by Haim Levy and Zvi Lerman

The Benefits of International Diversification in Bonds

Some institutional investors may be confined (either by policy or by regulation) to holdings in the bond market. In the 1960–80 period, the U.S. stock market dominated the U.S. bond market in terms of risk-adjusted returns. But an internationally diversified portfolio of bonds dominated an internationally diversified stock portfolio. The low correlations across world bond markets allowed U.S. investors to increase their dollar returns at the price of a smaller increase in risk than that required to achieve the same incremental returns from diversification in stocks.

The gain from international diversification was substantial. A U.S. investor who diversified across world bond markets could have earned more than double the mean rate of return on a U.S. bond portfolio, at the same risk level. For investors not confined to bonds, the gains from international diversification in bonds and stocks were even more impressive.

THE RISK-REDUCTION available from international diversification in stocks is well documented.[1] Much less research has been devoted to bonds as a component of internationally diversified portfolios, despite their importance in the international capital markets. International bond return data are less widely available than stock data, but recent research by Ibbotson, Carr and Robinson provides a valuable database for comparing internationally diversified portfolios of bonds and stocks.[2]

This article focuses on three issues.

- To what extent can international diversification among bonds produce returns in excess of those available from investment only in domestic risky bonds?
- Is it possible to construct internationally diversified bond portfolios that will outperform stock portfolios, despite the relatively low mean returns of bonds compared with stocks?
- What is the impact of diversification on portfolios made up of bonds and stocks from various markets?

The article considers two scenarios—international markets with risky assets only and such markets with riskless lending and borrowing opportunities.

The Data

We used the database of world bonds and stocks published by Ibbotson, Carr and Robinson. The data comprise dollar-adjusted annual rates of return earned by aggregated, market-value-weighted portfolios of bonds and stocks in the U.S. and a sample of foreign countries over the 21-year period 1960–80. In effect, "stocks" represent some stock market index in the corresponding country, while "bonds" represent a similar bond market index.

The rates of return in all countries are calculated in U.S. dollars and represent the returns earned by a U.S. investor with consumption needs denominated in U.S. dollars. In addition to incorporating the risk of the security returns in their domestic markets, these figures also incorporate the exchange rate risks associated with conversion of the various currencies into U.S. dollars.

1. Footnotes appear at end of article.

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Table I Dollar-Adjusted Annual Mean Rates of Return on Bonds and Stocks in Various Countries, 1960–1980

	Bonds		*Stocks*	
	Mean	*St. Dev.*	*Mean*	*St. Dev.*
Belgium	8.11%	9.66%	10.14%	14.19%
Denmark	6.99	13.14	11.37	24.83
France	5.99	12.62	8.13	21.96
Germany	10.64	9.45	10.10	20.34
Italy	3.39	13.73	5.60	27.89
Holland	7.90	8.28	10.68	18.24
Spain	5.17	11.52	10.35	20.33
Sweden	6.41	6.06	9.70	17.09
Switzerland	9.11	12.68	12.50	23.48
United Kingdom	6.81	15.30	14.67	34.40
Japan	11.19	12.21	19.03	32.20
Canada	3.52	6.44	12.10	17.89
U.S.	4.31	5.53	10.23	18.12

Source: Ibbotson, Carr and Robinson, "International Equity and Bond Returns," *Financial Analysts Journal*, July/August 1982.

Bonds are on the whole less risky than stocks: The standard deviation of bond returns in any particular market is normally lower than the standard deviation of the stock returns in that market. Lower risk, of course, implies in general lower mean or expected rates of return for bonds compared with stocks. Table I compares rate of return statistics for bonds and stocks in various markets from the point of view of a U.S. investor. All the bond means and standard deviations in the sample period were lower than the corresponding stock statistics in each market (with the exception of Germany). In terms of the mean-variance decision rule, both stocks and bonds were efficient investments in each market.

When diversification involves both bonds and stocks, it is relevant to consider the correlations, or covariances, between these asset classes. The appendix presents the full correlation matrixes for the bonds and stocks of the 13 countries included in the sample. We used these correlation matrixes, together with the means and standard deviations from Table I, as inputs to construct various internationally diversified portfolios for the U.S. investor.

International Bond Portfolios

Some investors hold only bonds, because of either personal risk preferences or constraints on institutional portfolios (e.g., pension funds, regulated portfolios). These bond holders may benefit by diversifying internationally.

The risk of a portfolio, as measured by standard deviation of returns, is determined by the correlations or covariances between all the possible asset pairs. Table AI in the appendix gives the correlation matrix between the bonds of the 13 relevant countries, measured in U.S. dollar terms. In general, the greater the geographical (and possibly cultural) proximity between countries, the higher the correlations of their bond markets. The correlation coefficients between the bonds of the EEC-member countries are, not surprisingly, very high, but there is much lower correlation between the European and North American bonds. Japanese bonds exhibit low correlations with all the other countries, and even negative correlations in three cases. The variability of correlation coefficients across the sample suggests that diversification among these bonds could produce substantial risk reduction.

We used the bond correlation matrix to construct efficient bond portfolios—i.e., portfolios that attain minimum risk at each level of return. Table II presents the composition of the efficient bond portfolios, with their risk and return parameters. Because the comovement of the EEC securities markets precluded significant gains from diversification across these countries, a single EEC member (usually Germany) acted in most cases as representative of the entire community in the diversified portfolio. Figure A plots the set of efficient bond portfolios in the mean-standard deviation plane, showing for comparison the risk-return combinations of the different bonds taken on their own.

International diversification in bonds clearly produced substantial benefits. U.S. bonds were characterized by a risk level of 5.53 per cent and mean return level of 4.31 per cent. At about the same level of risk (standard deviation of 5.22 to 5.72 per cent in Table II), the efficient bond portfolio earned a mean rate of return between 8.5 and 9 per cent—more than double the U.S.-only return. This was achieved by investing in a portfolio of German, Swedish and Japanese bonds (with small proportions in U.S. and Spanish bonds). In Figure A, the point representing undiversified investment in U.S. bonds is located deep inside the efficient frontier; it is inefficient. The international portfolio A in Figure A outperformed the U.S. bonds in terms of mean rate of return at the same risk level.

Riskless Lending and Borrowing

The straight line superimposed on the set of

Table II Efficient Bond Portfolios from the U.S. Investor's Perspective (U.S.-dollar-adjusted annual data for 1960–80)*

Mean Return (%)	8.00	8.50	9.00	9.50	10.00	10.50	11.00
St. Dev. (%)	4.76	5.22	5.72	6.32	7.02	7.80	9.43
Germany	19.66	24.36	29.13	37.83	46.99	56.15	34.13
Spain	1.87	1.75	1.59	0	0	0	0
Sweden	40.53	40.39	40.39	31.00	19.48	7.96	0
United Kingdom	0.68	0	0	0	0	0	0
Japan	22.70	25.94	28.84	31.17	33.53	35.89	65.87
U.S.	14.57	7.56	0.05	0	0	0	0
Total Invested	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Risk-Free Rate (%)	1.79	3.07	3.81	4.63	5.27	7.26	8.10
Slope of Market Line	1.30	1.04	0.90	0.77	0.67	0.42	0.31

*The figures in the body of the table are the investment proportions, in percentages adding up to 100 per cent for each portfolio. The risk-free rate at the bottom of the table is that rate at which the portfolio in the corresponding column is optimal for all investors. Countries excluded from portfolios in the relevant range of risk-free rates have been omitted from the table. The *slope of the market line* is calculated for each column as (portfolio mean rate of return − risk-free rate)/portfolio standard deviation.

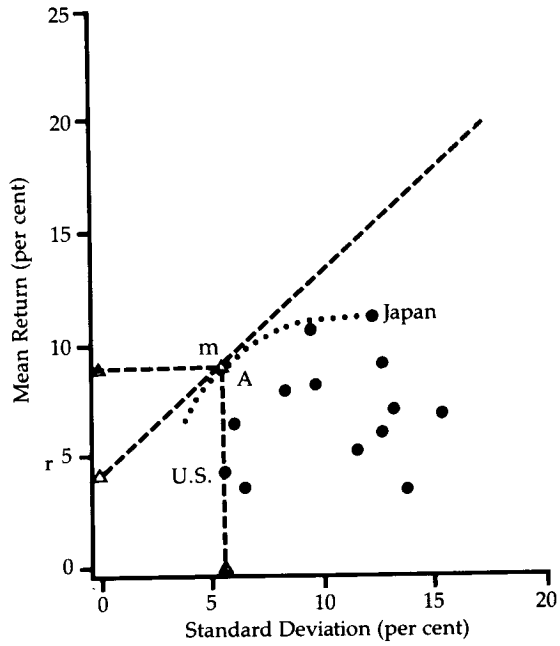
efficient bond portfolios in Figure A is the approximate *ex post* market line corresponding to riskless rate of return r. The two bottom lines in Table II present the risk-free rate at which the corresponding efficient portfolio is optimal for all investors (the "market portfolio" m in Figure A) and the slope of the market line for each risk-free rate.

Because we are concerned with the performance of international portfolios held by a U.S. investor, the relevant risk-free rate is the domestic U.S. rate that provides U.S. investors with riskless lending and borrowing opportunities. This rate is usually represented by the rate of return on U.S. government securities. The U.S. Treasury bill rate for the 1960–80 period averaged 5.4 per cent per annum, and the total rate of return on U.S. government bonds for that period was 3.1 per cent.[3] It would thus appear that the relevant range of risk-free rates for a U.S. investor in the period under study was between 3 and 5.5 per cent.

Given this information, we can easily identify the corresponding range of optimal bond portfolios in Table II: These are the four portfolios corresponding to risk-free rates of 3.07, 3.81, 4.63 and 5.27 per cent. Each of these optimal portfolios consisted primarily of German, Swedish and Japanese bonds. The optimal portfolios at the lower end of the relevant range (at risk-free rates of 3.07 and 3.81 per cent) also contained a small proportion of Spanish and U.S. bonds. The bonds of the remaining countries were not held in the optimal portfolios of the U.S. investor.

Taking the portfolio corresponding to a risk-free rate of 3.81 per cent as representative of the relevant range, we see that the risk of this optimal portfolio was virtually equal to that of an undiversified investment in U.S. bonds (5.72 per cent, versus 5.53 per cent), while its mean

Figure A Efficient Bond Portfolios for U.S. Investor Diversifying Across 13 Countries (riskless rate, r, =4%)



return was more than double (9 per cent for the optimal portfolio, versus 4.31 per cent for U.S. bonds).

The superiority of the optimal bond portfolio relative to undiversified investment in U.S. bonds emerges also from a comparison of the slopes of the respective market lines. The slope of the market line through the optimal bond portfolio corresponding to a risk-free rate of 3.81 per cent is 0.90 (see Table II), whereas the slope of the market line through U.S. bonds at this risk-free rate is merely 0.09 (= (4.31−3.81)/5.53, based on the parameters from Table I). A similar ranking is obtained for all specific values of the risk-free rate from the relevant range.

Bond vs. Stock Portfolios

Table III presents the efficient stock portfolios for investment in the same 13 countries, again based on U.S.-dollar-adjusted rates of return for the 1960–80 period. Table I showed that, on the whole, bonds were characterized by lower mean rates of return and lower risk levels than stocks. In risk-return terms, neither stocks nor bonds were the one optimal investment in any of the sample countries.

The availability of riskless lending and borrowing opportunities (at risk-free rates between 3 and 5.5 per cent) shifts the balance between U.S. stocks and bonds; stocks become preferable to bonds. For the U.S. investor, U.S. stocks provided a steeper market line than U.S. bonds at the relevant range of risk-free rates. For example, given a representative risk-free rate of 4 per cent and the U.S. stock and bond parameters from Table I, we see that the slope of the U.S. bond market was 0.06 (= (4.31 −4)/5.53)—much less than the slope of the U.S. stock market line, which was 0.34 (= (10.23−4)/18.12). The same result is obtained for all specific values of the risk-free rate in the relevant range. Investing only domestically, the U.S. investor would prefer stocks to bonds.

The situation changes dramatically, however, when we compare the sets of efficient bond and stock portfolios for all 13 countries. Figure B overlays the efficient sets of internationally diversified bond and stock portfolios. At relatively low mean rates of return, up to about 11 per cent (the maximum attainable with Japanese bonds), the bond portfolios definitely outperformed the stock portfolios. At every level of mean return up to 11 per cent, the bond portfolios had a lower risk level than the corresponding stock portfolios. Thus, at an 8.5 per cent mean return, the risk level of the efficient bond portfolio was 5.2 per cent, while the stock portfolio had a risk measure of 12.3 per cent. The bond portfolio was definitely preferable to the stock portfolio.

The efficient bond portfolio set stops at a mean return level of about 11 per cent, however, while the efficient set of internationally diversified stock portfolios extends up to a mean return level of about 19 per cent (with a standard deviation of about 32 per cent). The upper bound represents investment in Japanese stocks, which also happened to have the highest risk and return of all the sample stocks. The higher range of risk-return combinations was

Table III Efficient Stock Portfolios from the U.S. Investor's Perspective (U.S.-dollar-adjusted annual data for 1960–80)

Mean Return (%)	11.50	12.00	13.00	13.50	14.00	15.50	17.50	18.50
St. Dev. (%)	11.87	12.50	14.03	14.95	15.96	19.32	25.40	29.28
Belgium	14.01	9.72	0.58	0	0	0	0	0
Germany	21.23	21.98	20.07	16.77	11.35	0	0	0
Spain	19.60	17.48	14.60	11.75	9.03	0	0	0
Sweden	4.09	3.46	0	0	0	0	0	0
Switzerland	0	0	0	0	3.63	11.37	0	0
United Kingdom	2.83	4.66	7.03	8.34	9.01	10.27	20.46	12.21
Japan	8.41	11.54	20.03	24.92	29.43	38.38	70.31	87.79
Canada	23.71	31.17	37.68	38.22	37.55	36.09	9.23	0
U.S.	6.12	0	0	0	0	0	0	0
Total Invested	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Risk-Free Rate (%)	1.36	2.71	4.93	5.73	6.48	7.82	10.17	12.44
Slope of Market Line	0.85	0.74	0.57	0.52	0.47	0.40	0.27	0.21

not attainable with bond portfolios, and here the stock portfolios played an efficient role on their own.

Riskless Lending and Borrowing

The introduction of riskless lending and borrowing enables us to make a clear-cut choice between bond and stock portfolios. Surprisingly, the "sluggish" international bond portfolios appear to outperform the "high-flying" stock portfolios. Comparison of the bottom lines in Tables II and III shows that the slope of the bond market line is consistently higher than the slope of the stock market line in the entire range of relevant risk-free rates (between 3 and 5.5 per cent). At a representative riskless rate of around 4 per cent, the optimal bond portfolio earned a mean return of 9 per cent, with 5.7 per cent standard deviation, while the optimal stock portfolio earned a mean return of 12.5 per cent at 13.25 per cent standard deviation.

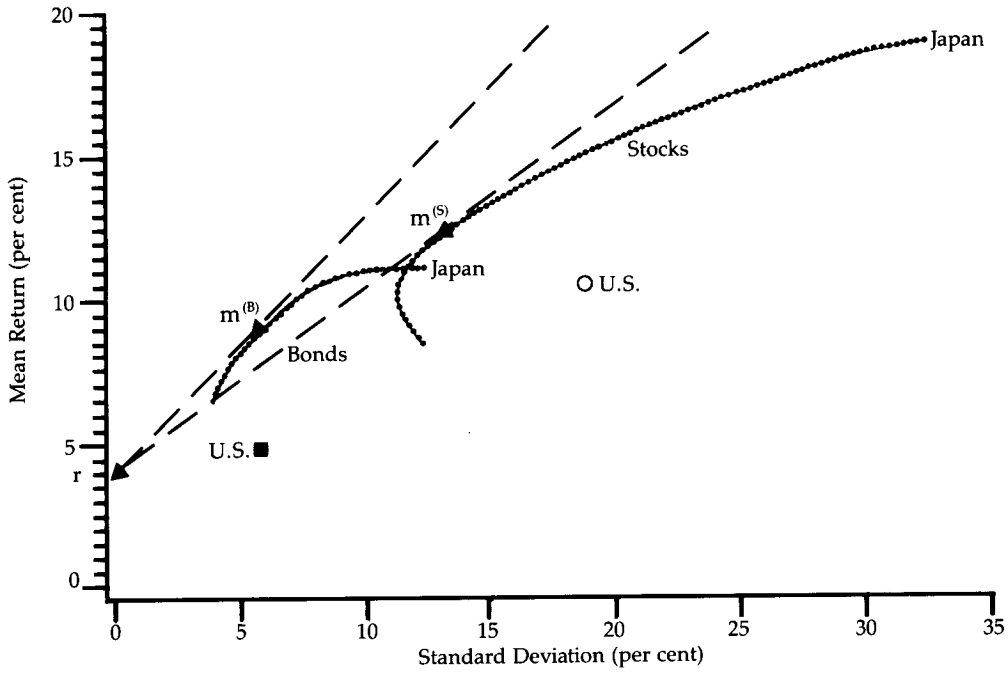
The market lines through these optimal bond and stock portfolios are superimposed on the efficient bond and stock sets in Figure B. Clearly, the market line through the optimal bond portfolio is the steeper of the two; its slope is 0.9 (=(9.0−4)/5.7), versus 0.6 (= (12.5−4)/13.25) for the stock portfolio. The optimal bond portfolio thus enabled investors to reach a higher level of expected utility than the optimal stock portfolio.

The results indicate that an investor who preferred a higher mean return (and higher risk) than international investment in bonds alone allowed would find it preferable to buy the bond market portfolio and achieve his optimum risk-return point by riskless borrowing or lending, rather than investing directly in a stock portfolio. Furthermore, he could do so fairly easily. The optimal bond portfolio for riskless rates of return between 3 and 5.5 per cent included basically three assets—German, Swedish and Japanese bonds. Such a portfolio was definitely attainable for an average investor, who could thus enjoy the benefits of international diversification in bonds.

Stability of Results

The reasons for the dominance of the international bond portfolios over the stock portfolios in our sample should be sought in the correla-

Figure B Efficient Sets and Optimal Portfolios for Bonds and Stocks



tion matrix, as this is one of the primary determinants of portfolios' risk-return profiles. As shown in Tables AI and AII in the appendix, the number of negative correlation coefficients between bonds was much higher than the number of negative correlation coefficients between stocks (24 versus only 14). Thus stock correlations were on the whole positive, while bond correlations were near zero or negative, offering very strong risk-reduction potential and allowing U.S. investors to increase their dollar returns at the price of a smaller increase in risk than that required to achieve the same increase in returns by diversification in stocks. This is in fact the implication of the steeper market line through the optimal bond portfolio.

The specific figures we have obtained by solving the general portfolio selection problems are, of course, sample-dependent. Developments in the future will not necessarily replicate historical data. However, the general conclusion—namely, that diversification in bonds allows an increase in mean return at the price of a smaller increase in risk than diversification in stocks—is determinated primarily by the correlation coefficients between the corresponding assets, and these are much more stable over time than the rates of return themselves.[4] We therefore believe that the general conclusion is independent of the *ex post* sample data and will repeat itself in the future.[5]

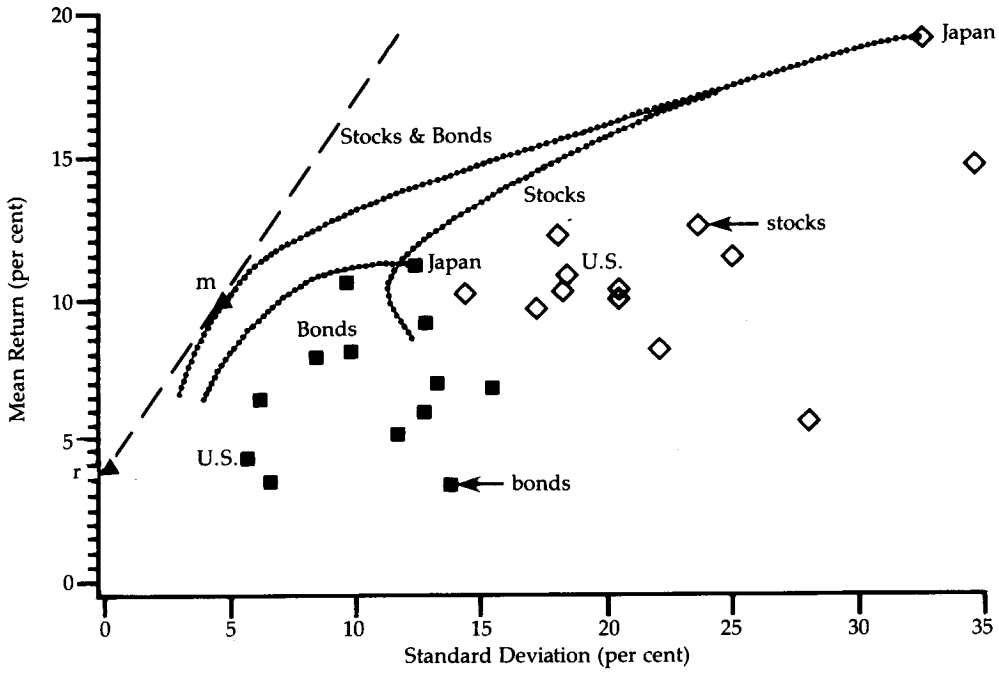
Some serious issues of macroeconomic equilibrium of supply and demand on international securities markets are raised by two of our findings—i.e., that neither U.S. bonds nor stocks were included in the optimal portfolios (even though these were constructed from the point of view of a U.S. investor) and that optimal stock and bond portfolios contained large holdings in securities from relatively minor markets such as Spain and Sweden. One possible explanation is that these findings are purely *ex post* and bear no relation to actual *ex ante* investment decisions.[6] We do not accept this argument, in view of the relative stability of correlations and efficient sets over time, which endows *ex post* portfolios with good *ex ante* predictive ability.

We attribute this effect, instead, to "behavioral imperfection" of investors in international markets. Despite the demonstrated advantages of international diversification, investors still find it easier to stick close to their domestic markets, largely ignoring international opportunities. The observed bias of investors everywhere toward their domestic stocks is usually attributed to various barriers to international investment, which may result from lack of information, discriminatory taxation, restrictions on funds flows or simply fear of expropriation.[7] Our results, of course, ignore these imperfections and indicate what would happen if investors felt no inhibition against diversifying internationally.

Table IV Efficient Bond-plus-Stock Portfolios from the U.S Investor's Perspective (U.S.-dollar-adjusted annual data for 1960-80)

Mean Return (%)	8.50	9.50	10.00	10.50	11.50	13.50	15.00	17.00	18.50
St. Dev. (%)	3.64	4.30	4.68	5.12	6.38	10.88	15.90	23.30	29.28
Stocks									
Italy	3.81	3.06	2.97	2.97	0	0	0	0	0
Spain	10.83	12.74	13.71	14.17	10.11	0	0	0	0
United Kingdom	0	0	0	0	2.45	8.63	11.68	18.31	12.21
Japan	0	0	0	0.85	6.99	27.27	39.01	66.98	87.79
Canada	0	0	0	2.38	12.11	12.73	7.88	0	0
U.S.	10.70	14.30	16.11	15.60	5.27	0	0	0	0
Bonds									
Germany	32.76	41.22	46.05	52.67	54.25	50.92	41.43	14.71	0
Sweden	14.13	12.72	10.50	1.13	0	0	0	0	0
United Kingdom	2.05	0.63	0	0	0	0	0	0	0
Japan	7.04	9.32	10.61	10.22	8.81	0	0	0	0
Canada	6.75	0	0	0	0	0	0	0	0
U.S.	11.93	6.00	0	0	0	0	0	0	0
Total Invested	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Risk-Free Rate (%)	2.12	3.65	4.33	5.33	7.38	9.88	10.53	10.89	12.47
Slope of Market Line	1.75	1.36	1.21	0.91	0.65	0.33	0.28	0.26	0.21

Figure C Efficient Set of Stock-plus-Bond Portfolios vs. Efficient Stock Portfolios and Bond Portfolios



Stocks and Bonds

The coefficients of correlation between stocks and bonds in each country are generally low—0.14 in Switzerland, 0.21 in the U.S., around 0.50 in Belgium, Spain and the U.K. (see Table AIII in the appendix). This suggests that considerable risk reduction can be achieved by constructing portfolios of both stocks and bonds. In order to explore the impact of bond-stock diversification in the international setting, we calculated the correlation coefficients between stocks and bonds for pairs of all the 13 countries in our sample (Table AIII) and determined the efficient set of stock-plus-bond portfolios on a pooled feasible set of assets comprising the stocks and bonds of all 13 countries (a total of 26 risky assets). Table IV presents the efficient stock-plus-bond portfolios. Figure C overlays the efficient frontier of stock-plus-bond portfolios on the separate sets of efficient bond portfolios and efficient stock portfolios.

The increase in the number of feasible assets increased, as expected, the benefits from diversification, and the efficient set of bond-plus-stock portfolios shifted to the "northwest," enveloping the two separate efficient sets of bond and stock portfolios. As a result, for every given riskless rate, the optimal bond-plus-stock portfolio is located on a steeper market line than either the optimal bond portfolio or the optimal stock portfolio, allowing the investor to reach a higher level of expected utility. This is clear from a comparison of the corresponding slopes given in the last lines of Table II, III and IV.

At the relevant riskless rates (between 3 and 5.5 per cent), over 60 per cent of the optimal stock-plus-bond portfolio was made up of bonds (mainly German, Swedish and Japanese). The balance of the portfolio comprised Spanish stocks, which were also included in the optimal stock portfolio, as well as U.S. stocks (around 14 to 16 per cent) and some Italian stocks (around 3 per cent), neither of which entered the optimal stock-only portfolio (see Table III). U.S. stocks had a very strong negative correlation with German bonds (−0.3564), which accounted for over 40 per cent of the optimal portfolio in the relevant range of riskless rates. Because of this negative correlation, there was a significant benefit from including U.S. stocks in a stock-plus-bond portfolio, although there was no incentive for their inclusion in the stock-only portfolio.

The efficient set of bond portfolios did not

attain risk-return combinations beyond the maximum point corresponding to Japanese bonds (11.2 per cent mean and 12.2 per cent standard deviation). Efficient portfolios corresponding to higher levels of mean return and higher levels of risk could be attained only by investing in all-stock portfolios. With bond-plus-stock portfolios, however, the U.S. investor could achieve mean return levels above the point corresponding to Japanese bonds by investing in portfolios with a fairly high component of German bonds (see Table IV).

The portfolios with risk-return combinations above the optimal portfolios corresponding to the relevant range of riskless rates were comprised mainly of four components—U.K. stocks, Japanese stocks, Canadian stocks and German bonds. The reason for this, as before, is the negative correlation of German bonds with most stocks (−0.1276 with Japanese stocks, −0.1557 with U.K. stocks, −0.2867 with Canadian stocks). This again emphasizes the importance of asset correlations in the composition of the optimal portfolio and the large benefit of negative correlation for diversification.

Conclusion

U.S. investors specializing in bonds could have improved their portfolio performance over the 1960–80 period by 3 to 5 per cent a year by diversifying internationally rather than restricting their investments to domestic bonds. It is the low correlations between the bond markets in various countries, compared with the correlations across the international stock markets, that account for the potential gains from international diversification in bonds.

The clearly superior performance of the international bond portfolio relative to the stock portfolio over the 1960–80 period is a highly interesting fundamental conclusion that requires further study in order to generalize it to *ex ante* data. It seems appropriate to change the traditional attitudes that focus on diversification in stocks only, and especially the familiar domestic stocks. There appears to be a very large potential for international diversification in stocks and bonds, even if we qualify the expectation of potential gains by recognizing the possible extra costs associated with holding foreign investments. ■

Footnotes

1. H. Levy and M. Sarnat, "International Portfolio Diversification," in R.J. Herring, ed., *Managing Foreign Exchange Risk* (Cambridge: Cambridge Univ. Press, 1983) and "Devaluation Risk and the Portfolio Analysis of International Investments," in Elton and Gruber, eds., *International Capital Markets* (Amsterdam: North Holland, 1975). For a recent review of empirical work on the construction of international equity portfolios, see J. Madura, "International Portfolio Construction," *Journal of Business Research* 13 (1985), pp. 87–95, where a comprehensive bibliography of 58 items has been compiled.
2. R.G. Ibbotson, R.C. Carr and A.W. Robinson, "International Equity and Bond Returns," *Financial Analysts Journal*, July/August 1982, pp. 61–83.
3. These averages are based on the time series of U.S. T-bill and bond rates of return in R.G. Ibbotson and R.A. Sinquefield, *Stocks, Bonds, Bills, and Inflation* (Charlottesville, VA: The Financial Analysts Research Foundation, 1982). Note that our U.S.-investor-based analysis requires using the U.S. risk-free rate. For a discussion of some conceptual difficulties associated with the definition of the "international" risk-free rate for multimarket analysis, see M. Alder and R. Horesh, "The Relationship Among Equity Markets: Comment," *Journal of Finance* 29 (1974), pp. 1311–1317.
4. For some evidence on intertemporal stability of correlations, see J. Watson, "The Stationarity of Inter-Country Correlation Coefficients: A Note," *Journal of Business, Finance and Accounting*, Spring 1980, and D. Panton, V. Lessing and D. Joy, "Comovement of International Equity Markets: A Taxonomic Approach," *Journal of Financial and Quantitative Analysis*, September 1976.
5. This conclusion is supported by Errunza's finding that the efficient set of international equity portfolios is stable in different periods (see V. Errunza, "Gains from Portfolio Diversification into Less Developed Countries' Securities," *Journal of International Business Studies*, 1977, pp. 83–99).
6. For a discussion of the general issue of using *ex post* data as *ex ante* predictors, see J. Madura, "International Portfolio Construction," *op. cit.*, and the references therein.
7. For a discussion of costs to domestic investors associated with the holding of foreign assets, see M. Adler and B. Dumas, "International Portfolio Choice and Corporation Finance: A Synthesis," *Journal of Finance*, June 1983, pp. 925–984. A theoretical model explaining the investor's bias toward domestic investment in the presence of such costs is developed by R. Stulz, "On the Effects of Barriers to International Investment," *Journal of Finance*, September 1981, pp. 923–934.

Table AI International Bonds: Correlation Coefficients of Annual U.S.-Dollar-Adjusted Returns, 1960–1980

	Belgium	*Denmark*	*France*	*Germany*	*Italy*	*Holland*	*Spain*	*Sweden*	*Switz-erland*	*UK*	*Japan*	*Canada*
Denmark	.5484											
France	.7160	.6927										
Germany	.7711	.2171	.4266									
Italy	.2475	.4257	.5303	−.0092								
Holland	.9281	.4481	.6442	.8622	.0363							
Spain	.3087	.4883	.4724	.0438	.6118	.2350						
Sweden	.6302	.4182	.2812	.3377	−.0392	.6306	.4397					
Switzer-land	.8952	.4754	.6624	.8540	.0752	.9444	.1741	.4632				
UK	.0949	.1207	.0989	.1245	.2876	.0327	−.1281	−.2383	.1336			
Japan	.3186	.3557	.2769	.2657	.2385	.2452	−.1582	−.1842	.3832	.5008		
Canada	.1595	−.0103	.0097	.1791	−.2251	.2110	−.1024	.2635	.0365	−.1471	−.1716	
U.S.	.0493	.2281	.1465	.0978	−.1316	.1656	.0718	.0589	.1040	.0760	.0959	.6317

Source: Based on return time series in Ibbotson, Carr and Robinson, "International Equity and Bond Returns," *Financial Analysts Journal*, July/August 1982.

Table AII International Stocks: Correlation Coefficients of Annual U.S.-Dollar-Adjusted Returns, 1960–1980

	Belgium	*Denmark*	*France*	*Germany*	*Italy*	*Holland*	*Spain*	*Sweden*	*Switz-erland*	*UK*	*Japan*	*Canada*
Denmark	.3873											
France	.5592	.2592										
Germany	.3032	.0577	.2727									
Italy	−.1037	.1563	.3981	−.0037								
Holland	.5665	.3419	.4835	.5365	.0313							
Spain	.2075	.4128	.3261	−.0750	.3376	−.1019						
Sweden	.3111	.2812	.2766	.2849	.1313	.4290	.3132					
Switzer-land	.4646	.1339	.4437	.6997	.1289	.6580	.1271	.2331				
UK	.2839	.1515	.4317	.2579	.1040	.6747	−.0392	.3010	.4537			
Japan	.3309	.8308	.3611	.3018	.3066	.2840	.3371	.3395	.2401	.1711		
Canada	.6231	.3414	.4407	−.0364	.2692	.5536	.2598	.3123	.3500	.3602	.2313	
U.S.	.3886	.2425	.2138	.2096	.2078	.7297	−.1154	.3976	.4540	.6166	.2157	.7098

Source: Based on return time series in Ibbotson, Carr and Robinson.

Table AIII Bond-Stock Cross-Correlations of Annual U.S.-Dollar-Adjusted Returns, 1960–1980

Bonds	*Belgium*	*Denmark*	*France*	*Germany*	*Italy*	*Holland*	*Spain*	*Sweden*	*Switz-erland*	*UK*	*Japan*	*Canada*	*U.S.*
Stocks													
Belgium	.4906	.5773	.5729	.3372	.5367	.4148	.5758	.2563	.3446	−.0751	.1877	.1915	.1137
Den-mark	−.0866	.3383	.0122	−.2112	.2766	−.1441	.3445	−.0193	−.1149	−.2138	.1708	−.1062	.1391
France	.2548	.5900	.6065	−.0629	.6377	.1481	.6694	.0759	.2010	.0720	.0983	−.3424	−.0674
Germa-ny	.1725	.1543	.2740	.2769	.1973	.2443	.0989	−.1744	.3155	−.1133	.2609	−.3267	−.1249
Italy	−.3369	−.0127	−.1677	−.5261	.2651	−.3667	.3225	−.0601	−.3347	.0671	.1059	−.5112	−.2398
Holland	−.0457	.4087	.2427	−.0630	.2982	−.0413	.1166	−.1782	−.0017	−.0676	.1356	−.1361	.0936
Spain	−.1737	.0085	−.1032	−.3071	.4365	−.3045	.5255	.0188	−.3591	−.1800	−.2053	−.2622	−.3260
Sweden	.0493	.3948	.0555	−.1836	.1632	−.0065	.3781	.3253	.0010	−.1661	.0137	−.1864	.0176
Switzer-land	.1169	.1039	.2952	.1818	.4084	.1731	.2534	−.1702	.1434	.0296	.1151	−.2012	.0813
UK	−.1137	.4263	.2133	−.1557	.5129	−.1897	.0474	−.3919	−.0834	.5155	.3500	−.1822	.2153
Japan	.0894	.3920	.0856	−.1276	.3560	.0003	.3848	.0529	.0580	−.0746	.4096	−.1395	.1630
Canada	−.1339	.1786	.0620	−.2867	.4196	−.1765	.4566	.0670	−.2730	.0254	−.1208	.1697	.0971
U.S.	−.2406	.1252	−.0674	−.3564	.2496	−.2746	.0654	−.1688	−.3136	.0258	.1073	.0720	.2099

Source: The bond-stock correlations across the sample countries were calculated from the U.S.-dollar-adjusted rates of return in Ibbotson, Carr and Robinson.