E C O N O M I C S   B U L L E T I N

Stockmarket comovements revisited

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Abstract

We revisit the issue of comovements of emerging and developed stockmarkets, and provide a simultaneous treatment of data for the eighties and nineties. We show that while emerging markets experience greater instability in the long term than their developed counterparts, there is room for short−term strategies to take advantage of profit opportunities in the emerging markets, especially in India.

Citation: Da Costa, Jr, Newton, Silvia Nunes, Paulo Ceretta, and Sergio Da Silva, (2005) "Stockmarket comovements revisited." *Economics Bulletin,* Vol. 7, No. 3 pp. 1−9
Submitted: February 15, 2005. **Accepted:** March 21, 2005.
URL: http://www.economicsbulletin.com/2005/volume7/EB−05G10001A.pdf

1. Introduction

Correlation between stock returns is key for successful strategies of investment diversification, as shown by Markowitz in the fifties. Since then stock return correlation has been considered to be a decisive factor in risk estimation of financial (and real) portfolios.

This can be extended to potential earnings from internationally diversified portfolios. Several studies in this regard show that non-negligible profits are available to those diversifying their investments in capital markets abroad.

The literature on international portfolio diversification has developed in three major branches. The first one focuses on the study of gains from international diversification. It is based on the estimation of a covariance (or correlation) matrix of stockmarket return indices for the countries. Here negative and low correlations between markets track the benefits from international diversification. Early studies have detected potential profits from international diversification (e.g. Grubel 1968, and Levy and Sarnat 1970).

Grubel (1968) studies stockmarket indices of eleven industrialized countries and finds huge diversification potential. A typical investor in the New York Stock Exchange, for instance, could increase his annual returns by 68 percent, while keeping his risk exposure constant, if he invested in international markets. Using Markowitz's efficient frontiers, Levy and Sarnat (1970) show that inclusion of emerging countries in the group of investment opportunities heightens the gains of an international investor.

The latter finding is unlikely to continue to hold in the more recent period, as barriers to foreign investment have been lifted or softened. Indeed greater globalization seems to have increased the comovements of international markets, thereby reducing profit opportunities (Errunza et al. 1994, and Bekaert and Harvey 1995). Employing models of international asset pricing, Bekaert and Harvey realize that several markets present time varying integration and show correlation greater than those of previous studies. Evaluating changes in the relationships of markets over time, Jeon and Von Furstenberg (1990) find that international stockmarket indices have become more integrated since October 1987. And Meric et al. (1998) show that correlations between Latin America and the US have been on the increase, thereby lessening the opportunities of diversification.

Thus whether the correlations are stable as time goes by is discussed in greater detail in the second major branch of this type of literature (e.g. Makridakis and Wheelwright 1974, Watson 1980, Maldonado and Saunders 1981, Bekaert and Harvey 1995, Longin and Solnik 1995, and Bracker and Koch 1999). Most studies find that the correlations between (developed) stockmarkets are intertemporally unstable.

The third branch usually employs multivariate analysis techniques to track the stockmarket comovements, keeping an eye on potential earnings from international diversification. One popular technique is principal component analysis (PCA) (e.g. Lessard 1973, Philippatos et al. 1983, Meric and Meric 1989, and Meric et al. 1998). Unlike the correlation coefficient, that measures comovements of two stockmarkets at a time, PCA captures the behavior of a number of stockmarkets at once.

The three branches of literature above mostly concentrate on developed capital markets. Comovements of emerging stockmarkets with both each other and the developed markets have been given relatively scant attention. A novelty in this paper is to provide a simultaneous treatment of data from selected Latin American and Asian stockmarkets. By doing so, we are able to show that such markets are not so unstable for shorter horizons, as one might think at first sight.

The comovements across the eighties and nineties of the stockmarkets of Latin America and Asia are contrasted with those of selected developed countries. We employ correlation analysis to track such comovements and check for their intertemporal stability with the help of stability tests and PCA.

The remainder of this paper is organized as follows. Section 2 presents data, some stylized facts, and descriptive statistics. Section 3 studies the correlation coefficients of the stockmarket return indices. Section 4 presents tests for intertemporal stability of the correlation matrix of returns. Section 5 employs PCA to make analysis in Section 3 robust. And Section 6 concludes.

2. Data

We take monthly indices of four Latin American stockmarkets (namely, Argentina, Brazil, Chile, and Mexico), three Asian ones (South Korea, India, and Thailand), and three developed markets (US, Japan, and UK). As for the emerging markets, the indices are the value-weighted, global indices supplied by the International Finance Corporation (IFC). The indices of the developed markets are also value-weighted and collected from Morgan Stanley Capital International.

Every emerging country presents 241 monthly observations, ranging from December 1979 to December 1999. (China and other major markets have been left out because their time series are too short in the IFC database.) Capitalization of the four Latin American stockmarkets accounts for more than 90 percent of the total market capitalization of Latin America in the year 2000. The three Asian markets account for about 25 percent of that year's total market capitalization of Asia.

Returns of the monthly indices are taken as the natural-log price differences in US dollar terms, i.e. $\ln P_t - \ln P_{t-1}$. And the return sample of 240 datapoints is further split in two sub-samples of 120 datapoints each in order to represent the decades of 1980 and 1990.

3. Correlation analysis

Table 1 presents estimates of the correlations between the stockmarket indices for the two subsets of data. Although the correlation coefficients of developed markets are practically stable across the two decades, there is a trend for correlation to increase overall. Indeed only seven out of 45 pairs of countries had their correlation reduced. This suggests that the benefits from international diversification into stockmarkets have decreased dramatically.

The average correlation coefficient of the eighties is 0.10, varying from −0.09 (between Brazil and Argentina, and Brazil and India) to +0.58 (between US and UK). Such average correlation increases to 0.27, varying from −0.09 (between India and Japan) to +0.58 (between US and UK).

In the eighties, just Thailand and Mexico present significant correlation with two of the developed markets in the sample (US and UK). As for Thailand, this can be explained by the fact that it opened its capital market to foreign investors at the beginning of the 1980s (Harvey and Roper 1999).

The general increase of the correlations between emerging and developed countries in the nineties has not been accompanied by a similar increase between Latin America and Asia. India's stockmarket stands as the most isolated within the sample, i.e. it presents the smallest correlation coefficients with all the other stockmarkets. (We guess that the same could be happening to China.)

4. Intertemporal stability

Stockmarket comovements are thus on the increase, meaning that less profit opportunities are left for an international investor. One might then wonder whether the correlation matrices are stable over time. This section evaluates that with the help of Box's M test from multivariate data analysis.

We take the matrices of correlation coefficients above and split the total sample of twenty years in ten 2-year, four 5-year, and two 10-year shorter samples. What is tested is whether the correlation matrix of a given sub-period matches the correlation matrix of the preceding sub-period.

Table 2 reports the Box's M statistics and their *p*-values. None of the 36 pairs of consecutive 2-year sub-periods presents correlation matrices that are significantly different at the one percent level. And correlation matrices are distinct for two out of 12 pairs of consecutive 5-year sub-periods, and for three out of four pairs of consecutive 10-year sub-periods.

We have also checked for 1-year samples of the correlation matrices (not shown). We found that only one out of 76 consecutive pairs are significantly different at the one percent level. We have also found that correlation matrices up to 2-year samples are generally stable, with Asian markets being even more stable than their Latin American counterparts.

Thus greater instability in the international stockmarket relationships follows as we increase the aggregation of years in samples. Our results mean that the comovements get unstable as time goes by. As for the developed markets, our findings are in line with those in previous work (e.g. Philippatos, Christofi, and Christofi 1983, Meric and Meric 1989, and Meric et al. 1998). And the emerging markets exhibit the same pattern of greater instability as time horizon increases, with Latin America exhibiting greater instability than Asia.

We have performed the same tests for variance-covariance matrices of the stockmarket indices (not shown), only to reach approximately similar results.

5. Principal component analysis

For robustness, we alternatively check for correlations (and their stability) between the international stockmarket indices using PCA. PCA is another multivariate statistical technique that transforms a set of observable variables presenting some correlation into another set that are orthogonal and therefore no longer correlated. The transformed variables are the principal components. Thus PCA focuses on the changing figures of its significant principal components. As values decrease, a trend is set for the markets to move in tandem, thereby lowering diversification potentials. Further details on PCA can be found elsewhere (Johnson and Wichern 1998).

We adopt Kaiser's significance rule, which takes solely the principal components with eigenvalues greater than one. And we also employ a varimax rotation of the principal components to get a better interpretation of the principal components.

The correlation between a principal component and the market index under scrutiny is dubbed factor loading. Table 3 reports the factor loadings of the statistically significant principal components for the two 10-year sub-periods. The highest factor loadings of every principal component are marked with an asterisk.

For the eighties, four principal components out of the ten possible are kept for analysis. The four components explain 58.71 percent of total variance in the data matrix. And the first component explains 22.97 percent of overall variance. The developed markets dominate such a component, which provides an indication that the comovements of these markets are similar in the eighties.

The second component is responsible for 13.97 percent of total variance and is dominated by the indices of Mexico and Thailand. This is in line with the results of the correlation coefficient analysis in Table 1. The third component, that explains 11.49 percent of total variance in the data matrix, is dominated by Argentina and India. Eventually the fourth component explains little more than 10 percent of total variance and is dominated by South Korea and Chile.

Whereas the eighties present four statistically significant principal components, the nineties have only three. This means that the ten stockmarkets indices get closer in the nineties. Which means that potential profits from international diversification have abated. The three principal components jointly explain 61.45 percent of total variance. The first principal component explains 35.43 percent of total variance and is dominated by the four Latin American countries together with the US and UK.

The Korean, Thai, and Japanese stockmarkets exhibit the highest factor loadings of the second principal component. This explains 14.85 percent of total variance and is also in line with the results of correlation analysis (Table 1). The third component explains 11.18 percent of total variance. It is dominated uniquely by the Indian stockmarket, which has the highest factor loading. This means that the Indian capital market moves independently from the other stockmarkets. This result also conforms to the low correlation of the Indian stockmarket index with those of the other markets, as shown in Table 1.

6. Conclusion

This paper analyzes the stockmarket comovements in the eighties and nineties of selected emerging countries in Latin America and Asia and of selected developed countries.

Overall our results show that the correlation between these markets has been on the increase, which means that potential profits from international portfolio diversification have lessened. The average coefficient of correlation between the markets almost triples to 0.27 in the 1990s, up from 0.10 in the 1980s. Yet opportunities could not be exploited in the eighties because barriers to foreign investment outperformed low correlation and high diversification potential.

Box's M statistics shows that the emerging markets of Latin America and Asia present long-term intertemporal instability in their correlation and variance-covariance matrices of stockmarket return indices. And principal component analysis shows that all the above findings are robust.

Yet we also find that the shorter the time period, the more stable the comovements of the international stockmarket indices are. Thus there is room for short-term strategies to take advantage of profit opportunities in the emerging markets. This is unambiguous for India and perhaps also for China.

January 1980 to December 1989										
	ARG	BRA	CHL	MEX	KOR	IND	THA	USA	JPN	UK
ARG	1.00									
BRA	–0.09	1.00								
CHL	0.04	–0.04	1.00							
MEX	0.13	–0.08	0.20	1.00						
KOR	–0.05	0.09	0.10	0.08	1.00					
IND	0.17	–0.09	0.05	0.00	0.01	1.00				
THA	0.07	–0.08	0.23	0.35*	–0.07	0.01	1.00			
USA	–0.01	0.03	0.08	0.35*	0.08	–0.00	0.33*	1.00		
JPN	–0.05	–0.03	0.20	0.05	0.19	–0.01	0.00	0.25*	1.00	
UK	–0.02	0.06	0.16	0.17	0.07	0.08	0.27*	0.58*	0.40*	1.00
January 1990 to December 1999										
	ARG	BRA	CHL	MEX	KOR	IND	THA	USA	JPN	UK
ARG	1.00									
BRA	0.25*	1.00								
CHL	0.35*	0.39*	1.00							
MEX	0.46*	0.39*	0.43*	1.00						
KOR	0.08	0.06	0.23*	0.21	1.00					
IND	0.15	0.17	0.29*	0.17	0.07	1.00				
THA	0.25*	0.20	0.37*	0.35*	0.52*	0.15	1.00			
USA	0.43*	0.32*	0.36*	0.43*	0.26*	0.01	0.45*	1.00		
JPN	0.10	0.26*	0.06	0.23*	0.44*	-0.09	0.28*	0.32*	1.00	
UK	0.24*	0.25*	0.21	0.30*	0.26*	-0.02	0.28*	0.58*	0.47*	1.00

Table 1. Pearson correlation coefficients.

Note
* significant at 1 percent in a two-tailed *t* test

	All Countries		USA , JPN, UK		ARG, BRA, CHL, MEX		KOR, IND, THA	
Sub-Period	Box's M	*P*-Value	Box's M	*P*-Value	Box's M	*P*-Value	Box's M	*P*-Value
2 Years								
80–81 vs 82–83	46.42	0.79	8.80	0.19	3.89	0.95	1.15	0.98
82–83 vs 84–85	37.57	0.97	1.28	0.97	6.86	0.74	3.26	0.78
84–85 vs 86–87	49.36	0.69	6.83	0.34	8.77	0.55	6.63	0.36
86–87 vs 88–89	50.46	0.65	5.06	0.54	8.10	0.62	0.59	1.00
88–89 vs 90–91	56.36	0.42	0.80	0.99	4.40	0.93	2.38	0.88
90–91 vs 92–93	79.38	0.02	4.51	0.61	8.44	0.59	1.60	0.95
92–93 vs 94–95	54.27	0.50	4.11	0.66	4.45	0.93	5.91	0.43
94–95 vs 96–97	38.35	0.96	5.01	0.54	7.53	0.68	2.83	0.83
96–97 vs 98–99	31.46	1.00	4.58	0.60	12.93	0.23	1.75	0.94
Average		0.667		0.604		0.691		0.794
5 Years								
80–84 vs 85–89	51.17	0.62	2.13	0.91	10.24	0.42	1.60	0.95
85–89 vs 90–94	44.66	0.84	0.69	0.99	6.84	0.74	5.34	0.50
90–94 vs 95–99	82.83	0.01*	1.47	0.96	38.12	0.00*	11.41	0.08
Average		0.490		0.953		0.387		0.510
10 Years								
80–89 vs 90–99	100.76	0.00*	0.69	0.99	33.77	0.00*	26.31	0.00*

Table 2. Box's M statistics for correlations.

Note
* significant at 1 percent

Country	January 1980 to December 1989				January 1990 to December 1999		
	PC #1	PC #2	PC #3	PC #4	PC #1	PC #2	PC #3
ARG	–0.0772	0.1449	0.6564*	–0.0197	0.7225*	–0.0098	0.0727
BRA	0.1197	–0.1624	–0.4707	0.0248	0.6641*	0.0368	0.0222
CHL	–0.0021	0.4158	0.1478	0.6124*	0.6098*	0.2557	0.4182
MEX	0.1019	0.7477*	0.0855	0.1419	0.7201*	0.2096	0.0916
KOR	0.0534	–0.0855	–0.1210	0.7553*	–0.0127	0.8938*	0.0337
IND	0.2045	-0.2276	0.7480*	0.0120	0.2042	0.1392	0.7364*
THA	0.2157	0.7507*	0.0723	–0.1194	0.2904	0.7365*	0.1731
USA	0.7490*	0.3878	–0.0907	–0.0612	0.6837*	0.3337	–0.2820
JPN	0.5889*	–0.1396	–0.0129	0.4839	0.1936	0.5933*	–0.4944
UK	0.8678*	0.1569	–0.0051	0.0463	0.5006*	0.3750	–0.4971
Eigenvalue	2.2971	1.3978	1.1499	1.0260	3.5432	1.4844	1.1175
Percentage of Total Variance	22.971	13.978	11.499	10.260	35.432	14.844	11.175
Percentage of Cumulative Total Variance	22.971	36.949	48.448	58.708	35.432	50.276	61.452

Table 3. Factor loadings of statistically significant principal components.

Note
* means the highest factor loading of a principal component (PC)

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