“The failure of BRIC equities as a diversifying agent for US investors: a note”

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The failure of BRIC equities as a diversifying agent for US investors: a note

Abstract

Investors widely assume that they enjoy risk reduction benefits whenever they hold securities whose returns are less than perfectly correlated. Because of their historically low correlation with US markets, equity shares in the emerging markets are alleged to have especially powerful diversification potential. In fact, however, the volatility of a two-security portfolio can only be reduced below that of the more stable component when the securities have a correlation coefficient less than the ratio of the two individual volatilities (with the larger in the denominator). A portfolio is most likely to fail to meet this criterion if it contains both stable and very volatile securities because the ratio of their standard deviations will be small. To illustrate this phenomenon, our paper focuses on a subset of the emerging markets, the so-called BRIC countries: Brazil, Russia, India, and China. When combined with a US portfolio, the higher volatility of the BRIC country indices results in a US investor finding no portfolio with a volatility less than that of a 100% domestic portfolio. For a resident of one of the BRIC countries, however, there are benefits to diversification across the BRIC markets.

Keywords: diversification, BRIC, risk reduction.
JEL Classification: G11, G14.

Introduction

The important role of security correlation and the merits of international investments are well known in portfolio construction. (See, for instance, Grubel (1968) and Solnik (1974)). It is less well known, however, that for an investor with an average risk portfolio the addition of *highly volatile* securities, such as those from emerging markets, may provide *no* risk reduction in the Markowitz (1952) sense even when they have a low correlation with the portfolio.

It is often possible to combine securities into a portfolio such that the minimum variance portfolio is less risky than any of the individual portfolio components. This risk reduction is generally the chief objective of diversification. This paper will show that adding a volatile security to a relatively stable portfolio may not accomplish this goal.

While this result holds true within any asset class and in any part of the world, we use market return data from the so-called BRIC countries (Brazil, Russia, India, and China) to illustrate the point. We investigate the extent of the reduction in portfolio standard deviation these equity investments might provide to a US investor holding a portfolio similar to the S&P 500 index.

Our results show that while investments in the BRIC country indices may be attractive for their potential returns, their risk-reduction characteristics may be less than expected.

1. Prior research

The work of Markowitz clearly shows the importance of return correlation in the construction of efficient portfolios. In the simple two-security case, there are three contributions to portfolio variance: variance from the first security, variance from the second, and a third contribution from the joint behavior of the two securities. See equation (1).

$$\sigma_p^2 = x_A^2\sigma_A^2 + x_B^2\sigma_B^2 + 2x_A x_B \rho_{AB}\sigma_A\sigma_B, \qquad (1)$$

where x_i = percentage invested in security i; σ_i = standard deviation of returns on security i; ρ_{ab} = return correlation between securities A and B.

Textbooks typically illustrate the importance of this with a diagram such as Figure 1. Point C, with its higher expected return and lower risk, clearly dominates Point B.

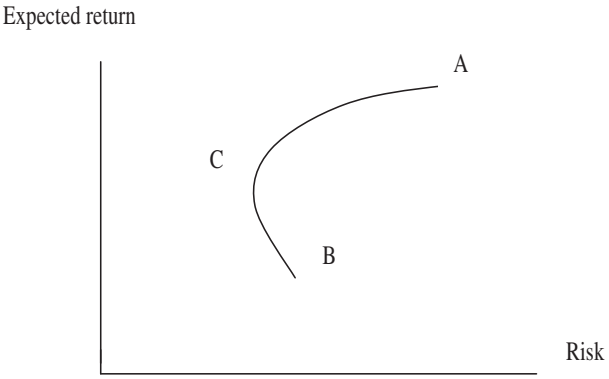

Fig. 1. Portfolio variance

What is less familiar, however, is that in certain situations the two-security plot of Figure 1 does not extend to the left of the lower-risk security. That is, two securities can be less than perfectly correlated, but it might not be possible to combine them in such a way that the portfolio risk is less than the risk of the less-volatile security. Figure 2 illustrates this. No combination of Securities A and B results in a portfolio risk less than that of Security B.

To our knowledge, only one prior published paper has dealt with this subject. Etebari and Rad (1995) provide a mathematical proof that the variance of point C (the minimum variance portfolio in Figure 1) will only be less than the variance of point B if the return correlation between B and C is less than the ratio of their standard deviations (with the larger standard deviation in the denominator). Equation (2) shows the required relationship.

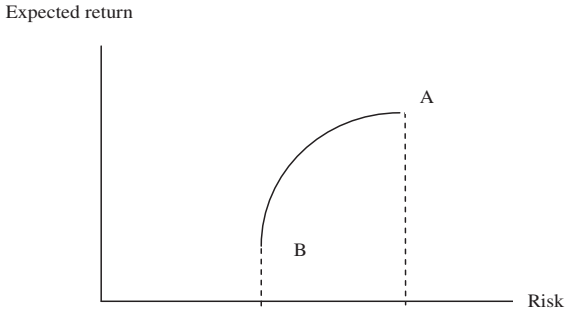

Fig. 2. Portfolio variance

$$\sigma_C^2 < \sigma_B^2 \text{ only if } \rho_{AB} < \frac{\sigma_A}{\sigma_B}, \text{ with } \sigma_A < \sigma_B. \quad (2)$$

Note that this condition is most likely to be violated when the two securities have very different levels of volatility. Two securities with return standard deviations of 0.10 and 0.50, for instance, would have to have a return correlation below 0.20 in order to be combined in a portfolio with a subsequent volatility less than 0.10. In contrast, two securities with identical volatilities would virtually always result in portfolio variance less than the individual securities.

To see an example of this, suppose a portfolio currently has only one holding, Security 1, with standard deviation of 0.20. Two other investments, each with a standard deviation of 0.40, are under consideration for inclusion in the portfolio. Security 2 and Security 1 have a correlation coefficient of 0.30, while Security 3 and Security 1 have a correlation coefficient of 0.60.

With two securities, the minimum variance portfolio comes from taking the first derivative of equation (1), setting it equal to zero, and solving for the two proportions x_A and x_B. Equation (3) solves for the proportion in security A; because this is a two-security portfolio, the proportion in the second security is one minus this amount: $x_B = 1 - x_A$.

$$x_A = \frac{\sigma_B^2 - \sigma_A \sigma_B \rho_{AB}}{\sigma_A^2 + \sigma_B^2 - 2\sigma_A \sigma_B \rho_{AB}}. \quad (3)$$

Equation (4) determines the minimum variance these proportions would produce.

$$\sigma_{\min}^2 = \frac{\sigma_B(\sigma_B - \rho_{AB}\sigma_A)}{\sigma_B(\sigma_B - \rho_{AB}\sigma_A) + \sigma_A(\sigma_A - \rho_{AB}\sigma_B)}. \quad (4)$$

In this example, the minimum variance portfolio of Security 1 and Security 2 is 89.47% for Security 1 and 10.53% for Security 2, with a variance of 0.0383 and a standard deviation of 0.1957. Note that the portfolio standard deviation of 0.1957 is less than 0.20, the lowest of the individual security standard deviations. The minimum variance portfolio of Security 1 and Security 3 is 100% for Security 1 and 0% for Security 3, with a variance of 0.0400 and a standard deviation of 0.2000. In this case, the minimum variance portfolio is a 100% investment in the least risky security; there are no diversification benefits. Securities 1 and 2 have a correlation coefficient less than the critical ratio of their standard deviations: $0.30 < \frac{0.20}{0.40}$. This is not true for Securities 1 and 3: $0.60 > \frac{0.20}{0.40}$, so total risk cannot be reduced below that of the least risky security.

2. Methodology

This study assumes the perspective of a passive, risk averse, US-based investor. There is good evidence that globally security correlations are increasing, which means that everything else being equal risk reducing opportunities are harder to find. Investments from the emerging markets allegedly offer diversification opportunities superior to those from more developed markets. In particular, the BRIC countries (Brazil, Russia, India, and China) are touted as effective diversifying agents.

Given the higher volatility of security returns in these markets, it is possible that for a US investor the investment appeal of BRIC investments will be predominantly from inefficient pricing rather than from risk reduction, because the condition in equation 2 may not be true for them. Our intent in this study is to see if the criterion shown in equation (2), i.e. $\rho_{AB} < \frac{\sigma_A}{\sigma_B}$, is met for various combinations of US and BRIC investments.

To test this, we gather country indices and calculate monthly returns, their variance and standard deviation, and the correlation between the indices. We account for exchange rate movements by multiplying each index holding period return by the exchange rate return, as shown in Equation (5).

Exchange rate adjusted country index return =

$$\left[1 + \frac{I_{t+1} - I_t}{I_t}\right] x \left[1 + \frac{E_{t+1} - E_t}{E_t}\right] - 1, \quad (5)$$

where I_t represents the country index at time t, and E_t represents the exchange rate at time t, measured as US dollars per unit of foreign currency.

We calculate minimum variance portfolio combinations, and then check to see if portfolio variance for a US investor can be reduced by holding a market index in one or more of the BRIC countries in addition to the US index.

3. Data and summary statistics

Table 1 provides descriptive data about the country indices. We investigate the period of 1997-2008, and the sub periods of 1997-2002 and 2003-2008[1]. We calculated monthly returns and the average annual return for the entire eleven-year (132 month) period and the two 5 ½ year (66 month) periods. Monthly returns were calculated using opening values of the indices[2] on the first business day of the month.

Table 1. Country equity indices

Country	Index	Description (year begun)	# of components
US	S&P 500	Capitalization weighted (1923)	500
Brazil	Bovespa	Capitalization weighted (1968)	379
Russia	Moscow Times index	Capitalization weighted (1994)	50
India	Sensex	Capitalization weighted (1978)	30
China	Hangseng Index	Capitalization weighted (1969)	33

To check the critical relationship in Equation (2) we require standard deviations of the country index returns and correlations among the country returns. These values appear in Tables 2 and 3.

Table 2. Monthly standard deviation of the country index

Country	1997-2002	2003-2008	1997-2008
US	5.36%	2.87%	4.29%
Brazil	12.16%	6.35%	9.67%
Russia	24.52%	8.00%	18.21%
India	7.51%	7.35%	7.46%
China	9.77%	5.55%	7.96%

Table 3. Correlation matrix*

Panel A. 1997-2002					
	US	Brazil	Russia	India	China
US	1.0				
Brazil	0.5754	1.0			
Russia	0.3087	0.2636	1.0		
India	0.3475	0.4138	0.0860	1.0	
China	0.6257	0.4723	0.4414	0.2601	1.0
Panel B. 2003-2008					
	US	Brazil	Russia	India	China
US	1.0				
Brazil	0.5832	1.0			
Russia	0.2502	0.2843	1.0		
India	0.5725	0.5375	0.3717	1.0	
China	0.6230	0.5343	0.2555	0.6268	1.0
Panel C. 1997-2008					
	US	Brazil	Russia	India	China
US	1.0				
Brazil	0.5743	1.0			
Russia	0.2903	0.2643	1.0		
India	0.4109	0.4290	0.1290	1.0	
China	0.6261	0.4979	0.3930	0.3862	1.0

Note: * exchange rate adjusted index returns.

4. Results

A. US investor. The critical statistics for this research are in Table 4. Here we compare the ratio of the standard deviations to the correlation coefficient to see if the relationship in Equation (2) holds. In the table, the "critical ratio" is $\frac{\sigma_{US}}{\sigma_{country}}$ because the BRIC country standard deviation is larger than the US standard deviation in every instance. In the first subperiod, only India has a correlation with the US less than the critical value, and in the second subperiod, it is only Russia. For a US investor, none of the four BRIC country indices provides risk reduction for both subperiods and the entire eleven-year period.

Table 4. Critical ratio comparison

	1997-2002		2003-2008		1997-2008	
	Correlation with US	Critical ratio	Correlation with US	Critical ratio	Correlation with US	Critical ratio
Brazil	0.5754	0.4411	0.5832	0.4519	0.5742	0.4439
Russia	0.3087	0.2188	0.2502	0.3590	0.2903	0.2357
India	0.3475	0.7140	0.5725	0.3905	0.4109	0.5753
China	0.6257	0.5488	0.6230	0.5177	0.6261	0.5390

Note: Correlations in bold provide diversification benefits for a US investor.

In addition to investigating a two-security portfolio comprised of the US and one other country, we also investigate the minimum variance portfolio for a security universe comprised of the US and all four of the BRIC indices. If portfolio weights are non-negative we found that for the entire period the portfolio variance still was minimized by holding only two securities, the US (88.98) and India (11.02%), as Table 5 shows.

[1] In our analysis the year begins July 1 and ends June 30; for example, year 1997 begins July 97 and ends June 98.
[2] The data came from the Internet: http://finance.yahoo.com/intlindices

Table 5. Minimum variance portfolios

	1997-2002	2003-2008	1997-2008
Brazil			
Russia		95.89% US 4.11% Russia	
India	74.18% US 25.82% India		88.98% US 11.02% India
China			

Note: Minimum variance portfolio: 51.5% India, 42.9% China, 5.6% Brazil, 0% Russia.

B. BRIC investor. It is noteworthy that while a US investor does not enjoy much risk reduction through BRIC investment, a BRIC-only investor finds substantial attraction in multiple country holdings. Table 6 shows that for the entire examination period an investor in Brazil, Russia, India, or China would benefit from holding one or more of the other BRIC country indices.

Table 6. BRIC-only critical ratio comparison 1997-2008

Countries	Correlation	Critical ratio
Brazil/Russia	**0.2643**	0.5310
Brazil/India	**0.4290**	0.7715
Brazil/China	**0.4979**	0.8235
Russia/India	**0.1290**	0.4096
Russia/China	**0.3930**	0.4372
India/China	**0.3862**	0.9369

Note: Correlations in bold provide diversification benefits.

Conclusion

While emerging market investments have a place in many portfolios and can contribute to expected return, investors should not assume that their inclusion reduces total portfolio risk. Their generally higher volatility means that when added to a much more stable portfolio, their attraction may be limited to return enhancement, with no potential for reducing portfolio risk below that of the original portfolio. When portfolio components are of generally similar total risk, pairwise ratios of their standard deviations will be high and normally greater than their return correlation, so the portfolio will enjoy risk reduction from the diversification.

We used equity investments in the BRIC countries to illustrate the phenomenon, but these results can be generalized to any asset class and any region of the world.

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