ASIAN ACADEMY *of*
MANAGEMENT JOURNAL
of ACCOUNTING
and FINANCE

AAMJAF, Vol. 10, No. 1, 151–165, 2014

THE PERSISTENCY OF INTERNATIONAL DIVERSIFICATION BENEFITS: THE ROLE OF THE ASYMMETRY VOLATILITY MODEL

Ung Sze Nie[1*], Choo Wei Chong[2], Murali Sambasivan[3] and Annuar Md. Nassir[4]

[1] *Graduate School of Management, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia*
[2] *Department of Management and Marketing, Faculty of Economics and Management, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia*
[3] *Taylor's Business School, Taylor's University Lakeside Campus, 1 Jalan Taylor's, 47500 Subang Jaya, Malaysia*
[4] *Department of Accounting and Finance, Faculty of Economics and Management, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia*

*Corresponding author: janys1219@gmail.com

ABSTRACT

This study restates the issue of international portfolio diversification benefits by considering the problem of perfect foresight assumption and constant variance-covariance estimation. Whilst emphasising the role of the asymmetry volatility model in portfolio formation, we also investigate the economic implication of the smooth transition exponential smoothing (STES) method in portfolio risk management. Our results suggest that all portfolios perform better in the ex-post period compared to the ex-ante period. However, investors may not be able to obtain any benefits from diversifying their portfolio in developed stock markets in both ex-ante and ex-post periods. Further investigation on the economic implications of the STES method also show that the STES method does help to cushion losses generated from the international diversification portfolio. Hence, this suggests the use of the STES method in computing and monitoring the risk of an internationally diversified portfolio.

Keywords: international portfolio diversification (IPD) benefits, smooth transition exponential smoothing (STES), *ex-post*, *ex-ante*, asymmetry volatility model

INTRODUCTION

There has been a great deal of interest on the benefits of international portfolio diversification (IPD) over the past few decades. It is believed that diversifying domestic portfolios internationally will provide significant risk-reduction benefits. Despite the conclusion of a large amount of literature that looks favourably on IPD benefits (see, for example, Solnik, 1974; Fletcher & Marshall, 2005; De Santis & Gérard, 2009), some studies find that IPD benefits diminish due to increasing correlations among international stock markets (Driessen & Laeven, 2007; Smith & Swanson, 2008). The incorporation of the time-varying conditional correlation model was shown to be important in the IPD benefits computation (see, Guidolin & Hyde, 2008; You & Daigler, 2010). However, most of the literature evaluates the IPD benefits based on the degree of constant correlation (Chiou, 2009; Fletcher & Marshall, 2005; Laopodis, 2005; Markellos & Siriopoulos, 1997).

Apart from the use of the constant correlation approach, the evaluation of IPD benefits based on a portfolio constructed from historical data is a common practice in financial literature. Such perfect foresight is impractical in the real world. The benefits delivered in the portfolio formation period could be different from those in the post-portfolio formation period (Meyer & Rose, 2003).

International diversification benefits may be overstated, especially when a large market disturbance exists after the portfolio has been formed and when the associated risks cannot be accurately forecasted. To our knowledge, no research has explicitly studied the benefits of IPD on an *ex-post* basis in conjunction with the use of time-varying conditional correlation models, with the exception of Aslanidis, Osborn and Sensier (2009).

This paper examines the persistency of IPD benefits from the *ex-ante* period to the *ex-post* period. To incorporate the time-varying variance-covariance feature, this study has adopted the STES method to compute the IPD benefits. The adaptive smoothing parameter of the STES method is able to capture the time-varying conditional correlation. It was proven to be the superior model in forecasting stock market volatility (Taylor, 2004a; Choo, 2008) and monthly portfolio risk (Ung, Choo, Nassir, & Sambasivan, 2010).

PRIOR RESEARCH

Earlier studies conducted on the benefits of IPD can be traced back to the work of Grubel (1968), Harvey (1995), Levy and Sarnat (1970), Markellos and Siriopoulos (1997), Odier and Solnik (1993) and Solnik (1974). These studies conclude that investors can gain from investing in other parts of the world. This viewpoint has also been proven in recent literature, such as Bonfiglioli and Favero (2005), Flavin and Panopoulou (2009), and Rezayat and Yavas (2006). However, another group of studies reaches the opposite conclusion, which includes Click and Plummer (2005), Driessen and Leaven (2007), Shawky, Kuenzel and Mikhail (1997), and Smith and Swanson, (2008). They claim that the reduction of IPD benefits is due mainly to the increasing level of interdependence among international stock markets.

The aforementioned studies used the constant correlation approach to draw their conclusions on IPD benefits. Goetzmann, Li and Rouwenhorst (2005), Longin and Solnik (1995), and Rua and Nunes (2009), among others, have found that correlations between stock markets were time varying. Other studies even documented that correlations tend to strengthen during the bear market periods (e.g., Bartram & Bodnar, 2009; Campbell, Koedijk, & Kofman, 2002; Haas, 2010; King & Wadhwani, 1990; Longin & Solnik, 2001; Yang, Tapon, & Sun, 2006). Thus, investors should carefully monitor the portfolio risk because the IPD benefits are time varying and resulted from the increased market integration (Kearney & Lucey, 2004).

There are studies that explicitly employ a time-varying conditional correlation model to examine the IPD benefits. By using the Multivariate GARCH model, Aslanidis et al. (2009) reveal that US and UK markets provide limited diversification benefits to investors in the *ex-post* period. Similarly, You and Daigler (2010) also reach the same conclusion with the use of US and European stock markets as their data set. Early studies that examined the *ex-post* diversification benefits include Eun and Resnick (1988, 1994), and Cumby, Figlewski and Hasbrouck (1994). They reveal that the performances of international portfolios are superior to that of domestic portfolios in the *ex-post* period. In the synthesis literature, Shawky et al. (1997) reveal the existence of IPD benefits in an *ex-post* period. Recently, Meyer and Rose (2003) mention that an optimal *ex-ante* portfolio may be unable to deliver the maximum international diversification benefits to the investors on an *ex-post* basis. Contrarily, Chiou (2009), and Chiou, Lee and Chang (2009) show that considerable risk reduction is achievable with the Markowitz model in the *ex-post* period.

EMPIRICAL STUDY

Description of the Study

Daily closing prices of eight international stock indices have been used in this study. These include the Standard and Poor's 500 (S&P 500, New York), the Financial Times and London Stock Exchange 100 (FTSE 100, London), the Hang Seng Index (HIS, Hong Kong), the Strait Times Index (STI, Singapore), the Nikkei 225 (Tokyo), the Deutscher Aktien Index (DAX, Frankfurt), the European Option Exchange (EOE, Amsterdam) and the Cotation Assistée en Continu (CAC 40, Paris).[1] To evaluate the international diversification benefits, the US monthly 3-month T-bill rates will be used as a proxy for the risk-free interest rate. The sample period spanned from early 1995 to the end of 2010.

We split the data into *ex-ante* (1995–2003) and *ex-post* (2004–2010) periods to examine the persistency of IPD benefits in the *ex-post* period and the post-sample forecasting performance of the asymmetry volatility model. Parameter estimates are drawn from 1995 to 2003 for the forecasting method. The remaining periods are used for post-sample forecasting performance evaluation. We focused on the multi-period forecasts (i.e., forecasts produced over a holding period of different lengths in every month) rather than on a one-step-ahead forecast in the forecasting evaluation; in view of the portfolio, rebalance activity is carried out once a month (Akgiray, 1989). The multi-period forecasts of the smooth transition exponential smoothing (STES) method will be discussed later.

Furthermore, the rolling window basis is applied on the parameter estimation in this study. We estimate parameters on *R* observations running from $t - R$, $t - R + 1$, ... t. The fixed window size, *R*, spanned over 96 months, in which our first window is from March 1995 to February 2003. The estimated parameters are used to produce the one-step-ahead forecast on the first day of the following month. The window is then rolled over to include the data in March 2003 for the following parameter estimates. This estimation procedure updates the parameter estimates on a monthly basis such that the latest information set is included. This process provides us with 94 forecasts for every portfolio in the *ex-post* period.

Minimum Variance Portfolio (MVP) Formation

Benchmark portfolio

The data in the *ex-ante* period will be used to calculate the variances $\sigma^2_{i(t)}$ and covariances $\sigma_{ij(t)}$ of stock index returns based on conventional formulae, as stated below:

$$\sigma^2_{i(t)} = \frac{\sum_{t=1}^{N}\left[r_{i(t)} - \bar{r}_i\right]\left[r_{i(t)} - \bar{r}_i\right]}{N} \tag{1}$$

where $r_{i(t)}$ is the return for stock index i at time t,

$$\sigma_{ij(t)} = \frac{\sum_{t=1}^{N}\left[r_{i(t)} - \bar{r}_i\right]\left[r_{j(t)} - \bar{r}_j\right]}{N} \tag{2}$$

where *N* is the number of trading days in a month and $\bar{r}_i$ is the mean return of stock index *i* for a specific month. The computed variance-covariance matrices will then serve as a basis for the minimum variance portfolio (MVP) formation.

The seven MVPs that combined the US stock market with other developed markets are as follows. These MVPs were based solely on historical data and will serve as the benchmark portfolio.

Portfolio 1: S&P 500 combined with Nikkei 225
Portfolio 2: S&P 500 combined with STI
Portfolio 3: S&P 500 combined with HSI
Portfolio 4: S&P 500 combined with EOE
Portfolio 5: S&P 500 combined with DAX
Portfolio 6: S&P 500 combined with CAC 40
Portfolio 7: S&P 500 combined with FTSE 100

We assumed that short selling is prohibited and that no risk-free asset will be chosen in the portfolio. The MVP formation model is then:

Minimise $$\sigma_p^2 = \sum_{i=1}^{N} x_i^2 \sigma_i^2 + \sum_{i=1}^{N}\sum_{j=1}^{N} x_i x_j \sigma_{ij} \quad (3)$$

Subject to: $$\sum_{i=1}^{N} x_i = 1$$

$$x_i \geq 0 \quad i = 1, \dots, N$$

where σ_p^2 is denoted as portfolio variance and x_i is the monthly portfolio composition for stock index *i*.

The resultant monthly portfolio composition (x_i) will be used to compute the monthly portfolio return in the *ex-ante* period. Portfolio return (r_p) is simply the summation of constituent stock index returns $r_p = \sum_{i=1}^{n} x_i r_i$, where r_i is the return of stock index *i*. Given each *ex-ante* MVP's risks and returns, a time-series of 96 monthly Sharpe ratios are being calculated. Thereafter, the mean Sharpe ratio as employed by Berger, Pukthuanthong and Yang (2011) is computed for each of the MVPs.

***Ex-post* portfolio**

We recalculate the monthly portfolio risk and return using *ex-post* data but with an *ex-ante* portfolio composition. This procedure ensures that *ex-post* MVPs are being constructed using *ex-ante* portfolio composition to evaluate the persistency of IPD benefits beyond the portfolio formation period. Similarly, the mean Sharpe ratio is computed for each *ex-post* MVP, and the value will be compared against that of the *ex-ante* MVPs to determine the persistency of IPD benefits. A procedure similar to the one stated above is then repeated in conjunction with the use of the STES method in estimating the variance-covariance matrices.

Smooth Transition Exponential Smoothing (STES)

Exponential smoothing is a simple volatility forecasting method. The one-step-ahead variance forecast under this method is an exponentially weighted moving average of past squared shocks. Most of the literature has generally applied a constant smoothing parameter on this method. Nevertheless, some previous studies argue that the smoothing parameter should be allowed to vary over time. The rationale of applying varying a smoothing parameter is that the characteristics of the time series are not static over time. Hence, several adaptive exponential smoothing methods have been developed (see Snyder, 1988; Trigg & Leach, 1967). The smoothing parameter of those adaptive exponential smoothing methods varies according to the value of the tracking signal but sometimes leads to unstable forecasts.

Taylor (2004a, b) has developed a new adaptive exponential smoothing, which is based on the smooth transition model. The STES was found to have a comparatively stable forecast. This new adaptive exponential smoothing is formulated as follows:

one-step-ahead variance forecast

$$\hat{\sigma}^2_{i(t+1)} = \alpha_t \varepsilon^2_{i(t)} + (1-\alpha_t)\hat{\sigma}^2_{i(t)} \tag{4}$$

where

$\hat{\sigma}^2_{i(t+1)}$ is the one-step-ahead variance forecast,

α is the smoothing parameter,

$\varepsilon^2_{i(t)}$ is the price ‘shock’,

$\hat{\sigma}^2_{i(t)}$ is the estimates of variance of the return for stock index *i* at time *t*, *one-step-ahead covariance forecast*

$$\hat{\sigma}_{ij(t+1)} = \alpha_t(\varepsilon_{i(t)} \times \varepsilon_{j(t)}) + (1-\alpha_t)\hat{\sigma}_{ij(t)} \qquad (5)$$

where

$\hat{\sigma}^2_{ij(t+1)}$ is the one-step-ahead covariance forecast,

$\hat{\sigma}^2_{ij(t)}$ is the estimates of covariance between stock index *i* and *j* at time *t*,

and $\alpha_t = \dfrac{1}{1+\exp(\beta+\gamma V_t)}$ under constraint $0 \le \alpha_t \le 1$. The daily residual of a stock index return $\varepsilon_{i(t)}$ was also considered as price 'shock', defined by $\varepsilon_t = r_t - E(r_t | I_{t-1})$. $E(r_t | I_{t-1})$ is the mean term at time *t* conditional upon I_{t-1}, the information set of all observed returns up to time *t*–1.

β and γ are constant parameters. It is noted that the smoothing parameter α_t is a logistic function of a user-specific transition variable, V_t. The smoothing parameter will always be bound between 0 and 1, regardless of the value of the transition variable, because the restriction is imposed by the logistic function. If $\gamma>0$, the weight will gradually shift from past shocks to past conditional variances as V_t increases. The transition variable is the crucial component in determining the performance of the STES method. Taylor (2004b) has proven that the daily squared residual ε_t^2 is more suitable when used as a transition variable compared to the absolute value of the daily residual $|\varepsilon_t|$. Both ε_t^2 and $|\varepsilon_t|$ are the 'size' of the price shock.

The parameters of the STES methods are obtained via minimising the sum of the in-sample one-step-ahead forecast error:

$$\min \sum_i (\varepsilon_i^2 - \hat{\sigma}_i^2)^2 \qquad (6)$$

Following this formula, the in-sample daily squared residual ε_i^2 acts as a proxy for actual variance. Transition variables V_t of the daily squared residual and daily estimated covariance are used in the variance and covariance forecast, respectively. The daily estimated covariance can be calculated by multiplying the daily residuals of two stock index returns $\varepsilon_i \times \varepsilon_j$. As the V_t changes, the smoothing parameter will vary accordingly. The multi-period forecast of the

STES method is the one-step-ahead forecast multiplied by the number of days in a month, *k*, as shown below:

monthly variance forecast

$$\hat{\sigma}^2_{i(t,k)} = \hat{\sigma}^2_{i(t+1)} \times k \tag{7}$$

monthly covariance forecast

$$\hat{\sigma}_{ij(t,k)} = \hat{\sigma}_{ij(t+1)} \times k \tag{8}$$

Evaluation Criterion

The Sharpe ratio (Sharpe, 1966) is used to evaluate the international diversification benefits. It is a reward-to-variability ratio and measures the excess return (difference between portfolio return and risk-free rate) over portfolio return volatility, which is measured by standard deviation. Hence, a higher Sharpe ratio indicates that larger benefits can be delivered from that portfolio. The formula can be written as:

$$S = \frac{r_p - r_f}{\sigma_p} \tag{9}$$

where
S is the Sharpe ratio,
r_p is the portfolio return,
σ_p is the portfolio return volatility as measured by standard deviation,

with 3-month US Treasury Bill rates (r_f) used as a proxy for the risk-free rate to evaluate the international diversification.

EMPIRICAL EVIDENCE

Descriptive Statistics of Data

Table 1 summarises the descriptive statistics of the daily rates of return. The natural log return, as used in this study, is computed based on $\ln(r_t) = \ln(P_t / P_{t-1})$. All stock markets have a positive average return, except the Japanese and Singapore stock markets. The return of the U.K. stock market is the least varied with a standard deviation of 1.19%, while Hong Kong has the highest return volatility with a standard deviation of 1.86%. The skewness and kurtosis coefficients clearly show that all return series are asymmetric and leptokurtic. These have been further strengthened by the Jarque-Bera test, which strongly rejects the null hypothesis of a normal distribution.

Table 1
Summary statistics of data on daily rates of return from March 1995 to February 2003

Index	Mean ($\times 10^{-4}$)	Standard deviation	Skewness	Kurtosis	Jarque-Bera (*p*-value)
Panel A: Developed markets					
S&P 500	2.71	0.0121	–0.1090	5.8205	671.90*
FTSE 100	1.06	0.0119	–0.2022	5.1454	401.18*
HSI	0.51	0.0186	0.1453	12.5985	7584.72*
NIKKEI 225	–3.90	0.0153	0.1101	4.7820	264.91*
STI	–2.26	0.0150	0.3262	11.4832	5963.10*
CAC 40	2.18	0.0153	–0.1091	5.1088	376.79*
DAX	1.25	0.0166	–0.2622	5.5585	572.09*
EOE	1.70	0.0133	–0.2199	5.7247	647.19*

Notes: * Rejection of null hypothesis at 1% level of significance. The Jarque-Bera test is a goodness-of-fit test that tests for the existence of skewness and kurtosis in a distribution. The null hypothesis assumes the data are from a normal distribution.

The average monthly correlations between stock markets from March 1995 to February 2003 are shown in Table 2. It is noted that the correlations of two stock markets formed from the same region are higher compared to that of stock markets in different regions.

The Persistency of IPD Benefits

Investors are concerned with the persistency of international diversification benefits beyond the portfolio formation period. Table 3 summarises the mean Sharpe ratio from different portfolios to reveal whether the diversification benefits found in the *ex-ante* period will last in the *ex-post* period. From the results, we find that all portfolios have a negative mean Sharpe ratio in both the *ex-ante* and the *ex-post* periods. This result indicates that investors would not be better off with internationally diversified portfolios. The result is consistent with the findings of You and Daigler (2010). Their findings reveal that internationally diversified portfolios had much higher losses against a US portfolio alone. Similar to You and Daigler (2010), as shown in our results, US–Asian portfolios deliver a smaller mean Sharpe ratio compared to US–European portfolios. For example, the mean Sharpe ratio for US–Singapore is –6.39 in the *ex-ante* period and –3.84 in the *ex-post* period. On the other hand, the mean Sharpe ratios for US–France portfolios in the *ex-ante* and *ex-post* periods are –5.87 and –3.16, respectively.

Table 2
Correlations between the return of developed stock markets from March 1995 to February 2003

Index	CAC 40	DAX	EOE	FTSE 100	HSI	NIKKEI	S&P 500	STI
CAC 40	1							
DAX	0.772167	1						
EOE	0.877671	0.830343	1					
FTSE 100	0.778247	0.705479	0.872540	1				
HIS	0.296343	0.335706	0.371176	0.331976	1			
NIKKEI	0.222377	0.208279	0.251544	0.226612	0.402939	1		
S&P 500	0.436122	0.474856	0.431128	0.411301	0.121299	0.105609	1	
STI	0.224544	0.219479	0.266200	0.246871	0.546324	0.307277	0.107313	1

Contrary to the results of Meyer and Rose (2003), our results show that optimal portfolio compositions implied in historical data do cushion the loss in the *ex-post* period. All portfolios deliver a mean Sharpe ratio that is smaller than –6 in the *ex-ante* period but have mean Sharpe ratios between –3 to –4 in the *ex-post* period. The differences of our results from the previous literature may be attributable to the different time periods being used for examination (Shawky et al. 1997). The sample period used by Meyer and Rose (2003) was from May 1992 to May 1998 only, whereas our analysis covers from 1995 until 2010. The potential impacts of the 1997 Asian Financial Crisis and of the 2002 bear market, which were excluded in the *ex-ante* period of Meyer and Rose (2003), have been included in our *ex-ante* period. Thus, the portfolio compositions obtained in the *ex-ante* period do take into account the financial crisis risk, and this helps to cushion the loss in the *ex-post* period even though the subprime crisis is occurring during our *ex-post* period. Meanwhile, unit trust was used as their data series, which is different from our data series.

Table 3
Mean Sharpe ratios for portfolios formed using the conventional method

Period	Mean Sharpe ratio (portfolio)						
	1	2	3	4	5	6	7
Ex-ante	–6.39	–6.93	–6.17	–6.40	–6.13	–5.87	–6.69
Ex-post	–3.39	–3.84	–3.39	–3.32	–3.09	–3.16	–3.41

Note: The abbreviations for the portfolios are as follows: Portfolio 1 (US and Japan), Portfolio 2 (US and Singapore), Portfolio 3 (US and Hong Kong), Portfolio 4 (US and the Netherlands), Portfolio 5 (US and Germany), Portfolio 6 (US and France) and Portfolio 7 (US and UK).

The Role of the Asymmetry Volatility Model in Portfolio Formation

To evaluate the role of the asymmetry volatility model in portfolio formation, the *ex-post* IPD benefit is computed using the STES method. Meanwhile, this study enables us to gauge the economic implication of the STES method. Table 4 displays the international diversification benefits in terms of the mean Sharpe ratio computed using the STES method and the conventional method. Although both methods yield negative mean Sharpe ratios, the STES method yields a smaller negative mean Sharpe ratio for all portfolios. Apparently, the STES method does help to cushion some losses incurred from portfolios formed using the conventional method. This result is in accordance with the findings of Aslanidis et al. (2009), which stated that the smooth transition conditional correlation model is able to capture the dynamic co-movement between stock markets and therefore helps to improve the performance of the portfolio and reduce losses.

Table 4
Mean Sharpe ratios based on post-sample weighting computed via the STES and the conventional methods

Method	Mean Sharpe ratio (portfolio)						
	1	2	3	4	5	6	7
Conventional	–3.39	–3.84	–3.39	–3.32	–3.09	–3.16	–3.41
STES	–0.76	–0.75	–0.81	–0.73	–0.78	–0.70	–0.75

Notes: Every portfolio being analysed here was formed from two stock markets: Portfolio 1 (US and Japan), Portfolio 2 (US and Singapore), Portfolio 3 (US and Hong Kong), Portfolio 4 (US and the Netherlands), Portfolio 5 (US and Germany), Portfolio 6 (US and France) and Portfolio 7 (US and UK). Equations (1) and (2) were used to calculate the variance-covariance matrix under the conventional approach. The post period sample was from March 1995 until February 2003.

CONCLUSION

Research on international diversification benefits has thus far employed the constant correlation model, which is not supported by empirical evidence and theory. Only a few studies have examined diversification benefits based on time-varying correlations. Furthermore, unrealistic perfect foresight assumptions have been widely applied in this research area with the conclusion that diversification offers benefits; this conclusion has been based on a portfolio formed from historical data, which may not reflect the actual IPD benefits in the future. This paper contributes by addressing the persistency of international portfolio diversification benefits from the *ex-ante* period to the *ex-post* period in conjunction with the use of the time-varying portfolio risk forecasting method. We provide a more realistic view on both computational and evaluation issues relating to diversification benefits.

The findings indicate that the diversification benefits disappeared in both the *ex-ante* and the *ex-post* periods for all portfolios. Interestingly, all portfolios yield a better performance in the *ex-post* period compared to the *ex-ante* period. The combination of the U.S. and Singapore stock markets faces the most severe loss, whereas the portfolio consisting of the U.S. and French stock markets has the smallest loss compared to other portfolios. Nonetheless, these findings are based on the benefits generated from the conventional variance-covariance formulae. The benefits generated from the time-varying portfolio risk forecasting method are worth examining. This study further examines the role of the asymmetry volatility model – STES method – in portfolio formation. By comparing the IPD benefits computed from the STES method to the conventional method, the STES method is shown to cushion losses in portfolios constructed using the conventional method. Therefore, our results suggest the use of the STES method in portfolio risk management to optimally allocate the fund.

NOTES

1. Data are not adjusted for exchange rates for several reasons. First, studies have proven that exchange rate effects on international diversification benefits, especially on stock markets, are not material and are insignificant (Heston & Rouwenhorst, 1994; Meyer & Rose, 2003). Second, currency risk can be hedged away using derivative instruments, and hedging strategies can reduce portfolio risk (see Soenan & Lindvall, 1992; Dumas & Solnik, 1995; Eun & Resnick, 1994; Bugár & Maurer, 2002). Third, studies that mainly focus on international diversification benefits also ignore currency effects (Aslanidis et al., 2009; You & Daigler, 2010).

REFERENCES

Akgiray, V. (1989). Conditional heteroskedasticity in time series of stock returns. *Journal of Business, 62*(1), 55–80.

Aslanidis, N., Osborn, D. R., & Sensier, M. (2009). Co-movements between US and UK stock prices: The role of time-varying conditional correlations. *International Journal of Finance and Economics*, *15*(4), 366–380.

Bartram, S. M., & Bodnar, G. M. (2009). No place to hide: The global crisis in equity markets in 2008/2009. *Journal of International Money and Finance, 28*(8), 1–47.

Berger, D., Pukthuanthong, K., & Yang, J. J. (2011). International diversification with frontier markets. *Journal of Financial Economics*, *101*(1), 227–242.

Bonfiglioli, A., & Favero, C. A. (2005). Explaining co-movements between stock markets: The case of US and Germany. *Journal of International Money and Finance*, *24*(8), 1299–1316.

Bugár, G., & Maurer, R. (2002). International equity portfolios and currency hedging: The viewpoint of German and Hungarian investors. *Astin Bulletin, 32*(1), 171–197.

Campbell, R., Koedijk, K., & Kofman, P. (2002). Increased correlation in bear markets. *Financial Analysts Journal, 58*(1), 87–94.

Chiou, P. W. (2009). Benefits of international diversification with invetsment constraints: An over-time perspective. *Journal of Multinational Financial Management, 19*(2), 93–110.

Chiou, P. W., Lee, A. C., & Chang, C. C. (2009). Do investors still benefit from international diversification with investment constraints? *The Quaterly Review of Economics and Finance, 49*(2), 448–483.

Choo, W. C. (2008). *Volatility forecasting with exponential weighting, smooth transition and robust methods*. PhD dissertation, Said Business School, University of Oxford.

Click, R. W., & Plummer, M. G. (2005). Stock market integration in ASEAN after the Asian financial crisis. *Journal of Asian Economics, 16*(1), 5–28.

Cumby, R., Figlewski, S., & Hasbrouck, J. (1994). International asset allocation with time varying risk: An analysis and implementation. *Japan and The World Economy, 6*(1), 1–25.

De Santis, R. A., & Gérard, B. (2009). International portfolio reallocation: Diversification benefitsand European monetary union. *European Economic Review, 53*(8), 1010–1027.

Driessen, J., & Laeven, L. (2007). International portfolio diversification benefits: Cross-country evidence from a local perspective. *Journal of Banking and Finance, 31*(6), 1693–1712.

Dumas, B., & Solnik, B. (1995). The world price of foreign exchange risk. *The Journal of Finance, 50*(2), 445–479.

Eun, C. S., & Resnick, B. G. (1994). International diversification of investment portfolios: US and Japanese perspectives. *Management Science, 40*(1), 140–161.

Eun, C. S., & Resnick, B. G. (1988). Exchnage rate uncertainty, forward contracts, and international portfolio selection. *The Journal of Finance, 43*(1), 197–215.

Flavin, T. J., & Panopoulou, E. (2009). On the robustness of international portfolio diversification benefits to regime-switching volatility. *Journal of International Financial Markets, Instituitions and Money, 19*(1), 140–156.

Fletcher, J., & Marshall, A. (2005). An empirical examination of the benefits of international diversification. *International Financial Markets, Instituitions and Money, 15*(5), 455–468.

Goetzmann, W. N., Li, L. F., & Rouwenhorst, K. G. (2005). Long-term global market correlations. *Journal of Business, 78*(1), 1–38.

Grubel, H. G. (1968). Internationally diversified portfolios: Welfare gains and capital flows. *The American Economic Review, 58*(5), 1299–1314.

Guidolin, M., & Hyde, S. (2008). Equity portfolio diversification under time-varying predictability: Evidence from Ireland, the US, and the UK. *Journal of Multinational Financial Management, 18*(4), 293–312.

Haas, M. (2010). Covariance forecasts and long-run correlations in a Markov-switching model for dynamic correlations. *Finance Research Letters, 7*(2), 86–97.

Harvey, C. R. (1995). Predictable risk and returns in emerging markets. *The Review of Financial Studies, 8*(3), 773–816.

Heston, S. L., & Rouwenhorst, K. (1994). Does industrial structure explain the benefits of international diversification? *Journal of Financial Economics, 36*(1), 3–27.

Kearney, C., & Lucey, B. M. (2004). International equity market integration: Theory, evidence and implications. *International Review of Financial Analysis, 13*(5), 571–583.

King, M. A., & Wadhwani, S. (1990). Transmission of volatility between stock markets. *The Review of Financial Studies, 3*(1), 5–33.

Laopodis, N. T. (2005). Portfolio diversification benefits within Europe: Implications for a US investor. *International Review of Financial Analysis, 14*(4), 455–476.

Longin, F., & Solnik, B. (2001). Extreme correlation of international equity markets. *The Journal of Finance, 56*(2), 649–676.

Longin, F., & Solnik, B. (1995). Is the correlation in international equity returns constant: 1960–1990? *Journal of International Money and Finance, 14*(1), 3–26.

Levy, H., & Sarnat, M. (1970). International diversification of investment portfolios. *The American Economic Review, 60*(4), 668–675.

Markellos, R. N., & Siriopoulos, C. (1997). Diversification benefits in the smaller European stock markets. *International Advances in Economic Research, 3*(2), 142–153.

Meyer, T. O., & Rose, L. C. (2003). The persistence of international diversification benefits before and during the Asian crisis. *Global Finance Journal, 14*(2), 217–242.

Odier, P., & Solnik, B. (1993). Lessons for international asset allocation. *Financial Analyst Journal, 49*(2), 63–77.

Rezayat, F., & Yavas, B. F. (2006). International portfolio diversification: A study of linkages among the U.S., European and Japanese equity markets. *Journal of Multinational Financial Management, 16*(4), 440–458.

Rua, A., & Nunes, L. C. (2009). International comovement of stock market returns: A wavelet analysis. *Journal of Empirical Finance, 16*(4), 632–639.

Sharpe, W. F. (1966). Mutual fund performance. *The Journal of Business, 39*(1), 119–138.

Shawky, H. A., Kuenzel, R., & Mikhail, A. D. (1997). International portfolio diversification: A synthesis and an update. *Journal of International Financial Markets, Instituitions and Money, 7*(5), 303–327.

Smith, K. L., & Swanson, P. E. (2008). The dynamics among G7 government bond and equity markets and the implications for international capital market diversification. *Research International Business and Finance, 22*(2), 222–245.

Soenan, L. A., & Lindvall, J. R. (1992). Benefits from diversification and currency hedging of international equity invetsments: Different countries' viewpoints. *Global Finance Journal, 3*(2), 145–158.

Solnik, B. H. (1974). Why not diversify internationally rather than domestically? *Financial Analyst Journal, 30*(4), 89–94.

Snyder, R. D. (1988). Progressive tuning of simple exponential smoothing forecasts. *Journal of the Operational Research Society, 39*(4), 393–399.

Taylor, J. W. (2004a). Volatility forecasting with smooth transition exponential smoothing. *International Journal of Forecasting, 20*(2), 273–286.

Taylor, J. W. (2004b). Smooth transition exponential smoothing. *Journal of Forecasting, 23(6)*, 385–404.

Trigg, D. W., & Leach, A. G. (1967). Exponential smoothing with an adaptive response rate. *The OR Society, 18*(1), 53–59.

Ung, S. N., Choo, W. C., Nassir, A. M., & Sambasivan, M. (2010). Generating portfolio volatility forecasts from smooth transition exponential smoothing. *Proceedings of 30th International Symposium of Forecasting 2010*, San Diego, California, USA, June 20–23, 2010. Massachusetts, USA: International Institute of Forecasters (IIF).

Yang, L., Tapon, F., & Sun, Y. (2006). International correlations across stock markets and industries: Trends and patterns 1988–2002. *Applied Financial Economics, 16* (16), 1171–1183.

You, L., & Daigler, R. T. (2010). Is international diversification really beneficial? *Journal of Banking and Finance, 34*(1), 163–173.