Proceedings of the 2005 International Conference on Simulation and Modelling
V. Kachitvichyanukul, U. Purintrapiban, P. Utayopas, eds.

ANALYZING THE RELATIVE IMPORTANCE OF VOLATILITY COMPONENTS IN EMERGING MARKETS

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ABSTRACT

In this paper, we decompose the total volatility of the average firm in an emerging market into volatility derived from the firm's own idiosyncratic behavior (FIRM), volatility imparted from being part of an emerging markets group (EMKT), and volatility from the domestic-level influences (COUNTRY). Using a sample of eighteen emerging markets over the period January 1995 to December 2000, we find a significant upward trend in all three volatility components. Apart from FIRM accounting for much of the total volatility, we find an increase in the share of COUNTRY against a fall in the share of FIRM after the Asian Crisis. We also find evidence of bilateral causality between EMKT and COUNTRY. Interestingly, our results suggest that the Asian Crisis had a significant effect on all eighteen emerging markets in our sample, whereas the effects of the Mexican Peso Crisis are only confined to the Latin American markets.

1 INTRODUCTION

In recent years, there has been an increasing trend in the investment activity related to stock markets in emerging countries. Although these markets comprise only a small fraction of the total world market capitalization, their growth relative to their counterparts in developed countries has nevertheless, been dramatic. For example, from 1990 until 1999, the total market capitalization of emerging markets increased by as much as five times to an estimated value of US$3,073.87871 million. While much of the attraction attached to these markets relates to higher expected returns, it is the ability of these markets to provide greater diversification benefits for investors that is of greater importance. In fact, studies by Lessard (1973), Errunza (1977), Agtmael and Errunza (1982), Errunza (1983) and Bailey and Stulz (1990) all find vidence of low correlation between the emerging and developed markets, suggesting potential diversification benefits from a portfolio strategy that includes emerging market stocks.

Despite these benefits, however, investments in emerging markets are typically more risky as compared to developed markets. Such risks may take the form of economic and political instability, severe currency fluctuations, illiquidity, high transaction costs, limited information and high market volatility. Harvey (1995) observes that among these risks involved, it is paradoxically, high volatility that lowers the level of integration between emerging markets and other global capital markets, which therefore enables emerging market stocks to be used as appropriate instruments for global portfolio diversification.

While earlier studies find that aggregate stock volatility in emerging markets is higher than developed markets, few known studies have, however, examined the constituent volatility components of a typical firm in an emerging market. Using a variance decomposition approach similar to Campbell et al. (2001), we compute the time series of three constituent volatility components for the average firm in an emerging market. These components comprise volatility from the firm's own idiosyncratic behavior (FIRM), volatility as a result of being an emerging markets stock (EMKT), and volatility from domestic influences (COUNTRY). Interestingly, we find evidence of a significant upward trend in all the volatility series, with FIRM contributing the largest share of total volatility. We also observe an increase in the share of COUNTRY against a fall in the share of FIRM after the Asian Crisis in 1997. Our results also suggest evidence of bilateral causality between the volatility components, notably between EMKT and COUNTRY.

2. THE VOLATILITY DECOMPOSITION APPROACH

In this paper, we decompose the return on a typical stock in an emerging market into three main components, namely, an emerging market return, a country-specific return, and a firm-specific return. Time series of volatility measures are then constructed for each the three return components. Specifically, these three components comprise volatility from the firm's own idiosyncratic behavior (FIRM), volatility as a result of being an emerging markets stock (EMKT), and finally, volatility from the country's own domestic influences (COUNTRY).

In what follows, we denote country with a c subscript, and the individual firm in each country with a k subscript. Excess returns on country *c* and firm *k* in period *t* are denoted as R_{ct}, and R_{kt}, respectively. Assuming that Purchasing Power Parity (PPP) holds, we measure the excess return (in US dollars) as the excess return over the risk-free rate of the said country.

Adopting the framework of the capital asset pricing model, we compute the return on country c as:

$$R_{ct} = \beta_c R_{mt} + \tilde{\varepsilon}_{ct}, \tag{1}$$

where β_c, is the appropriate beta for country c with respect to the emerging market return, R_{mt}, and $\tilde{\varepsilon}_{ct}$, is the country specific residual, assumed to be orthogonal to the emerging market return, R_{mt}. The return on firm is computed similarly as:

$$R_{kt} = \beta_k R_{ct} + \tilde{\varepsilon}_{kt}, \tag{2}$$

where β_k, is the beta for firm k with respect to its appropriate country return, R_{ct}, and $\tilde{\varepsilon}_{kt}$ is the firm specific residual, which is orthogonal to R_{ct}, R_{mt} and $\tilde{\varepsilon}_{kt}$. The weighted sums of the different betas at each different level sum to unity, namely:

$$\sum_c \omega_{ct}\beta_c = 1 \text{ and, } \sum_k \omega_{kt}\beta_k = 1 \tag{3}$$

Using the capital asset pricing model ensures that the three volatility components of a firm's return are orthogonal to one another. In this way, the variance of the country return and the firm return may be expressed as:

$$\text{var}(R_{ct}) = \beta_c^2 \text{ var}(R_{mt}) + \text{var}(\tilde{\varepsilon}_{ct}) \tag{4}$$

$$\text{var}(R_{kt}) = \beta_k^2 \beta_c^2 \text{ var}(R_{mt}) + \beta_k^2 \text{ var}(\tilde{\varepsilon}_{ct}) + \text{var}(\tilde{\varepsilon}_{kt}) \tag{5}$$

This decomposition, however, requires the estimation of betas from individual firms, which may be difficult to estimate and which may also be time-varying, especially in merging markets (see Harvey, 1995a). To decompose volatility into different levels without the need to estimate individual firm betas, we use a "market-adjusted-return" approach, from which we obtain the country return *c*, and firm return *k*, as follows:

$$R_{ct} = R_{mt} + \varepsilon_{ct} \tag{6}$$

$$R_{kt} = R_{ct} + \varepsilon_{kt}, \tag{7}$$

where ε_{ct}, is the difference between the country return and the emerging market return, and ε_{kt}, is the difference between the firm return and country return. Using equations (1) and (6), we obtain:

$$\varepsilon_{ct} = \tilde{\varepsilon}_{ct} + (\beta_c - 1)R_{mt}. \tag{8}$$

The variance of country c's return based on equation (6) is computed as:

$$\begin{aligned}\text{var}(R_{ct}) &= \text{var}(R_{mt}) + \text{var}(\varepsilon_{ct}) + 2\,\text{cov}(R_{mt}, \varepsilon_{ct}) \\ &= \text{var}(R_{mt}) + \text{var}(\varepsilon_{ct}) + 2(\beta_c - 1)\,\text{var}(R_{mt}).\end{aligned} \tag{9}$$

As the weighted average betas of all countries in our emerging markets group sum to unity, the weighted average volatility across the countries no longer includes country covariance factors, and hence allows us to derive the following:

$$\begin{aligned}\sum_c \omega_{ct} \text{ var}(R_{ct}) &= \text{var}(R_{mt}) + \sum_c \omega_{ct} \text{ var}(\varepsilon_{ct}) + 2\sum_c \omega_{ct}(\beta_c - 1)\,\text{var}(R_{mt}) \\ &= \text{var}(R_{mt}) + \sum_c \omega_{ct} \text{ var}(\varepsilon_{ct})\end{aligned} \tag{10}$$

The residuals from equation (6) are subsequently used to construct the average country level volatility without the need to estimate their respective betas.

For the individual firm k in country c, the variance of firm k based on the country-adjusted-model, namely, equation (7) is as follows:

$$\begin{aligned}\text{var}(R_{kt}) &= \text{var}(R_{ct}) + \text{var}(\varepsilon_{kt}) + 2\,\text{cov}(R_{ct}, \varepsilon_{kt}) \\ &= \text{var}(R_{ct}) + \text{var}(\varepsilon_{kt}) + 2(\beta_k - 1)\,\text{var}(R_{ct})\end{aligned} \tag{11}$$

Since the weighted average betas of individual firms in country c sum to unity, the weighted average of firm variance across firms in country c is, therefore:

$$\sum_k \omega_{kt} \operatorname{var}(R_{kt}) = \operatorname{var}(R_{ct}) + \sum_k \omega_{kt} \operatorname{var}(\varepsilon_{kt}) \quad (12)$$

Similarly, when computing the weighted average of individual firm variance in equation (12), the estimation of the individual firms' betas is no longer required. The average variance of an individual stock, that is, $\sum_c \omega_{ct} \sum_k \omega_{kt} \operatorname{var}(R_{kt})$, may be obtained by summing the weighted average variance of the individual stock k. Accordingly, the weighted average variance of the individual stock across countries is obtained using (given in equation (13) below:

$$\sum_c \omega_{ct} \sum_k \omega_{kt} \operatorname{var}(R_{kt}) = \sum_c \omega_{ct} \operatorname{var}(R_{ct}) + \sum_c \omega_{ct} \sum_k \omega_{kt} \operatorname{var}(\varepsilon_{kt})$$

$$= \operatorname{var}(R_{mt}) + \sum_c \omega_{ct} \operatorname{var}(\varepsilon_{ct}) + \sum_c \omega_{ct} \sum_k \omega_{kt} \operatorname{var}(\varepsilon_{kt})$$

$$= \sigma_{mt}^2 + \sigma_{\varepsilon t}^2 + \sigma_{kt}^2 \quad (13)$$

From equation (13), we can see the decomposition of aggregated volatility into the three distinct volatility components, namely,: emerging market level volatility, country level volatility, and firm level volatility. Aggregating equations (4) and (5) across both countries and firms results in:

$$\sigma_{\varepsilon t}^2 = \tilde{\sigma}_{\varepsilon t}^2 + SV_t(\beta_c)\sigma_{mt}^2, \quad (14)$$

where $\tilde{\sigma}_{\varepsilon t}^2 \equiv \sum_c w_{ct} Var(\tilde{\varepsilon}_{ct})$, is the average variance of the country shock, $\tilde{\varepsilon}_{ct}$, and $SV_t(\beta_c) \equiv \sum_c w_{ct}(\beta_c - 1)^2$ is the cross-sectional variance of country betas across countries. We further derive:

$$\sigma_{nt}^2 = \tilde{\sigma}_{nt}^2 + SV_t(\beta_{km})\sigma_{mt}^2 + SV_t(\beta_k)\tilde{\sigma}_{\varepsilon t}^2, \quad (15)$$

where $\tilde{\sigma}_{nt}^2 \equiv \sum_c w_{ct} \sum_{k \in c} w_{kct} Var(\tilde{n}_{kct})$;, β_{km} is the beta for firm k with respect to the emerging market return, R_{mt};, $SV_t(\beta_{km}) \equiv \sum_c w_{ct} \sum_k w_{kct}(\beta_{km} - 1)^2$ is the cross sectional variance of firm betas in the market across all firms in all countries;, and $SV_t(\beta_k) \equiv \sum_c w_{ct} \sum_k w_{kct}(\beta_k - 1)^2$ is the cross-sectional variance of firm betas on country shocks across all firms in all countries. From equations (14) and (15), we also see that cross-sectional variation in betas may result in common movements in the three variance components, σ_{mt}^2, $\sigma_{\varepsilon t}^2$ and σ_{nt}^2, even when the variance components $\tilde{\sigma}_{\varepsilon t}^2$ and $\tilde{\sigma}_{nt}^2$ do not change significantly with the market variance, σ_{mt}^2.

3. DATA AND ESTIMATION OF VOLATILITY COMPONENTS

Our data comprise firm-level returns obtained from 18 emerging markets selected from a representative cross-section of emerging economies similar to Bekaert and Harvey (1997). The 18 countries include 8 Asian markets (India, Indonesia, Korea, Malaysia, Pakistan, Philippines, Taiwan, Thailand), 6 Latin American markets (Argentina, Brazil, Chile, Colombia, Mexico, Venezuela), 3 European markets (Greece, Portugal, Turkey), and 1 African market (Zimbabwe), over the period January 1995 until December 2000.

We select stocks from each market stock on the basis that they are constituent stocks of the local stock market index. However, stocks that are infrequently traded, suspended by the local stock exchange(s), or constrained by data availability, and which are subsequently removed from the index during the sample period, are excluded. From Table 1, we note that the local stock market indices of Indonesia, Korea, Taiwan, Thailand and Zimbabwe are all-share indices that comprises all firms listed on their respective each exchanges. Taiwan has the largest market value (about 26%), followed by Korea (about 15%) and Malaysia (about 10%). Our entire dataset comprise the returns of 1983 stocks. All returns in local currency are converted currency are converted to their US dollar equivalent returns using the appropriate exchange rate (middle rate) obtained from DataStream International to minimize the impact of currency effects between countries. Daily excess returns are obtained by subtracting the risk-free rate which is based upon either the local interbank rate or 3 months T-bill return.

We adopt the following procedure to estimate the three volatility components described in equation (13). Let s denote the interval over which returns are measured. For this study, returns of interval s are used to construct volatility estimates at intervals t. (s refers to days and t refers to months). Therefore, using returns of interval s from our constructed the emerging market index and the country index as well as the individual firm, we construct volatility estimates at interval t. Each country return is computed as the weighted average of all constituent country over the data period. From these returns, we compute the sample volatility of the emerging market return in period t, EMKT_t as:

$$\text{EMKT}_t = \hat{\sigma}_{mt}^2 = \sum_{s \in t} (R_{ms} - \mu_m)^2, \quad (16)$$

where μ_m is the mean of the emerging market return, R_{ms}, over the entire sample period with the weights used based on the market capitalization of each constituent country on the last trading day in period $t-1$, and which is assumed constant within period t.

Country level volatility is obtained by summing the squares of the country-specific residuals in equation (13) for each of the 18 markets within period t as:

$$\hat{\sigma}^2_{\varepsilon ct} = \sum_{s \in t} \varepsilon^2_{cs} \quad (17)$$

Applying this estimation procedure ensures that the country-specific residuals are eliminated. Following this, the average aggregated country volatility, COUNTRY_t, is:

$$\text{COUNTRY}_t = \sum_c \omega_{ct} \hat{\sigma}^2_{\varepsilon ct} \quad (18)$$

To estimate the firm-specific volatility, we sum the squares of the firm-specific residuals in equation (13) for each firm in country C as follows:

$$\hat{\sigma}^2_{\varepsilon_{kt}} = \sum_{s \in t} \varepsilon^2_{ks} \quad (19)$$

Subsequently, the weighted average of the firm-specific volatilities across all constituent countries is used to obtain the average firm-level volatility, FIRM_t:

$$\text{FIRM}_t = \sum_C \omega_{Ct} \sum_k \omega_{kt} \hat{\sigma}_{\varepsilon kt} \quad (20$$

4. ANALYZING THE VOLATILITY COMPONENTS

A time plot of the three volatility components reveals that emerging market-level volatility, EMKT, increases substantially after the Asian Crisis in 1997. In fact, from the second half-year of 1997 onwards, EMKT has numerous spikes purposes with the largest mean volatility of 10.38% recorded around November 1997. Despite a reduction in volatility towards the end of 1999, we observe a permanent increase in EMKT relative to its values before July 1997. Compared to EMKT, country-level volatility or COUNTRY is higher on average. Since the Asian crisis, COUNTRY has increased substantially, with two notable spikes in Dec 1997 and Sep 1998 at 38.88 percent and 35.99 percent, respectively. This is close to four times higher than EMKT over the same period. From end-1998 onwards, we observe a steady decline in COUNTRY although mean volatility remains higher as compared to their pre-Asian Crisis values. FIRM is, on average, much higher than EMKT and COUNTRY. Unlike EMKT and COUNTRY, FIRM continues to experience high volatility after the Asian Crisis. The volatility of FIRM itself fluctuates within a wide band that averages about 10 percent across the sample period after the Asian Crisis.

In general, we find that FIRM constitutes the largest component of total volatility for the average firm in an emerging market over the entire data period except for between December 1997 and August 1998, where COUNTRY supersedes FIRM. Outside of this period, all three volatility series tend to move closely together. This co-movement among the three series is instructive, especially for COUNTRY, which is invariably the volatility component most affected by economic events.

Summary measures for all three series are given in Table 2. Over the full period, the mean of EMKT is 2.9 percent with a standard deviation of 2.75 percent. The mean of COUNTRY which is higher at 9.96 percent, has the largest standard deviation. FIRM has the highest mean at 17.4 percent with a standard deviation of 6.8 percent. A sub-period analysis reveals that the mean and standard deviations of all three series increased after the Asian Crisis. The mean of FIRM increased from 11.11 percent to 21.91 percent while its standard deviation increased from 2.73 percent to 5.06 percent. The largest increase was observed in EMKT, which saw a fourfold rise in mean value and a fivefold surge in standard deviation after the Asian Crisis. Values of the mean and standard deviation of COUNTRY also increased substantially, tripling in value in the post-Crisis period. Events since the Asian Crisis, while having a major impact on FIRM have, however, a stronger influence on EMKT and COUNTRY. Skewness and kurtosis measures are found to have declined in the post-Crisis period. We also find that the null hypothesis of a unit root is strongly rejected in all three volatility series for both sub-sample periods, suggesting that all three series are stationary processes.

5. COVARIATION AND LEAD-LAG RELATIONSHIPS

Table 3 presents the correlation matrix between the three volatility series. Over the full sample period, the highest correlation is obtained between COUNTRY and EMKT while the lowest correlation is observed between FIRM and EMKT. Similar, although slightly smaller correlations are obtained using detrended data. We see that the largest and smallest correlations in two sub-samples using both raw and detrended data are consistent with the full sample results. Detrending the data lowers the correlation between COUNTRY and EMKT while increasing the correlation between FIRM and EMKT in the pre-Crisis sub-sample. While detrending results in a similar increase for the correlation between COUNTRY and EMKT in the post-Crisis period, the correlation between FIRM and EMKT during this period also decreases. Across the sample periods, the results are consistent for both raw and detrended data; the correlations between COUNTRY and EMKT increase in the post-Crisis period, while the correlations between FIRM and EMKT decrease in the post-Crisis period.

To assess the importance of each volatility component for the average firm, we compute the ratios of mean and variance for each volatility series relative to the total

mean and variance, respectively. Their relative share in the total mean of an average stock is defined as follows:

$$1 = \frac{\mathrm{E}(\mathrm{EMKT}_t)}{\mathrm{E}(\sigma_{rt}^2)} + \frac{\mathrm{E}(\mathrm{COUNTRY}_t)}{\mathrm{E}(\sigma_{rt}^2)} + \frac{\mathrm{E}(\mathrm{FIRM}_t)}{\mathrm{E}(\sigma_{rt}^2)} \qquad (21)$$

where, $\mathrm{E}(\mathrm{EMKT}_t)$, $\mathrm{E}(\mathrm{COUNTRY}_t)$ and $\mathrm{E}(\mathrm{FIRM}_t)$ are the mean values of EMKT, COUNTRY, and FIRM, respectively and $\mathrm{E}(\sigma_{rt}^2)$, is the sum of the three individual mean volatilities. Over the full period, EMKT accounts for about 8 percent while COUNTRY accounts for about 30 percent of the unconditional mean of the total volatility (see Table 4). The largest portion of total volatility is FIRM, accounting for about 61 percent. This result is consistent with Campbell et al. (2001) who also find that firm-level volatility accounts for much of the volatility of an average firm in the US. COUNTRY accounts for a larger share of mean volatility compared to EMKT over the full period and also across the two sub-periods. While both the shares of EMKT and COUNTRY have increased in the post-Crisis period, we observe a corresponding 11 percent decrease in the contribution of FIRM.

To analyze the importance of each volatility component on the basis of the total volatility of the average firm, we also define the relative share of the total variance of the average firm as follows:

$$1 = \frac{\mathrm{Var}(\mathrm{EMKT}_t)}{\mathrm{Var}(\sigma_{rt}^2)} + \frac{\mathrm{Var}(\mathrm{COUNTRY}_t)}{\mathrm{Var}(\sigma_{rt}^2)} + \frac{\mathrm{Var}(\mathrm{FIRM}_t)}{\mathrm{Var}(\sigma_{rt}^2)}$$

$$+ \frac{2\mathrm{COV}(\mathrm{EMKT}_t, \mathrm{FIRM}_t)}{\mathrm{Var}(\sigma_{rt}^2)} + \frac{2\mathrm{COV}(\mathrm{COUNTRY}_t, \mathrm{FIRM}_t)}{\mathrm{Var}(\sigma_{rt}^2)} \qquad (22)$$

Over the full period, much of the variation in total volatility is due to COUNTRY and the covariation between COUNTRY and FIRM. In the pre-Crisis period, however, this is largely due to FIRM and COUNTRY, while in the post-Crisis period, COUNTRY and the covariation between EMKT and COUNTRY, accounts for much of this variation in total volatility. These results and the pattern of mean volatility highlight the increased importance of COUNTRY and EMKT and its consequent impact on the importance of FIRM in the post-Crisis period.

To counter the effect of low frequency variation in the volatility measures on our overall results, we derive a conditional mean of the total volatility which enables long-run movements in each volatility series to be identified. For this purpose, we decompose each volatility series into its expected and unexpected components as follows using equation (23) below:

$$v_t = E_{t-1} v_t + e_t, \qquad (23)$$

where $v_t \in$ {E MKT, COUNTRY, FIRM}; $E_{t-1} v_t$ is the conditional expectation of v_t; and e_t is a white noise process. We obtain the conditional expectation by regressing each series on its own lags and on the lags of the other volatility series. On applying the variance decomposition methods to the conditional means, we observe that the share of both COUNTRY and EMKT has increased while that of FIRM has fallen. While being similar to results from the full period, the impact on COUNTRY for the pre-Crisis period is stronger than the post-Crisis period.

Movements in EMKT may produce variation in COUNTRY if country betas differ from one another. Hence, the estimate from regressing COUNTRY on EMKT should be equal to the cross-sectional variance of betas across countries. The estimate of 2.34 that we obtain is markedly different from the cross sectional variance of the country betas at 0.11, suggesting that cross sectional variation in beta is only able to explain a small portion of the variation in both EMKT and COUNTRY. We find a similar result for covariation between FIRM and the other two volatility components where the regression coefficients of FIRM on EMKT and COUNTRY are 1.49 and 0.55, respectively. These estimates are again too large to be explained by the cross-sectional variation in firm's beta coefficients which is only 0.23.

To examine causality among the three volatility series, we apply both the bivariate and trivariate forms of the Granger Causality test, results of which are presented in Table 5. The bivariate test result shown in Panel A suggests that COUNTRY granger-causes EMKT and vice-versa. FIRM is, however, not found to exhibit significant granger-causality between either of the other two volatility measures. Similar results are obtained in the trivariate Granger Causality tests presented in Panel B.

6. VOLATILITY ACROSS INDIVIDUAL EMERGING MARKETS

The values of COUNTRY and FIRM are based on volatilities that are averaged over 18 emerging markets. While both measures contain information regarding the average emerging market, each constituent emerging market may experience variation due to different risk factors that include amongst other things, political uncertainty, currency fluctuations, and different patterns of economic growth. To gain a fuller understanding of the impact of each country's market volatility, we further analyze the volatilities of each of the 18 markets separately. The return for each country based on the capital asset pricing model is:

$$R_{ct} = \beta_c R_{mt} + \tilde{\varepsilon}_{ct} \qquad (24)$$

Similarly, the return for the firm in each country is defined as:

$$R_{kct} = \beta_c R_{mt} + \tilde{\varepsilon}_{ct} + n_{kct} \quad (25)$$

As R_{mt} and $\tilde{\varepsilon}_{ct}$ are orthogonal, by construction, the volatility of the country return may be estimated as:

$$\text{var}(R_{ct}) = \beta_c^2 \text{ var}(R_{mt}) + \text{var}(\tilde{\varepsilon}_{ct}) \quad (26)$$

Summing across all the firms in the country, the average firm volatility in the country is given as:

$$\sum_{k \in c} w_{kct} \text{ var}(R_{kct}) = \beta_c^2 \text{ var}(R_{mt}) + \text{var}(\tilde{\varepsilon}_{ct}) + \text{var}(n_{kct}) \quad (27)$$

Using the residuals $\tilde{\varepsilon}_{ct}$ from equation (24) and n_{kct} from equation (25), we construct country and firm-level volatility measures for the individual countries. Although the above formulation does not involve the computation of covariance terms, country betas are still required. Assuming the country betas are constant over our sample period, we estimate country betas by regressing monthly country excess returns against R_{mt}.

Unit root tests applied to both COUNTRY and FIRM indicate that both series are stationary in all 18 markets. Table 6 presents some summary statistics of COUNTRY and FIRM in the eighteen countries over the period Jan 1995 to Dec 2000. We observe that many of the larger emerging markets in terms of market capitalization (for example, Taiwan, Korea, Malaysia and Brazil) have betas that are greater than unity. There is also substantial variation in COUNTRY and FIRM among the 18 markets. Indonesia, a country plagued by political unrest and one that has been at the centre of the Asian Crisis, has the highest value of COUNTRY at 37.10 percent. Unlike Indonesia, COUNTRY is about 10 times smaller in Chile. As expected, the largest standard deviation is obtained for Indonesia, with the smallest, observed in Chile.

The most volatile FIRM series is obtained for Indonesia. Although the highest mean of FIRM is found in Korea, its value is only marginally higher than Indonesia. Unlike the results for COUNTRY, the lowest mean and standard deviation for FIRM is, however, obtained in Portugal. Venezuela has the second highest maximum value of COUNTRY at 327% which occurred around April 1996 and is largely due to stock market rallies as a result of the dismantling of foreign exchange controls and news of the government's commitment to provide lines of credit to support the country's structural reform.

Our earlier findings suggest that the Asian Crisis has had some impact on volatility, most notably upon COUNTRY. To further examine the effect of the Asian Crisis on the individual markets, we estimated the following regression:

$$\text{var}(R_{ct}) = \alpha_1 + \alpha_2 D_t + \varepsilon_t, \quad (28)$$

where $\text{var}(R_{ct})$ is the volatility of the country return defined in equation (26) and D_t represents a dummy variable equal to 1 for observations after Jul 1997 and is zero, otherwise. Interestingly, as Table 7 reveals, the Asian Crisis does not appear to have had a significant impact on COUNTRY in the six Latin American markets. Among the Asian emerging markets, the impact of the crisis is greatest for Indonesia, Korea, Malaysia and Thailand, with the crisis resulting in a 57.9% increase in COUNTRY for Indonesia.

7. CONCLUSION

While investing in emerging markets is considered generally more risky than developing markets, the low correlations between stocks in emerging market and developing markets, suggests benefits to be derived from strategic portfolio diversification. In analyzing the risk elements involved in emerging market stocks, it is instructive to determine how the extent of idiosyncratic risk associated with the average stock in an emerging market. A comparison of the different volatility components for the average stock in an emerging market indicates that although firm level volatility still contributes the largest share towards total volatility, it is less important in the context of an emerging market. In our paper, we find that after the Asian Crisis, the share of firm level volatility has fallen by as much as 11 percent. We also find that, for the average firm in an emerging market, country and emerging market factors are more important. The higher share of country-level volatility of emerging market stocks relative to total volatility is, in fact, consistent with the earlier studies that document the importance of country factors. Interestingly, we find that the impact of the Asian Crisis does not have a significant impact on the Latin American markets. Instead, the effects of the crisis appear to be clearly captured by country-level volatility. What is even more surprising is our finding that the firm level volatility of the average stock in an emerging market is far smaller than the firm level volatility of an average stock in a global market. In a globalizing equity market, where investors look beyond national stock markets, the argument for portfolio diversification strategies to include stocks of emerging markets becomes more and more tenable

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Table 1. Country selection and weights

Country	Number of firms	Average Weights (%)	Local Stock Market Price Index
Argentina	12	2.766	Merval
Brazil	29	7.180	Bovespa
Chile	87	5.555	Indice general de precios de las acciones (IGPA)
Colombia	15	0.732	Bogota Stock Market index (IBB)
Greece	41	0.006	Athens Stock Exchange (ASE) General Index
India	27	5.529	Bombay Stock Exchange (BSE) 30
Indonesia	187	4.188	Jakarta Stock Exchange (JSE) Composite Index
Korea	687	15.38	Korea Composite Index (KOSPI)
Malaysia	83	10.50	Kuala Lumpur Stock Exchange (KLSE) Composite Index
Mexico	27	7.306	The Price and Quotation Index (IPC)
Pakistan	74	1.017	Karachi Stock Exchange (KSE) 100
Philippines	23	2.991	Philippines Stock Exchange (PSE) Composite Index
Portugal	13	0.014	Bolsa de Valores de Lisboa (BVL) General Index
Taiwan	269	26.16	Taiwan Stock Exchange (TSE) Weighted
Thailand	286	6.277	Stock Exchange of Thailand (SET) Index
Turkey	62	3.848	Istanbul Stock Exchange (ISE) National 100 Index
Venezuela	7	0.288	Caracas Stock Index (IBC)
Zimbabwe	54	0.262	ZWE Industrial Index, Zimbabwe Mining Index
Total	1983	100.0	

Notes: This table shows the number of firms and the local stock market price index by country and the average weight of each country measured as percentage of the total market value.

Table 2: Descriptive Statistics

A: Jan 1995 to Dec 2000			
	EMKT	COUNTRY	FIRM
Mean*10^2	2.931	9.964	17.409
Std Dev*10^2	2.753	7.617	6.826
Skewness	1.286	1.990	0.378
Kurtosis	3.720	7.547	2.099
Jarque Bera	21.391	109.597	4.153

B: Jan 1995 to Jun 1997			
	EMKT	COUNTRY	FIRM
Mean*10^2	0.833	4.709	11.108
Std Dev*10^2	0.591	2.623	2.723
Skewness	2.413	2.263	0.726
Kurtosis	10.329	7.518	2.748
Jarque Bera	96.254	51.143	2.713

C: Jul 1997 - Dec 2000			
	EMKT	COUNTRY	FIRM
Mean*10^2	4.429	13.717	21.909
Std Dev*10^2	2.712	11.776	5.063
Skewness	0.891	1.970	0.309
Kurtosis	2.587	6.367	2.001
Jarque Bera	5.859	47.016	2.411

Notes: The table reports some descriptive statistics of three volatility components in the EMKT-COUNTRY-FIRM approach. EMKT is defined in equation (17), COUNTRY in equation (19), and FIRM in equation (21). The mean and standard deviation of annualized variance are multiplied by 100

Table 3.Correlation structure

A: Jan 1995 – Dec 2000						
	With trend			Detrended		
	EMKT	COUNTRY	FIRM	EMKT	COUNTRY	FIRM
EMKT	1.000			1.000		
COUNTRY	0.847	1.000		0.820	1.000	
FIRM	0.604	0.619	1.000	0.432	0.616	1.000

Table 3.Correlation structure (continued)

B: Jan 1995 – Jun1997						
	With trend			Detrended		
	EMKT	COUNTRY	FIRM	EMKT	COUNTRY	FIRM
EMKT	1.000			1.000		
COUNTRY	0.695	1.000		0.623	1.000	
FIRM	0.348	0.432	1.000	0.381	0.480	1.000

C: Jul 1997 - Dec 2000						
	With trend			Detrended		
	EMKT	COUNTRY	FIRM	EMKT	COUNTRY	FIRM
EMKT	1.000			1.000		
COUNTRY	0.763	1.000		0.824	1.000	
FIRM	0.194	0.303	1.000	0.207	0.334	1.000

Notes: This table reports the correlation structure of the three volatility components in the EMKT-COUNTRY-FIRM decomposition. EMKT is defined in equation (17), COUNTRY in equation (19), and FIRM in equation (21). Correlations of both the raw (with trend) and detrended volatility series are given below.

Table 4. Mean and Variance Decomposition

A: Jan 1995 – Dec 2000				
		EMKT	COUNTRY	FIRM
Mean		0.082	0.305	0.613
Variance	EMKT	0.032		
	COUNTRY	0.149	0.247	
	FIRM	0.102	0.270	0.198
Conditional Mean	EMKT	0.033		
	COUNTRY	0.163	0.296	
	FIRM	0.074	0.266	0.161

B: Jan 1995 – Jun1997				
		EMKT	COUNTRY	FIRM
Mean		0.048	0.273	0.679
Variance	EMKT	0.014		
	COUNTRY	0.086	0.286	
	FIRM	0.056	0.247	0.308
Conditional Mean	EMKT	0.039		
	COUNTRY	0.103	0.382	
	FIRM	0.003	0.263	0.287

C: Jul 1997 - Dec 2000

		EMKT	COUNTRY	FIRM
Mean		0.105	0.328	0.567
Variance	EMKT	0.047		
	COUNTRY	0.203	0.392	
	FIRM	0.043	0.150	0.165
Conditional Mean	EMKT	0.032		
	COUNTRY	0.158	0.282	
	FIRM	0.112	0.279	0.157

Notes: This table presents the mean and variance decomposition of the three volatility components according to the EMKT-COUNTRY-FIRM approach. EMKT is defined in equation (17), COUNTRY in equation (19) and FIRM in equation (21). The total volatility of the average firm in the emerging markets group is computed as:

$\sigma_{rt}^2 = EMKT_t + COUNTRY_t + FIRM_t$.

The Mean of each volatility component is defined in equation (22), and its Variance is given in equation (23). The row entitled "Conditional Mean" shows the variance decomposition applied to the conditional mean of the three volatility measures

Table 5. Granger Causality Tests

A. Bivariate VAR

	$EMKT_{t-l}$	$COUNTRY_{t-l}$	$FIRM_{t-l}$
$EMKT_{t-l}$	-	0.001 (1)	0.32459 (2)
$COUNTRY_{t-l}$	0.0312 (8)	-	0.761 (7)
$FIRM_{t-l}$	0.053 (5)	0.625 (1)	-

B. Trivariate VAR

	$EMKT_{t-l}$	$COUNTRY_{t-l}$	$FIRM_{t-l}$
$EMKT_{t-l}$	-	0.029	0.587
$COUNTRY_{t-l}$	0.0256	-	0.630
$FIRM_{t-l}$	0.089 (12)	0.875 (12)	- (11)

Notes: This table presents *p*-values of bivariate (Panel A) and trivariate (Panel B) Granger causality tests among the three volatility series. For each test, the lag length chosen on the basis of the Akaike information Criterion is given in parentheses below the *p*-values. EMKT is defined in equation (17), COUNTRY in equation (19), and FIRM in equation (21). All three volatility measures are linearly detrended, value-weighted variances

Table 6. Unit root tests for individual emerging markets

	COUNTRY	FIRM
Argentina	-6.32	-6.24
Brazil	-4.61	-4.49
Chile	-6.62	-5.96
Colombia	-6.55	-4.62
Greece	-6.75	-5.06
India	-7.05	-4.83
Indonesia	-4.77	-4.21
Korea	-3.83	-4.94
Malaysia	-5.52	-4.91
Mexico	-8.78	-7.35
Pakistan	-5.76	-7.25
Philippines	-5.03	-4.47
Portugal	-4.22	-4.71
Taiwan	-5.31	-5.64
Thailand	-3.20	-3.59
Turkey	-6.72	-6.71
Venezuela	-8.43	-7.98
Zimbabwe	-5.80	-6.43

The table presents results from Phillips-Perron test for unit roots applied to COUNTRY and FIRM in eighteen emerging markets. COUNTRY is defined in equation (27) and FIRM in equation (28). A PP test with a constant and a trend is used for all markets except Argentina, Brazil, Chile, Colombia, Malaysia, Mexico, Pakistan, Thailand, Venezuela, and Zimbabwe. All values are found to be significant at the 5% level of confidence.

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