change in the CPI over that quarter) as well as the actual real yields on TIPS between January 1997 and April 1999. The U.S. Treasury was not the first to offer inflation-protected bonds. Inflation-protected bonds had been issued in other countries for some time. Australia, Canada, Israel, the United Kingdom and Sweden had been issuing similar bonds for over a decade.

Inflation-indexed notes are issued with maturities of at least one year but not more than ten years. Inflation-indexed bonds have maturities of more than ten years. These securities are auctioned by the U.S. Treasury in single-price auctions in terms of a real yield.

TIPS’s structure requires the principal and coupon of the bond to change based on the monthly level of inflation as determined by the CPI. Specifically, the inflation-adjusted principal value of the securities on any date equals the product of the stated value at issuance, or par amount, times the index ratio applicable to that date. The index ratio is the reference CPI applicable to a particular valuation date divided by the reference CPI applicable to the original issue date.⁵ The adjustment to the principal is paid at maturity when the securities are redeemed at the greater of their inflation-adjusted principal amount or par amount. The securities are issued with a stated rate of interest that remains constant until maturity. Interest (i.e., coupon) payments for a particular security are

⁴ This section draws extensively on Harvard case 298-017, “Treasury Inflation-Protection Securities (TIPS),” written by Professor Sanjiv Das and Jeffrey Slovin.

⁵ There is a two-month lag between the time when the CPI is announced and the date that the principal is increased. The TIPS inflation index uses the non-seasonally adjusted CPI (seasonal changes in price levels have been significant). TIPS have built in covenants to protect investors from a fundamental change in the methodology of computing the CPI. However, technical changes made by the BLS to the CPI to improve its accuracy as a measure of the cost of living are not considered fundamental changes.

determined by multiplying the inflation-adjusted principal by one-half of the stated rate of interest on each semi-annual interest payment date. Thus, coupons increase proportionately with increases in principal due to inflation. **Table A** gives an example of the TIPS structure.

Table A. An example of how to compute the interest and principal of TIPS

Terms of TIPS 10-year note:

- Value at issuance (par amount) = \$1,000.
- Stated rate of interest (coupon rate) = 3.5% payable semiannually.

CPI at issuance = 100

Coupon payment and accretion to principal at the end of first 6 month period (first payment date):

- CPI = 101.49 (3% annual inflation rate)
 - Inflation - adjusted principal = $\frac{101.49}{100} \times \$1,000 = \$1,014.90$
 - Semi - annual interest (coupon) payment = $\$1,014.90 \times \frac{3.5\%}{2} = \17.77
 - Accretion to principal = $\$1,014.90 - \$1,000 = \$14.90$ (Not received until maturity)
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Like other Treasury securities, TIPS are exempt from state and local taxes. However, interest payments are taxed at the federal level. The taxation structure is similar to that of Treasury zero-coupon bonds. Any inflation adjustment that causes an accretion to principal is taxed in the period in which it is made. In the example shown in **Table A**, taxable income at the end of the first six-month period would be $\$14.90 + \$17.77 = \$32.67$. Many economists argue that the inflation-adjustment to principal should have been tax free to establish a guaranteed real after-tax return for investors.

The Asset Allocation Recommendation

Jack Meyer and his team had been watching the market for TIPS since their inception in 1997. They had noted that TIPS had offered a real yield that ranged from 3.2% to 4.25% (see **Exhibit 3**). By contrast, real yields on Treasury bills had been historically around 2%, and real yields on Treasury nominal bonds had been around 3%. In view of this relatively high yield on TIPS, and their inflation-protection characteristics, the HMC team believed that TIPS could be an attractive asset to hold in a diversified portfolio. They also believed that the real yields delivered by TIPS suggested that the 2% real return on cash they had assumed historically in their portfolio analysis was too low, and that a better estimate was 3.5%.

To evaluate the importance of both including TIPS in the Harvard portfolio and increasing the expected real return on cash, the HMC team had conducted a mean-variance analysis. This analysis

required estimating the expected real return on TIPS, its volatility and its correlation with the real return on other assets. Unfortunately, TIPS represented a new asset class for which there was scant historical data available. However, the HMC team considered that the current real yield on TIPS (about 4%) was a good estimate of the expected real return on TIPS for an institution with long investment horizons such as Harvard. They had also computed estimates of the volatility and correlation of the real return on TIPS with other assets based on the performance of TIPS in the last three years, and on the historical performance of other asset classes such as nominal U.S. Treasury bonds or commodities. Commodities had historically offered investors protection against inflation. **Exhibit 4** shows the set of capital market assumptions the HMC team used as input to the mean-variance optimization.

The HMC team ran several optimization exercises, each one including different portfolio constraints. **Exhibits 5** and **6** show mean-variance optimal asset allocations resulting from two of these exercises. **Exhibit 5** shows allocations when portfolio weights for all asset classes except cash were constrained to lie between 0% and 100%. The constraints for cash were set to -50% and 100%. **Exhibit 6** shows allocations when portfolio weights for all asset classes except inflation-indexed bonds were constrained to lie between 10 percent points below and 10 percent points above the weights in the May 1999 Policy Portfolio (**Exhibit 1**). This was the Harvard Policy Portfolio before considering the inclusion of inflation-indexed bonds. In this exercise, the constraints for inflation-indexed bonds were set to 0% and 100%.

Overall, these mean-variance optimizations suggested that inflation-protected bonds were an attractive asset to hold in a portfolio. The analysis also suggested long positions in private equity, commodities, real estate and emerging markets, at the expense of domestic equities and domestic bonds. Thus the results of the analysis supported a move away from domestic equities and nominal bonds toward inflation-protected bonds. However, before recommending any specific changes to the Policy Portfolio, Jack Meyer and his team had also reviewed how other institutions similar to Harvard allocated their portfolios. Data on the asset allocations of a group of university endowments is shown on **Exhibit 7**.

After careful consideration of the mean-variance optimization results, and the portfolios of peer institutions, Jack Meyer and his team had decided to recommend a new Policy Portfolio that would include a new position in TIPS of 7% and no shorting of cash, at the expense of smaller positions in U.S. equities and U.S. domestic bonds. In the new portfolio, U.S. equities would represent 22%, down from 32% one year ago, and US bonds would represent 7%, down from 11% one year ago. **Exhibit 8** shows the new Policy Portfolio that Meyer was planning to propose. However, Jack Meyer was not sure how the Board would react to his proposal. TIPS represented a new and relatively unproven asset class, while U.S. equities had performed very well in the recent past. Was this right the time to move away from U.S. equities to explore such unfamiliar territory?

Exhibit 1 Policy Portfolio in May 1999 (All numbers are percentages except for Sharpe Ratio.)

	Minimum	Policy	Maximum	Benchmark
1. Domestic Equity	22	32	42	80% S&P 500; 16% S&P Mid Cap; 4% Russell 2000
2. Foreign Equity	10	15	20	93% EAFE ^b ; 7% Salomon Extended Market Index (excluding US and EAFE overlap)
3. Emerging Markets	3	9	13	IFC Global Index and EMBI ⁺ ^c
4. Private Equity	10	15	20	Cambridge Associates Weighted Composite
5. Absolute Return	0	4	8	LIBOR + 5%
6. High Yield	0	2	4	Salomon High Yield and Bankrupt
7. Commodities	2	5	8	60% GSCI ^d ; 40% NCREIF ^e Timber Index
8. Real Estate	4	7	10	NCREIF Property Index
9. Domestic Bonds	6	11	22	Lehman 5 + Year Treasury Index
10. Foreign Bonds	0	5	10	J.P. Morgan Non U.S.
11. Cash	-10	-5	20	3 month LIBOR
		100		
Expected Real Return		6.51		
Standard Deviation		10.81		
Sharpe Ratio ^a		0.28		

Source: Harvard Management Company.

^a The Sharpe ratio is defined as the ratio of the expected excess return on a portfolio over its standard deviation. The excess return is usually computed over the return on cash.

^b EAFE is the Morgan Stanley Europe, Australia, and Far East Index.

^c IFC is the International Finance Corporation. EMBI⁺ is the J.P. Morgan Emerging Markets Bond Index Plus: EMBI (which covers only Brady bonds) plus loans, Eurobonds, and US dollar-denominated local instruments.

^d GSCI is the Goldman Sachs Commodity Index.

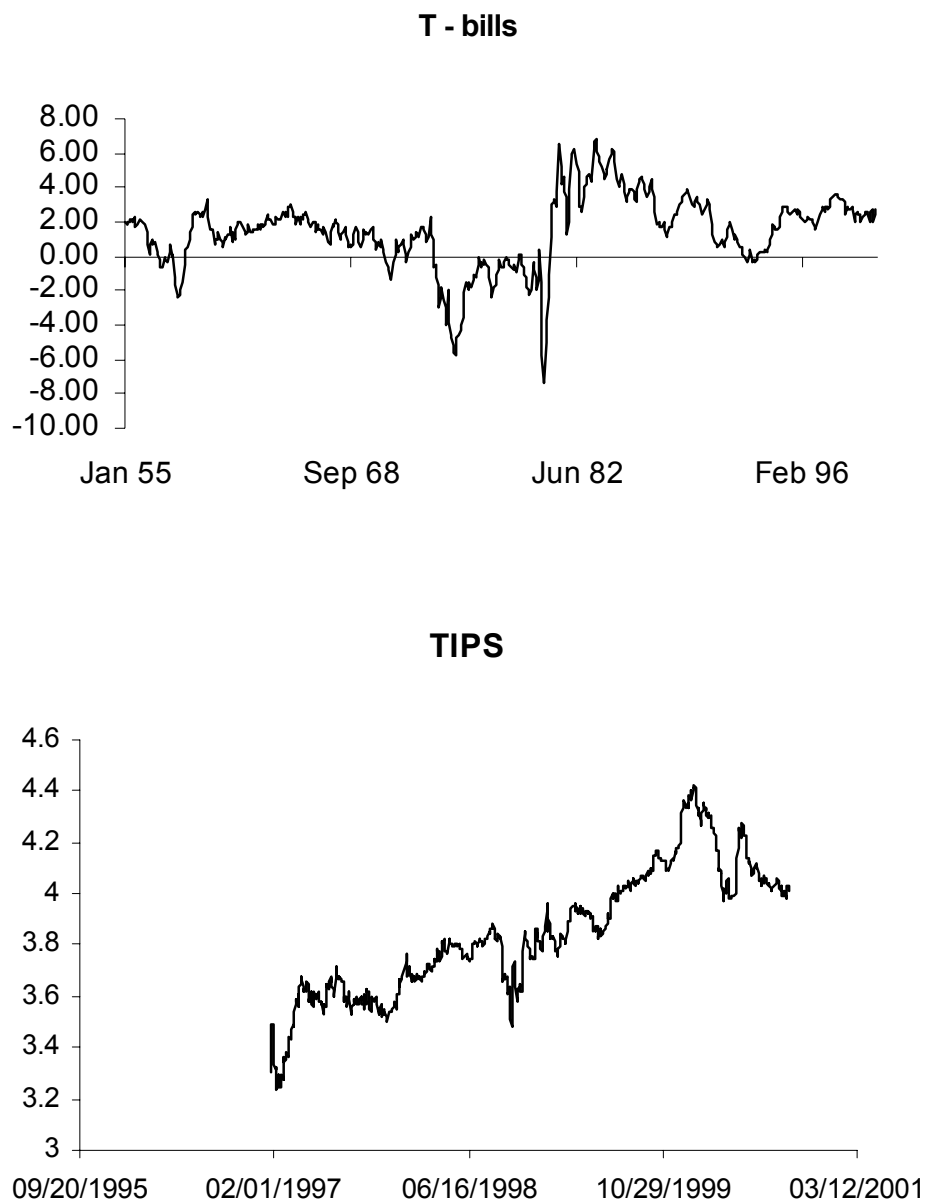
^e NCREIF is the National Council of Real Estate Investment Fiduciaries.

Exhibit 2 Twenty-Year Historical Mean, Standard Deviation and Correlation Matrix of Real Returns

		Correlations ^a												
		Mean Real Return (%)	S.D. (%)	Domestic Equity	Foreign Equity	Emerging Markets	Private Equity	Absolute Return	High Yield	Commodities	Real Estate	Domestic Bonds	Foreign Bonds	Cash
1	Domestic Equity	13.2	15.2	1.00	0.51	0.37	0.26	0.86	0.56	(0.00)	0.06	0.32	0.10	0.14
2	Foreign Equity	10.2	17.4	0.51	1.00	0.37	0.12	0.89	0.35	0.02	0.13	0.22	0.40	0.16
3	Emerging Markets	4.9	21.2	0.37	0.37	1.00	0.16	0.56	0.39	(0.05)	(0.08)	(0.09)	(0.07)	(0.06)
4	Private Equity	17.9	15.2	0.26	0.12	0.16	1.00	0.27	0.06	0.05	0.12	(0.12)	(0.30)	0.03
5	Absolute Return ^b	8.6	8.6	0.86	0.89	0.56	0.27	1.00	0.50	0.04	0.07	0.37	0.40	0.29
6	High Yield ^b	7.1	7.3	0.56	0.35	0.39	0.06	0.50	1.00	(0.32)	(0.11)	0.31	(0.01)	0.32
7	Commodities	1.1	10.7	(0.00)	0.02	(0.05)	0.05	0.04	(0.32)	1.00	(0.04)	(0.09)	0.19	(0.20)
8	Real Estate	1.4	6.4	0.06	0.13	(0.08)	0.12	0.07	(0.11)	(0.04)	1.00	(0.06)	(0.15)	0.39
9	Domestic Bonds	6.0	7.8	0.32	0.22	(0.09)	(0.12)	0.37	0.31	(0.09)	(0.06)	1.00	0.42	0.28
10	Foreign Bonds ^b	5.1	8.7	0.10	0.40	(0.07)	(0.30)	0.40	(0.01)	0.19	(0.15)	0.42	1.00	0.01
11	Cash	3.1	0.9	0.14	0.16	(0.06)	0.03	0.29	0.32	(0.20)	0.39	0.28	0.01	1.00

Source: Harvard Management Company.

^a Correlations are calculated using quarterly returns^b All numbers are based on 10-year historical real returns

Exhibit 3 Real Yield on 3-month T-bills^a and January 1997 TIPS

Source:

^a Yield on 3 -month T-bills minus annual CPI inflation rate (percent).

Exhibit 4 Assumed Real Expected Returns, Volatilities, and Correlations

Expected			Correlations										
Real Return (%)	S.D. (%)	Domestic Equity	Foreign Equity	Emerging Markets	Private Equity	Absolute Return	High Yield	Commodities	Real Estate	Domestic Bonds	Foreign Bonds	Infl-Indexed Bonds	Cash
6.5	16.0	1.00	0.50	0.40	0.40	0.60	0.55	(0.05)	0.20	0.40	0.15	0.10	0.10
6.5	17.0	0.50	1.00	0.35	0.30	0.50	0.35	(0.05)	0.15	0.25	0.40	(0.05)	0.05
8.5	20.0	0.40	0.35	1.00	0.25	0.30	0.35	0.00	0.15	0.15	0.10	0.00	0.00
9.5	22.0	0.40	0.30	0.25	1.00	0.30	0.20	(0.10)	0.15	0.20	0.10	0.10	0.05
5.5	12.0	0.60	0.50	0.30	0.30	1.00	0.40	0.00	0.15	0.30	0.20	0.20	0.10
5.5	12.0	0.55	0.35	0.35	0.20	0.40	1.00	0.10	0.10	0.45	0.15	0.30	0.10
4.5	12.0	(0.05)	(0.05)	0.00	(0.10)	0.00	0.10	1.00	0.00	(0.15)	(0.10)	0.20	(0.05)
5.5	12.0	0.20	0.15	0.15	0.15	0.15	0.10	0.00	1.00	0.20	0.10	0.20	0.15
4.3	7.0	0.40	0.25	0.15	0.20	0.30	0.45	(0.15)	0.20	1.00	0.40	0.50	0.15
4.3	8.0	0.15	0.40	0.10	0.10	0.20	0.15	(0.10)	0.10	0.40	1.00	0.10	0.10
4.0	3.0	0.10	(0.05)	0.00	0.10	0.20	0.30	0.20	0.20	0.50	0.10	1.00	(0.10)
3.5	1.0	0.10	0.05	0.00	0.05	0.10	0.10	(0.05)	0.15	0.15	0.10	(0.10)	1.00

Source: Harvard Management Company.

Exhibit 5 Portfolio Optimization Based on Capital Market Assumptions and 0% Constraint (Cash to -50%)

(All Numbers in %)		Portfolio Allocation										Constraints	
												Lower	Upper
Domestic Equity	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1.00
Foreign Equity	3.5	3.8	4.3	4.7	4.8	4.8	4.8	4.8	4.8	4.8	4.2	0.00	1.00
Emerging Markets	13.1	14.8	15.9	17.3	19.1	19.1	19.1	20.8	22.3	22.3	22.3	0.00	1.00
Private Equity	14.1	15.9	17.3	18.8	21.1	21.1	21.1	23.4	25.7	25.7	25.7	0.00	1.00
Absolute Return	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1.00
High Yield	0.0	0.0	0.5	0.3	1.1	1.1	1.1	1.9	3.4	3.4	3.4	0.00	1.00
Commodities	11.2	12.5	13.6	14.7	16.1	16.1	16.1	17.6	19.7	19.7	19.7	0.00	1.00
Real Estate	10.6	11.5	13.1	14.2	15.9	15.9	15.9	17.6	19.7	19.7	19.7	0.00	1.00
Domestic Bonds	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1.00
Foreign Bonds	7.5	8.4	8.6	9.7	9.4	9.4	9.4	9.5	11.5	11.5	11.5	0.00	1.00
Inflation-Indexed Bonds	52.3	54.1	63.1	70.3	62.6	62.6	62.6	54.5	43.5	43.5	43.5	0.00	1.00
Cash	(12.2)	(21.0)	(36.4)	(50.0)	(50.0)	(50.0)	(50.0)	(50.0)	(50.0)	(50.0)	(50.0)	(0.50)	1.00
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0		
Expected Real Return	5.75	6.00	6.25	6.50	6.75	6.75	6.75	7.00	7.25	7.25	7.25		
Standard Deviation	5.87	6.52	7.17	7.83	8.49	8.49	8.49	9.18	9.88	9.88	9.88		
Sharpe Ratio	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38		

Source: Harvard Management Company.

Exhibit 6 Portfolio Optimization Based on Capital Market Assumptions and 10% Constraint

(All Numbers in %)	Portfolio Allocation										Constraints	
											Lower	Upper
Domestic Equity	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	42.0
Foreign Equity	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	25.0
Emerging Markets	9.9	11.8	13.8	15.9	18.0	19.0	19.0	19.0	19.0	(1.0)	19.0	19.0
Private Equity	10.4	12.8	15.2	17.6	20.0	22.8	25.0	25.0	25.0	5.0	25.0	25.0
Absolute Return	(6.0)	(6.0)	(6.0)	(6.0)	(6.0)	(6.0)	(6.0)	(6.0)	(6.0)	(6.0)	(6.0)	14.0
High Yield	(8.0)	(8.0)	(8.0)	(8.0)	(8.0)	(6.9)	0.3	0.3	0.3	(8.0)	(8.0)	12.0
Commodities	12.4	13.9	15.0	15.0	15.0	15.0	15.0	15.0	15.0	(5.0)	(5.0)	15.0
Real Estate	7.7	9.3	10.9	12.6	14.3	16.4	17.0	17.0	17.0	(3.0)	(3.0)	17.0
Domestic Bonds	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	21.0
Foreign Bonds	4.2	4.1	3.9	3.5	3.1	2.9	4.0	4.0	4.0	(5.0)	(5.0)	15.0
Inflation-Indexed Bonds	56.4	49.1	42.2	36.4	30.6	23.8	12.3	12.3	12.3	0.00	0.00	100.0
Cash	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	5.0
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0			
Expected Real Return	5.75	6.00	6.25	6.50	6.75	7.00	7.25	7.25	7.25			
Standard Deviation	6.46	7.08	7.74	8.42	9.12	9.84	10.61	10.61	10.61			
Sharpe Ratio	0.35	0.35	0.36	0.36	0.36	0.36	0.35	0.35	0.35			

Source: Harvard Management Company.

Exhibit 7 Asset Allocations of a Selected Group of University Endowments in June 2000 (All Numbers in %)

University	U.S. Equity	Foreign Equity	Emerging Markets	Private Equities	Absolute	Commodities	Real Estate	Bonds	TIPS	Cash
A	34.2	14.2	2.0	11.2	7.3	4.7	3.3	17.3	0.0	5.8
B	14.6	4.4	4.8	25.9	19.8	4.0	10.2	9.5	0.0	6.8
C	15.8	6.0	6.9	17.7	24.6	1.3	8.0	11.7	0.0	8.0
D	22.2	11.8	5.6	27.6	1.5	5.7	15.2	4.1	4.3	2.0
E	58.1	1.2	8.5	9.2	5.8	1.6	4.5	7.3	0.0	3.8
F	53.2	6.0	1.0	6.5	0.0	0.0	0.8	29.5	1.5	1.5
G	39.8	8.9	NA	29.5	6.1	0.0	1.6	10.6	0.0	3.5
H	56.3	17.8	NA	1.9	0.0	0.0	1.4	11.3	10.1	1.2
I	21.7	5.8	5.5	20.1	20.6	1.1	4.9	10.0	2.6	7.7
J	41.8	10.8	7.0	0.9	3.6	0.0	5.4	27.5	0.0	3.0
K	49.4	10.3	1.0	12.4	6.1	4.7	2.1	11.6	0.0	2.4
L	37.1	9.8	0.9	10.1	19.1	0.0	3.2	19.8	0.0	0.0
M	34.8	9.1	4.2	25.7	2.2	0.9	3.2	17.9	0.0	2.0
N	27.8	8.1	2.9	21.4	14.4	3.4	6.2	13.2	1.3	1.3
O	25.0	10.0	NA	25.0	10.0	3.5	6.5	20.0	0.0	0.0
P	22.4	14.9	3.1	32.8	7.1	3.3	3.8	11.3	0.9	0.4
Q	28.4	11.5	7.3	21.9	10.5	0.8	2.9	13.9	0.0	2.8
R	26.0	9.4	2.7	24.2	6.7	1.3	6.5	16.6	3.3	3.3
S	21.0	9.0	3.5	21.5	18.5	2.5	4.0	12.0	4.5	3.5
LOW	14.6	1.2	0.9	0.9	0.0	0.0	0.8	4.1	0.0	0.0
MEDIUM	32.5	9.7	4.4	18.1	9.4	2.3	5.0	14.5	1.8	3.0
HIGH	58.1	17.8	8.5	32.8	24.6	5.7	15.2	29.5	10.1	8.0

Source: Harvard Management Company

Exhibit 8 Proposed Policy Portfolio (All numbers are percentages except for Sharpe Ratio).

	<u>Minimum</u>	<u>Policy</u>	<u>Maximum</u>	<u>Benchmark</u>
1. Domestic Equity	12	22	40	80% S&P 500; 16% S&P Mid Cap; 4% Russell 2000
2. Foreign Equity	10	15	20	93% EAFE; 7% Salomon Extended Market Index (excluding US and EAFE overlap)
3. Emerging Markets	3	9	13	IFC Global Index and EMBI ⁺
4. Private Equity	10	15	20	Cambridge Associates Weighted Composite
5. Absolute Return	0	5	10	LIBOR + 5%
6. High Yield	0	3	5	Salomon High Yield and Bankrupt
7. Commodities	3	6	9	60% GSCI; 40% NCREIF Timber Index
8. Real Estate	4	7	10	NCREIF Property Index
9. Domestic Bonds	2	7	12	Lehman 5 + Year Treasury Index
10. Foreign Bonds	0	4	10	J.P. Morgan Non U.S.
11. Inflation-Indexed	2	7	12	Salomon TIPS
12. Cash	-5	0	10	3 month LIBOR
		100		
Expected Real Return		6.44		
Standard Deviation		9.30		
Sharpe Ratio		0.32		

Source: Harvard Management Company.