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INTERNATIONAL PORTFOLIO DIVERSIFICATION: A MULTIVARIATE ANALYSIS FOR A GROUP OF LATIN AMERICAN COUNTRIES

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SEVERAL RECENT ARTICLES (most notably Grubel [1968] and Levy and Sarnat [1970]) have used portfolio theory to demonstrate that international diversification can be a major gain from international economic relationships. This article examines international diversification potential among a set of developing countries and determines the feasibility of creating investment unions which provide diversification benefits while meeting the political requirements of participants. The methodology employed, primarily multivariate analysis, appears to be a useful approach to the examination of international diversification of all kinds, whether constrained to small groups of countries or not.

I. THE INVESTMENT UNION CONCEPT

Complete freedom of international capital movements would provide investors with a maximum opportunity for diversification, but it also would conflict with the objective of economic sovereignty that is so important to many developing countries. An Investment Union (IU),[1] on the other hand, would allow international diversification among a group of countries with similar levels of development where some degree of reciprocity could be maintained and the loss of economic sovereignty could be limited.[2,3]

1. The term investment union refers to an arrangement between countries which allows greater freedom of capital movements among the union countries than with non-union countries. The decision to deal with IU's of only developing countries is based on the consideration that only under such a structure would multinational diversification be consistent with the objective of economic sovereignty. Also, such an IU would allow efficient development of information on investment opportunities in each country, something which would not be economically feasible if a large number of geographically dispersed countries were involved.

2. The reasons favoring an IU closely parallel those proposed by Cooper and Massell [1965] favoring a commercial union. They argue that integration must be justified on the basis that it reduces the cost of domestic industrialization, since the traditional approach, which associates benefits with movements toward free trade, fails to show why any regional integration would be preferred to free trade or optimal non-preferential tariffs.

Implicit in the Cooper-Massell approach to commercial integration is the recognition that governments of developing countries impose a "tax" on certain sectors of the economy, principally the consumers of products which could be obtained at lower cost under free trade, in order to enable the economy to develop in a manner the government considers beneficial in the long run.

Similarly, most developing countries impose a "tax" on domestic investors in order to maintain the external value of the currency and to retain economic sovereignty. This "tax" consists of the loss which investors suffer by being restricted from investing in the most attractive assets regardless of the country of issue. This loss should be measured in terms of both return and risk since

II. POTENTIAL SOURCES OF GAINS FROM AN INVESTMENT UNION

As Levy and Sarnat [1970] point out, there is a strong tendency for returns on individual securities within an economy to move together. The greater the degree of comovement, the less opportunity there is for risk reduction through diversification. It is likely that these common tendencies are even stronger in individual developing countries than in advanced countries with efficient capital markets. This is true for many reasons: greater volatility of economic activity, political instability, concentration of the economy in certain industries, irregular changes in the purchasing power of the currency, and "crises of confidence."

It is unlikely that the common movements in various countries are related. Changes in the level of economic activity may be related through dependence on a world business cycle or trade in the same products in world markets, but it is probable that other sources of comovement within each country will outweigh this impact. For example, political crises in one country seldom coincide with those in other countries, and no evidence exists to show that the fiscal and monetary policies of the respective governments are synchronized over time. The fact that most developing countries restrict investments in foreign securities further isolates their market-wide movements because few funds move between the respective countries.

If (1) *returns within each country share a strong common element of variance* and (2) *the common elements for each country are largely independent from those of the other countries,* it is very likely that multinational diversification within an IU will result in significantly larger gains than diversification within single countries. Also, the gains would be larger than those provided simply by increasing the number of stocks available in one country.

III. A TEST OF POTENTIAL GAINS FOR AN IU OF FOUR LATIN AMERICAN COUNTRIES

In this section we report the results of an analysis of historical returns on corporate equities[4] in four Latin American countries—Colombia, Chile, Argentina, and Brazil.[5] The sample for the study consisted of quarterly returns

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investors are risk-averse and, therefore, interested in both the return and the risk associated with that return.

3. For a more extensive discussion of the investment union concept and some of the potential difficulties with its application see Lessard [1970].

4. The analysis was limited to common stocks for three reasons: (1) they are similar instruments in each country, (2) they are more subject to large fluctuations in returns than other securities, and (3) governments are more likely to be willing to allow integration of markets for equities than they are for their own obligations.

5. The selection of countries for the study was based both on the existence of an active stock exchange and on their relevance for the creation of an IU. Colombia and Chile were of special interest because of their membership in the Andean Group, a potential vehicle for the formation of an IU. Other Andean Group countries did not have sufficiently active markets to provide the data necessary for this study.

The four exchanges are small in relation to the major stock exchanges of the world, with annual trading volumes in 1967 from 12 to 67 million dollars. This raises questions about the quality of the data and the ability to create IU's among these countries. However, we feel that the returns are at least indicative of the type of situation that will exist as these markets become

on 110 common stocks, 30 each from Colombia, Chile, and Argentina, and 20 from Brazil.[6]

The series of returns covered the period from December, 1958 to December, 1968. The returns included dividends and capital gains and were adjusted for all capital changes such as stock dividends, stock splits, and subscriptions. The representativeness of the sample of securities is demonstrated by the fact that in 1968 the Colombian sample accounted for more than 88 per cent of the volume on the Colombian exchange; the Argentine sample for 48 per cent;[7] and the Brazilian sample, 65 per cent. We did not have the data to determine the proportion for the Chilean sample, but it was drawn at random from the 47 actively traded issues in that country. The returns were all translated into dollar-equivalents by the use of the official rate of exchange applied to capital transactions.[8]

Two types of analysis were employed: (1) a multivariate examination of the structure of returns on individual stocks to determine the existence of the two conditions cited above and (2) a comparison of the historical performances of hypothetical national and international portfolios.

Analysis of the Structure of Returns

It is possible to examine the covariances of returns on individual stocks directly to determine the existence of the two conditions cited above. However, this approach is unlikely to reveal complex patterns of association among securities, and for that reason, the multivariate methods of factor and principal component analysis were used to simplify the problem since in many cases they provide an adequate explanation of the interdependence of a large number of variables in terms of a few basic constructs.[9] Principal component or factor analysis have been used in several recent empirical studies (Farrar [1962], King [1967], and Feeney and Hester [1967]) concerned with the existence of general movements in the returns from common stocks.

The factor analysis model assumes that each observation, in this case the

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more developed. Furthermore, we see no reason why trading in equity securities would not increase rapidly within an improved institutional setting.

6. Individual common stocks rather than stock market indexes were used since the indexes were of questionable validity and since an analysis based on indexes (even if correct) may produce biased results because it limits comparisons to an arbitrary set of national portfolios.

Two considerations entered into the selection of individual stocks for the sample; (1) representativeness in terms of industrial composition, etc. and (2) the need to select issues traded in sufficient volume and frequency to provide reliable data. The latter criterion precluded a random sampling of the entire population of listed securities. Instead, the final sample was selected at random from lists of those issues traded on a regular basis (generally on a daily basis and at least once a week). The industrial composition of the samples was surprisingly broad and in all cases contained some firms in basic industries (steel, cement, chemicals, etc.), some in agriculture or related industries, some consumer products firms, and some financial firms (banks and insurance companies).

7. This sample was drawn at random from a 50 stock sample that accounted for more than 66 per cent of the transactions on that exchange.

8. The analysis was extended to dollar-equivalents based on parallel market exchange rates and a smoothed series of the official rates. In each case the results were similar.

9. For an excellent exposition of principal component analysis and factor analysis see Harman [1967].

period return on an individual common stock, is a function of several under-
lying factors and a unique element. In equation form the general model is:

$$y_{jt} = \alpha_j + \beta_{j1}F_{1t} + \beta_{j2}F_{2t} + \ldots + \beta_{jm}F_{mt} + u_{jt}, \ (j = 1,2, \ldots n, m < n) \quad (1)$$

where y_{jt} is the observed period t return on stock j, α_j is a constant term for
stock j, the F_{it}'s are the values of the unobservable factors, the β_{ji}'s are the co-
efficients linking each stock's returns to the factor and u_{jt} is the unique
element.[10]

The factors may be general, i.e., they may contribute to the variance of the
returns on all stocks, or they may be group elements, i.e., they may contribute
only to the variance of some subset of the n stocks. A market index is a gen-
eral element since it is assumed to contribute to the variance of all stocks.

A common solution to the factor model is the principal component solution,
an eigen roots and vectors solution of the correlation or covariance matrix of
the variables. In this solution, no unique factors are assumed to exist, i.e.:

$$y_{jt} = \alpha_j + \beta_{j1}F_{1t} + \beta_{j2}F_{2t} + \ldots + \beta_{jn}F_n \quad (2)$$

and therefore n components are required to fully reproduce the covariances
among the n variables. However, generally it is possible to explain a large
percentage of the total variance with only a few components. The components
are selected so that each successive one explains a maximum of the remaining
variance, i.e., the first component is selected to explain the maximum propor-
tion of the total variance, the second to explain the maximum of the remaining
variance, etc. Therefore, the principal component solution is a particularly
appropriate test for the first condition, the existence of a strong market factor.

In order to determine the extent to which all returns in individual countries
move together, principal component analysis was applied to twelve different
ex post covariance matrices of dollar-equivalent returns,[11] a covariance matrix
of returns within each country (Colombia, Chile, Argentina, and Brazil) for
each of three periods (December 1958-December 1963, December 1963-
December 1968, and the entire period, December 1958-December 1968).
Table 1 shows the proportion of the trace (total variance of all securities) of
each covariance matrix explained by the first principal component. This pro-
portion is equivalent to that obtained by computing the best single index for
each country and determining the proportion of the total variance of the indi-
vidual securities in that country that can be explained by the index.

In all cases, the proportions of the total variance explained by the first
components of the returns for each of the four Latin American countries in
each of the three periods is large, much larger than the proportion explained

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10. The factor analysis model is very similar to a regression model in which both the coeffi-
cients and the independent variables must be estimated. Because of this, there are an infinite
number of possible factor solutions, and a large number of specific methods, many of them arbi-
trary, have been formulated to solve the factor analysis problem. This potential for arbitrary
solutions and the frequent lack of *a priori* modelling in factor analysis have led to a distrust of
factor analysis by many economists. See Meyer [1967] for an excellent discussion of this issue.

11. The returns in this case are the logarithms of the period relatives for each stock. This is
the same return measure as used by King [1966] in a similar study of U.S. returns.

TABLE 1
PROPORTION OF VARIANCE EXPLAINED BY FIRST PRINCIPAL COMPONENT

	Dec. 1958- Dec. 1963	Dec. 1963- Dec. 1968	Dec. 1958- Dec. 1968
Colombia	.70	.73	.71
Chile	.61	.40	.50
Argentina	.73	.58	.66
Brazil	.41	.60	.47

in similar analyses of U.S. stocks, which is around 30 per cent for the same time period.[12]

To determine if these national market movements are related, the correlations were computed between the first principal components for each of the four countries. The results of this analysis are shown in Table 2. While there

TABLE 2
CORRELATIONS BETWEEN FIRST PRINCIPAL COMPONENTS FOR THE FOUR COUNTRIES

Ten Years 1958-1968 (n = 40)				
	Colombia	Chile	Argentina	Brazil
Colombia	—			
Chile	−.16	—		
Argentina	.12	−.42*	—	
Brazil	−.08	.16	−.08	—

Five Years 1958-1963 (n = 20)				
	Colombia	Chile	Argentina	Brazil
Colombia	—			
Chile	.13	—		
Argentina	−.17	.43	—	
Brazil	−.15	.46*	.13	—

Five Years 1963-1968 (n = 20)				
	Colombia	Chile	Argentina	Brazil
Colombia	—			
Chile	−.23	—		
Argentina	.46*	−.32	—	
Brazil	−.12	−.05	−.07	—

For n = 20 r = .443 is significant at .05 level (two-tailed test)
   n = 40 r = .312 is significant at .05 level (two-tailed test)

are several significant correlations among some of the components, there do not appear to be any stable patterns over the different time periods. One extremely interesting result is that no significant correlation exists between the market factors in Colombia and Brazil, the two countries in the study which do compete directly in terms of their major export product. The analysis does not

12. For recent results see Blume [1971].

reveal any systematic relationships between the major movements in the various stock markets.

The results shown in Tables 1 and 2 are a strong indication that the two conditions hold. However, since they are based on analyses of single-country covariance matrices, it is possible that they fail to show some influences which do transcend national boundaries. For this reason, we also analyzed the covariance matrix of all 110 stocks (the four countries considered simultaneously). A varimax rotation of the component solution, rather than the component solution itself, was used since it favors explanation of the data in terms of a structure that is consistent with the results for the single-country covariance matrices, i.e., strong market factors for each country (group factors in the 110-stock analysis) which are largely independent. The varimax rotation is likely to extract group factors of approximately equal strength while the principal component solution extracts components with declining contributions to total variance.[13] The varimax solution[14] confirms that the returns in each country can be explained by a market factor and that the market factors are independent of each other.

TABLE 3

PROPORTIONS OF VARIANCE EXPLAINED BY FIRST EIGHT VARIMAX FACTORS OF THE
COVARIANCE MATRIX OF DOLLAR-EQUIVALENT RETURNS—
DECEMBER 1958-DECEMBER 1968

	FACTOR NO. 1	FACTOR NO. 2	FACTOR NO. 3	FACTOR NO. 4	FACTOR NO. 5	FACTOR NO. 6	FACTOR NO. 7	FACTOR NO. 8	TOTAL
Proportion of Total Variance Explained by Factor									
	.207	.159	.128	.083	.046	.029	.035	.027	.714
Proportion of Total Variance Explained by Factor For—									
Colombia	.013	.010	.010	*.687*	.007	.012	.008	.014	.761
Chile	.039	.099	*.454*	.022	.024	.030	.016	.028	.617
Argentina	*.621*	.013	.038	.009	.009	.006	.015	.034	.745
Brazil	.012	*.422*	.029	.023	.101	.055	.071	.023	.738

Table 3 reports the proportion of total variance of stocks from each country and from all four countries explained by each factor.[15] For the full ten years, factor 1 is clearly identified with the Argentine market and accounts for 62 per cent of the total variance of the Argentine stocks. Factor 2 is identified

13. Harman [1967] provides a good explanation of the varimax solution.

14. The rotation was made on the first eight principal components, which account for 71 per cent of the total variance of the 110 stocks. The rotated factors also account for 71 per cent of the total variance, but the variance is redistributed among them. The decision to rotate eight factors was based on two considerations: a rapid dropoff in the proportions of variance explained by additional factors and a desire to avoid forcing the expected four-factor solution by rotating only four factors. The unrotated principal component solution does not show any major common movements that transcend national boundaries. The first component, for example, accounts for only 26 per cent of the total variance and contributes heavily to the returns on only one country —Argentina. However, this solution does not establish that the variances and covariances can be explained entirely in terms of independent components for each country, a result that would be extremely desirable for an IU.

15. Appendix A shows the proportion of variance of each stock which is explained by each rotated factor as well as the proportion for all stocks in each country and the region explained by each factor.

in Brazil, and explains 42 per cent of the total variance of the Brazilian stocks. Factor 3 represents the Chilean market and accounts for 45 per cent of the total variance of the Chilean stock. Factor 4 is allied with the Colombian market. It explains 69 per cent of the total variance of the Colombian stocks. Of the 110 stocks, only six are closely identified with the market factor from another country and all 110 are related to their respective market factors. The results are similar for the two subperiods.

Additional support for this conclusion is provided by a comparison of the proportion of variance in the returns for each country which is explained by the first principal component of those returns and by the independent factors resulting from the varimax solution. Table 4 shows both sets of figures. These

TABLE 4

PROPORTION OF TOTAL VARIANCE OF ALL STOCKS IN EACH COUNTRY EXPLAINED BY PRINCIPAL COMPONENTS (INDIVIDUAL COUNTRY SOLUTION) AND VARIMAX FACTORS (REGIONAL SOLUTION), DECEMBER 1958-DECEMBER 1968

	Colombia	Chile	Argentina	Brazil
Principal component for individual country	.71	.50	.66	.77
Varimax factor corresponding to country	.69	.45	.62	.42

figures indicate that even though the principal components for each country are not absolutely independent, it is possible to explain an average of 93 per cent as much variance for each country as is explained by the principal components with four completely *independent* factors.

The results demonstrate that the conditions for substantial gains from an IU exist among this group of countries, but, they do not show the magnitude of these potential gains; therefore, the analysis of the structure of returns was supplemented by the more common type of analysis, the comparison of the historical performances of national and international portfolios.

Comparisons of National and International Portfolios

In order to estimate the magnitude of gains from diversification within an IU, we compared the historical performances of two different types of national and international portfolios: those selected by a naive strategy and those selected according to the criterion of mean-variance efficiency.

The naive rule used to choose national portfolios was to invest equal amounts in each stock, creating a type of market portfolio. For the international portfolios the stocks from each country were weighted so that they comprised one-fourth of the total—equivalent to an equally weighted combination of the four single-market naive portfolios.

The performances of the naive portfolios for all three periods are reported in Table 5.

The four-country naive portfolio dominates all of the single-country naive portfolios with the exception of Colombia for 1963-1968 and Brazil for all three periods. Furthermore, the risk-return mix provided by the four-country

TABLE 5
QUARTERLY PERFORMANCES OF NAIVELY DIVERSIFIED PORTFOLIOS

		Dec. 1958-Dec. 1963	Dec. 1963-Dec. 1968	Dec. 1958-Dec. 1968
Colombia	—Mean	.0374	.0366	.0369
	—Std. Dev.	.100	.121	.110
Chile	—Mean	.0557	.0000	.0279
	—Std. Dev.	.212	.128	.175
Argentina	—Mean	.0540	−.0118	.0211
	—Std. Dev.	.243	.145	.200
Brazil	—Mean	.0853	.0733	.0793
	—Std. Dev.	.208	.229	.216
All Four	—Mean	.0581	.0245	.0413
	—Std. Dev.	.096	.089	.094

portfolio would appear to be more attractive to investors *ex ante* than the Brazilian portfolio for 1958-1963 and for the full ten years, 1958-1968. This can be demonstrated by computing a hypothetical risk-free borrowing-lending rate at which an investor would be indifferent between the two.[16]

For example, based on the results for 1958-1968, an investor whose risk-free rate did not exceed 1.5 per cent per quarter would prefer the return risk mix of the four-country portfolio to that of the Brazilian portfolio. This relationship is shown in Figure 1.[17]

A further test is obtained by comparing the performances of the four naive single-country portfolios and mean-variance efficient combinations, both *ex ante* and *ex post*, of these naive portfolios. The expectations for the *ex ante* selection were derived from the outcomes for 1958 and 1963 and the performance of the portfolios was measured over the 1963 to 1968 period. In Figure 2 it can be seen that the actual performances of the *ex ante* efficient international portfolios dominate all the naive portfolios except Brazil. Furthermore, again employing the concept of an indifference risk-free rate, investors would have to have risk-free lending opportunities in excess of 3.4 per cent quarterly before they would choose the Brazilian portfolio's mix of return and risk over that of the *ex ante* efficient portfolio with the highest return and risk.

The results of naive diversification and the *ex ante* efficient diversification taken together demonstrate that investors employing simple strategies would have gained by diversifying internationally. This result is striking. During the 1963 to 1968 period, the Brazilian portfolio, taken by itself, performed much better than any of the other national portfolios yet even Brazilian investors would have gained by diversifying internationally.[18, 19]

16. This analysis is similar to that used by Levy and Sarnat [1970] except that we compute the indifference risk-free rate rather than compare portfolios at several different risk-free rates.

17. The indifference rate is the point of intersection of the dotted line with the return axis in Figure 1.

18. Because of space limitations, we do not report the results of efficient portfolios of individual stocks. These results are similar to those reported in this paper.

19. These results are biased in favor of the Brazilian portfolios with their extremely high variability of return since they are based on the arithmetic mean return, itself a function of the
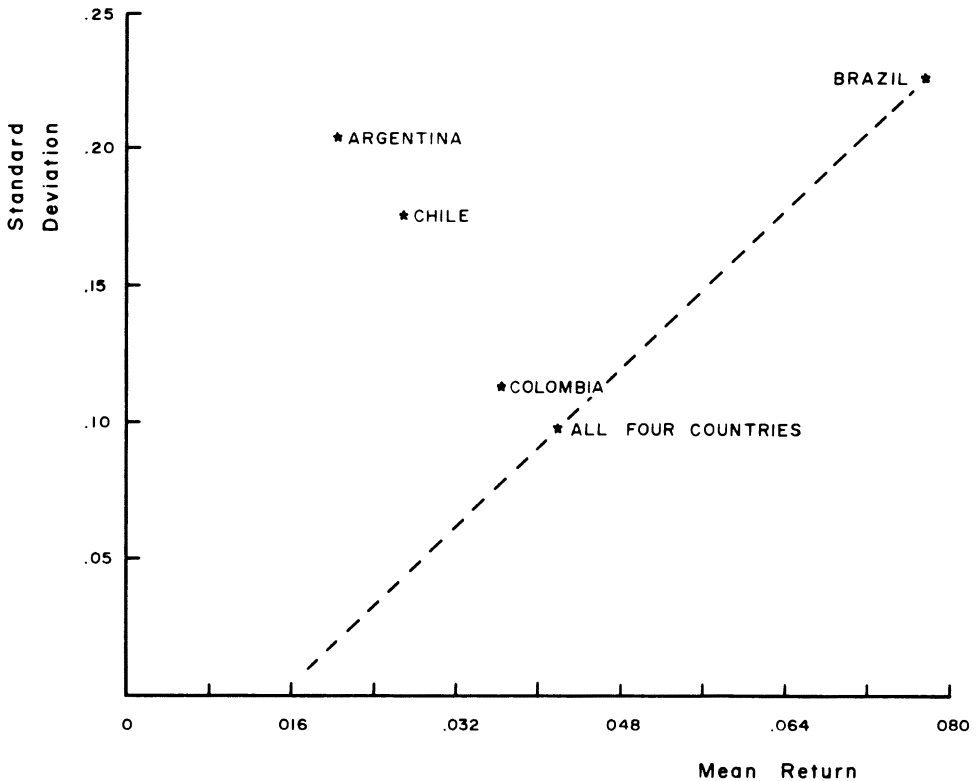
FIGURE 1
Quarterly Performances of Naively
Diversified Portfolios—1958-1968

The performances of the *ex post* efficient portfolios, shown in Figure 3 for the 1958-1968 period, dominate all single-country portfolios but Brazil and are clearly superior to Brazil for all reasonable risk-free rates.

The *ex post* portfolios represent the efficient combinations of risk and return given knowledge of the performances of individual stocks. They are compared with the performances of naive market portfolios (indexes) by both Grubel [1968] and Levy and Sarnat [1970] to determine gains from international diversification. In a strict sense, this is not a test of these gains because the performances of international portfolios selected on an *ex post* basis will at least equal those of the national portfolios and these outcomes could not be repeated by investors without perfect foresight. However, these comparisons do show the maximum gains obtainable through international diversification and, therefore, are useful additions to the analysis.[20]

standard deviation. Analyses using the mean of logarithms (analogous to geometric mean return) and the standard deviation of logs show a much greater advantage for international diversification. Unfortunately, the analytical devices of mean-variance efficiency and risk-free borrowing-lending do not apply to the logarithmic measures. See Lessard [1970] for the full set of results based on *both* arithmetic and logarithmic performance statistics.

20. To rely solely on these results, however, would be misleading.

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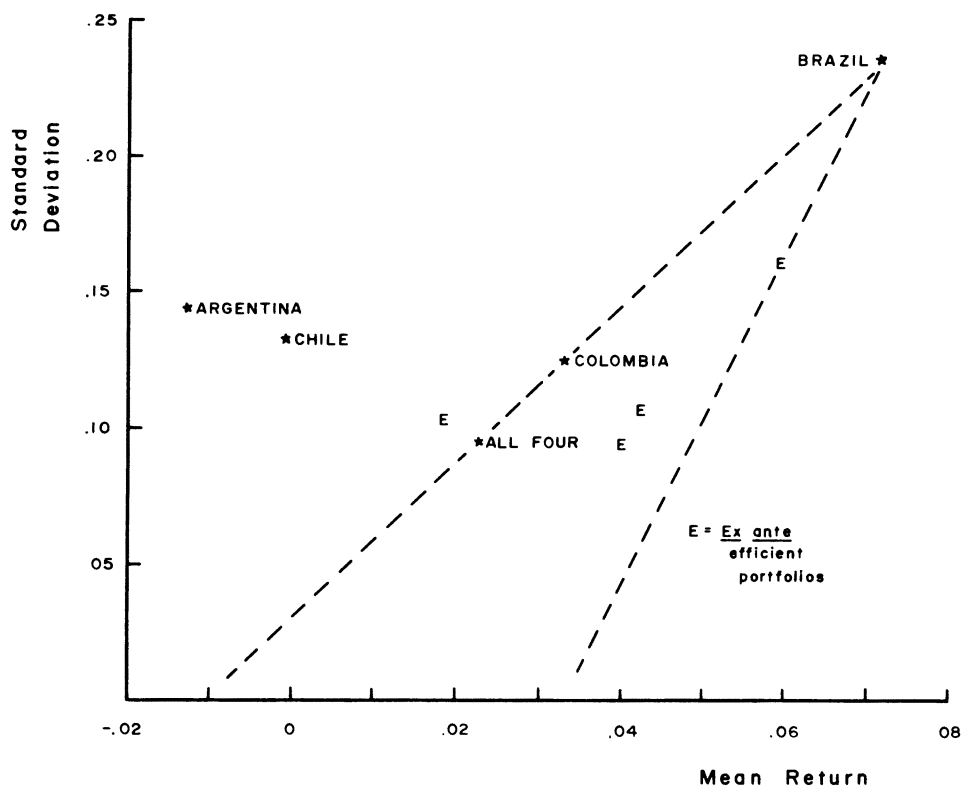
FIGURE 2
Performances of *Ex Ante* Efficient and
Naively Diversified Portfolios—1963-1968

Comparison with Returns on U.S. Stocks

An IU's success would depend in large part on the relative attractiveness of IU investments to those available in major world capital markets; therefore, the performance of the naive Latin American portfolio was compared with that of a representative index of returns on U.S. stocks (the Standard and Poor's 500).

The risk-return outcomes of investing equal amounts in the four Latin American countries compare favorably with those obtainable by investing in the U.S. as can be seen in Table 6.

TABLE 6
COMPARISON OF QUARTERLY RETURNS FROM LATIN AMERICAN AND U.S. PORTFOLIOS

	Dec. 1958– Dec. 1963	Dec. 1963– Dec. 1968	Dec. 1958– Dec. 1968
Naive Latin American Portfolio			
Mean	5.81	2.45	4.13
Standard Deviation	9.55	8.94	9.41
Standard & Poor's 500 Index (Including Dividends)			
Mean	2.64	2.57	2.61
Standard Deviation	7.29	5.32	6.38

For 1958 to 1963, the Latin American portfolio dominates the U.S. portfolio by a substantial margin. For 1963 to 1968, the outcome is reversed, but it should be remembered that the end of 1968 was an unusually high point for U.S. stock prices. For the full ten years, neither portfolio dominates, but the Latin American portfolio would be superior if the risk-free rate is above an indifference level of .35 per quarter.

IV. SUMMARY

Several sets of results have been obtained which show the superiority of multinational diversification within an IU over investment in single countries, even if the portfolios are constrained to consist of equal proportions of stocks from each country. Although all the results reflect the difficulties of examining historical data to estimate future outcomes, their general agreement and consistency over time support the inference that an IU would result in considerable gains.

The results of the multivariate analysis are especially important since they show that (1) substantial gains are likely to result from a wide range of investment strategies and that (2) the results are substantially the same for different time periods and can therefore be taken as predictions of the future with some confidence if interpreted in a general manner.

The four countries chosen for this study probably do not form a viable grouping for an IU.[21] However, the sample is sufficiently representative to show that, contrary to a common assumption, a great deal of diversification can take place among developing countries in a single geographical area.[22]

21. An investment fund for the Andean Pact countries which would be a type of IU is currently being studied by CORANFO, the regional development bank.

22. These results also suggest that a diversified portfolio of Latin American stocks would be attractive to non-Latin American investors. Grubel [1970] has suggested that mutual funds be used as a vehicle to channel foreign investments to developing countries. We concur with Grubel's suggestion although we consider new mechanisms to facilitate increased domestic or regional investment in developing countries to be of even greater importance.

APPENDIX A
PROPORTIONS OF VARIANCE EXPLAINED BY FIRST EIGHT VARIMAX FACTORS OF THE COVARIANCE MATRIX OF DOLLAR-EQUIVALENT RETURNS—DECEMBER 1958-DECEMBER 1968

Stock	–Industry	Factor No. 1	Factor No. 2	Factor No. 3	Factor No. 4	Factor No. 5	Factor No. 6	Factor No. 7	Factor No. 8
Mangle	–Tannin	.000	.001	.030	.410	.004	.041	.013	.015
Chocolates	–Food Prod	.021	.035	.015	.856	.011	.002	.006	.000
Cer. Andina	–Beverages	.001	.014	.001	.690	.007	.015	.032	.017
Bavaria	–Beverages	.001	.000	.030	.843	.013	.001	.006	.006
Cer. Union	–Beverages	.005	.001	.007	.747	.002	.003	.008	.000
Postobon	–Beverages	.005	.001	.003	.784	.002	.000	.010	.000
Coltobaco	–Tobacco	.000	.005	.022	.797	.004	.000	.006	.001
Celanese	–Textiles	.092	.000	.009	.534	.003	.008	.043	.009
Coltejer	–Textiles	.004	.001	.002	.849	.001	.003	.001	.001
Fabricato	–Textiles	.002	.000	.002	.849	.004	.000	.008	.001
Tejicondor	–Textiles	.036	.004	.011	.616	.009	.003	.003	.006
Conf. Col.	–Textiles	.006	.013	.002	.741	.000	.034	.012	.001
Codi Petr.	–Petroleum	.017	.000	.002	.840	.000	.001	.005	.001
C. Curtidos	–Leather	.000	.002	.002	.721	.000	.051	.001	.007
La Corona	–Leather	.002	.000	.000	.385	.006	.005	.001	.047
Cmto Argos	–Cement	.007	.017	.009	.765	.003	.005	.000	.001
Cmto Sampr	–Cement	.026	.006	.002	.703	.022	.001	.009	.006
Cmto Valle	–Cement	.048	.002	.004	.571	.011	.000	.004	.030
Eternit C.	–Bldg. Prod	.007	.003	.008	.574	.013	.035	.001	.118
Emp. Sid.	–Steel	.001	.000	.039	.718	-.013	.109	.001	.002
Avianca	–Air Trans	.002	.082	.000	.650	.003	.001	.010	.020
Bco Bogota	–Banking	.016	.004	.001	.807	.000	.002	.011	.005
Bco Colomb	–Banking	.008	.008	.017	.829	.002	.014	.002	.007
Bco Comer.	–Banking	.000	.047	.012	.754	.020	.000	.005	.000
Bco C. Ant.	–Banking	.013	.008	.005	.881	.008	.002	.007	.001
Bco Indust	–Banking	.000	.014	.000	.762	.001	.017	.008	.006
Colseguros	–Insurance	.001	.012	.021	.700	.001	.002	.008	.007
Surseguros	–Insurance	.023	.000	.008	.843	.012	.000	.003	.012
Inv. Bogota	–Real Est.	.003	.000	.001	.663	.026	.003	.003	.007
Cine Col.	–Entertain	.010	.004	.052	.783	.012	.001	.001	.002
Colcura	–Agricltre	.003	.002	.243	.018	.047	.011	.006	.034
Lag. Blanca	–Agricltre	.049	.000	.296	.137	.040	.003	.019	.006
Alcanglcha	–Mining	.004	.003	.119	.129	.089	.033	.041	.011
Disputada	–Mining	.002	.001	.434	.021	.017	.016	.013	.002
Cer. Unidas	–Beverages	.075	.000	.363	.014	.014	.001	.002	.015
Caupolican	–Textiles	.034	.001	.549	.018	.002	.000	.000	.171
Oveja Tome	–Textiles	.005	.083	.360	.040	.001	.007	.000	.030
Yarur	–Textiles	.163	.001	.431	.000	.003	.004	.015	.038
Papelycart	–Paper	.053	.000	.682	.002	.023	.003	.005	.000
Farmo Quim	–Chemicals	.052	.003	.436	.000	.005	.053	.010	.004
Copec	–Petroleum	.018	.007	.416	.047	.008	.000	.046	.116
Insa	–Tires, Etc.	.006	.007	.632	.008	.036	.028	.000	.000
Cristalras	–Glass Prd	.020	.006	.473	.016	.014	.025	.000	.002
Vidlirquen	–Glass Prd	.028	.003	.752	.008	.013	.003	.002	.042
Polpaico	–Cement	.005	.015	.648	.000	.000	.005	.017	.001
Loza Penco	–Bldg. Prod	.030	.030	.589	.002	.016	.000	.000	.024
Pizarreno	–Bldg. Prod	.033	.000	.547	.001	.019	.005	.001	.008
Volcan	–Manufact.	.074	.005	.443	.001	.007	.000	.003	.054
Cic	–Metal Prd	.024	.000	.469	.029	.069	.010	.002	.065
Elecmetal	–Metal Prd	.021	.014	.420	.007	.022	.287	.039	.006
Mademsa	–Metal Prd	.042	.045	.499	.007	.001	.005	.000	.003
Interocean	–Shipping	.008	.010	.574	.019	.042	.060	.006	.001
Vapores	–Shipping	.032	.000	.682	.050	.029	.002	.000	.001
Telefonos	–Phone sys	.012	.002	.506	.001	.000	.000	.000	.000
Gas Santgo	–Pub. Util.	.053	.004	.403	.000	.000	.001	.031	.031
Saavedra	–Ec. Sales	.037	.045	.306	.000	.065	.001	.000	.007
Tattersall	–Auctions	.15	.023	.393	.062	.000	.002	.027	.005
Bco Chile	–Banking	.041	.001	.530	.004	.077	.007	.036	.002
Bcoedwards	–Banking	.055	.002	.211	.016	.053	.000	.188	.006
Bcoespanel	–Banking	.027	.000	.189	.003	.026	.062	.001	.105

COLUMBIA

CHILE

APPENDIX A (*Continued*)

	Stock	−Industry	Factor No. 1	Factor No. 2	Factor No. 3	Factor No. 4	Factor No. 5	Factor No. 6	Factor No. 7	Factor No. 8
ARGENTINA	Azucarera	−Sugar	.532	.000	.090	.004	.008	.000	.049	.087
	San Martin	−Sugar	.619	.014	.050	.010	.024	.006	.008	.052
	Ledesma	−Sugar	.577	.001	.123	.007	.018	.005	.007	.031
	Iggam	−Construct	.672	.003	.008	.003	.001	.000	.010	.060
	Bagley	−Food Prod	.455	.004	.045	.073	.007	.002	.014	.001
	Mol. Plata	−Food Prod	.616	.045	.001	.000	.010	.022	.008	.034
	Saint hnos	−Food Prod	.713	.022	.039	.006	.000	.000	.000	.004
	G. Padilla	−Beverages	.605	.004	.071	.030	.005	.003	.011	.026
	Tab. Part.	−Tobacco	.576	.015	.088	.000	.004	.001	.000	.001
	Textil Oes	−Textiles	.587	.005	.081	.026	.031	.000	.040	.032
	Fiplasto	−Wood Prod	.594	.001	.044	.004	.039	.001	.074	.007
	Celulosa	−Paper	.689	.012	.030	.006	.022	.000	.000	.054
	Pap. Plata	−Paper	.573	.013	.040	.000	.000	.001	.065	.002
	Scholnick	−Paper	.489	.067	.064	.020	.010	.006	.010	.003
	Atanor	−Chemicals	.727	.004	.035	.007	.004	.006	.008	.029
	Jabon Fed.	−Soap	.784	.006	.005	.016	.005	.006	.000	.022
	Di Paolo	−Plastics	.590	.000	.121	.004	.000	.015	.001	.041
	Astra	−Petroleum	.567	.015	.009	.001	.000	.002	.011	.119
	Alpargatas	−Footwear	.785	.005	.001	.003	.001	.002	.034	.004
	Rigolleau	−Glass	.325	.006	.000	.014	.010	.038	.028	.049
	Acindar	−Steel	.828	.002	.022	.001	.008	.000	.004	.026
	Rosamet	−Steel	.730	.006	.009	.001	.024	.001	.007	.001
	Tamet	−Steel	.760	.001	.035	.005	.009	.000	.021	.007
	Cantabrica	−Machinery	.737	.025	.015	.038	.002	.019	.003	.060
	Siamdtella	−Appliance	.599	.001	.027	.004	.001	.000	.016	.036
	Ferrum	−Houseware	.578	.003	.017	.004	.028	.040	.001	.023
	Salvo	−Houseware	.548	.050	.003	.004	.005	.000	.001	.019
	Bco Italia	−Banking	.604	.001	.008	.001	.005	.000	.021	.029
	Bco Pop.A.	−Banking	.560	.045	.010	.003	.011	.008	.001	.078
	Tornquist	−Finance	.660	.026	.009	.007	.001	.002	.014	.003
BRAZIL	Carioca In	−Food Prod	.010	.331	.000	.079	.175	.014	.000	.021
	Kibon	−Food Prod	.012	.681	.018	.004	.000	.008	.011	.038
	Cer. Brahma	−Beverages	.001	.850	.000	.019	.008	.002	.007	.001
	Souza Culz	−Tobacco	.003	.636	.001	.052	.035	.022	.000	.001
	Amerfabril	−Textiles	.000	.014	.001	.068	.377	.001	.002	.022
	Nova Amer.	−Textiles	.017	.398	.010	.001	.020	.007	.324	.026
	Cmto Aratu	−Cement	.040	.587	.089	.000	.018	.009	.000	.000
	Ferrobras	−Iron Pipe	.009	.353	.010	.044	.054	.311	.000	.014
	Belgo-Min.	−Steel	.012	.754	.021	.001	.013	.000	.000	.001
	Mannesmann	−Steel	.003	.424	.000	.006	.012	.002	.000	.157
	White Mart	−Ind Gases	.016	.541	.017	.006	.004	.003	.065	.057
	Arno	−Appliance	.003	.459	.002	.082	.080	.007	.007	.036
	Willys	−Autos	.008	.226	.093	.003	.006	.005	.084	.013
	Docas Sant	−Docks	.009	.348	.019	.004	.029	.328	.033	.003
	Bras. E.E.	−Elecpower	.010	.111	.094	.015	.374	.018	.034	.040
	Brasroupas	−Apparel	.008	.462	.045	.022	.165	.000	.122	.005
	Lojas Amer	−Ret. Trade	.005	.768	.012	.000	.005	.001	.025	.001
	Mesbla	−Ret. Trade	.036	.329	.014	.052	.001	.002	.408	.001
	Bco Boavta	−Banking	.013	.460	.001	.005	.043	.014	.017	.050
	Bco Brasil	−Banking	.003	.647	.009	.004	.025	.006	.057	.013

Proportion of Total Variance Explained by Factor

All			.207	.159	.128	.083	.046	.029	.035	.027

Proportion of Total Variance Explained by Factor For—

Columbia			.013	.010	.010	*.687*	.007	.012	.008	.014
Chile			.039	.099	*.454*	.022	.024	.030	.016	.028
Argentina			*.621*	.013	.038	.009	.009	.006	.015	.034
Brazil			.012	*.422*	.029	.023	.101	.055	.071	.023

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