Global Portfolio Diversification with Emerging Stock Markets

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Abstract

Because of their low correlation with each other and with developed stock markets, emerging stock markets are generally mentioned as attractive portfolio diversification prospects for global investors. In this paper, we use the Principal Components Analysis (PCA) method to study the global portfolio diversification opportunities for the investors of seven developed stock markets in twenty emerging stock markets with data for the January 1, 2003-January 1, 2014 period.

Keywords: Global Portfolio Diversification, Emerging Stock Markets, Correlation of National Stock Markets, Principal Components Analysis, Factor Loadings of Principal Components

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1. Introduction

Studying the co-movements of global stock markets has been a popular research topic in finance [see, e.g., Makridakis and Wheelwright (1974); Philippatos et al. (1983); Meric and Meric (1996); Meric et al. (2001)]. Low correlation between national stock markets is often presented as evidence in support of the benefit of global portfolio diversification [see, e.g., Levy and Sarnat (1970), Solnik (1974), Lessard (1976), Watson (1978), Meric and Meric (1989, 2004), and Meric et al. (2011)]. Because of their low correlation with each other and with developed stock markets, emerging stock markets can provide substantial portfolio diversification benefit to global investors [see, e.g., DeFusco et al. (1995) and Ratner and Leal (1996)]. However, global portfolio diversification opportunities with emerging stock markets have not been sufficiently studied. In this paper, we study this issue with a sample of seven developed and twenty emerging stock markets with data for the January 1, 2003-January 1, 2014 period.

2. Emerging Markets[1]

According to the World Bank, the emerging markets can be divided into six regions: East Asia & Pacific, Europe & Central Asia, Latin American & Caribbean, Middle East & North Africa, South Asia, and Sub-Saharan Africa. In Table 1, we compare the descriptive statistics of these six emerging market regions with the world average.

We can obtain the following observations from Table 1:

Observation 1: East Asia and Pacific is the most important region. Its GDP growth rate 7.1% is the highest among all the regions, and is also higher than the world average (2.2%). This region accounts for 15% of the world's GDP and 28% of the world's population.

Observation 2: Latin America & Caribbean is the richest region. Its GDP per capita (US$ 9,536) is the highest among all the regions, and is very close to the world average (US$ 10,584). There is potential to increase the trade percentage of the GDP for this region.

Observation 3: South Asia and Sub-Saharan Africa are the poorest regions. Their GDP per capita is less than 20% of the world average. However, the bright side for these regions is that they are experiencing higher GDP growth rate than the world average.

3. Data And Methodology

The weekly stock market index returns used in the study are computed with the MSCI global stock market indices downloaded from the DataStream database for the January 1, 2003-January 1, 2014 period. The study includes the following seven major developed stock markets: US, Canada, Germany, UK, France, Japan, and Australia. The following twenty emerging stock markets are included in the study: Argentina, Brazil, Chile, China, Colombia, Egypt, India, Indonesia, Jordan, Malaysia, Mexico, Morocco, Pakistan, Peru, Philippines, Russia, South Africa, South Korea, Thailand, and Turkey.

Table 1: Descriptive Statistics of Emerging Markets: 2013 (Using data from the World Bank)

	GDP (in trillion US$)	GDP Growth (annual %)	GDP per Capita (in US$)	Population (in million)	Population Growth (in %)	Trade (% of GDP)
East Asia & Pacific (24 countries)	11.41	7.1	5,536	2,006	0.7	61
Europe & Central Asia (20 countries)	1.984	3.6	7,087	272	0.7	74
Latin America & Caribbean (26 countries)	5.655	2.4	9,536	588	1.1	47
Middle East & North Africa (13 countries)	1.49	-0.4	3,460	345	1.7	73
South Asia (8 countries)	2.355	5.2	1,474	1,671	1.3	51
Sub-Saharan Africa (47 countries)	1.591	3.9	1,615	936	2.7	65
World	**74.91**	**2.2**	**10,584**	**7,125**	**1.2**	**61**

Principal Components Analysis (PCA) is a statistical technique widely used in empirical studies to analyze the contemporaneous co-movements of global stock markets. A detailed discussion of the technique can be found in Mardia et al. (1979) and Marascuilo and Levin (1983). The PCA technique clusters global markets with similar movement patterns in the same principal component. Stock markets with high factor loadings in the same principal component are highly correlated and can provide limited portfolio diversification benefit. Global investors can maximize the benefit of portfolio diversification by choosing stock markets with high factor loadings in different principal components.

Makridakis and Wheelwright (1974), Philippatos, Christofi, and Christofi (1983), and Meric and Meric (1989) have made the use of the PCA multivariate technique popular in studying the contemporaneous co-movements of national stock markets. We use the PCA technique in this paper to study

[1] The authors acknowledge the contribution of Dr. Yunxıa (Peter) Zhu to this section.

the co-movements of seven developed and twenty emerging global stock markets with data for the January 1,2003-January 1, 2014 period.

4. Principal Components Analysis Method

Multivariate analysis often starts out with data involving a substantial number of correlated variables. The main purpose of Principal Component Analysis (PCA) is to reduce a set of observed variables into a smaller set of uncorrelated artificial variables called principal components, with minimal loss of information. The resulting principal components can then be used in subsequent analyses.

PCA is a mathematics procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components. The number of principal components is less than or equal to the number of original variables. This transformation is defined in such a way that the first principal component has the largest possible variance (that is, it accounts for as much of the variability in the data set as possible), and each succeeding principal component in turn has the highest variance possible under the constraint that it is orthogonal to (i.e., uncorrelated with) the preceding components.

The principal components are orthogonal because they are the eigenvectors of the covariance matrix. That is, the covariance matrix of these principal components is a diagonal matrix in which the entries outside the main diagonal are all zeros. The diagonal values of the covariance matrix of these principal components are called eigenvalues and they are put in a descending order. These eigenvalues are the variances of all the principal components (new artificial variables).

Listed below are the steps for performing a principal component analysis, which we use in the next section of the paper to analyze the co-movements of the twenty-seven national stock markets included in the study.

1. Take the whole dataset consisting of *n*-dimensional samples and find the covariance matrix of the data set
2. Compute eigenvectors and corresponding eigenvalues
3. Sort the eigenvectors by decreasing eigenvalues
4. Use the first *m*-eigenvectors ($m < n$) to transform the samples onto the new subspace.

5. Empirical Findings

To determine the principal components of the stock markets with similar contemporaneous movement patterns, the covariance matrix of the weekly index returns of the twenty-seven global stock markets is used as input in the SPSS/PCA computer program. The Varimax rotation is employed to maximize the factor loadings of the stock markets in each principal component with similar movement patterns. Using Kaiser's significance rule, statistically significant principal components with eigenvalues greater than unity are retained for analysis.

The analysis yielded three statistically significant principal components. The factor loadings of the three principal components are presented in Table 2.

Table 2: Principle Components Analysis: January 1, 2003-January 1, 2013

Stock Markets	P.C. #1	P.C. #2	P.C. #3
France	**0.862**		
Canada	**0.853**		
UK	**0.848**		
US	**0.847**		
Germany	**0.846**		
Brazil	**0.789**		
South Africa	**0.782**		
Mexico	**0.745**		
Peru	**0.693**		
Australia	**0.686**	*0.516*	
Russia	**0.662**		
Chile	**0.633**		
Argentina	**0.587**		
Turkey	**0.521**	*0.443*	
Colombia	**0.487**		
Indonesia		**0.757**	
Philippines		**0.732**	
Malaysia		**0.725**	
Thailand		**0.708**	
South Korea	*0.413*	**0.687**	
China	*0.453*	**0.680**	
India	*0.422*	**0.648**	
Japan	*0.410*	**0.517**	
Jordan			**0.683**
Morocco			**0.629**
Egypt			**0.591**
Pakistan			**0.326**
Variance Explained	**34.34%**	**20.92%**	**8.34%**
Cum. Variance Explained	**34.34%**	**55.26%**	**63.6%**

The factor loadings of the stock markets with the highest factor loading in each principal component are shown in dark font. If a stock market also has a high factor loading in another principle component, it is shown in italics in light font.

The first principal component explains 34.34 percent of the total variation in the original data matrix. All developed stock markets, except the Japanese stock market, have their highest factor loadings in this principal component. These stock markets are highly correlated and investing in these stock markets would provide only a minimal global portfolio diversification benefit to investors. Investors who invest in these stock markets would maximize the benefits of global portfolio diversification by investing in the stock markets with high factor loadings in the other two principal components such as the Indonesian, Philippine, Malaysian, and Thai stock markets in the second principal component and the Jordanian, Moroccan, Egyptian, and Pakistani stock markets in the third principal component.

Although they have their highest factor loadings in the first principal component, the Australian and Turkish stock markets also have high factor loadings in the second principal component. Therefore, the investors in the Australian and Turkish stock markets can have limited portfolio diversification benefit if they invest in the stock markets with high factor loadings in the second principal component. However, they can obtain significant portfolio diversification benefit by investing in the stock markets with high factor loadings in the third principal component.

The second principal component explains 20.92 percent of the total variation in the original data matrix and it is dominated by Asian stock markets. These stock markets are highly correlated and investing in these stock markets would provide minimal global portfolio diversification benefit to investors. Global investors who invest in the Indonesian, Philippine, Malaysian, and Thai stock markets, which have their highest factor loadings in the second principal component, can maximize their global portfolio diversification benefits by investing in the stock markets with high factor loadings in the first and third principal components.

Although they have their highest factor loadings in the second principal component, the South Korean, Chinese, Indian, and Japanese stock markets also have high factor loadings in the first principal component. Therefore, investors in these stock markets can only have limited portfolio diversification benefit if they invest in the stock markets with high factor loadings in the first principal component. However, they can have substantial portfolio diversification benefit if they invest in the stock markets with high factor loadings in the third principal component.

The third principal component explains 8.34 percent of the total variation in the original data matrix. The Jordanian, Moroccan, Egyptian, and Pakistani stock markets have their highest factor loadings in this principal component. These stock markets are highly correlated and investing in these stock markets would provide minimal global portfolio diversification benefit to investors. However, the investors of the stock markets with high factor loadings in the first and second principal components can obtain significant portfolio diversification benefit by investing in the Jordanian, Moroccan, Egyptian, and Pakistani stock markets.

6. Summary and Conclusions

Because of their low correlation with each other and with developed stock markets, emerging stock markets can provide a substantial portfolio diversification benefit to global investors. In this paper, we use the Principal Components Analysis (PCA) methodology to study the global portfolio diversification prospects of twenty emerging stock markets for the investors of seven major developed stock markets with data for the January 1, 2003-January 1, 1014 period.

Our PCA results yielded three statistically significant principal components. The PCA technique clusters the stock markets with similar contemporaneous movement patterns into the same principal component. Stock markets with high factor loadings in the same principal component are highly correlated and they could provide only a minimal portfolio diversification benefit. Investors can maximize the benefit of portfolio diversification by choosing stock markets with high factor loadings in different principal components.

We find that developed stock markets are generally highly correlated and investing in these stock markets can provide limited diversification benefit to global investors. The investors who invest in developed stock markets can obtain greater portfolio diversification benefit by investing in emerging stock markets. However, some emerging stock markets such as the Brazilian, South African, Mexican, Peruvian, Russian, Chilean, Argentine, Turkish, and Colombian stock markets are highly correlated with the developed stock markets and they can provide a limited portfolio diversification benefit to investors in developed stock markets.

Our results indicate that the investors of the US, Canadian, German, UK, and French stock markets, which have their highest factor loading in the first principal component, can obtain the greatest portfolio diversification benefit by investing in the Indonesian, Philippine, Malaysian, and Thai emerging stock markets, which have their highest factor loading in the second principal component, and in the Jordanian, Moroccan, Egyptian and Pakistani emerging stock markets, which have their highest factor loading in the third principal component. The investors of the Australian and Japanese stock markets, which have their highest factor loadings in the first and second principal components, respectively, can obtain the greatest portfolio diversification benefit by investing in the Jordanian, Moroccan, Egyptian and Pakistani emerging stock markets, which have their highest factor loading in the third principal component.

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