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Institutional Investment Diversification: Foreign Stocks vs. U.S. Farmland

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INSTITUTIONAL INVESTMENT DIVERSIFICATION: FOREIGN STOCKS vs U.S. FARMLAND

**David Lins, Andrew Kowalski
and Carlos Hoffman¹**

SECTION 1: INTRODUCTION

The potential gains from portfolio diversification into investments in foreign stocks has been amply emphasized in the academic literature (Grubel; Jorion; Solnik; Levy and Sarnat). However, investment in foreign stocks is not without problems. Inadequate knowledge of the economic factors influencing foreign stock prices, higher transactions costs, exchange rate risk, and political risk all contribute to the challenges of diversification through investment in foreign stocks.

The potential benefits of diversifying portfolios dominated by domestic stocks and/or bonds with investments in farmland have also received some attention in the academic literature (Moss, Featherstone and Baker; Webb and Rubens; and Kaplan). These authors found that risk/return tradeoffs on farmland compared well with both common stocks and bonds. Moreover, the market value of farm real estate as a percent of market wealth of the U.S. is over 5 percent (Ibbotson, Siegel, and Love). Yet farmland remains a relatively insignificant component of the portfolios of most major institutional investors. As of 1989, the asset mix of U.S. pension funds was approximately 60% in U.S. stocks and 40% in U.S. bonds (Jorion).

The purpose of this paper is to compare the benefits of diversifying domestic stock and bond portfolios with investments in international stocks and/or investments in U.S. farmland.

The remainder of the paper is organized into the following sections. Section 2 discusses methodology and data sources. Section 3 provides a discussion of optimal portfolios using different combinations of U.S. stocks, long term corporate and government bonds, business real estate, farm real estate, and foreign stocks. Section 4 summarizes the results and draws conclusions for institutional investors.

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SECTION 2: METHODOLOGY AND DATA

Methodology:

Markowitz's mean-variance portfolio theory is used to derive risk efficient (E-V) frontiers. This method assumes the decision maker's utility function is quadratic. Despite the problems and limitations surrounding mean-variance portfolio theory (Roll), the procedure is still commonly used to estimate risk efficient frontiers.

To derive the efficient portfolios and the associated efficient frontiers, the General Algebraic Modelling System (GAMS) was used. This model allows the user to determine the minimum standard deviation for a given level of return. Using GAMS, the composition of efficient portfolios at different levels of portfolio returns were determined. The GAMS model was solved using both one and five-year holding periods for returns on the assets under consideration.

Data:

Data used in this analysis covers the period 1970 through 1990. Annual returns on equities (stocks) for seven countries were obtained from the Morgan Stanley Capital International group. These seven countries include: the United States, Japan, Canada, Germany, Switzerland, France, and the United Kingdom. Combined, these seven countries account for over 80 percent of the world wide equities in organized stock trading. The returns to equities for these seven countries were measured as annual average returns adjusted for exchange rate fluctuations. That is, all returns are converted to U.S. equivalent returns after adjusting for changes in exchange rates. Annual returns include both the dividend return and any capital gains or losses.

In addition to the returns on equities, data was also obtained for the annual returns on business real estate, long-term corporate bonds, long-term government bonds, and farmland. These data were obtained from Ibbotson and Associates and again cover the 1970-1990 time period.

The time period studied was restricted to the 1970-1990 period due to data limitations. Returns on foreign equities were not available prior to 1970. This limitation may influence results since in some earlier periods, the correlation of returns between farmland and U.S. stocks was higher than during the 1970-1990 period.

Mean Returns and Correlations:

The average returns for the various asset classes uses in this study are shown in Table 1. For 1-year holding periods the returns are arithmetic averages while for five year holding periods the returns are measures as the geometric mean because that allows us to view the returns as compound annual averages.

Results show that the highest returns over this time period would have been achieved by investing in the Japanese stock market while the lowest returns would have come from investments in long-term U.S. government bonds. Notice also that there is some variation in the ranking of asset returns depending upon whether one uses one or five year holding periods.

Correlations coefficients among the asset classes are shown in Table 2 for both one and five year holding periods. Farmland returns have a low or negative correlation with returns on all other asset classes when measured over a one year holding period. When moving to a five year holding period, the correlation of farmland returns with other returns decreases. In contrast, the correlations among returns of stocks from various counties often, but not always, increase when moving from a one to a five year holding period. These results suggest that optimal portfolios obtained from returns measured over one year holding periods are likely to differ somewhat from those obtained from those obtained from returns measured over five year holding periods.

SECTION 3: RESULTS

One Year Holding Periods

Table 3 identifies several optimal portfolio combinations that lie on the E-V frontier when the asset choices are restricted to U.S. stocks, long-term government bonds, long-term corporate bonds, and business real estate. The restriction to these four asset classes was imposed because it tends to reflect the major asset classes now held by many institutional investors (pension funds) in the United States. It also provides a starting point against which other portfolios can be judged. Results indicated that at relatively high levels of risk and return, the optimal portfolios are dominated by U.S. stocks. However, as both the risk and return are lowered, business real estate becomes a much more prominent component of the optimal portfolio, while U.S. stocks diminish in importance. At relatively low levels of risk and return, long term corporate bonds enter the portfolio. Long-term government bonds, however, never entered the optimal portfolio.

To examine the potential benefits of diversifying the asset classes to include farmland and/or foreign stocks, three additional E-V frontiers were estimated. In Table 4, optimal portfolios after expanding the choice set to include farmland, but not foreign stocks, are presented. In Table 5, the E-V frontier was found after expanding the choice set to include the six foreign stocks identified above, but not farmland. Finally, Table 6 presents the E-V frontier when the choice set has been expanded to included both foreign stocks and farmland. Comparison of these results allows one to examine changes in E-V frontiers resulting from diversification into farmland and/or foreign stocks.

As shown in Figure 1, expanding the choice set to include farmland but not foreign stocks allows for much lower levels of risk for the same level of returns, particularly in the middle portion of the E-V frontier. The E-V frontier reflected by Table 4 also shows that the

proportion of farmland in the efficient set peaks at just over 65 percent near the upper end of the E-V frontier and then diminishes to 25%. Also notice that now long-term corporate bonds enter the efficient set, whereas they did not when farmland was excluded from the choice set.

Figure 2 identifies the E-V frontier when the original choice set is expanded to include foreign stocks, but not farmland. Under these conditions the upper range of possible risk return combinations is dramatically increased because of the high risks and high returns associated with a number of foreign equities, especially Japanese stocks. However, at the lower end of the E-V frontier it was not possible to find a lower risk efficient set than was available from the original four assets. In contrast, lower risk points were available if the choice set was expanded to include only farmland.

If one compares results in Tables 4 and 5 at a return of 11%, we see that expanding the choice set to include only farmland results in a standard deviation of 5.14% contrasted to 4.22% when the choice set was expanded to include only foreign stocks. Thus, at this point on the E-V frontier, foreign stocks do offer a better choice set for diversification than farmland, but by a rather small amount. Or if you look at it from the returns side of the equation, diversification with foreign stock rather than farmland would have increased the expected return by less than one percentage point for the same level of risk. (Starting from a standard deviation of 5.14%)

Table 6 shows the E-V frontier when the choice set is expanded to include both farmland and foreign stocks. At high risk high return combinations, foreign stocks dominate the optimal portfolios, while at low risk low return combinations, foreign stocks are a relatively minor component of the optimal portfolios. Farmland starts to enter the optimal portfolio at quite high risk return combinations, increases to a high of over 50 percent of the optimal portfolio in the mid range of the E-V frontier and then slowly declines to about 25% of the optimal portfolios at the lower end of the E-V frontier.

The results of these analyses suggest that farmland offers significant potential for improving the risk return performance of institutional portfolios which are now dominated by domestic stocks and bonds. In addition, unless the objective is to obtain high risk-high return choices, farmland will provide nearly as much diversification potential as will foreign stocks. This is particularly useful to those investors who prefer to avoid investment in foreign stock because of political risks or because they fail to understand the economic and social forces which drive stock prices in other countries.

Restricted Portfolios:

It seems unlikely that institutional portfolio managers would be willing to include foreign stocks, farmland, or business real estate in their portfolios to the degree suggested by the efficient frontiers calculated from historical data. Consequently, we estimated three additional E-V frontiers in which the proportion of these assets was limited to a maximum

percentage of the entire portfolio.

Table 7 shows the optimal portfolio combinations when foreign stocks are completely excluded from consideration and the percentage of farmland and business real estate are each restricted to a maximum of 10 percent of the total portfolio. Under this scenario, both farmland and business real estate enter the optimal portfolio at the maximum percentage over the entire range of the E-V frontier, with the exception of those areas which reflect high risk-return combinations. By comparing results in Tables 4 and 7 we can see the impact of such restrictions. The primary effect on portfolio composition is to maintain a higher proportion of common stocks over a much wider range of the E-V frontier. Also, at low levels of risk and return, long-term government bonds are a much higher proportion of the total portfolio. And as expected, the optimal portfolio combinations show a much higher level of risk for the same level of returns, or conversely lower returns for the same level of risk.

Table 8 shows the optimal portfolios when foreign stocks are restricted to 10 percent of the total portfolio and farmland is completely excluded from the portfolio. Comparing Tables 5 and 8 allows one to examine the impact of restrictions of this nature. This restriction eliminates many of the very high risk-high return portfolios that were possible when foreign stocks were not restricted. For returns of less than 11 percent, there was no effect on the optimal portfolios since foreign stock constituted less than 10 percent of the total portfolio in that range of the E-V frontier. The restriction on foreign stock primarily results in a substitution of domestic stocks for foreign stocks.

Table 9 shows the optimal portfolios when foreign stocks, farmland, and business real estate are each restricted to 10 percent of the portfolio. Comparing Tables 6 and 9 allows one to examine the impact of such restrictions. At the upper end of the E-V frontier, foreign stocks are replaced by domestic stocks. At the lower end of the E-V frontier, it is interesting to note that Canadian stocks enter the restricted portfolio, whereas they did not when the portfolio was unrestricted. Again as expected, the restrictions result in much higher levels of risk for the same level of return.

Five-Year Holding Periods:

The optimal portfolios reflected in Tables 3 through 9 were all developed under the assumption of one-year holding periods for the assets under consideration. However, many institutional investors have much longer investment horizons and the ownership of common stocks, farmland, and business real estate are often viewed as longer term investments. To examine the effects of longer holding periods, we estimated the annual compound rate of return over 5 year holding periods using a moving average. The process of using a five year moving average tends to reduce the variance of returns within any particular asset class, but the effect on the covariance of returns across different asset classes is indeterminate. However, in most cases one would expect the covariance of returns to decrease when moving averages are used.

Tables 10 through 16 are comparable in nature to Tables 3 through 9 except that the returns are now measured over 5-year rather than 1-year holding periods. Comparison of corresponding tables (Table 3 vs Table 10, Table 4 vs Table 11 etc) allows one to evaluate the impact of the longer holding period on the optimal portfolio combinations and the risk-return tradeoffs.

Comparing Table 3 and 10 we see that the move to 5-year holding periods results in the elimination of common stocks from the E-V frontier. Business real estate becomes the dominant asset class over the entire range of the E-V frontier.

Comparing Table 4 and 11 we see that the move to the 5-year holding period substantially increases the proportion of farmland at the upper end of the E-V frontier, but lowers it in the middle of the E-V frontier. These results suggest that over longer holding periods, farmland is more risky relative to other assets than when shorter holding periods are used.

When the available asset classes include foreign stocks (Tables 5 and 12), the move to 5-year holding periods significantly increases the proportion of business real estate, particularly in portfolios near the upper end of the E-V frontier. The move to 5-year holding periods also eliminates stock from the United Kingdom as part of the optimal portfolios.

If both foreign stocks and farmland are allowed into the optimal portfolios, the move to 5-year rather than 1-year holding periods appears to impact the inclusion of stock from the United Kingdom the most. (Tables 6 and 13). As with all optimal portfolios computed from 5-year holding periods, the standard deviation of returns is much lower than if 1-year holding periods are used.

When restricted portfolios are compared for 1 versus 5 year holding periods, (Tables 7-9 vs Tables 14-16) there appears to be no major differences in the composition of the optimal portfolios. The biggest change is that the move to 5-year holding periods allows one to achieve much lower levels of risk for the same level of return, but part of that outcome is due to the use of a moving average.

SECTION 4: SUMMARY AND CONCLUSIONS

Portfolios of institutional investors in the United States tend to be dominated by domestic stocks and bonds. Recognizing the potential gains from a wider choice of assets, many such institutional investors are now slowly moving toward international diversification. This diversification is proceeding very slowly as fund managers often lack knowledge of the potential problems associated with foreign investments.

There is also some growing interest in diversification through investment in U.S. business real estate and farmland. Historically, business real estate appears to have been the more accepted vehicle for diversification into real estate. One recent estimate placed the total institutional investment in farmland by pension funds at no more than \$500 million, or less

than 1% of the assets controlled by pension funds in the United States.

Using historical data for the period 1970-1990, it was demonstrated that farmland offers good diversification potential for portfolios currently dominated by domestic stocks and bonds. Further, many of the gains achieved by international diversification could also be achieved with farmland. Diversification into foreign stocks does offer the possibility of high risk-high return combinations which were not possible with only domestic investment choices.

It should be recognized that much of the gains from diversifying into farmland come not from higher rates of return generated by farmland, but rather by the fact that returns on farmland have a very low or negative correlation with returns on other assets. And as the holding period for assets becomes longer (a reasonable assumption for most institutional investors), the correlation of farmland returns with other asset returns tends to decrease. While not shown in this article, the results of including farmland in optimal portfolios does not appear to be particularly sensitive to an arbitrary increase in the variance of farmland returns or to an arbitrary decrease in the returns to farmland. Thus, farmland appears to offer good diversification potential for portfolios dominated by U.S. stocks and bonds.

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Table 1. Mean Returns for Various Asset Classes by Holding Period, 1970-1990.

Asset Class	1-Year Holding Period	5-Year Holding Period
	--Percent--	
Business Real Estate (BUSRE)	10.4	10.9
Long-Term U.S. Corporate Bonds (LTC)	10.0	9.3
Long-Term U.S. Government Bonds (LTG)	9.4	8.9
U.S. Stocks (USA)	11.3	10.5
Canadian Stocks (CAN)	11.5	10.0
French Stocks (FR)	16.7	14.6
German Stocks (GER)	16.0	14.7
Japanese Stocks (JAP)	24.4	22.5
Swiss Stocks (SWIT)	14.2	13.2
United Kingdom Stocks (UK)	18.3	14.7
U.S. Farmland (FARM)	11.2	11.0

Table 2. Correlation Coefficients for Various Asset Classes by Holding Period, 1970-1990.

	BUSRE	LTC	LTG	USA	CAN	FR	GER	JAP	SWIT	UK	FARM
1-Year Holding Period											
BUSRE	1.0										
LTC	-.30	1.0									
LTG	-.27	.96	1.0								
USA	.11	.50	.43	1.0							
CAN	.39	-.04	-.10	.65	1.0						
FR	.02	.24	.26	.50	.49	1.0					
GER	-.10	.43	.50	.42	.14	.70	1.0				
JAP	.09	.08	.11	.36	.37	.48	.30	1.0			
SWIT	-.05	.40	.42	.54	.34	.75	.93	.42	1.0		
UK	.01	.16	.07	.61	.36	.44	.35	.25	.56	1.0	
FARM	.09	-.57	-.60	-.29	.14	-.23	-.35	-.11	-.24	-.14	1.0
5-Year Holding Period											
BUSRE	1.0										
LTC	-.38	1.0									
LTG	-.41	.99	1.0								
USA	.18	.59	.58	1.0							
CAN	.46	-.10	-.09	-.67	1.0						
FR	-.37	.60	.62	.67	.44	1.0					
GER	-.58	.72	.73	.35	-.10	.78	1.0				
JAP	-.35	.59	.62	.55	.30	.88	.68	1.0			
SWIT	-.48	.51	.51	.37	.15	.85	.93	.70	1.0		
UK	.15	.21	.21	.78	.73	.74	.35	.53	.54	1.0	
FARM	.04	-.82	-.83	-.79	-.23	-.59	-.44	-.28	-.28	-.48	1.0

Table 3
Optimal Portfolios for U.S. Stocks, Long-Term Government Bonds, Long-Term Corporate Bonds, Business Real Estate.
1970 - 1990 ----- 1 Year Holding Periods

<i>Annual Return</i>	<i>Standard Deviation</i>	<i>Portfolio Mix</i>			
		<i>U.S. Stocks</i>	<i>Long-Term Government Bonds</i>	<i>Long-Term Corporate Bonds</i>	<i>Business Real Estate</i>
11.33%	16.20%	100%	0.00%	0.00%	0.00%
11.30%	15.75%	97.10%	0.00%	0.00%	2.90%
11.20%	14.11%	86.60%	0.00%	0.00%	13.40%
11.10%	12.49%	76.00%	0.00%	0.00%	24.00%
11.00%	10.91%	65.50%	0.00%	0.00%	34.50%
10.90%	9.37%	54.90%	0.00%	0.00%	45.20%
10.80%	7.92%	44.40%	0.00%	0.00%	55.60%
10.70%	6.60%	33.80%	0.00%	0.00%	66.20%
10.60%	5.52%	23.30%	0.00%	0.00%	76.70%
10.50%	4.74%	14.50%	0.00%	5.00%	80.50%
10.40%	4.14%	6.50%	0.00%	12.40%	81.10%
10.35%	3.93%	2.50%	0.00%	16.00%	81.50%
10.30%	3.83%	0.60%	0.00%	19.40%	80.00%

Table 4
Optimal Portfolios for U.S. Stocks, Long-Term Government Bonds, Long-Term Corporate Bonds, Business Real Estate, and Farmland.
1970 - 1990 ----- 1 Year Holding Periods

		Portfolio Mix				
Annual Return	Standard Deviation	Farmland	U.S. Stocks	LTG Bonds	LTC Bonds	Business Real Estate
11.33%	16.20%	0.00%	100%	0.00%	0.00%	0.00%
11.30%	10.12%	34.80%	65.20%	0.00%	0.00%	0.00%
11.20%	6.48%	65.50%	27.90%	0.00%	3.90%	2.70%
11.10%	5.80%	59.90%	23.50%	0.00%	6.90%	9.70%
11.00%	5.14%	54.2%	19.20%	0.00%	9.90%	16.70%
10.90%	4.52%	48.50%	14.90%	0.00%	15.00%	23.60%
10.80%	3.96%	42.90%	10.60%	0.00%	15.90%	30.60%
10.70%	3.48%	37.20%	6.30%	0.00%	18.90%	37.60%
10.60%	3.12%	31.50%	2.00%	0.00%	21.90%	44.60%
10.50%	2.96%	25.80%	0.00%	4.10%	19.60%	50.50%
10.40%	2.94%	25.00%	0.00%	14.90%	9.60%	50.50%

Table 5
Optimal Portfolios for U.S. Stocks, Long-Term Government Bonds, Long-Term Corporate Bonds,
Business Real Estate, and Six Foreign Countries (Canada, France, Germany, Japan, Switzerland, UK).
1970 - 1990 ----- 1 Year Holding Periods

Portfolio Mix											
Annual Return	Standard Deviation	U.S. Stocks	Switzerland	LTC Bonds	LTC Bonds	Japan	United Kingdom	Germany	France	Canada	Business Real Estate
24.434%	37.806%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%
24.00%	35.78%	0.00%	0.00%	0.00%	0.00%	92.88%	7.12%	0.00%	0.00%	0.00%	0.00%
23.00%	31.80%	0.00%	0.00%	0.00%	0.00%	76.48%	23.52%	0.00%	0.00%	0.00%	0.00%
22.00%	28.98%	0.00%	0.00%	0.00%	0.00%	62.77%	32.03%	4.47%	0.00%	0.00%	0.73%
21.00%	26.52%	0.00%	0.00%	0.00%	0.00%	57.24%	29.31%	4.36%	0.00%	0.00%	9.09%
20.00%	24.07%	0.00%	0.00%	0.00%	0.00%	51.71%	26.58%	4.26%	0.00%	0.00%	17.45%
19.00%	21.62%	0.00%	0.00%	0.00%	0.00%	46.18%	23.86%	4.15%	0.00%	0.00%	25.81%
18.00%	19.19%	0.00%	0.00%	0.00%	0.00%	40.65%	21.12%	4.05%	0.00%	0.00%	34.18%
17.00%	16.77%	0.00%	0.00%	0.00%	0.00%	35.12%	18.39%	3.95%	0.00%	0.00%	42.54%
16.00%	14.39%	0.00%	0.00%	0.00%	0.00%	29.59%	15.67%	3.84%	0.00%	0.00%	50.90%
15.00%	12.05%	0.00%	0.00%	0.00%	0.00%	24.06%	12.94%	3.74%	0.00%	0.00%	59.26%
14.00%	9.79%	0.00%	0.00%	0.00%	1.49%	18.67%	10.25%	3.34%	0.00%	0.00%	66.25%
13.00%	7.63%	0.00%	0.00%	0.00%	6.62%	13.60%	7.61%	2.25%	0.00%	0.00%	69.92%
12.00%	5.67%	0.00%	0.00%	0.00%	11.76%	8.54%	4.96%	1.16%	0.00%	0.00%	73.58%
11.00%	4.22%	0.00%	0.00%	0.00%	16.89%	3.47%	2.33%	0.07%	0.00%	0.00%	77.25%
10.90%	4.12%	0.00%	0.00%	0.00%	17.36%	2.95%	2.05%	0.00%	0.00%	0.00%	77.63%
10.80%	4.04%	0.00%	0.00%	0.00%	17.78%	2.42%	1.76%	0.00%	0.00%	0.00%	78.05%
10.70%	3.97%	0.00%	0.00%	0.00%	18.19%	1.88%	1.46%	0.00%	0.00%	0.00%	78.46%
10.60%	3.91%	0.00%	0.00%	0.00%	18.61%	1.35%	1.17%	0.00%	0.00%	0.00%	78.87%
10.50%	3.87%	0.00%	0.00%	0.00%	19.02%	0.81%	0.88%	0.00%	0.00%	0.00%	79.29%
10.40%	3.84%	0.00%	0.00%	0.00%	19.44%	0.28%	0.00%	0.00%	0.00%	0.00%	79.70%
10.30%	3.8313%	0.00%	0.00%	1.07%	18.88%	0.00%	0.13%	0.00%	0.00%	0.00%	79.92%

Table 6
Optimal Portfolios for U.S. Stocks, Long-Term Government Bonds,
Long-Term Corporate Bonds, Business Real Estate, Six Foreign Countries
(Canada, France, Germany, Japan, Switzerland, UK), and Farmland.
1970 - 1990 ----- 1 Year Holding Periods

Portfolio Mix									
Annual Return	Standard Deviation	U.S. Stocks	LTC Bonds	LTC Bonds	Business Real Estate	Farmland	Japan	United Kingdom	Germany
24.434%	37.806%	0.00%	0.00%	0.00%	0.00%	0.00%	100%	0.00%	0.00%
24.00%	35.78%	0.00%	0.00%	0.00%	0.00%	0.00%	92.88%	7.12%	0.00%
23.00%	31.80%	0.00%	0.00%	0.00%	0.00%	0.00%	76.48%	23.52%	0.00%
22.00%	28.86%	0.00%	0.00%	0.00%	0.00%	4.89%	65.77%	29.34%	0.00%
21.00%	26.08%	0.00%	0.00%	0.00%	0.00%	13.36%	59.34%	26.96%	0.34%
20.00%	23.33%	0.00%	0.00%	0.00%	0.00%	21.37%	52.75%	24.26%	1.62%
19.00%	20.62%	0.00%	0.00%	0.00%	0.00%	29.38%	46.16%	21.55%	2.91%
18.00%	17.96%	0.00%	0.00%	0.00%	0.00%	37.39%	39.57%	18.85%	4.19%
17.00%	15.39%	0.00%	0.00%	0.00%	0.00%	45.40%	32.98%	16.14%	5.48%
16.00%	12.96%	0.00%	0.00%	0.00%	0.00%	53.41%	26.39%	13.44%	6.76%
15.00%	10.71%	0.00%	0.00%	4.76%	3.79%	53.34%	21.07%	10.93%	6.11%
14.00%	8.51%	0.00%	0.00%	8.87%	14.65%	46.81%	16.33%	8.53%	4.81%
13.00%	6.39%	0.00%	0.00%	12.97%	25.51%	40.29%	11.59%	6.13%	3.51%
12.00%	4.48%	0.00%	0.00%	17.07%	36.37%	33.76%	6.85%	3.73%	2.22%
11.00%	3.15%	0.00%	0.17%	21.02%	47.19%	27.25%	2.12%	1.34%	0.91%
10.90%	3.08%	0.00%	3.87%	18.01%	47.56%	26.88%	1.73%	1.32%	0.64%
10.80%	3.02%	0.00%	7.57%	14.99%	47.93%	26.52%	1.34%	1.29%	0.36%
10.70%	2.97%	0.00%	11.28%	11.98%	48.30%	26.15%	0.95%	1.27%	0.09%
10.60%	2.94%	0.00%	14.38%	9.37%	48.81%	25.78%	0.50%	1.16%	0.00%
10.50%	2.93%	0.00%	17.22%	6.95%	49.39%	25.40%	0.03%	1.02%	0.00%
10.479%	2.9243%	0.00%	18.12%	18.12%	49.55%	25.25%	0.00%	0.89%	0.00%

Table 7
Optimal Portfolios for U.S. Stocks, Long-Term Government Bonds, Long-Term Corporate Bonds, Business Real Estate, and Farmland.
Portfolio Restrictions: Farmland \leq 10% and Business Real Estate \leq 10%
1970 - 1990 ----- 1 Year Holding Periods

		Portfolio Mix				
Annual Return	Standard Deviation	Farmland	U.S. Stocks	LTG Bonds	LTC Bonds	Business Real Estate
11.33%	16.20%	0.00%	100%	0.00%	0.00%	0.00%
11.30%	14.02%	10.00%	87.96%	0.00%	0.00%	2.04%
11.20%	12.58%	10.00%	78.08%	0.00%	1.92%	10.00%
11.10%	11.78%	10.00%	70.28%	0.00%	9.72%	10.00%
11.00%	11.04%	10.00%	62.48%	0.00%	17.52%	10.00%
10.90%	10.37%	10.00%	54.67%	0.00%	25.33%	10.00%
10.80%	9.78%	10.00%	46.87%	0.00%	33.13%	10.00%
10.70%	9.30%	10.00%	39.06%	0.00%	40.94%	10.00%
10.60%	8.94%	10.00%	31.26%	0.00%	48.74%	10.00%
10.50%	8.70%	10.00%	24.04%	1.25%	54.71%	10.00%
10.40%	8.54%	10.00%	22.91%	15.39%	41.69%	10.00%
10.35%	8.4744%	10.00%	22.35%	22.47%	35.19%	10.00%
10.30%	8.41%	10.00%	21.78%	29.54%	28.68%	10.00%
10.20%	8.31%	10.00%	20.65%	43.69%	15.66%	10.00%
10.10%	8.24%	10.00%	19.52%	57.84%	2.65%	10.00%
10.015%	8.21%	10.00%	15.86%	64.14%	0.00%	10.00%

Table 8
Optimal Portfolios for U.S. Stocks, Long-Term Government Bonds, Long-Term Corporate Bonds,
Business Real Estate, and Six Foreign Countries (Canada, France, Germany, Japan, Switzerland, UK).
Portfolio Restrictions: Foreign Countries ≤ 10%
1970 - 1990 ----- 1 Year Holding Periods

Portfolio Mix											
Annual Return	Standard Deviation	U.S. Stocks	Switzerland	LTC Bonds	LTC Bonds	Japan	United Kingdom	Germany	France	Canada	Business Real Estate
12.63%	16.30%	90.00%	0.00%	0.00%	0.00%	10.00%	0.00%	0.00%	0.00%	0.00%	0.00%
12.60%	15.71%	86.01%	0.00%	0.00%	0.00%	10.00%	0.00%	0.00%	0.00%	0.00%	3.99%
12.50%	14.12%	75.45%	0.00%	0.00%	0.00%	10.00%	0.00%	0.00%	0.00%	0.00%	14.55%
12.40%	12.58%	64.90%	0.00%	0.00%	0.00%	10.00%	0.00%	0.00%	0.00%	0.00%	25.10%
12.00%	7.25%	22.69%	0.00%	0.00%	0.00%	10.00%	0.00%	0.00%	0.00%	0.00%	67.31%
11.00%	4.22%	0.00%	0.00%	0.00%	16.89%	3.47%	2.33%	0.07%	0.00%	0.00%	77.25%
10.90%	4.12%	0.00%	0.00%	0.00%	17.36%	2.95%	2.05%	0.00%	0.00%	0.00%	77.63%
10.80%	4.04%	0.00%	0.00%	0.00%	17.78%	2.42%	1.76%	0.00%	0.00%	0.00%	78.05%
10.70%	3.97%	0.00%	0.00%	0.00%	18.19%	1.88%	1.46%	0.00%	0.00%	0.00%	78.46%
10.60%	3.91%	0.00%	0.00%	0.00%	18.61%	1.35%	1.17%	0.00%	0.00%	0.00%	78.87%
10.50%	3.87%	0.00%	0.00%	0.00%	19.02%	0.81%	0.88%	0.00%	0.00%	0.00%	79.29%
10.40%	3.84%	0.00%	0.00%	0.00%	19.44%	0.28%	0.00%	0.00%	0.00%	0.00%	79.70%
10.30%	3.8313	0.00%	0.00%	1.07%	18.88%	0.00%	0.13%	0.00%	0.00%	0.00%	79.92%

Table 9
Optimal Portfolios for U.S. Stocks, Long-Term Government Bonds,
Long-Term Corporate Bonds, Business Real Estate, Six Foreign Countries (Canada, France,
Germany, Japan, Switzerland, UK), and Farmland.
Portfolio Restrictions: Foreign Countries <= 10%, Farmland <= 10%, Business Real Estate <= 10%
1970 - 1990 ----- 1 Year Holding Periods

		Portfolio Mix							
Annual Return	Standard Deviation	U.S. Stocks	LTC Bonds	LTC Bonds	Business Real Estate	Farmland	Japan	Canada	United Kingdom
12.638%	16.30%	90.00%	0.00%	0.00%	0.00%	10.00%	10.00%	0.00%	0.00%
12.60%	14.02%	76.83%	0.00%	0.00%	3.17%	10.00%	10.00%	0.00%	0.00%
12.50%	12.71%	67.25%	0.00%	2.75%	10.00%	10.00%	10.00%	0.00%	0.00%
12.40%	11.93%	59.44%	0.00%	10.56%	10.00%	10.00%	10.00%	0.00%	0.00%
12.00%	9.49%	28.23%	0.00%	41.77%	10.00%	10.00%	10.00%	0.00%	0.00%
11.00%	8.05%	8.76%	32.77%	28.47%	10.00%	10.00%	5.21%	3.83%	0.96%
10.90%	7.96%	8.61%	36.17%	25.23%	10.00%	10.00%	4.69%	4.50%	0.82%
10.80%	7.88%	8.45%	39.57%	21.98%	10.00%	10.00%	4.16%	5.16%	0.68%
10.70%	7.81%	8.29%	42.98%	18.74%	10.00%	10.00%	3.64%	5.83%	0.54%
10.60%	7.74%	8.13%	46.38%	15.49%	10.00%	10.00%	3.11%	6.49%	0.40%
10.50%	7.68%	7.97%	49.78%	12.25%	10.00%	10.00%	2.58%	7.16%	0.26%
10.40%	7.62%	7.81%	53.19%	9.00%	10.00%	10.00%	2.06%	7.82%	0.12%
10.30%	7.57%	7.65%	56.66%	5.70%	10.00%	10.00%	1.52%	8.48%	0.00%
10.20%	7.52%	7.44%	60.54%	2.02%	10.00%	10.00%	0.951%	9.05%	0.00%
10.10%	7.48%	7.05%	62.95%	0.00%	10.00%	10.00%	0.33%	9.67%	0.00%
10.016%	7.4617%	4.84%	65.16%	0.00%	10.00%	10.00%	0.00%	10.00%	0.00%

Germany, France, and Switzerland have 0.00% of the portfolio mix for all values along the frontier.

Table 10
Optimal Portfolios for U.S. Stocks, Long-Term Government Bonds, Long-Term Corporate Bonds, Business Real Estate.
1970 - 1990 ----- 5 Year Holding Periods

		<i>Portfolio Mix</i>			
<i>Annual Return</i>	<i>Standard Deviation</i>	<i>U.S. Stocks</i>	<i>Long-Term Government Bonds</i>	<i>Long-Term Corporate Bonds</i>	<i>Business Real Estate</i>
10.944%	3.265%	0.00%	0.00%	0.00%	100%
10.90%	3.12%	2.57%	0.00%	1.91%	95.52%
10.80%	2.83%	0.00%	0.00%	8.61%	91.39%
10.70%	2.59%	0.00%	0.00%	14.59%	85.41%
10.60%	2.40%	0.00%	0.00%	20.56%	79.44%
10.50%	2.30%	0.00%	0.00%	26.54%	73.46%
10.40%	2.25%	0.00%	17.99%	10.07%	71.94%
10.30%	2.23%	0.00%	30.85%	0.00%	69.15%
10.292%	2.22%	0.00%	31.24%,	0.00%	68.76%

Table 11
Optimal Portfolios for U.S. Stocks, Long-Term Government Bonds, Long-Term Corporate Bonds, Business Real Estate, and Farmland.
1970 - 1990 ----- 5 Year Holding Periods

		<i>Portfolio Mix</i>				
<i>Annual Return</i>	<i>Standard Deviation</i>	<i>Farmland</i>	<i>U.S. Stocks</i>	<i>LTG Bonds</i>	<i>LTC Bonds</i>	<i>Business Real Estate</i>
11.016%	8.461%	100%	0.00%	0.00%	0.00%	0.00%
11.00%	6.60%	77.24%	0.00%	0.00%	0.00%	22.76%
10.90%	2.67%	20.11%	12.39%	0.00%	0.00%	67.50%
10.80%	2.21%	26.34%	24.56%	0.00%	2.80%	46.30%
10.70%	1.86%	26.41%	21.09%	0.00%	9.76%	42.74%
10.60%	1.54%	26.48%	17.62%	0.00%	16.72%	39.18%
10.50%	1.27%	26.56%	14.15%	0.00%	23.68%	35.62%
10.40%	1.09%	26.63%	10.67%	0.00%	30.64%	32.05%
10.30%	1.02%	26.51%	9.04%	13.65%	20.05%	30.75%
10.20%	0.96%	26.28%	8.38%	34.65%	0.00%	30.69%
10.157%	0.95%	26.19%	7.00%	37.00%	0.00%	29.81%

Table 12
Optimal Portfolios for U.S. Stocks, Long-Term Government Bonds, Long-Term Corporate Bonds,
Business Real Estate, and Six Foreign Countries (Canada, France, Germany, Japan, Switzerland, UK).
1970 - 1990 ----- 5 Year Holding Periods

Portfolio Mix											
Annual Return	Standard Deviation	U.S. Stocks	Switzerland	LTC Bonds	LTC Bonds	Japan	United Kingdom	Germany	France	Canada	Business Real Estate
22.488%	11.224%	0.00%	0.00%	0.00%	0.00%	100%	0.00%	0.00%	0.00%	0.00%	0.00%
22.00%	10.70%	0.00%	0.00%	0.00%	0.00%	95.77%	0.00%	0.00%	0.00%	0.00%	4.23%
21.00%	9.64%	0.00%	0.00%	0.00%	0.00%	87.11%	0.00%	0.00%	0.00%	0.00%	12.89%
20.00%	8.58%	0.00%	0.00%	0.00%	0.00%	78.45%	0.00%	0.00%	0.00%	0.00%	21.55%
19.00%	7.54%	0.00%	0.00%	0.00%	0.00%	69.78%	0.00%	0.00%	0.00%	0.00%	30.22%
18.00%	6.52%	0.00%	0.00%	0.00%	0.00%	61.12%	0.00%	0.00%	0.00%	0.00%	38.88%
17.00%	5.54%	0.00%	0.00%	0.00%	0.00%	52.46%	0.00%	0.00%	0.00%	0.00%	47.54%
16.00%	4.60%	0.00%	0.00%	0.00%	0.00%	43.80%	0.00%	0.00%	0.00%	0.00%	56.20%
15.00%	3.76%	0.00%	0.00%	0.00%	0.00%	35.13%	0.00%	0.00%	0.00%	0.00%	64.87%
14.00%	3.06%	0.00%	0.00%	0.00%	0.00%	24.91%	0.00%	4.75%	0.00%	0.00%	70.35%
13.00%	2.51%	0.00%	0.00%	0.00%	0.00%	14.12%	0.00%	11.21%	0.00%	0.00%	74.68%
12.00%	2.20%	0.00%	0.00%	3.58%	0.00%	4.87%	0.00%	14.95%	0.00%	0.00%	76.61%
11.00%	2.06%	0.00%	11.98%	15.59%	0.00%	0.16%	0.00%	2.47%	0.00%	0.00%	69.80%
10.90%	2.05%	0.00%	13.77%	17.29%	0.00%	0.00%	0.00%	0.21%	0.00%	0.00%	68.74%
10.811%	2.04%	0.00%	12.34%	19.63%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	68.04%

Table 13
Optimal Portfolios for U.S. Stocks, Long-Term Government Bonds,
Long-Term Corporate Bonds, Business Real Estate, Six Foreign Countries
(Canada, France, Germany, Japan, Switzerland, UK), and Farmland.
1970 - 1990 ----- 5 Year Holding Periods

Portfolio Mix									
Annual Return	Standard Deviation	U.S. Stocks	LTG Bonds	LTC Bonds	Business Real Estate	Farmland	Japan	United Kingdom	Germany
22.488%	11.224%	0.00%	0.00%	0.00%	0.00%	0.00%	100%	0.00%	0.00%
22.00%	10.53%	0.00%	0.00%	0.00%	0.00%	4.26%	95.74%	0.00%	0.00%
21.00%	9.13%	0.00%	0.00%	0.00%	0.00%	12.97%	87.03%	0.00%	0.00%
20.00%	7.80%	0.00%	0.00%	0.00%	0.00%	21.69%	78.31%	0.00%	0.00%
19.00%	6.55%	0.00%	0.00%	0.00%	0.00%	30.41%	69.59%	0.00%	0.00%
18.00%	5.46%	0.00%	0.00%	0.00%	0.00%	39.12%	60.88%	0.00%	0.00%
17.00%	4.51%	0.00%	0.00%	0.00%	12.07%	35.69%	52.24%	0.00%	0.00%
16.00%	3.61%	0.00%	0.00%	0.00%	24.65%	31.75%	43.60%	0.00%	0.00%
15.00%	2.81%	0.00%	0.00%	0.00%	37.23%	27.81%	34.96%	0.00%	0.00%
14.00%	2.18%	0.00%	0.00%	4.82%	42.23%	25.59%	26.84%	0.00%	0.51%
13.00%	1.62%	0.00%	0.00%	14.92%	29.96%	25.30%	19.82%	0.00%	0.00%
12.00%	1.16%	0.00%	0.00%	24.55%	38.08%	24.82%	12.55%	0.00%	0.00%
11.00%	0.91%	0.00%	32.84%	0.00%	34.53%	24.99%	5.60%	2.04%	0.00%
10.90%	0.90%	0.00%	33.80%	0.00%	34.05%	25.05%	4.84%	2.26%	0.00%
10.80%	0.89%	0.00%	34.76%	0.00%	33.58%	25.10%	4.07%	2.50%	0.00%
10.70%	0.88%	0.00%	35.72%	0.00%	33.10%	25.16%	3.30%	2.72%	0.00%
10.60%	0.88%	0.00%	36.68%	0.00%	32.62%	25.21%	2.53%	2.96%	0.00%
10.593%	0.8788%	0.00%	36.75%	0.00%	32.59%	25.21%	2.48%	2.97%	0.00%

Table 14
Optimal Portfolios for U.S. Stocks, Long-Term Government Bonds, Long-Term Corporate Bonds, Business Real Estate, and Farmland.
Portfolio Restrictions: Farmland \leq 10% and Business Real Estate \leq 10%
1970 - 1990 ----- 5 Year Holding Periods

Portfolio Mix						
Annual Return	Standard Deviation	Farmland	U.S. Stocks	LTC Bonds	LTC Bonds	Business Real Estate
10.573%	5.05%	10.00%	80.00%	0.00%	0.00%	10.00%
10.50%	4.81%	10.00%	73.96%	0.00%	6.04%	10.00%
10.40%	4.50%	10.00%	65.62%	0.00%	14.38%	10.00%
10.30%	4.22%	10.00%	57.29%	0.00%	22.71%	10.00%
10.20%	3.99%	10.00%	48.96%	0.00%	31.04%	10.00%
10.10%	3.81%	10.00%	40.62%	0.00%	39.38%	10.00%
10.00%	3.68%	10.00%	32.29%	0.00%	47.71%	10.00%
9.90%	3.62%	10.00%	24.00%	0.11%	55.89%	10.00%
9.80%	3.59%	10.00%	23.40%	22.53%	34.07%	10.00%
9.70%	3.57%	10.00%	22.80%	44.95%	12.25%	10.00%
9.60%	3.55725%	10.00%	19.75%	60.25%	0.00%	10.00%

Table 15
Optimal Portfolios for U.S. Stocks, Long-Term Government Bonds, Long-Term Corporate Bonds,
Business Real Estate, and Six Foreign Countries (Canada, France, Germany, Japan, Switzerland, UK).
Portfolio Restrictions: Foreign Countries ≤ 10%
1970 - 1990 ----- 5 Year Holding Periods

Portfolio Mix											
Annual Return	Standard Deviation	U.S. Stocks	Switzerland	LTC Bonds	LTC Bonds	Japan	United Kingdom	Germany	France	Canada	Business Real Estate
12.09%	2.75%	0.00%	0.00%	0.00%	0.00%	10.00%	0.00%	0.00%	0.00%	0.00%	90.00%
12.00%	2.55%	0.00%	0.00%	0.00%	5.89%	10.00%	0.00%	0.00%	0.00%	0.00%	84.11%
11.00%	2.09%	0.00%	4.03%	18.17	0.00%	1.52%	0.00%	4.44%	0.00%	0.00%	71.83%
10.90%	2.08%	0.00%	6.25%	19.12	0.00%	0.93%	0.00%	2.82%	0.00%	0.00%	70.88%
10.80%	2.06%	0.00%	8.46%	20.06	0.00%	0.34%	0.00%	1.20%	0.00%	0.00%	69.94%
10.713	2.047%	0.00%	10.00%	21.82	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	68.18%

Table 16
Optimal Portfolios for U.S. Stocks, Long-Term Government Bonds,
Long-Term Corporate Bonds, Business Real Estate, Six Foreign Countries (Canada, France,
Germany, Japan, Switzerland, UK), and Farmland.
Portfolio Restrictions: Foreign Countries ≤ 10%, Farmland ≤ 10%, Business Real Estate ≤ 10%
1970 - 1990 ----- 5 Year Holding Periods

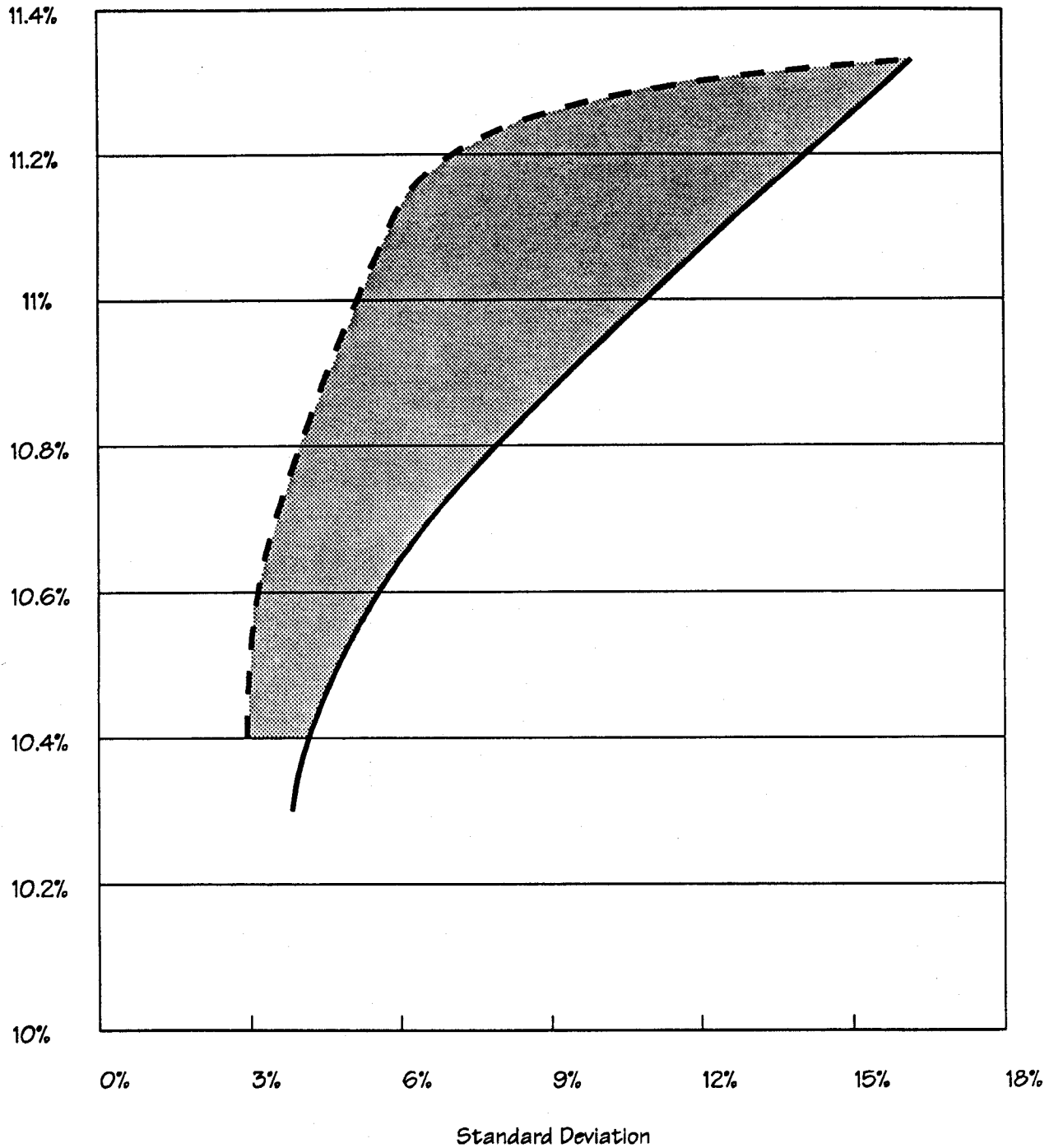
Portfolio Mix									
Annual Return	Standard Deviation	U.S. Stocks	LTG Bonds	LTC Bonds	Business Real Estate	Farmland	Japan	Canada	United Kingdom
11.774%	4.99%	70.00%	0.00%	0.00%	10.00%	10.00%	10.00%	0.00%	0.00%
11.00%	3.74%	21.80%	0.00%	48.20%	10.00%	10.00%	8.40%	1.60%	0.00%
10.90%	3.69%	21.00%	0.00%	49.00%	10.00%	10.00%	7.71%	2.29%	0.00%
10.80%	3.64%	20.23%	0.00%	49.77%	10.00%	10.00%	6.98%	3.02%	0.00%
10.70%	3.59%	19.47%	0.00%	50.53%	10.00%	10.00%	6.26%	3.74%	0.00%
10.60%	3.54%	18.70%	0.00%	51.30%	10.00%	10.00%	5.53%	4.47%	0.00%
10.50%	3.49%	17.94%	0.00%	52.07%	10.00%	10.00%	4.80%	5.20%	0.00%
10.40%	3.44%	17.17%	0.00%	52.83%	10.00%	10.00%	4.08%	5.92%	0.00%
10.30%	3.39%	16.41%	0.00%	53.60%	10.00%	10.00%	3.35%	6.65%	0.00%
10.20%	3.35%	15.64%	0.00%	54.36%	10.00%	10.00%	2.62%	7.38%	0.00%
10.10%	3.30%	14.87%	0.00%	55.13%	10.00%	10.00%	1.90%	8.10%	0.00%
10.00%	3.26%	14.11%	0.00%	55.89%	10.00%	10.00%	1.17%	8.83%	0.00%
9.90%	3.21%	13.34%	0.00%	56.66%	10.00%	10.00%	0.45%	9.55%	0.00%
9.80%	3.18%	10.99%	3.91%	55.10%	10.00%	10.00%	0.00%	10.00%	0.00%
9.70%	3.15%	10.39%	26.33%	33.28%	10.00%	10.00%	0.00%	10.00%	0.00%
9.60%	3.14%	9.80%	48.74%	11.46%	10.00%	10.00%	0.00%	10.00%	0.00%
9.521%	3.1297%	7.87%	62.14%	0.00%	10.00%	10.00%	0.00%	10.00%	0.00%

Germany, France, and Switzerland have 0.00% of the portfolio mix for all values along the frontier.

FIGURE #1
EV FRONTIER

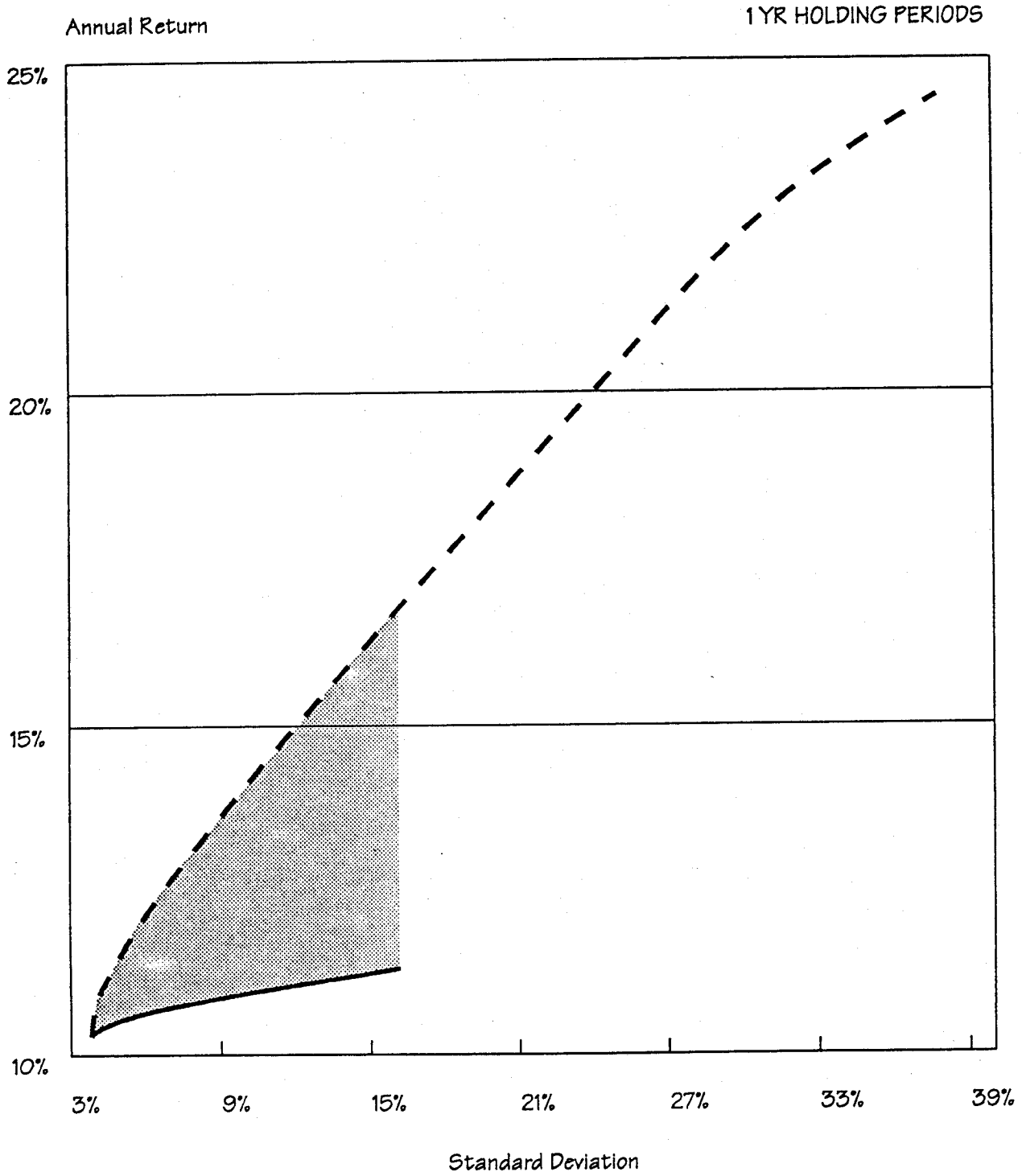
Annual Return

1 YR HOLDING PERIODS



- - - U.S. Stocks, LTCB, LTGB, Business Real Estate, Farmland.
- U.S. Stocks, LTCB, LTGB, Business Real Estate.

FIGURE # 2
EV FRONTIER



———— U.S. Stocks, LTCB, LTGB, Business Real Estate.

- - - - U.S. Stocks, LTCB, LTGB, Business Real Estate, Six Foreign Countries.