Do Short-Selling and Margin Trading Impact the Replication of Emerging Market Indexes?

Yes, for the decade of the nineties.

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Whether investors can mimic, replicate, or span international market indexes with domestically traded assets has became a perennial question. If one can replicate international market indexes with domestic assets, any reported benefits of international diversification are diminished or perhaps not there at all.

Errunza, Hogan, and Hung [1999] investigate the international diversification question by constructing portfolios of MNCs, country funds, and American Depository Receipts, studying the return correlations of domestic and international assets at the market index level, and conducting a mean-variance spanning test. They find that domestic assets span all seven of the developed countries and four of the nine emerging markets studied. They conclude that the need to hold international assets to obtain international diversification is fast disappearing.

Bekaert and Urias [1999] also look at the ability of domestic assets to span international indexes. They use the benchmark assets, FT-Actuaries U.S. index, U.K. index, Europe less U.K. index, and the Pacific index, to span emerging market test assets consisting of closed-end funds in the U.S. and the U.K., U.S. open-end funds, and U.S.-traded ADRs. They conclude that direct investment in their sample period almost always provided diversification benefits at least as great as the benefits from managed funds. For the 1993-1996 test period, closed-end funds, open-end funds, and ADRs provided statistically significant diversification benefits.

Bekaert and Harvey [2003] note that increasing integration of world and emerging markets has resulted in a small increase in the degree of correlation with the world market and a small decline in dividend yields. Recent changes in the economic, legal, accounting, and financial

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factors in emerging markets have helped to mitigate differences in capital markets.

Given increased correlation between markets and the relative positions of efficient frontiers, Saunders and Walter [2002] conclude that, although some frictions and barriers restrict full capital market integration, capital market integration has accelerated. They argue that the 10 to 15 largest emerging markets should no longer be considered a separate asset class from developed markets.

Bris, Goetzmann, and Zhu [2004] report the prevalence and implications of short sales in global markets. They note that 93% of the world's equity market capitalization is potentially shortable; that in some regions of the world it is difficult to obtain short positions; and that for some time periods an index of non-shortable securities is a major determinant for the global equity portfolio and increased tracking error even through the ADR market has developed. Markets that allow short sales and see active short sales participation have improved market efficiency and reduced global capital outflows. The only countries in our sample of 19 emerging countries where short-sales were allowed and were utilized were Mexico (1990-1999) and Thailand (1997-1999). No information was available concerning short sales in Nigeria.

We examine whether a portfolio of individual U.S. common stocks, ADRs, and country funds traded in the U.S. can replicate, mimic, or span emerging market indexes. Unlike other authors, we allow for short sales, 50% margin, and Regulation T requirements. The portfolios we establish are investable.

The first step is to establish portfolios of domestic securities that minimize the tracking error between the domestic portfolio returns and the emerging market index returns. The second step is to test the equivalence of the domestic portfolio and the merging market index through a mean-variance spanning test. The final step is to analyze the tracking error between the returns of the portfolio and the index.

Our results support the position that one can replicate emerging market indexes using domestically traded assets. This implies that the emerging and the developed capital markets are becoming more integrated; that emerging market equities are rapidly becoming similar to developed market equities; and that there are reduced benefits to international diversification and less of a need for direct investment to gain the benefits of investing in emerging market securities.

PORTFOLIO SELECTION MODELS

We approach the replication or spanning of emerging market equity indexes with U.S. traded securities using a variation of the portfolio optimization model in Rudd [1980] and Larsen and Resnick [1998]. This class of portfolio indexing models relies on formulating a quadratic programming model whose objective is to minimize the portfolio's residual uncertainty relative to emerging market equity index returns. The optimization is subject to the constraint that the indexed portfolio returns are equal to the emerging market equity index returns period by period.

We use two optimization models. Model 1 is used to determine the portfolio weights that satisfy a quadratic programming problem, defined as:

$$\text{Min}\,\hat{\sigma}_{e_{Ip}} = \sum_{i=1}^{NS}\sum_{j=1}^{NS} w_i w_j \hat{\sigma}_{e_i e_j} \quad \text{for } w_i,\ i = 1, 2, 3, \ldots, NS \tag{1}$$

$$\text{subject to:} \quad 1 \le \sum_{i=1}^{NS} |w_i| \le 2 \tag{1-A}$$

$$\sum_{i=1}^{NS} w_i \hat{\gamma}_i = \hat{\gamma}_{Ip} = 1 \tag{1-B}$$

$$\sum_{i=1}^{NS} w_i \hat{\delta}_i = \hat{\delta}_{Ip} = 0 \tag{1-C}$$

where $\hat{\delta}_p$, $\hat{\gamma}_i$, and $\tilde{e}_{i,t}$ are estimated by the regression:

$$\tilde{r}_{i,t} = \hat{\delta}_i + \hat{\gamma}_i \tilde{r}_{em,t} + \tilde{e}_{i,t} \quad \text{for } i = 1,\ 2,\ 3,\ \ldots,\ NS \tag{2}$$

and the variables are defined as:

$\hat{\sigma}^2_{\tilde{e}_{Ip}} \equiv$ variance of the index portfolio residual risk relative to an emerging market equity index returns;
$NS \equiv$ number of U.S. traded securities in the portfolio opportunity set;
$w_i \equiv$ proportion of wealth invested in security i;
$\hat{\sigma}_{e_i, e_j} \equiv$ variance/covariance matrix of residual risks, $\tilde{e}_{i,t}$, between each security, i, in the opportunity set;
$\hat{\gamma}_i \equiv$ regression slope between $\tilde{r}_{i,t}$ and $\tilde{r}_{em,t}$;
$\hat{\delta}_i \equiv$ regression intercept between $\tilde{r}_{i,t}$ and $\tilde{r}_{em,t}$;
$\tilde{r}_{i,t} \equiv$ monthly holding-period returns on each security, i, over time t;
$\tilde{r}_{em,t} \equiv$ monthly holding-period returns on each emerging market index, em, over time t; and
$\tilde{e}_{i,t} \equiv$ unsystematic monthly holding-period returns on each security, i, over time t relative to an emerging market equity index returns; these returns are distributed as $N(0, \hat{\sigma}^2_{\tilde{e}_i})$.

The objective of Model 1 [Equation (1)], is to minimize the tracking error variance between the indexed

portfolio returns and the emerging market index returns. Equation (1-A) allows for margin trading up to a 50% margin. Equation (1-B) constrains the elasticity of the indexed portfolio returns and the emerging market portfolio returns to unity. Equation (1-C) together with equation (1-B) constrains the average return on the indexed portfolio to be equal to the average return on the emerging market portfolio.

We modify Model 1 to create Model 2 by adding the constraint that the portfolio weights must be positive and margin trading is still allowed. That is, constraint (1-A) is modified to:

$$w_i \geq 0 \quad \text{for } i = 1,\ 2,\ 3,\ \ldots,\ NS$$

The indexed portfolio returns for Model 1 or Model 2 are defined by:

$$\sum_{i=1}^{NS} w_i \tilde{r}_{i,t} = \sum_{i=1}^{NS} w_i \delta_i + \left(\sum_{i=1}^{NS} w_i \gamma_i \right) \tilde{r}_{em,t} + \sum_{i=1}^{NS} w_i \tilde{e}_{i,t} \quad (3)$$

or:

$$\tilde{r}_{Ip,t} = \tilde{r}_{em,t} + \tilde{e}_{Ip,t}$$

since

$$\hat{\gamma}_{Ip} = \sigma_{r_{Ip}, r_{em}} / \sigma^2_{r_{em}} = 1$$

and

$$\hat{\delta}_{Ip} = \bar{r}_{Ip} - \bar{r}_{em} = 0$$

where $\bar{r}$ denotes the average holding-period return.

We investigate two variations of Models 1 and 2 that restrict trading on margin to judge their potential as optimization models for replicating emerging market indexes. That is, we replace Equation (1-A) with:[1]

$$\sum_{i=1}^{NS} |w_i| = 1$$

DATA

The data consist of monthly holding-period returns on 2,889 common stocks, ADRs, and country funds that are exchange-traded in the United States and 30 common stock indexes for 19 emerging markets from January 1990 through December 1999. The returns on the common stocks, ADRs, and country funds come from Compustat. The only restriction placed on the data is that a security have a complete time series of returns for the decade of the 1990s.

The monthly holding-period returns on the 30 emerging market common stock indexes come from Standard & Poor's Emerging Markets Data Base 2000. The holding-period returns on the emerging market indexes are stated in U.S. dollars.

METHODOLOGY

A statistical test of the hypothesis that the indexed portfolio models, Model 1 and Model 2, have replicated the emerging market index returns is developed using restricted and unrestricted least squares. The restrictions are linear equality restrictions. The error terms from the restricted and unrestricted least squares are used to form a statistic distributed as an F to test the validity of the restrictions.

The linear unrestricted least squares model used to test our hypothesis is:

$$\tilde{r}_{em,t} = \hat{\alpha}_{em} + \hat{\beta}_{em} \tilde{r}_{Ip,t} + \tilde{v}_{em,t} \quad (4)$$

where

$$\hat{\alpha}_{em} = \bar{r}_{em,t} - \hat{\beta}_{em}\ \bar{r}_{Ip,t}$$

and

$$\hat{\beta}_{em} = \sigma_{r_{em}, r_{Ip}} / \sigma^2_{r_{Ip}}$$

The linear restricted least squares model restricts $\hat{\alpha}_{em} = 0$ and $\hat{\beta}_{em} = 1$ in Equation (4) and results in $\tilde{r}_{em,t} = \tilde{r}_{Ip,t} + \tilde{u}_{em,t}$. The combination of this relationship and the relationship in Equation (3) implies that $\tilde{u}_{em,t} = -\tilde{e}_{Ip,t}$. That is, the test statistic evaluates the validity of Model 1 and Model 2 by comparing the negative of the error term in the portfolio selection models, $-\tilde{e}_{Ip,t}$, and the error term in the unrestricted least squares models in Equation (4), $\tilde{v}_{em,t}$.

If we cannot reject the null hypothesis that $\hat{\alpha}_{em} = 0$ and $\hat{\beta}_{em} = 1$ in Equation (4), the relations as follows hold:

1. If $\hat{\beta}_{em} = 1$, then $\hat{\beta}_{em} = \hat{\gamma}_{Ip}$ and $\sigma^2_{em} = \sigma^2_{Ip}$.
2. If $\hat{\alpha}_{em} = 0$, then $\bar{r}_{em,t} = \bar{r}_{Ip,t}$.

The implication is that 1) the mean and variance of the returns on the emerging market equities are statistically indistinguishable from the mean and variance of the returns on the indexed portfolio resulting from either portfolio selection Model 1 or Model 2; and 2) the correlation between the rates of return on the indexed and the emerging market portfolios is 1.0.[2]

The null hypothesis that $\hat{\alpha}_{em} = 0$ and $\hat{\beta}_{em} = 1$ in Equation (4) is tested using the test statistic:

$$ER = \frac{\left(\sum_{t=1}^{T} e^2_{Ip,t} - \sum_{t=1}^{T} v^2_{em,t} \right)}{\sum_{t=1}^{T} v^2_{em,t}} \times \frac{(T-k)}{m}$$

This follows the F distribution with m, $T - k$ degrees of freedom; T (= 60) is the number of observations on the error terms; k (= 2) is the number of parameters in the unrestricted regression; and m (= 2) is the number of linear restrictions. If the computed ER value is not statistically significant, we cannot reject the hypothesis that the linear restrictions, $\hat{\alpha}_{em} = 0$ and $\hat{\beta}_{em} = 1$, are valid (see Theil [1971]).

For the ER statistic to be distributed as F, the restricted and unrestricted linear errors, $-\tilde{e}_{lpt}$ and $\tilde{v}_{em,t}$, must be homoscedastic. Engle's [1982] ARCH test is used to determine if the error terms are homoscedastic.

RESULTS

Exhibits 1 and 2 provide the p-values from Engle's ARCH test on the residuals, $-\tilde{e}_{lpt}$ and $\tilde{v}_{em,t}$ (13 lags). In general, the exhibits indicate that the residuals are homoscedastic. In only 8 of the 120 tests conducted is the homoscedastic nature of the residuals rejected at the 5% level of significance.

Exhibit 3 summarizes the results of the portfolio replication model that allows for both margin trading and for the portfolio to include both long and short

EXHIBIT 1
Engle ARCH Test—Restricted and Unrestricted Errors for Model 1

		S&P Global Index		S&P Investable Index	
		p-Value		p-Value	
		90-94	95-99	90-94	95-99
Argentina	Restricted	0.99911	0.98617	0.99406	0.98199
	Unrestricted	0.99861	0.98822	0.99617	0.98359
Brazil	Restricted	0.07057	0.35972	0.57228	0.21902
	Unrestricted	0.01813	0.49156	0.43450	0.21539
Chile	Restricted	0.19168	0.27493	0.71368	0.72435
	Unrestricted	0.33058	0.19379	0.67489	0.61287
Colombia	Restricted	0.47652	0.23562	n. a.	n. a.
	Unrestricted	0.47614	0.24979	n. a.	n. a.
Greece	Restricted	0.74624	0.81428	0.73325	0.81422
	Unrestricted	0.74913	0.80398	0.73511	0.82988
India	Restricted	0.41030	0.84628	n. a.	n. a.
	Unrestricted	0.33499	0.82582	n. a.	n. a.
Indonesia	Restricted	0.77002	0.35773	n. a.	n. a.
	Unrestricted	0.60276	0.31526	n. a.	n. a.
Jordan	Restricted	0.60633	0.99578	0.58976	0.82652
	Unrestricted	0.50266	0.99499	0.72977	0.84824
Korea	Restricted	0.41120	0.14330	n. a.	n. a.
	Unrestricted	0.38956	0.14766	n. a.	n. a.
Malaysia	Restricted	0.99993	0.30907	0.95279	0.50483
	Unrestricted	0.99998	0.24782	0.96073	0.43410
Mexico	Restricted	1.00000	1.00000	0.68824	0.99927
	Unrestricted	1.00000	1.00000	0.61992	0.99868
Nigeria	Restricted	0.79045	0.30317	n. a.	n. a.
	Unrestricted	0.38834	0.13869	n. a.	n. a.
Pakistan	Restricted	0.77269	0.46572	n. a.	n. a.
	Unrestricted	0.81726	0.44450	n. a.	n. a.
Philippines	Restricted	0.64606	0.33874	0.93083	0.99994
	Unrestricted	0.58938	0.51141	0.94483	0.99988
Taiwan	Restricted	0.69910	1.00000	n. a.	n. a.
	Unrestricted	0.61758	1.00000	n. a.	n. a.
Thailand	Restricted	0.74893	0.20814	0.59177	0.68829
	Unrestricted	0.76357	0.20526	0.51151	0.74560
Turkey	Restricted	0.09372	0.61342	0.11664	0.60317
	Unrestricted	0.29890	0.59125	0.30788	0.58267
Venezuela	Restricted	0.58310	0.91396	0.48713	0.93526
	Unrestricted	0.64120	0.93530	0.92789	0.94380
Zimbabwe	Restricted	0.00323	0.14848	n. a.	n. a.
	Unrestricted	0.00287	0.24169	n. a.	n. a.

EXHIBIT 2
Engle ARCH Test—Restricted and Unrestricted Errors for Model 2

		S&P Global Index		S&P Investable Index	
		p-Value		p-Value	
		90-94	95-99	90-94	95-99
Argentina	Restricted	0.27725	0.75630	0.21815	0.76516
	Unrestricted	0.62681	0.57736	0.53809	0.62034
Brazil	Restricted	0.02760	0.57268	0.56319	0.74121
	Unrestricted	0.37207	0.92802	0.60046	0.92975
Chile	Restricted	0.74455	0.77672	0.74379	0.47194
	Unrestricted	0.64111	0.95319	0.25078	0.62363
Colombia	Restricted	0.34737	0.98183	n. a.	n. a.
	Unrestricted	0.87340	0.46271	n. a.	n. a.
Greece	Restricted	0.08545	0.47467	0.99985	0.57147
	Unrestricted	0.70368	0.48222	0.01156	0.68739
India	Restricted	0.98595	0.96649	n. a.	n. a.
	Unrestricted	0.91922	0.63136	n. a.	n. a.
Indonesia	Restricted	0.85148	0.74728	n. a.	n. a.
	Unrestricted	0.64997	0.74264	n. a.	n. a.
Jordan	Restricted	0.94085	0.93257	0.25586	0.92963
	Unrestricted	0.95127	0.66460	0.83218	0.50307
Korea	Restricted	0.03114	0.95257	n. a.	n. a.
	Unrestricted	0.96792	0.67059	n. a.	n. a.
Malaysia	Restricted	0.27601	0.90981	0.20969	0.72743
	Unrestricted	0.68373	0.66889	0.26781	0.67469
Mexico	Restricted	0.96251	0.82399	0.36602	0.76482
	Unrestricted	0.85659	0.71535	0.99404	0.57308
Nigeria	Restricted	0.77482	0.01225	n. a.	n. a.
	Unrestricted	0.56893	0.73865	n. a.	n. a.
Pakistan	Restricted	0.57696	0.96716	n. a.	n. a.
	Unrestricted	0.66833	0.41449	n. a.	n. a.
Philippines	Restricted	0.98782	0.77365	0.23736	0.81638
	Unrestricted	0.95488	0.32343	0.57916	0.45361
Taiwan	Restricted	0.00168	0.72703	n. a.	n. a.
	Unrestricted	0.53910	0.91194	n. a.	n. a.
Thailand	Restricted	0.53938	0.98283	0.21947	0.96668
	Unrestricted	0.56251	0.70036	0.98371	0.55735
Turkey	Restricted	0.99198	0.81824	0.99688	0.82398
	Unrestricted	0.92395	0.91563	0.89142	0.94996
Venezuela	Restricted	0.80939	0.78827	1.00000	0.54697
	Unrestricted	0.82679	0.85165	0.65377	0.89758
Zimbabwe	Restricted	0.66637	0.61292	n. a.	n. a.
	Unrestricted	0.14893	0.71529	n. a.	n. a.

EXHIBIT 3

Unrestricted Regression Estimates and Econometric Restrictions Test—Model 1

Panel A. S&P Global Index

Country	Period	Size	Intercept	Slope	ER-statistic
Argentina	1/1990-12/1994	42	0.116* (.490)	0.963* (.025)	1.130*
	1/1995-12/1999	56	0.009* (.109)	0.994* (.011)	0.165*
Brazil	1/1990-12/1994	34	0.223* (.629)	0.941* (.031)	1.810*
	1/1995-12/1999	48	0.013* (.382)	0.966* (.024)	1.000*
Chile	1/1990-12/1994	95	0.002* (.002)	1.000* (.000)	0.928*
	1/1995-12/1999	113	-0.002* (.003)	1.000* (.000)	0.599*
Colombia	1/1990-12/1994	60	0.007* (.069)	0.998* (.008)	0.050*
	1/1995-12/1999	114	-0.002* (.002)	1.000* (.000)	0.901*
Greece	1/1990-12/1994	59	-0.003* (.055)	0.999* (.004)	0.033*
	1/1995-12/1999	56	0.027* (.111)	0.993* (.011)	0.213*
India	1/1990-12/1994	60	0.008* (.095)	0.996* (.009)	0.117*
	1/1995-12/1999	109	-0.003* (.002)	1.000* (.000)	1.641*
Indonesia	1/1990-12/1994	51	0.026* (.273)	0.949* (.029)	1.570*
	1/1995-12/1999	38	0.036* (.605)	0.939* (.032)	1.897*
Jordan	1/1990-12/1994	103	0.001* (.002)	0.999* (.000)	0.929*
	1/1995-12/1999	89	-0.000* (.004)	1.000* (.001)	0.097*
Korea	1/1990-12/1994	67	0.000* (.047)	0.998* (.005)	0.040*
	1/1995-12/1999	57	0.000* (.114)	0.997* (.007)	0.077*
Malaysia	1/1990-12/1994	117	-0.000* (.002)	1.000* (.000)	1.419*
	1/1995-12/1999	50	-0.002* (.208)	0.988* (.014)	0.359*
Mexico	1/1990-12/1994	94	0.001* (.003)	1.000* (.000)	0.137*
	1/1995-12/1999	101	-0.004* (.005)	1.000* (.000)	0.312*
Nigeria	1/1990-12/1994	43	0.171* (.523)	0.995* (.030)	1.699*
	1/1995-12/1999	49	0.053* (.351)	0.952* (.028)	1.463*
Pakistan	1/1990-12/1994	50	0.069* (.208)	0.972* (.022)	0.860*
	1/1995-12/1999	58	-0.003* (.039)	0.999* (.003)	0.016*
Philippines	1/1990-12/1994	119	0.001* (.001)	1.000* (.000)	0.256*
	1/1995-12/1999	104	0.004* (.003)	1.000* (.000)	1.884*
Taiwan	1/1990-12/1994	49	0.015* (.273)	0.979* (.019)	0.622*
	1/1995-12/1999	109	-0.007* (.005)	1.000* (.001)	1.207*
Thailand	1/1990-12/1994	56	0.006* (.084)	0.996* (.009)	0.121*
	1/1995-12/1999	39	-0.019* (.316)	0.997* (.020)	0.683*
Turkey	1/1990-12/1994	40	0.067* (.865)	0.868 (.044)	4.388
	1/1995-12/1999	48	0.080* (.333)	0.981* (.018)	0.547*
Venezuela	1/1990-12/1994	44	0.263* (.565)	0.920* (.036)	2.503*
	1/1995-12/1999	47	0.048* (.378)	0.965* (.024)	1.047*
Zimbabwe	1/1990-12/1994	56	0.003* (.050)	0.999* (.005)	0.045*
	1/1995-12/1999	50	0.044* (.376)	0.944* (.030)	1.742*

Panel B. S&P Investable Index

Argentina	1/1990-12/1994	44	0.205* (.586)	0.949* (.029)	1.548*
	1/1995-12/1999	57	0.007* (.107)	0.993* (.011)	0.204*
Brazil	1/1990-12/1994	26	0.466* (.949)	0.909* (.038)	2.920*
	1/1995-12/1999	59	0.007* (.042)	1.000* (.003)	0.014*
Chile	1/1990-12/1994	88	0.000* (.001)	1.000* (.000)	0.059*
	1/1995-12/1999	102	-0.004* (.002)	1.000* (.000)	1.311*
Greece	1/1990-12/1994	55	0.003* (.102)	0.996* (.008)	0.120*
	1/1995-12/1999	56	0.028* (.119)	0.992* (.012)	0.245*
Jordan	1/1990-12/1994	125	-0.001* (.002)	1.000* (.000)	1.134*
	1/1995-12/1999	91	0.002* (.002)	1.000* (.000)	1.001*
Malaysia	1/1990-12/1994	115	-0.003* (.002)	1.000* (.000)	1.908*
	1/1995-12/1999	49	-0.002* (.220)	0.987* (.015)	0.395*
Mexico	1/1990-12/1994	69	-0.002* (.002)	1.000* (.000)	1.464*
	1/1995-12/1999	97	0.002* (.002)	1.000* (.000)	0.747*
Philippines	1/1990-12/1994	51	0.019* (.143)	0.991* (.012)	0.261*
	1/1995-12/1999	104	-0.008* (.004)	1.000* (.000)	2.147*
Thailand	1/1990-12/1994	59	0.003* (.056)	0.998* (.005)	0.055*
	1/1995-12/1999	41	-0.029* (.318)	0.974* (.021)	0.765*
Turkey	1/1990-12/1994	41	0.080* (.892)	0.863 (.045)	4.614
	1/1995-12/1999	48	0.079* (.334)	0.981* (.018)	0.560*
Venezuela	1/1990-12/1994	27	4.366 (2.101)	0.576 (.102)	10.337
	1/1995-12/1999	51	0.044* (.387)	0.964* (.025)	1.089*

Intercept *Intercept is not statistically different from 0.0 at an α level of 5%.
Slope *Slope is not statistically different from 1.0 at an α level of 5%.
ER-statistic *Econometric restrictions, $\hat{\alpha}_{cm} = 0$ and $\hat{\beta}_{cm} = 1$, cannot be rejected at an α level of 5%.

EXHIBIT 4

Unrestricted Regression Estimates and Econometric Restrictions Test—Model 2

Panel A. S&P Global Index

Country	Period	Size	Intercept	Slope	ER-statistic
Argentina	1/1990-12/1994	26	0.806* (1.212)	0.770 (.055)	8.643
	1/1995-12/1999	26	0.254* (.558)	0.815 (.051)	6.604
Brazil	1/1990-12/1994	15	0.966* (1.291)	0.750 (.057)	9.673
	1/1995-12/1999	25	0.123* (.488)	0.915 (.037)	2.705*
Chile	1/1990-12/1994	36	0.634* (.488)	0.815 (.051)	6.581
	1/1995-12/1999	31	0.021* (.869)	0.869 (.044)	4.353
Colombia	1/1990-12/1994	27	0.648* (.595)	0.853 (.047)	5.009
	1/1995-12/1999	35	-0.154* (.543)	0.771 (.055)	8.637
Greece	1/1990-12/1994	22	0.358 *(.859)	0.740 (.058)	10.198
	1/1995-12/1999	34	0.417* (.465)	0.871 (.044)	4.300
India	1/1990-12/1994	28	0.518* (.757)	0.732 (.058)	10.623
	1/1995-12/1999	30	0.093* (.478)	0.820 (.050)	6.375
Indonesia	1/1990-12/1994	23	0.153* (.705)	0.658 (.062)	15.107
	1/1995-12/1999	22	0.160* (1.267)	0.730 (.058)	10.700
Jordan	1/1990-12/1994	41	0.197* (.280)	0.798 (.053)	7.359
	1/1995-12/1999	31	0.208* (.280)	0.645 (.063)	15.982
Korea	1/1990-12/1994	19	0.059* (.555)	0.756 (.056)	9.369
	1/1995-12/1999	31	0.080* (.617)	0.922 (.035)	2.446*
Malaysia	1/1990-12/1994	34	0.286* (.442)	0.805 (.052)	7.010
	1/1995-12/1999	31	-0.005* (.609)	0.896 (.040)	3.371
Mexico	1/1990-12/1994	37	0.215* (.387)	0.904 (.039)	3.072*
	1/1995-12/1999	26	0.101* (.400)	0.923 (.035)	2.417*
Nigeria	1/1990-12/1994	25	0.967* (1.252)	0.691 (.061)	12.943
	1/1995-12/1999	22	0.717* (1.313)	0.349 (.063)	54.110
Pakistan	1/1990-12/1994	23	1.060* (.796)	0.576 (.065)	21.333
	1/1995-12/1999	29	-0.122* (.756)	0.774 (.055)	8.472
Philippines	1/1990-12/1994	25	0.210* (.473)	0.875 (.043)	4.156
	1/1995-12/1999	21	-0.055* (.464)	0.906 (.038)	3.015*
Taiwan	1/1990-12/1994	20	0.192* (1.005)	0.717 (.059)	11.454
	1/1995-12/1999	27	0.085* (.478)	0.844 (.048)	5.348
Thailand	1/1990-12/1994	36	0.271* (.487)	0.856 (.046)	4.774
	1/1995-12/1999	22	-0.155* (.812)	0.848 (.047)	5.185
Turkey	1/1990-12/1994	8	0.373* (2.024)	0.280 (.059)	74.64
	1/1995-12/1999	28	0.425* (.772)	0.899 (.040)	3.245
Venezuela	1/1990-12/1994	9	2.017* (1.522)	0.407 (.065)	42.182
	1/1995-12/1999	24	0.279* (.960)	0.776 (.055)	8.377
Zimbabwe	1/1990-12/1994	19	0.406* (.969)	0.473 (.066)	32.374
	1/1995-12/1999	35	0.169* (.718)	0.796 (.053)	7.441

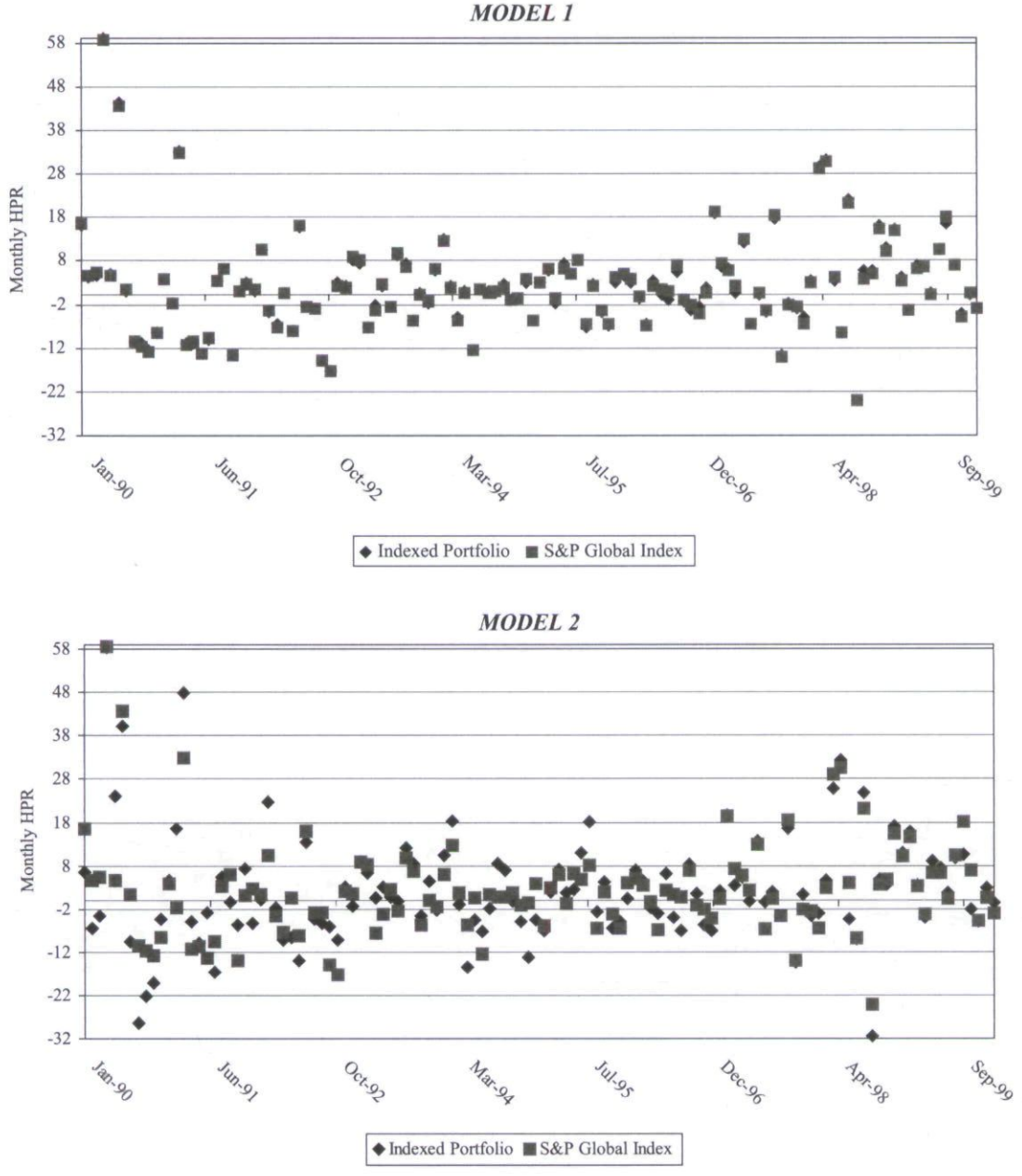
Panel B. S&P Investable Index

Argentina	1/1990-12/1994	23	0.880* (1.266)	0.762 (.056)	9.080
	1/1995-12/1999	28	0.261* (.566)	0.811 (.051)	6.773
Brazil	1/1990-12/1994	14	1.505* (1.706)	0.704 (.060)	12.286
	1/1995-12/1999	31	0.089* (.412)	0.940* (.031)	1.866*
Chile	1/1990-12/1994	17	1.323 (.679)	0.639 (.063)	16.380
	1/1995-12/1999	15	0.028* (.408)	0.826 (.050)	6.105
Greece	1/1990-12/1994	12	0.842* (1.317)	0.452 (.065)	35.097
	1/1995-12/1999	9	2.270 (1.048)	0.304 (.060)	66.321
Jordan	1/1990-12/1994	38	0.268* (.318)	0.769 (.055)	8.719
	1/1995-12/1999	37	0.295* (.296)	0.639 (.063)	16.390
Malaysia	1/1990-12/1994	33	0.319* (.468)	0.795 (.053)	7.494
	1/1995-12/1999	29	-0.007* (.640)	0.888 (.041)	3.661
Mexico	1/1990-12/1994	26	0.375* (.523)	0.838 (.048)	5.620
	1/1995-12/1999	20	0.095* (.380)	0.929 (.034)	2.201*
Philippines	1/1990-12/1994	27	0.328* (.649)	0.815 (.051)	6.564
	1/1995-12/1999	21	-0.071* (.474)	0.902 (.039)	3.138*
Thailand	1/1990-12/1994	18	0.429* (.645)	0.763 (.056)	9.020
	1/1995-12/1999	16	-0.270* (.983)	0.757 (.056)	9.298
Turkey	1/1990-12/1994	9	0.414* (2.045)	0.277 (.059)	75.663
	1/1995-12/1999	27	0.426* (.774)	0.899 (.040)	3.262
Venezuela	1/1990-12/1994	3	4.241* (2.422)	0.149 (.047)	161.821
	1/1995-12/1999	27	0.237* (.896)	0.807 (.052)	6.954

Intercept *Intercept is not statistically different from 0.0 at an α level of 5%.
Slope *Slope is not statistically different from 1.0 at an α level of 5%.
ER-statistic *Econometric restrictions, $\hat{\alpha}_{cm} = 0$ and $\hat{\beta}_{cm} = 1$, cannot be rejected at an α level of 5%.

EXHIBIT 5

Greece: Indexed Portfolio and S&P Global Index HPR versus Time



positions (Model 1). The decade is divided into two five-year periods to evaluate sensitivity of the results to the passage of time.

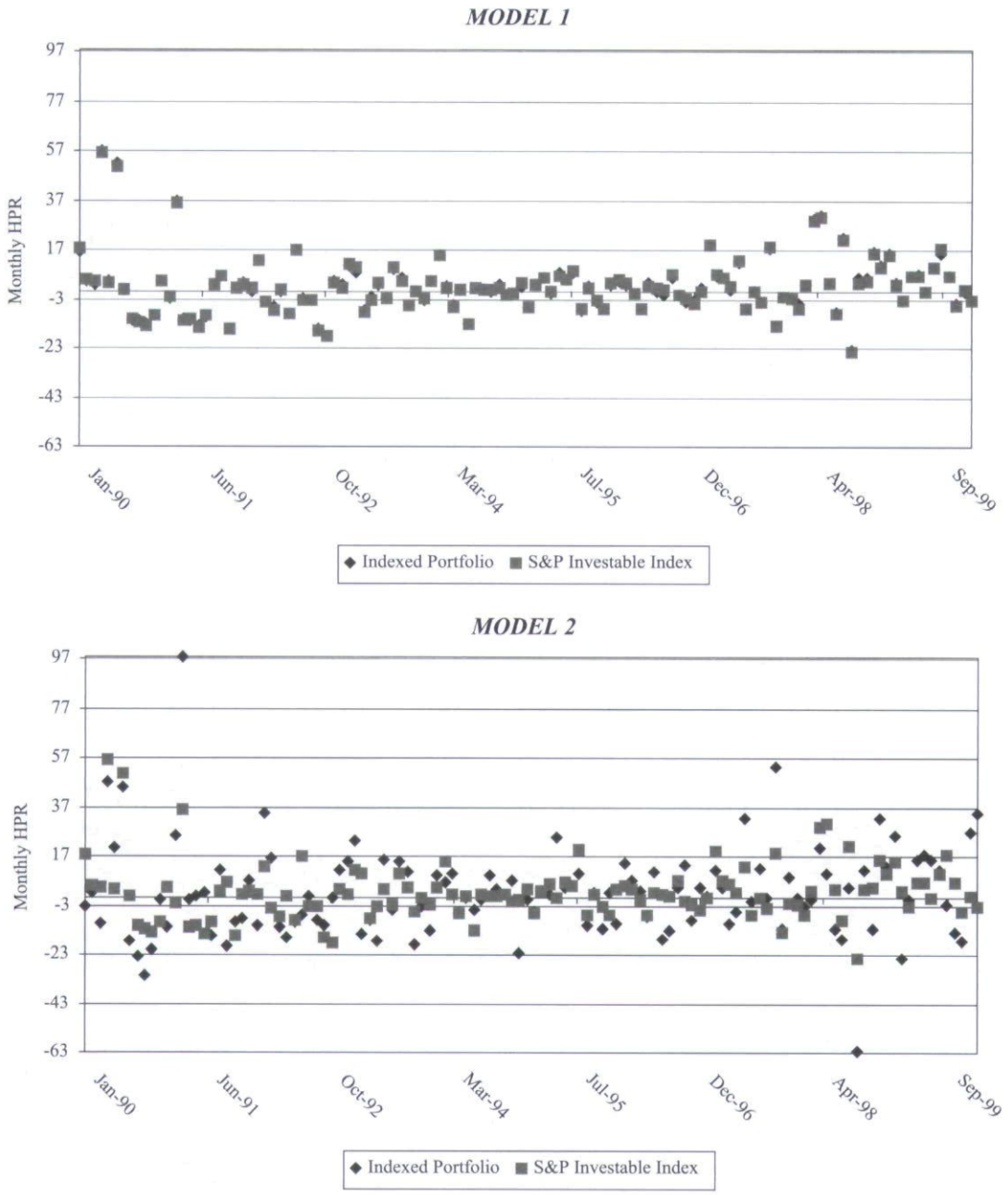
We report the size of each portfolio along with the intercept and slope of regression Equation (4). The last column reports the joint test statistic, *ER*, for the linear restrictions, $\hat{\alpha}_{em} = 0$ and $\hat{\beta}_{em} = 1$.

In 57 of the 60 tests the *ER* statistic could not be rejected or the emerging market assets were spanned by the domestic assets. There is no difference in the results between the two time periods.

Panel A shows the country global indexes of 19 emerging countries. Foreign investment is available through an investable index for the 11 countries in Panel B.

EXHIBIT 6

Greece: Indexed Portfolio and S&P Investable Index HPR versus Time



The investable index varies from the global index because some companies in emerging countries are not available for foreign investment.

Exhibit 4 summarizes the results of the portfolio replication model that allows margin trading but restricts the portfolio to long positions (Model 2). In this case, in 8 of the 60 tests the *ER* statistic could not be rejected or the emerging market assets are spanned by domestic assets. In other words, spanning is highly dependent on the ability to engage in short sales.

Exhibits 5 and 6 graph the performance of the replicating portfolios for Greece. Exhibit 5 compares the holding-period returns for the indexed portfolio and the S&P Global Index for Greece over the decade of the

1990s; the first graph shows the results for Model 1 and the second graph results for Model 2. Exhibit 6 compares the holding-period returns for the indexed portfolio and the S&P Investable Index for Greece.

We put forth Greece as representative of the general results; when short sales are allowed (Model 1), both the global and the investable index for Greece is spanned. In the absence of short sales (Model 2), neither global nor investable index could be spanned. In Exhibit 6, Model 1 tracks both the global index and the investable index very closely. The wider scatter indicates Model 2 tracks either index less well.

CONCLUSIONS

We conclude that investments in emerging market stocks can be replicated, or spanned, using U.S. traded securities if the investor can choose to use a portfolio allocation model that includes long positions, short sales, and margin trading. For these investors, emerging markets do not provide diversification benefits beyond the choices available in the U.S.

Portfolio managers who are restricted by law or policy from either short-selling securities or trading on margin (e.g., mutual funds) will find emerging market stocks provide a risk-return opportunity that cannot be replicated by trading only in U.S. securities. For these portfolio managers, an investment in emerging market stocks may be a way to construct a portfolio in a manner consistent with a portfolio allocation model that includes long positions, short sales, and margin trading in U.S. securities.

In general, investment in emerging market stocks can be replicated by a portfolio allocation model that includes long positions, short sales, and margin trading in U.S. traded securities.

ENDNOTES

[1]The empirical results for these two models are not reported because the results are problematic. Without the possibility of trading on margin, many of the portfolios constructed resulted in an infeasible solution due to the binding nature of the constraints. These portfolio models indicate that emerging markets provide unique risk-return characteristics. Portfolio selection models that restrict margin trading should not be considered as a good characterization of investment in emerging market equities.

[2]Larsen and Resnick [1998] show that this also implies that the correlation between the rates of return on the indexed portfolio and the emerging market portfolio is 1.0.

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