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ABSTRACT

This paper investigates the diversification prospects which may be reaped when investing in a mixture of emerging and developed market assets. Given that emerging markets are somewhat distinct from developed ones, one may expect significant diversification potential and therefore risk reduction. Yet, the latter may be counterbalanced by the fact that emerging markets usually present higher risks when considered on their own; for instance higher price volatility and fluctuating liquidity.

We use a panel data set spanning over a 10 year period and form a number of portfolios. We find that over the sample period, emerging market assets could be combined into efficient portfolios when assessed in terms of risk and return. By contrast, portfolios involving developed market assets tended to be inefficient.

We also investigate whether emerging markets have converged to developed ones over the past years. When analysing co-movements between indices, the correlation values suggest that emerging markets have offered diversification potential. However we also find evidence of features which make it more challenging to reap the expected risk reduction benefits. The latter factors are the tendency for emerging markets to exhibit a higher individual variability, and the trend for markets to move more in line with each other as suggested by convergence literature.

1. INTRODUCTION

Emerging markets continue to attract the attention of investors from all over the world. Nowadays, many emerging market companies such as Samsung and Infosys are global players and industry leaders. Emerging securities markets grew steadily during the last decades witnessing increased portfolio flows, share of market capitalisation in world markets and number of listings. Such trends are clearly visible in Asian markets (Ding and Charoenwong, 2006), and similar progress is evident in other emerging markets in Latin America, Eastern Europe and North Africa. Portfolio investment in these markets was facilitated by the pronounced increase in emerging country funds, fully automated trading and settlement systems and liberalised access to foreign investors. A country is deemed "emerging" if its GDP per capita is less than a designated threshold that is periodically revised by the World Bank. The term conveys the idea that such economies "emerge" from less-developed status and join the group of developed countries; a process known as convergence in development economics (Bekaert and Harvey, 2002).

The main scope of this paper is to examine the potential for portfolio diversification when investing in a mixture of assets from developed and emerging markets. Given that emerging markets are somewhat distinct from developed ones, one may expect significant diversification potential and therefore risk reduction. Yet, the latter may be counterbalanced by the fact that emerging markets usually present higher risks when considered on their own; for instance higher price volatility and fluctuating liquidity. This paper considers the comovements between emerging and developed markets and delves into the risk-return combinations offered by portfolios which include emerging market assets. We also investigate whether emerging markets have converged to developed ones over the years. These issues are examined through a panel data set consisting of daily index observations for eight markets: four of which are emerging and the rest are developed ones. The data span over the 10 year period 1998 to 2007.

The rest of the paper is structured as follows. Section 2 summarises the issues relating to diversification prospects offered by emerging markets and the risks inherent in such types of investments. Section 3 describes the data and considers the correlations across markets. Minimum variance portfolios are set up in Section 4. The performance of these portfolios is analysed in terms of their risk-return trade-off. Section 5 investigates whether emerging markets have moved more in line with developed ones in recent years, thus reducing the diversification extent. Section 6 concludes.

2. EMERGING MARKETS: RISKS, DIVERSIFICATION AND INTEGRATION

The following is an overview of the literature relating to diversification through emerging markets. Section 2.1 focuses on the risks which are typically associated with emerging markets, whilst Section 2.2 presents basic concepts relating to diversification and how these were investigated in the context of emerging markets. Section 3.3 tackles the issue of financial integration and how this may affect diversification prospects.

2.1   Risks Inherent in Emerging Markets

One of the main advantages of investing in emerging markets is a higher return potential, on the grounds that emerging economies tend to enjoy faster growth rates than developed ones as outlined by Wilson (2006). Yet, high expected returns are usually associated with high risks. Emerging market economies were subject to many crises in the past, particularly when balance of payments problems and low international reserves made them prone to abrupt capital outflows (White, 2007).

The risks relating to financial investment may differ in the context of emerging economies as compared to developed ones, given that some kinds of risks may become pronounced in emerging markets. Goriaev and Zabotkin (2006) in an empirical study of the Russian stock market, noted that investors take account of both country and firm-specific risk, and securities pricing is sensitive both to actual risks and to participants' perceptions of such risks.

One salient risk relating to cross-border investment emanates from political factors. Research shows that political risk is priced in emerging market securities (Bekaert *et. al.*, 1997) and emerging economies may reduce the cost of funds through reducing political risk. Whilst most emerging economies implemented reforms to reduce political risk, other countries may still be in need of more significant efforts to achieve this objective. For instance, Girard and Omran (2007) considered the current state of various Arab capital markets and argued that institutional reforms are needed to reduce political risk, such as curtailing corruption and improving legal frameworks to ensure rule and contract enforceability. Further risks associated with emerging market investments emanate from deficiencies of the broader legal and regulatory setup such as lack of transparency and inadequate corporate governance practices.

The risks of emerging market investment may exacerbate during financial crises. Experience shows that financial crises are usually caused by a variety of factors such as overvalued exchange rates, bank balance sheets unprepared for financial or real asset volatility, and deficiencies in financial system supervision. Emerging economies should therefore strive to make their financial systems more resilient to external shocks through emphasising prudential regulation and supervision and upgrading their settlement systems to make them less prone to liquidity shocks. The former problems tend to be amplified by the tendency of portfolio investors to withdraw funds at the first signs of financial distress, reducing liquidity in the emerging economy and amplifying asset price volatility. In fact, Reynolds (2001) argued that liberalisation has made emerging markets more vulnerable to global financial crises.

The overall risk of particular markets is often gauged by measuring volatility, and research has also focused on the issue of whether liberalisation may lead to volatility changes. One may argue that as speculative capital moves in and out of emerging markets, it may impact on stock prices and induce higher volatility. Yet, one may also expect that as emerging markets become integrated with their overseas counterparts, they should become more informationally efficient, and therefore less prone to excess volatility. Research presents mixed evidence on volatility changes following liberalisation; for instance Jayasuriya (2005) considered changes in stock return volatility following liberalisation of eighteen emerging markets and found that whether countries experience lower or increased volatility might depend on market characteristics. In particular, when markets allocate significant priorities to higher transparency, investor protection and ancillary factors, they are likely to experience reduced volatility. Cuñado *et. al.* (2006) analysed long-term time series for six emerging markets and argued that past research might have overstated volatility changes. They concluded that financial liberalisation might have reduced average volatility in these markets, whereas the higher post-liberalisation volatility inferred by other researchers could have been due to occasional large shocks.

2.2 Diversifying through Emerging Markets

The concept of diversification was formalised by Markowitz (1952) who published a model of portfolio selection embodying diversification principles. The author showed that it is possible to reduce the total risk of investment portfolios by mixing risky assets. The Markowitz (1952) framework suggests that diversification reduces risk, except when the correlation between the selected assets is equal to one. Despite this, if constraints are imposed on asset weightings (e.g. they are restricted from taking negative values) it might not always be possible to obtain a portfolio variance which is lower than that of the individual assets. In addition, subsequent research by Fama (1965) and Samuelson (1967) shows that the risk reduction benefits of diversification may be compromised by the characteristics of the underlying rates of return. These authors extended the Markowitz (1952) framework to incorporate non-normal return distributions, and obtained results which suggest that diversification may at times increase risk. These notions are summarised in Los (2003; Chapter 12) and Los (2004).

The Markowitz (1952) framework was extended by Sharpe (1964), Lintner (1965) and Mossin (1966) to include a risk free asset. Whilst risk-free assets are impossible to find in practice, a short term treasury bill may be taken as an approximation. In this extension, commonly known as the Capital Asset Pricing Model (CAPM), investors may reduce portfolio return variability by holding a greater proportion of the risk-free asset in conjunction with a market portfolio. The CAPM introduces an important distinction between firm-specific risks and systematic risks. The former types of risks may be easily diversified away through a random selection of stocks, since unsystematic risk is different across companies. Conversely, systematic risks are common to the economy in general, and therefore may not be diversified away given that all companies in the particular economy are exposed to such risks.

The main motive for international diversification is to take advantage of the low correlation between stocks in different national markets. By diversifying across countries, investors may possibly reduce their exposure to the systematic risks relating to their home economy. Such risk reduction may be even more effective if investors diversify into countries which feature a low correlation with the home country; and this is one main rationale behind mixing emerging market assets with industrialised market ones. Despite this, given that some factors may affect the global economy in general, an investor may never diversify away *all* risks.

Research has focused on whether holding emerging market assets in a portfolio may present diversification benefits, given the risks which are peculiar to emerging markets discussed above. Susmel (2001) confirmed the presence of fatter tails for Latin American market return distribution, and this feature is particularly pronounced in case of the lower tail. This suggests a higher tendency for large negative returns, as compared to a normal distribution. The author found that including a portion of Latin American stocks in a US-based portfolio may reduce the chance of the portfolio value to fall below a given value. Meyer and Rose (2003) investigated whether diversification benefits may still be realised in the context of a financial crisis such as the Asian crisis of the 1990s. The authors reported a tendency for increased correlations across markets during the crisis, however diversification benefits were still attainable during the crisis period.

Researchers have also tackled the issue that the effectiveness of diversification is typically analysed using *ex-post* data whereas investors take portfolio decisions *ex-ante*. Shawky *et. al.* (1997) noted that due to the time-changing correlations as between markets, it becomes problematical to use past data in order to construct a suitably diversified portfolios. Fifield *et. al.* (2002) investigated this issue by forming *ex-ante* portfolios based on forecasted parameters, where the predictions were based on past data. Overall, the *ex-ante* portfolios did not match the diversification benefits attained on the basis of *ex-post* data.

2.3   Integration of Emerging Markets with Developed Ones

Economic integration refers to decreased barriers to trading in goods and services. Financial integration refers to reduced restrictions on capital flows and this implies that assets of comparable risk in different countries should promise similar expected returns (Bekaert and Harvey, 2000). In theory, liberalisation should bring about integration with the global capital market; foreign investors bid up the prices of local stocks with diversification potential while inefficient sectors are sidelined. This may imply changes in the cost of equity. Market integration is a gradual process and the speed of the process is determined by the particular circumstances of the country.

One reason why markets have become more integrated is that it is nowadays easier for investors to purchase overseas assets, partly due to the growth in international asset management business which was spurred by pension fund reforms. Stock market integration implies that assets in different countries are increasingly subject to the same set of sentiments and decisions. Higher correlations across assets may also be attributable to a new economic environment where firms are more global and economies are more interlinked.

According to Purfield *et. al.* (2006), the correlation between global equity markets and Asian ones has increased since the 1990s, and this trend seems representative of emerging markets in general. Contrasting evidence was presented by Hunter (2006) who found no significant evidence of integration between Latin American stock markets and international ones. The degree of integration seems to change around crisis periods, a finding confirmed in various papers such as Yang *et. al.* (2003) in the context of Asian stock markets. A detailed survey of the theoretical and empirical literature relating to the integration of stock markets is found in Kearney and Lucey (2004).

As markets become more integrated, the diversification prospects traditionally offered by emerging economies may be reduced as returns become more correlated across markets. Despite this, Li *et. al.* (2003) empirically found that the integration of world equity markets does not wholly eliminate the expected benefits of diversification from the point of view of US investors. Similar findings were reported by Miles (2005) who tested for cointegration between US markets and emerging markets in Eastern Europe and Africa.

3. DATA DESCRIPTION

For the scope of this study we chose stock market indices representing eight countries: four of which are emerging and the others constitute developed economies. In selecting the particular countries, we choose indices representing various geographic regions including US, Europe, Asia and Latin America. The choice of the specific indices was otherwise random. Data comprises daily observations of the chosen indices for the ten-year period starting from 1st January 1998 to 31st December 2007 – approximately 2500 observations for each index.

The selected indices are:

- S&P 500 (United States): a capitalisation-weighted index comprising stocks of 500 large-cap corporations trading on the New York Stock Exchange and Nasdaq;

- FTSE 100 (United Kingdom): a capitalisation-weighted index of the largest 100 companies traded on the London Stock Exchange;
- DAX (Germany): a total return index of 30 blue chip stocks traded on the Frankfurt Stock Exchange;
- Nikkei 225 (Japan): a price-weighted average of 225 top-rated Japanese companies listed on the First Section of the Tokyo Stock Exchange;
- Bovespa Index (Brazil): a volume-weighted index which includes the most liquid stocks traded on the Sao Paulo Stock Exchange;
- Shanghai SE Composite (China): a capitalisation-weighted index comprising A-shares and B-shares listed on the Shanghai Stock Exchange;
- Bolsa (Mexico): a capitalisation-weighted index of the leading stocks traded on the Mexican Stock Exchange; and
- RTS (Russia): a capitalisation-weighted index comprising fifty shares of the most highly capitalised companies traded on the Russian Trading System.

The use of index data (rather than individual stock data) is worthy of further comment, given that indices already represent some degree of diversification since they are comprised of a number of stocks. In particular, one would expect that index portfolios diversify away firm-specific risks. This makes the use of index data appropriate for this research, since emerging markets exposure may make particular sense when aiming to minimise the impacts of the systemic risks which are common to developed economies. Theory would suggest that a portfolio manager may easily diversify firm-specific risk by holding a random number of stocks independent of their country of origin; thus the main aim of investing in emerging markets would be to reduce the impact of those risks which are communal to industrialised countries.

As customary in finance research, the analysis is not conducted on the original observations which tend to be non-stationary and may give rise to spurious regression results (Granger and Newbold, 1974). We thus use log returns calculated as follows:

$$r_t = log\ (P_t/P_{t-1}) = p_t - p_{t-1} \qquad\qquad (Equation\ 1)$$

where P_t is the price level and $p_t = log\ P_t$.

The mean and standard deviation values for each series are shown in Table 1 Panel A. The standard deviations confirm that emerging markets tend to be more volatile than developed ones. As a preliminary exercise, we also computed a correlation matrix to capture the degree of association between the indices and gauge the extent to which the developed and emerging markets fluctuate in the same direction. Correlation coefficients are shown in Table 1 Panel B where the lower the correlation value, the higher the diversification opportunities between the respective indices.

The table discloses a broad cross-section of correlation values: the highest correlation being 0.76 (FTSE and DAX) while the lowest correlations are associated with the Shanghai Index. Most correlation values are positive (with the exception of the Shangai Index). Whilst negative correlations present the highest diversification potential, it may not be easy to find negatively correlated assets in practice. Despite this, positive correlations do not wipe out diversification benefits as may be seen from the following formula of the variance of a two-asset portfolio, which emanates from Markowitz (1952):

$$\sigma^2{}_P = a^2\sigma^2{}_X + b^2\sigma^2{}_Y + 2\ ab\ \rho_{X,Y}\ \sigma_X\ \sigma_Y \qquad\qquad (Equation\ 2)$$

where $\sigma^2{}_P$ is the portfolio variance, a and b are the weights invested in assets X and Y respectively, σ_X is the standard deviation of asset X and $\rho_{X,Y}$ is correlation between assets X

and *Y*. The risk of a portfolio is usually less than the risk of the individual assets since squaring the weights will make them smaller (given that these are usually fractions of 1). Further reduction may be obtained through the third term if the correlation is negative. In the extreme case of a correlation value of minus one, risk may be reduced to zero by selecting the proper asset weightings.

Table 1: Descriptive Statistics of the Sampled Indices

Panel A: Basic Statistics

	DAX	FTSE	NIKKEI	S&P	BOVESPA	MEXBOL	RTS	SHANGAI
Mean	0.00025	0.00009	0.00001	0.00016	0.00073	0.00069	0.00069	0.00061
Std. Devn.	0.016	0.012	0.014	0.011	0.022	0.016	0.026	0.015

Panel B: Correlation Matrix

	DAX	FTSE	NIKKEI	S&P	BOVESPA	MEXBOL	RTS	SHANGAI
DAX	1							
FTSE	0.76	1						
NIKKEI	0.23	0.26	1					
S&P	0.55	0.46	0.12	1				
BOVESPA	0.35	0.34	0.13	0.52	1			
MEXBOL	0.42	0.41	0.15	0.60	0.57	1		
RTS	0.32	0.34	0.20	0.19	0.25	0.27	1	
SHANGAI	-0.02	-0.02	0.07	-0.02	0.02	0.00	0.00	1

The mean and standard deviation of the sampled indices are shown in Panel A.

Panel B shows the correlations among the indices. The upper shaded part represents portfolios restricted to developed market assets (D-D). The unshaded part represents a mixture of developed and emerging market assets (D-E). The lower shaded part represents portfolios restricted to emerging market assets (E-E).

Taking the sampled indices into account, an investor may formulate three simple portfolio strategies: investing exclusively in developed markets (D-D), a mixture of developed and emerging market assets (D-E) and investing exclusively in emerging markets (E-E). As shown in Table 1, the D-D strategy options are characterised by a maximum correlation value of 0.76 and a lowest one of 0.12. The D-E strategy presents a highest correlation value of 0.60 and a minimum one of -0.02. In case of the E-E strategy the highest correlation value is 0.57 and the lowest one is 0.00. This gives a preliminary indication that the emerging country indices provided greater scope for diversification during the data period under review, although as stated above this correlation effect may be outweighed by the tendency for emerging markets to feature higher intrinsic volatility.

4. THE PERFORMANCE OF MINIMUM VARIANCE PORTFOLIOS

We now form minimum variance portfolios, in order to compare the risk-return characteristics of emerging and developed market assets. For the sake of computational and interpretation simplicity, we restrict the number of assets in each portfolio to two. Whilst such restriction might not be realistic since fund managers typically invest in a wider range of assets, we should keep in mind that each index comprises a number of stocks, implying that the portfolios still represent a broad selection of assets. In addition, portfolios which involve a relatively wide

cross-section of markets with elaborate weighting strategies do not always present significant diversification benefits, as reported by Kohers *et. al.* (1998).

Through our sample of eight indices, we may form a maximum of 28 (two-asset) portfolios: six in the D-D category, another six in the E-E category, and a further sixteen in the D-E category. Each possible combination is shown in Table 2. For each portfolio, the asset weightings are set in such a way to obtain the lowest possible variance, given that one important objective behind portfolio construction is to minimise variability. The minimum-variance portfolio weights as given in Copeland *et. al.* (2005, pg117) are:

$$W_{\min X} = \frac{\sigma^2_Y - \rho_{XY}\sigma_X\sigma_Y}{\sigma^2_X + \sigma^2_Y - 2\rho_{XY}\sigma_X\sigma_Y}$$
(Equation 3)

$$W_{\min Y} = 1 - W_{\min X}$$
(Equation 4)

where W_{minX} and W_{minY} represent the weightings allotted to assets X and Y in the minimum variance portfolio.

The weighting to be invested in each index was restricted to take a value between zero and one. This restriction was only necessary in the portfolio comprising FTSE and DAX where the minimum variance weights were 1.03 and -0.03. The latter weightings imply a portfolio strategy of shorting the DAX to invest further proceeds in FTSE. This may arise due to the rather high correlation between the former indices. Given that fund managers do not typically short assets (indeed they may face short-sale restrictions) the weights of this portfolio were adjusted to a 100% investment in FTSE. The weightings for each portfolio are shown in Table 2, together with the mean daily return and standard deviation of each portfolio. For all portfolios, the standard deviation is lower than the standard deviation of the more risky asset in the particular portfolio.

The risk-return characteristics of each portfolio are presented in Figure 1, where the scatter-plot shows that the two portfolios with the lowest variability are in the D-E category. Both of these portfolios comprise the Shangai Index; and this may be attributed to the negative correlation coefficients of the former index with that of the other respective indices.

As seen in Figure 1, the portfolios featuring emerging markets (D-E and E-E) have a higher overall variability. Despite this, considering variability on its own, only tells half the story since one should also analyse the returns realised on the portfolios. D-D portfolios offered the lowest returns during the sample period. In this respect, if we imagine an efficient frontier running through the upper portfolios, we note that D-D portfolios proved inefficient, and most of the D-E portfolios proved inefficient as well. The scatter plot reveals that in our sample of indices, investing in emerging market assets makes sense when considering risk-return combinations (as customary in finance) however emerging market investments are not necessarily desirable when considering risk on its own. This may be attributed to the higher variability of the emerging market indices; volatility implies higher risk yet it also materialised in higher returns during the sample period.

Table 2: Descriptive Statistics of the Minimum Variance Portfolios				
Type	**Component 1**	**Component 2**	**Mean Ret.**	**Std. Devn.**
D-E	SHANGAI (0.36)	S&P (0.64)	0.00030	0.0090
D-E	SHANGAI (0.37)	FTSE (0.63)	0.00019	0.0091
D-D	S&P (0.62)	NIKKEI (0.38)	0.00004	0.0093
D-D	S&P (0.52)	FTSE (0.48)	0.00011	0.0097
D-D	NIKKEI (0.37)	FTSE (0.63)	-0.00005	0.0100
D-E	BOVESPA (0.28)	NIKKEI (0.72)	0.00017	0.0101
D-E	SHANGAI (0.46)	NIKKEI (0.54)	0.00013	0.0108
D-E	SHANGAI (0.51)	DAX (0.49)	0.00039	0.0108
D-E	MEX (0.26)	FTSE (0.74)	0.00024	0.0109
E-E	SHANGAI (0.52)	MEX (0.48)	0.00057	0.0110
D-E	RTS (0.11)	S&P (0.89)	0.00027	0.0110
D-E	MEX (0.44)	NIKKEI (0.56)	0.00014	0.0111
D-D	S&P (0.18)	DAX (0.82)	0.00016	0.0111
D-E	MEX (0.14)	S&P (0.86)	0.00016	0.0112
D-E	BOVESPA (0.11)	FTSE (0.89)	0.00018	0.0114
D-E	BOVESPA (0.004)	S&P (0.996)	0.00021	0.0114
D-D	NIKKEI (0.57)	DAX (0.43)	0.00002	0.0115
D-D	FTSE (1.00)	DAX (0.00)	0.00009	0.0116
D-E	RTS (0.05)	FTSE (0.95)	0.00018	0.0116
E-E	SHANGAI (0.68)	BOVESPA (0.32)	0.00064	0.0126
E-E	SHANGAI (0.25)	RTS (0.75)	0.00051	0.0131
D-E	MEX (0.50)	DAX (0.50)	0.00046	0.0132
D-E	RTS (0.17)	NIKKEI (0.83)	0.00011	0.0133
E-E	RTS (0.20)	MEX (0.80)	0.00070	0.0146
D-E	BOVESPA (0.26)	DAX (0.74)	0.00039	0.0146
D-E	RTS (0.18)	DAX (0.82)	0.00035	0.0150
E-E	MEX (0.87)	BOVESPA (0.13)	0.00073	0.0155
E-E	RTS (0.52)	BOVESPA (0.48)	0.00078	0.0190

The first column shows the portfolio type, and the next two columns show the component indices of the portfolio and the respective weight of each index. The mean and standard deviation of the daily returns of the portfolio are shown in the subsequent columns. Portfolios are listed in ascending order of standard deviation.

Overall, the results confirm that emerging markets are more volatile than developed ones, since the standard deviations of D-E and E-E portfolios tend to be higher than those of D-D ones. This limits the risk-reduction benefits which may materialise when investing in emerging markets. The overall higher variability of emerging market assets is counterbalanced by the fact that the developed country portfolios offered lower returns than emerging market ones.

Figure1: Minimum Variance Portfolios Scatter Plot
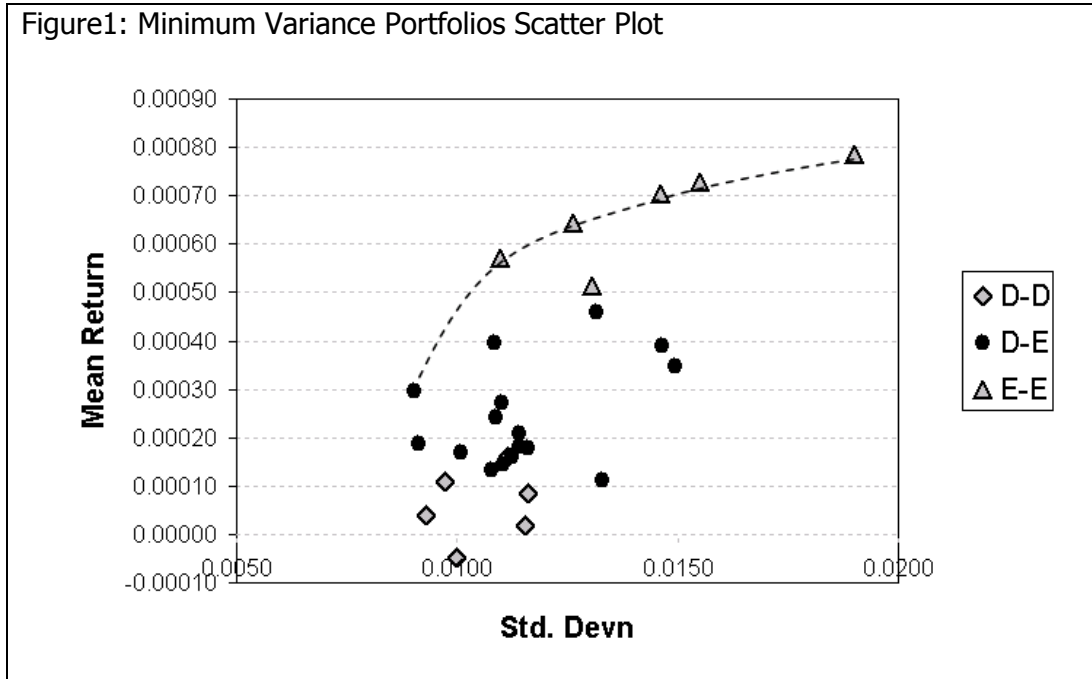
5. CHANGES IN COMOVEMENT LINKS BETWEEN MARKETS

We next inquire whether emerging markets tended to move more in line with developed ones in recent years, as suggested by financial integration literature (Bekaert and Harvey, 1997; Chelley-Steeley, 2005; and Purfield *et. al.*, 2006). We investigated this issue by splitting the sample period into two: 1998-2002 and 2003-2007. We then estimated OLS regression models with a developed market as independent variable and an emerging market as the dependent variable. This follows the assumption that developed markets tend to influence emerging markets to a higher degree, as compared to the reverse relationship. (In practice one cannot rule out the possibility that both types of markets influence each other; yet this does not affect the inferences of our results).

We thus estimated the model:

$$Y_i = \beta_0 + \beta_1 X_i + e_i \hspace{4cm} \text{(Equation 5)}$$

where Y_i denotes the emerging market index, X_i is the developed market index and e_i is the error term. Combining each developed market with an emerging market in the same model, yields 16 possible groupings. Two models were estimated with respect to each combination (using the two sub-sample periods). Results for the 32 estimations are summarised in Table 3. When looking at the coefficients and t-ratios for the β_1 estimates, we confirm the tendency for the markets to move more in line with each other. The only exceptions are the combinations of: S&P500 – RTS and DAX – RTS. We also conducted a paired two sample t-test for means on the t-ratios of β_1, in order to check whether the difference between these ratios across the periods is significant. The t-test rejected the hypothesis of no difference between the t-ratios for the two sub periods at the 99% level of confidence, confirming a significant tendency for markets to move more in line with each other. This suggests that the diversification prospects which were traditionally sought through emerging markets are becoming less obvious.

Table 3: Summary of Regression Estimates

Dependent Variable	Period	Observations	β_0	t-ratio	B_1	t-ratio	R-Squared
Independent Variable: S&P 500							
Bovespa	98-02	1202	0.0001	0.21	0.9066	18.67	0.225
	03-07	1206	0.0008	2.18	1.2083	26.93	0.376
Shangai Comp	98-02	1157	0.0001	0.34	-0.0480	-1.51	0.002
	03-07	1170	0.0010	2.33	0.0566	1.06	0.001
Bolsa	98-02	1219	0.0002	0.47	0.8082	25.41	0.347
	03-07	1229	0.0008	3.21	0.8727	27.97	0.389
RTS	98-02	1198	-0.0002	-0.25	0.4270	6.25	0.032
	03-07	1195	0.0012	2.40	0.3451	5.75	0.027
Independent Variable: FTSE 100							
Bovespa	98-02	1207	0.0003	0.37	0.5802	10.94	0.090
	03-07	1212	0.0011	2.52	0.7319	15.27	0.162
Shangai Comp	98-02	1165	0.0001	0.25	-0.0555	-1.74	0.003
	03-07	1179	0.0010	2.31	0.0660	1.31	0.001
Bolsa	98-02	1223	0.0002	0.46	0.5261	14.43	0.146
	03-07	1236	0.0010	3.32	0.5977	18.30	0.213
RTS	98-02	1207	-0.0001	-0.09	0.7882	12.24	0.111
	03-07	1204	0.0011	2.32	0.6724	12.91	0.122
Independent Variable: DAX							
Bovespa	98-02	1221	0.0003	0.38	0.4440	11.55	0.099
	03-07	1230	0.0009	2.12	0.5285	14.96	0.154
Shangai Comp	98-02	1168	0.0001	0.26	-0.0258	-1.10	0.001
	03-07	1186	0.0010	2.29	0.0399	1.07	0.001
Bolsa	98-02	1229	0.0002	0.49	0.3998	15.02	0.155
	03-07	1248	0.0009	3.07	0.4310	17.72	0.201
RTS	98-02	1211	-0.0002	-0.21	0.5572	11.66	0.101
	03-07	1213	0.0011	2.21	0.4051	10.12	0.078
Independent Variable: NIKKEI							
Bovespa	98-02	1172	-0.0004	-0.49	0.1708	3.78	0.012
	03-07	1171	0.0010	2.22	0.2591	6.58	0.036
Shangai Comp	98-02	1146	0.0001	0.19	0.0506	1.86	0.003
	03-07	1156	0.0009	2.07	0.1717	4.56	0.018
Bolsa	98-02	1189	-0.0001	-0.28	0.1673	4.97	0.020
	03-07	1195	0.0010	3.15	0.1799	6.48	0.034
RTS	98-02	1184	-0.0002	-0.25	0.3652	6.27	0.032
	03-07	1179	0.0012	2.36	0.3320	8.05	0.052

The table summarises the results obtained when the returns of emerging market indices were regressed on developed market returns as an independent variable. Two estimations were conducted for each possible grouping using the sub-periods 1998-2002 and 2003-2007.

The increased comovement between emerging and developed countries may be mainly attributed to globalisation and market integration. Lower restrictions on capital flows, more efficient trading systems, information availability and cross-border trading are making it easier for larger companies to cross-list abroad. Profits across countries become more highly correlated as a result of the increase of cross-border mergers and acquisitions.

6. CONCLUSION

This paper investigated the diversification prospects which may be reaped when investing in a mixture of emerging and developed market assets. The sampled emerging market indices exhibited positive correlations with those of developed markets – the only exception being Shangai Index which was negatively correlated with S&P500, FTSE and DAX. Whilst diversification prospects are enhanced when correlation coefficients are negative, positive correlations do not imply the absence of any diversification potential. We thus formed minimum variance portfolios and found that over the sample period, emerging market assets could be combined into two-asset portfolios which are efficient when assessed in terms of risk and return. Most portfolios which included developed market assets proved inefficient. The finding that emerging markets present diversification benefits becomes more significant when we consider that this analysis was conducted on index data (rather than on individual stock data). In particular, we may assume the absence of firm-specific risks in index data and this suggests that the diversification obtained when forming the above portfolios, was not a mere reduction of unsystematic risks which may be achieved through a random selection of a number of stocks.

When splitting the sampled data into two sub-periods we confirmed the tendency for emerging markets to move more in line with developed ones in recent years. Whilst correlation values suggest that emerging markets have offered diversification potential, we have also shown factors which point that the risk reduction benefits might be challenging to reap. The latter factors are the tendency for emerging markets to exhibit a higher individual variability as compared to developed ones and the trend for markets to move more in line with each other as suggested by convergence literature.

We should also mention a number of limitations inherent in this analysis. Firstly, results may be sample-specific: past relationships may not necessarily hold in subsequent periods especially when keeping in mind that prior research indicates that financial crises may result in significant changes in market comovements. A second limitation is that we considered portfolios consisting of two-assets for the sake of simplicity. Whilst real-life portfolios would comprise a higher number of assets, we do not believe that this is a significant drawback. This is due to the fact that each index comprises a number of securities, and due to the prior research findings suggesting that relatively broad portfolios do not necessarily present increased diversification benefits (Kohers *et. al.*, 1998). Thirdly, the assets included in the sampled indices are denominated in different currencies. We do not account for currency fluctuations on the grounds that such adjustments would also capture subsidiary variability which is irrelevant for the scope of this analysis. Finally, when analysing stock market data which spans over long periods of time, one should be aware that the conditions which underlie the pricing process are likely to change due to modifications in trading procedures and regulations.

This analysis suggests further issues which may be tackled in future research, such as whether the diversification benefits offered by emerging markets differ across bull and bear periods.

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