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Integration among global equity markets: portfolio diversification using exchange-traded funds

Abstract

We study global equity market integration utilizing daily closing price data (January 2001-January 2004) from five selected Exchange-Traded Funds (ETF). Standard & Poor's 500 (SPY), Ishares Taiwan (EWT), Ishares Australia (EWA), Ishares Spain (EWP) and Ishares Austria (EWO) are used to represent the U.S., and the four emerging countries, two from Asia and two from European equity markets, respectively. We analyze the correlations between the five return series and examine how the returns on a single ETF are affected by the other four ETF returns in order to evaluate the case for portfolio diversification. We also study the stability of equity market interdependence after an exogenous shock. While the findings indicate that the interdependences among the five markets are significant, there is still room for international portfolio diversification. For example, investing in Austria provides diversification benefits for American, Taiwanese and Australian investors. Investors from Taiwan can realize benefits by investing in Europe and in Australia but not in the US. Austrian investors, on the other hand, can diversify portfolios by investing in the US, Taiwan and Australia. Finally, the study of the effect of the Iraq war on the co-movement of the equity markets provides mixed results for the hypothesis that the international market correlations increase after an exogenous shock.

Keywords: international equity market integration, exchange-traded funds, multivariate autoregressive moving average models, event methodology.
JEL Classification: G15.

Introduction

All of the major U.S. indices ended the year (2006) having logged double-digit gains. However, even though Standard and Poor's 500 index turned in a 13.6 percent performance, an investor would have done better if he/she had ventured outside the U.S. since year-to-date returns in foreign equity markets had generally exceeded those of the U.S. market indices. The French stock market (CAC 40) returned 17.5 percent; the German stock market (DAX 30) returned 19.9 percent; the Japanese stock market (Nikkei 225) was up 6.9 percent, and the British stock market (FTSE 100) returned 10.7 percent.

Other foreign markets have shown even higher performance. The leading index in Shanghai gained 130.47 percent, while Hong Kong's Hang Seng index posted a gain of 34.2 percent for the year. Key emerging markets closed 2006 posting solid gains. Mexico's Bolsa index surged 48.6 percent and Brazil's Bovespa climbed 32.9 percent. Using averages, domestic stock funds gained 12.6 percent in 2006 compared to 25.5 percent for international stock funds. Not surprisingly, Charles Schwab, a leading U.S.-based broker, recommends that its customers rebalance their portfolios in favor of foreign equities (Saunders, 2006). Many other financial advisors are also advising their clients to consider investment opportunities in overseas.

Two well-known theories in the finance literature, the Capital Asset Pricing Model (CAPM) and the Modern Portfolio Theory, suggest that individual and institutional investors should hold a well-diversified portfolio. It is argued that since differences exist in levels of economic growth and timing of business cycles among various countries, international portfolio diversification can be used as a vehicle to reduce risk. In fact, the 1990s witnessed an explosion of international portfolio investment, especially among emerging markets. Mutual fund companies such as Janus and Templeton achieved phenomenal rates of return on their investments during the mid to late 1990s, thereby elevating international portfolio investment to new and hitherto unknown heights.

National economies have recently become more closely linked, not only because of growing international trade and investment flows, but also in terms of international financial transactions. Influences contributing to an increased general level of correlation among markets and markets integration include the following: 1) the development of global and multinational companies and organizations; 2) advances in information technology; 3) deregulation of the financial systems of the major industrialized countries; 4) explosive growth in international capital flows, and 5) the abolishment of foreign exchange controls (Bracker and Koch, 1999).

While some controversy exists among investment professionals regarding the benefits and costs of international portfolio investment, there is agreement that international equity portfolio diversification recommendation is based on the existence of a low correlation among national stock markets which allows for reduced total risk without sacrificing expected returns (Cosset and Suret, 1995). Investors diversify

to reduce investment risk. The extent to which the risk is reduced by diversification depends on the co-variance among individual securities comprising the portfolio. Since security returns tend to co-vary much less across countries than within a country, investors can reduce portfolio risk more by diversifying internationally than purely domestically.

On the other hand, if it is true as some recent studies have shown that cross-country correlation is increasing due perhaps to the growing interdependence among the international markets, then benefits of international portfolio diversification may be overstated.

The present paper aims to shed light on the international equity market interdependence by extending the literature on the linkages among the international equity markets and by utilizing data from relatively recent financial instruments called exchange-traded funds (ETF). In studying the co-movements of the U.S., and the four emerging equity markets, the study seeks to identify diversification opportunities for international investors and investigates the stability of the relationships among the markets. As such, the paper considers an important topic that may interest retail and institutional investors, portfolio managers, corporate executives and policy makers. While significant, the topic is not new and important contributions have been made as indicated in the next section. However, the novelty of this paper stems from its use of recent data on exchange-traded funds (ETF) as well as the utilization of the multivariate-autoregressive-moving average models in identifying the inter-market linkages. Further, the paper studies the effect of the Iraq war on the equity market co-movements.

1. Literature review

In the literature, numerous studies exist that deal with the issue of stock market integration and interdependencies. Earlier studies include Grubel (1968) and Levy and Sarnat (1978), both highlighting international diversification as a source of possible welfare gains for individual investors. These studies and others made correlation analyses the cornerstone of internationalization and market interdependencies. For example Kaplanis (1988), Ratner (1992) and King and Wadhani (1990) all utilized cross correlations. Later researchers into market interdependencies rely on the cointegration methodology and include Kasa (1992), Arshanapalli and Doukas (1993), Choudhry (1997), Francis and Leachman (1998), Manning (2002), Chen et al. (2002).

Madura (2003) finds that cross-market correlations markedly increased over time. Longin and Solnik (1995) investigate the behavior of monthly international equity returns over the period of 1960-1990 and find that the correlations rise in periods of high market volatility. Solnik et al. (1996) indicate that deregulation and the opening of the British economy to foreign investment were the main reason that the British market became more correlated with the U.S. market. Meric and Meric (1997) study the changes in the co-movements of the 12 European equity markets after the 1987 crash. Their results indicate that the co-movements of these equity markets increased significantly after the crash, implying that the benefits of international diversification decreased considerably after the crash.

Ball and Torous (2000), utilizing data from January 1987 to May 1999, also find evidence that the correlations tended to increase in response to higher volatility. Karolyi and Stulz (1996), using the daily returns of U.S. and Japan also find evidence of changing correlations over time. Their study distinguishes between "global" and "competitive" shocks for asset returns. Global shocks are defined as those that affect the value of all firms in the same direction, and competitive shocks as those which increase the market value of all firms in one country relative to firms in another country.

Furthermore, Karolyi and Stulz found global shocks to be associated with high return co-variances, whereas competitive shocks were associated with low return co-variances. They also consider the possibility that a cause of markets' co-movement could be "markets contagion". Contagion effects result when enthusiasm (negativity) for stocks in one market brings about enthusiasm (negativity) for stocks in other markets, regardless of the evaluation of market fundamentals.

Forbes and Rigobon (1999) test the stock market contagion during the 1997 East Asian crises, the 1994 Mexican Peso collapse, and the 1987 U.S. stock market crash. They test a contagion based on both adjusted and unadjusted correlation coefficients. When the researchers use unadjusted correlation coefficients, their findings indicate evidence of contagion in several countries, whereas when they base the tests on the adjusted coefficients, they find virtually no contagion and indicate that during these periods strong cross-market linkage existed. Rezayat and Yavas (2006) analyze linkages among the U.S., European and Japanese equity markets for the period of 1999-2002. Their findings indicate that both European and Japanese investors can invest in each others' markets for effective portfolio diversification. However, diversification benefits for European investors are greatly diminished if they invest only in the U.S. in addition to their own markets. Yavas, Rezayat and Bilici (2004) utilize ETF data to analyze linkages

among the U.S., European and Japanese markets and find that although the correlations among the markets are statistically significant, they are not strong.

The above examples from the literature clearly point out that international equity markets are becoming increasingly correlated. The aim of this study is to expand upon the literature using daily data to focus on the short-run linkages among five equity markets (US, Taiwan, Australia, Austria and Spain). Of the countries included in our sample, four are classified as "emerging markets." This was deliberate. While there are many studies of equity market interaction among the major equity markets, there are only a few on emerging markets. In view of the fact that investing in emerging markets has become easier due to the existence of new products (such as ETF) and technology, we wanted to study if these countries offer diversification benefits for international investors. Kose et al. (2003) argue that there has been a significant decline in the volatility of business cycle fluctuations and a slight increase in the degree of cyclical co-movement among industrialized countries over time. However, for emerging market economies, financial globalization appears to have been associated, on average, with an increase in macroeconomic volatility as well as declines in the degree of co-movement of output and consumption growth with their corresponding world aggregates.

In the next section, we review the sources of data and the methodology, followed by presentation of the analysis and our findings and culminating with our summary and conclusions.

However, instead of utilizing different stock market index data, we have chosen to concentrate on exchange-traded funds (ETF). ETF are arguably the most versatile among the financial instruments introduced since the "futures" came on the scene some thirty years ago. Some examples are: SPDRS, shares of a unit trust that holds an S&P 500 portfolio; ISHARES, NASDAQ 100 QQQQ and sector SPDRS. ETF are similar to mutual funds in that they allow investors to diversify and allocate their assets and manage risk. However, they are much more flexible and generally less expensive than mutual funds. First launched in 1993, ETF now number 200 and account for over 300 Billion dollars (LA Times, March 12, 2006).

ETF shares are created or redeemed in large blocks through the deposit of securities to, or delivery of securities from, the funds portfolio. Secondary trading, in lots as small as single fund share, takes place on a stock exchange. In other words, there is dual trading. The dual trading process permits the fund shares to trade close to their Net Asset Value (NAV) at all times. In other words, ETF are similar to mutual funds that trade like stocks. They are also similar to mutual funds in that they consist of a basket of stocks that reflects a particular market index – such as the Standard and Poor's index of 500 US stocks or the Morgan Stanley international index. There are ETF for those who want to invest in baskets of large cap stocks, small cap stocks, health care stocks, emerging country stocks and so on. If there is an index, there is likely to be an ETF that mimics it. The fund holds these stocks trading them only when component companies of the index change.

ETF' relatively low expense ratios are among their attractiveness. One of the reasons why ETF have lower costs is the redemption process. First, redemption-in-kind rather than in cash (like in mutual funds) reduces the fund's transaction costs and improves its tax efficiency. Secondly, elimination of the fund accounting at the shareholder level contributes to the lower costs. Third, many ETF are very large, taking advantage of the economies of scale (Gastineau, 2003).

We use Ishares for emerging markets designed to track Morgan Stanley Capital International (MSCI) indices in respective countries. Thus, ETF track a portfolio to allow benchmark performance comparisons while being traded on organized exchanges. Therefore, a US based investor can have the opportunity to replicate a market portfolio of an emerging market without buying a closed-end fund that is traded in the secondary market where there is usually a discrepancy between the net asset value (NAV) and the share prices.

The choice of ETF as opposed to market indices used in most previous studies may be justified on three important grounds. The first is the time inconsistency issue. On a daily basis, Asian stock markets are closed while the U.S. and the European markets are open. Thus, the effects of the latter two markets, if any, are only reflected in the next trading day in Asia. Following the close of the Asian markets, the European markets open. European markets have one hour of overlapping period (from 9:30 a.m. to 10:30 a.m., New York time) with the U.S. stock market which functions between 9:30 a.m. and 4:00 p.m., New York time. Thus, global information is already embedded in the movements of the non-U.S. markets, prior to the U.S. market's opening. ETF, however, avoid the issue of time inconsistency because they all trade on the American Stock Exchange (AMEX) at the same time.

The second advantage of using ETF is their comprehensiveness and convenience allowing easy international diversification with minimal transaction

costs. For example, the five ETF used in this study represent 500 largest stocks from the US; and stock indices of the four emerging markets.

The third advantage of ETF is that they can be purchased at real time intraday trading prices and not end-of-the-day prices used in mutual fund trading. By including broader measures of the stock markets that can be easily purchased by individual investors this study represents an improvement over most of the other studies that utilize popular but narrower indices that may not be easily incorporated into an individual's portfolio due to entry barriers and high cost of maintaining equivalent portfolios. In addition, recent scandals about after-hour mutual fund trades that have shaken confidence in mutual funds might have lessened their future use. Practices such as "market timing" trades that can hurt investors by driving up transaction costs and "late trading" in which after-the-bell trades are posted at that day's closing price, rather than at the next day's closing price as required. As such, ETF appear to be a better vehicle to fit in investors' need to diversify.

Owing mostly to their relative newness, despite the advantages of using ETF over national stock market indices, there are not many studies using them as proxies for foreign equity markets. Durant and Scott (2003) and Olienyk et al. (1999) are among those that compare performances of ETF with the respective closed-end funds to highlight their diversification benefits. More recently, Barari et al. (2005) utilize ETF to study integration among the Group of seven (G7) country equity markets. In this backdrop, the present study makes the following contributions to the existing literature. First, it considers a recent time period (2001-2004) to measure equity market integration among the US and four emerging countries. Second, we use ETF price data as three-month moving segments in calculating moving correlations. Third, we employ the multivariate-auto-regressive-moving average (MARMA) models in identifying the inter-market linkages to test the hypotheses previously advanced in the international finance literature. Finally, we test the hypothesis that equity market correlations change after an exogenous shock, such as the start of the war in Iraq in 2003. Therefore, the novelty of the present paper consists in its use of ETF data on emerging markets as well as its methodology (the use of MARMA) which differentiates it from the other studies on correlations. In addition, the paper studies the impact of the Iraq war on the co-movements of the ETF returns.

Taking international investor's perspective we measure the status of integration between U.S. and Taiwan, Spain, Austria, Australia. Daily closing values of relevant ETF were collected from Yahoo Finance. These are SPY (U.S.), EWT (Taiwan), EWA (Australia), EWO (Austria) and EWP (Spain). To examine the short-term linkages between these ETF, we compute daily rates of change of ETF closing prices and slice the data into 46 segments, each containing three months of data. For each segment, we add a new month's data and drop data from the most outdated month. For example, the first segment includes daily data for the months of January, February and March. The second segment contains daily data for February, March and April. Thus, in every two successive segments a two-month data overlap exists. This two-month overlap not only smoothes the causal relationship, but it also helps to identify the month in which a change has occurred and possibly helps to isolate the source of the change.

Cross-correlation, auto-correlation and partial auto-correlation analyses are used to identify whether the rate of change of a particular ETF at time "t" can be described with its own past value as well as the past and present values of the rate of changes of other ETFs. Based on the "principle of parsimony" concentration is on the first few coefficients of each of the functions. For the analysis, the SPSS version 11 for windows is used.

2. Findings and results

We calculate the bi-variate correlation coefficients and conduct the following tests of hypothesis to study whether they are statistically significant.

$$H_0: \rho_{ij}=0;\ H_1: \rho_{ij}\neq 0;\ for\ all\ i, j, \qquad (1)$$

where $i \neq j$, i, j = $Rcspy_t$, $Rcewp_t$, $Rcewt_t$, $Rcewa_t$, $Rcewo_t$; $Rcspy_t$, $Rcewp_t$, $Rcewt_t$, $Rcewa_t$, $Rcewo_t$, denote, respectively, the daily rates of changes of the ETF used in this study.

Figures 1-10 (see Appendix) summarize our results. The upper bound and the lower bound on each figure identify the results of the tests at the 5% level of significance. Correlation coefficients falling inside the boundaries indicate low values of the coefficients (close to zero) that are not statistically significant. Since ETF can be used by investors for international diversification of their portfolios and reduce their portfolio risk, the correlations found amongst markets gain importance. By buying ETF of foreign market indices, investors reduce portfolio risk. However, all foreign markets do not provide equal results in diversification of portfolios. For a quicker and more efficient diversification of risk for a US based investor, investing in ETF with low correlation with U.S. markets is preferred. Clearly, international diversification will result in risk reduction as long as correlation coefficient between the domestic and the foreign market is less than one (i.e., less than 100 percent). Lower correlation will provide deeper risk reduction.

The results indicate that the correlation coefficients of RCSPY (US) and RCEWT (Taiwan) are all significant (see Fig. 1). When the pair-wise correlations of the US market (RCSPY) are studied along with the Australian (RCEWA) and Spanish (RCEWP) markets (Fig. 2 & 3) correlation coefficients are significant for most of the 46-segmented data. Turning to Figure 4, we note that the correlations of RCSPY with RCEWO (U.S. and Austria) are mostly contained within the lower and upper bounds in the early part of the sample indicating low values for correlations and hence statistical insignificance. However, we also note that they have been increasing since year 2000, pointing toward growing interdependence between the U.S. and the Austrian markets. The implication from an American investor's perspective is that there are small diversification benefits with Taiwan, Australia and Spain while Austria offers better diversification opportunities (median value of the correlation coefficients is .140). On the other hand, the correlations of the European ETF (RCEWO and RCEWP) indicate an interesting pattern; first they are statistically significant indication of existence of significant correlations, then contained within the upper and lower bounds, implying insignificant correlation and finally significant and increasing correlations with the median value being equal to .303 (see Fig. 5). Increasing co-movement of the Spanish and Austrian markets may suggest greater interdependence between the equity markets of the two countries after the adoption by both countries of the Euro as their currency after 2001. The implication is that since co-movements have increased, both Spanish and Austrian investors will find little diversification benefits by investing in each other's markets.

Figure 6 shows correlations between the two emerging Asian markets, Taiwan and Australia. While not statistically significant in the beginning of the sample period, correlations quickly increase and become significant toward the end but with no discernable pattern. The implication for Taiwanese and Australian investors is that diversifications benefits derived from cross investing are diminishing over time (median value is .297).

Examining cross correlations between Spain and the two emerging countries of Asia (Taiwan and Australia) we note that, generally, correlations tend to increase and become significant over time implying that the co-movements (or interdependence) of these markets have increased over time (see Fig. 7 & 8). Similarly, Figures 9 and 10 indicate that the correlations between Taiwan and Austria on the one hand and Australia and Austria on the other follow a pattern of insignificant correlation for most of the sample period, becoming significant toward the very end. In summary, therefore, from the perspective of the international investor, these results imply that the benefits of international portfolio diversification across the countries studied may be becoming less significant.

3. Dynamic market linkages

It is not possible to reach conclusions with regard to market integration by looking at correlations alone (Longin & Solnik, 1995). Therefore, we next utilized the MARMA or regression analysis (depending on the results of the autocorrelations, partial auto correlations and cross correlations) to examine the effect of the rate of change in the ETF of four markets on the fifth one. The main purpose of this step is to further isolate the effect of any four markets on the fifth one in an effort to shed more light with regard to interrelationships of the five markets studied in this paper. MARMA models combine some of the characteristics of univariate autoregressive moving average models and, at the same time, some of the characteristics of multiple regression analysis (Makridakis et al., 1983).

A MARMA model deals with an output time series Y_t, which is presumed to be influenced by an input time series X_t, and other inputs (factors) collectively grouped and called "noise", e_t. The input series X_t exerts its influence on the output series via a transfer function, which distributes the impact of X_t over several future time periods. The objective of the transfer function modeling is to determine a parsimonious model relating Y_t, to X_t, and e_t. (Makridakis et al., 1983). The transfer function model, in general, may be represented as:

$$\varphi(L)Y_t = \omega(L)X_t + \theta(L)e_t, \qquad (2)$$

where $\varphi(L)$, $\omega(L)$, $\theta(L)$ are polynomials of different orders in L.

Polynomial $\varphi(L) = (1 - \varphi_1 L^2 - \varphi_2 L^3 - \varphi_p L^p)$ represents autoregressive part of order p, "L" denotes lag, $L^1 Y_t$ represents Y_{t-1}, and polynomial $\theta(L) = = (1 - \theta_1 L^1 - \ldots - \theta_p L^q)$ represents moving average part of order q.

Findings are summarized in Table 1, which reports only the coefficients found to be significant at the 5% level or lower.

Table 1. Summary of findings on linkages among the exchange-traded funds (January 2001-December 2004)

	2001	2002
Jan-Mar	$RCSPY_t$=.58 $RCEWP_t$ +.15 $RCEWT_t$ -.25 $RCEWO_t$ + e_t	$RCSPY_t$ = .24$RCEWP_t$ +.16 $RCEWT_t$ + e_t
	$RCEWP_t$ =.535 $RCSPY_t$+.267 $RCEWA_t$ +.505 $RCEWO_t$ +e_t	$RCEWP_t$ = .365$RCSPY_t$ + .18$RCEWT_t$ + e_t
	$RCEWT_t$= .635 $RCSPY_t$ +e_t	$RCEWT_t$ = .93$RCSPY_t$ + .75$RCEWA_t$ + e_t
	$RCEWA_t$= .33 $RCEWP_t$+e_t	$RCEWA_t$ = .18 $RCEWT_t$ + e_t
	$RCEWO_t$ =.60 $RCEWP_t$-.29 $RCSPY_t$ +e_t	$RCEWO_t$ = .21$RCEWP_t$ + e_t
Feb-Apr	$RCSPY_t$ =.80$RCEWP_t$ +.17 $RCEWT_t$ -.33 $RCEWO_t$ + e_t	$RCSPY_t$ = .16 $RCEWT_t$ + .30$RCEWA_t$ +e_t
	$RCEWP_t$ =.53 $RCSPY_t$+.53 $RCEWO_t$+.24 $RCEWA_t$ + e_t	$RCEWP_t$ = .365 $RCSPY_t$ +.24$RCEWT_t$ + e_t
	$RCEWT_t$=.57$RCEWT_{t-1}$+.56 $RCSPY_t$-.42$RCEWO_t$+e_t-.88 e_{t-1}	$RCEWT_t$ = .58$RCSPY_t$ + .44$RCEWP_t$ +e_t
	$RCEWA_t$= .45 $RCEWP_t$ +e_t	$RCEWA_t$ = .45$RCSPY_t$ +.195 $RCEWP_{t-1}$+ e_t
	$RCEWO_t$ =.79 $RCEWP_t$ -.39 $RCSPY_t$ +e_t	$RCEWO_t$ = e_t
Mar-May	$RCSPY_t$ =.61 $RCEWP_t$ +.38 $RCEWT_t$ + e_t	$RCSPY_t$ = .27$RCEWP_t$ + .22$RCEWT_t$ + e_t
	$RCEWP_t$ =.52 $RCSPY_t$+.39 $RCEWO_t$ +.23$RCEWA_t$ +e_t	$RCEWP_t$ = .45$RCSPY_t$ -.34$RCEWO_{t-1}$ + e_t
	$RCEWT_t$= .65 $RCSPY_t$ -.51 $RCEWO_t$ + e_t	$RCEWT_t$ = .69 $RCSPY_t$ + .59 $RCEWA_t$ + e_t
	$RCEWA_t$= .44 $RCEWP_t$ +e_t	$RCEWA_t$ = .31 $RCSPY_t$ + .17 $RCEWT_t$ + e_t
	$RCEWO_t$ =.480 $RCEWP_t$ +e_t -.32 e_{t-1}	$RCEWO_t$ = e_t
Apr-Jun	RCSPY=.21 $RCEWT_t$ + .29 $RCEWP_t$ + e_t	$RCSPY_t$ = .19 $RCEWT_t$ +.295$RCEWA_t$ + e_t
	$RCEWP_t$ =.30$RCSPY_t$+ .295$RCEWA_t$ +.34$RCEWO_t$ + e_t	$RCEWP_t$ = e_t
	$RCEWT_t$= .81 $RCSPY_t$ +e_t -.29 e_{t-1}	$RCEWT_t$ = .72$RCSPY_t$ + .67 $RCEWA_t$ + e_t
	$RCEWA_t$= .48 $RCEWP_t$ +e_t	$RCEWA_t$ = .23$RCEWT_t$ - .37 $RCEWA_{t-1}$ + e_t
	$RCEWO_t$ =.34 $RCEWP_t$ +e_t	$RCEWO_t$ = e_t
May-Jul	RCSPY=.21 $RCEWP_t$ + .12 $RCEWA_t$ +e_t	$RCSPY_t$ = .26 $RCEWP_t$ + .33 $RCEWT_t$ + e_t
	$RCEWP_t$ = .38 $RCEWA_t$ +e_t	$RCEWP_t$ = .4 $RCSPY_t$ +.45 $RCEWO_t$ + e_t -.53e_{t-1}
	$RCEWT_t$= .59 $RCSPY_t$ +e_t	$RCEWT_t$ = .700$RCSPY_t$ + .635$RCEWA_t$ + e_t
	$RCEWA_t$= .32 $RCEWP_t$ +e_t	$RCEWA_t$ = .21$RCSPY_t$ + .17$RCEWT_t$ + e_t
	$RCEWO_t$ =e_t	$RCEWO_t$ = .21 $RCEWP_t$ + e_t
Jun-Aug	$RCSPY_t$ = .275$RCEWP_t$ + .16$RCEWT_t$ -.29$RCEWO_t$ + e_t	$RCSPY_t$ = .20$RCEWP_t$ +.29 $RCEWT_t$ + .29 $RCEWA_t$ +e_t
	$RCEWP_t$ = .37$RCSPY_t$ + .385$RCEWA_t$ + e_t	$RCEWP_t$ = .43 $RCSPY_t$ +.40 $RCSPY_{t-1}$+ e_t
	$RCEWT_t$ = .97 $RCSPY_t$ -.51$RCEWA_t$ + .81$RCEWO_t$ + e_t	$RCEWT_t$ = 1.001$RCSPY_t$ + e_t
	$RCEWA_t$ = .33 $RCEWP_t$ + e_t	$RCEWA_t$ = .48 $RCSPY_t$ + e_t
	$RCEWO_t$ = .17 $RCEWP_t$ + e_t	$RCEWO_t$ = .21 $RCEWP_t$ + e_t
Jul-Sep	$RCSPY_t$ = .40 $RCEWP_t$ + .15$RCEWT_t$ + e_t	$RCSPY_t$ = .21$RCEWP_t$ + .31$RCEWT_t$ + .28$RCEWA_t$ +e_t
	$RCEWP_t$ = .74 $RCSPY_t$ + .24 $RCEWA_t$ + e_t	$RCEWP_t$ = .56$RCSPY_t$ + .26$RCEWT_{t-1}$ + e_t
	$RCEWT_t$ = .94 $RCSPY_t$ + e_t,	$RCEWT_t$ = .998$RCSPY_t$ + e_t
	$RCEWA_t$ = .545$RCEWP_t$ + e_t	$RCEWA_t$ = .425$RCSPY_t$ + e_t
	$RCEWO_t$ = e_t	$RCEWO_t$ = .19 $RCEWP_t$ - .27 $RCEWO_{t-2}$ + e_t
Aug-Oct	$RCSPY_t$ = .26$RCEWP_t$ +.12 $RCEWT_t$ +.15 $RCEWA_t$ + e_t	$RCSPY_t$= .24$RCEWP_t$ + e_t
	$RCSPY_t$ = .26 $RCEWP_t$ +.12 $RCEWT_t$ +.15$RCEWA_t$ + e_t	$RCSPY_t$= .24 $RCEWP_t$+.23$RCEWT_t$+.44 $RCEWA_t$+ e_t
	$RCEWP_t$ = .78 $RCSPY_t$ + e_t	$RCEWP_t$ = .54 $RCSPY_t$ + e_t
	$RCEWT_t$ = .99 $RCSPY_t$ + e_t	$RCEWT_t$ = 1.30 $RCSPY_t$ + e_t - .22e_{t-1} - .34e_{t-2}
	$RCEWA_t$ = .69 $RCSPY_t$ + e_t	$RCEWA_t$ = .50 $RCSPY_t$ + e_t
	$RCEWO_t$ = e_t	$RCEWO_t$ = .25 $RCEWP_t$ + e_t
Sep-Nov	$RCSPY_t$ = .27$RCEWP_t$ + .14$RCEWT_t$ + .17$RCEWA_t$ + e_t	$RCSPY_t$ = .3$RCEWP_t$+.14$RCEWT_t$ + .50 $RCEWA_t$ + e_t
	$RCEWP_t$ = .81 $RCSPY_t$ + e_t	$RCEWP_t$ = .57 $RCSPY_t$ +e_t

Table 1 (cont.). Summary of findings on linkages among the exchange-traded funds (January 2001-December 2004)

	2001	2002
Sep-Nov	$RCEWT_t = 1.11\ RCSPY_t + e_t$	$RCEWT_t = .87\ RCSPY_t - .23\ RCEWT_{t-1} + e_t$
	$RCEWA_t = .71\ RCSPY_t + e_t$	$RCEWA_t = .39\ RCSPY_t + e_t - .36\ e_{t-1}$
	$RCEWO_t = e_t$	$RCEWO_t = .19\ RCEWP_t + e_t$
Oct-Dec	$RCSPY_t = .24RCEWP_t + .12RCEWT_t + e_t$	$RCSPY_t = .36RCEWP_t + .16RCEWT_t + .36RCEWA_t + e_t$
	$RCEWP_t = .52RCSPY_t + .18\ RCEWT_t + e_t - .58e_{t-1}$	$RCEWP_t = .59RCSPY_t + e_t - .45e_{t-1}$
	$RCEWT_t = .999RCSPY_t + e_t$	$RCEWT_t = 1.15RCSPY_t + e_t$
	$RCEWA_t = e_t$	$RCEWA_t = .38\ RCSPY_t - .48\ RCEWA_{t-1} + e_t$
	$RCEWO_t = e_t$	$RCEWO_t = e_t$
Nov-Jan	$RCSPY_t = .30\ RCEWP_t + .145RCEWT_t + e_t$	$RCSPY_t = .37RCEWP_t + .14RCEWT_t + .24RCEWA_t + e_t$
	$RCEWP_t = .47RCSPY_t + e_t$	$RCEWP_t = .764RCSPY_t + e_t$
	$RCEWT_t = .91RCSPY_t + e_t$	$RCEWT_t = .784RCSPY_t + e_t - .29\ e_{t-1}$
	$RCEWA_t = .24\ RCEWP_{t-1} + e_t$	$RCEWA_t = .27RCSPY_t + .23RCEWP_t + e_t - .56e_{t-1}$
	$RCEWO_t = .25\ RCEWA_t + e_t$	$RCEWO_t = e_t - .30\ e_{t-1}$
Dec-Feb	$RCSPY_t = .25RCEWP_t + .11RCEWT_t + .24RCEWA_t + e_t$	$RCSPY_t = .43RCEWP_t - .32\ RCSPY_{t-1} + .15\ RCEWT_t + e_t$
	$RCEWP_t = .465RCSPY_t + .14RCEWT_t + .43RCEWO_t + e_t$	$RCEWP_t = .74\ RCSPY_t + e_t$
	$RCEWT_t = 1.12RCSPY_t + e_t$	$RCEWT_t = .72\ RCEWP_t + e_t$
	$RCEWA_t = .34RCSPY_t + e_t$	$RCEWA_t = .264\ RCSPY_t - .29\ RCEWA_{t-1} + e_t$
	$RCEWO_t = .275RCEWP_t + e_t$	$RCEWO_t = e_t$
	2003	2004
Jan-Mar	$RCSPY_t = .42RCEWP_t + .18\ RCEWT_t + e_t$	$RCSPY_t = .14\ RCEWT_t + .31\ RCEWA_t + e_t$
	$RCEWP_t = .85RCSPY_t + .37RCEWO_t + e_t$	$RCEWP_t = .57\ RCEWA_t + .52RCEWO_t + e_t$
	$RCEWT_t = 1.10RCSPY_t + e_t - .27e_{t-1}$	$RCEWT_t = 1.83\ RCSPY_t + e_t - .54\ e_{t-1}$
	$RCEWA_t = .20\ RCEWP_t + e_t$	$RCEWA_t = .49\ RCSPY_t + .47\ RCEWP_t + e_t$
	$RCEWO_t = .18\ RCEWP_t + e_t$	$RCEWO_t = .51\ RCEWP_t + .16\ RCEWT_t + e_t$
Feb-Apr	$RCSPY_t = .48\ RCEWP_t + .14\ RCEWT_t + e_t$	$RCSPY_t = .28\ RCEWP_t + .14\ RCEWT_t + e_t$
	$RCEWP_t = .83\ RCSPY_t + .155Rcewt_t + e_t$	$RCEWP_t = .42RCSPY_t + .36RCEWA_t + .47RCEWO_t + e_t - .32e_{t-1}$
	$RCEWT_t = .62\ RCSPY_t + .48\ RCEWP_t + e_t$	$RCEWT_t = 1.97\ RCSPY_t - .50\ RCEWA_t + .72\ RCEWO_t + e_t$
	$RCEWA_t = .172RCEWP_t + e_t$	$RCEWA_t = .40RCSPY_t + .52RCEWP_t + e_t$
	$RCEWO_t = e_t$	$RCEWO_t = .45RCEWP_t + .13RCEWT_t + e_t$
Mar-May	$RCSPY_t = .39\ RCEWP_t + .21RCEWT_t + e_t$	$RCSPY_t = .27\ RCEWP_t + .11\ RCEWT_t + e_t$
	$RCEWP_t = .80\ RCSPY_t + .33\ RCEWA_t + e_t - .39\ e_{t-1}$	$RCEWP_t = .76\ RCSPY_t + .53RCEWO_t + e_t - .50e_{t-1}$
	$RCEWT_t = 1.20\ RCSPY_t + e_t$	$RCEWT_t = 1.46\ RCSPY_t + .62\ RCEWO_t + e_t$
	$RCEWA_t = .23\ RCEWP_t + e_t$	$RCEWA_t = .69RCSPY_t + .40\ RCEWP_t + e_t$
	$RCEWO_t = e_t$	$RCEWO_t = .45\ RCEWP_t + .13\ RCEWT_t + e_t$
Apr-Jun	$RCSPY_t = .38RCEWP_t + .21\ RCEWT_t + e_t$	$RCSPY_t = .17RCEWP_t + .07RCEWT_t + .13RCEWA_t + e_t$
	$RCEWP_t = .706RCSPY_t + e_t$	$RCEWP_t = .68RCSPY_t + .26RCEWA_t + .32RCEWO_t + e_t$
	$RCEWT_t = 1.03\ RCSPY_t + e_t$	$RCEWT_t = 1.25\ RCSPY_t + .60RCEWA_t + e_t$
	$RCEWA_t = .31RCEWP_t + e_t$	$RCEWA_t = .68RCSPY_t + .25\ RCEWP_t + .45RCEWO_t + e_t$
	$RCEWO_t = e_t$	$RCEWO_t = .26\ RCEWP_t + .37\ RCEWA_t + e_t$
May -Jul	$RCSPY_t = .34RCEWP_t + .29\ RCEWT_t + e_t$	$RCSPY_t = .15RCEWP_t + .21\ RCEWA_t + e_t$
	$RCEWP_t = .71RCSPY_t + .22\ RCEWA + e_t$	$RCEWP_t = .64\ RCSPY_t + .48\ RCEWA_t + e_t$
	$RCEWT_t = 1.61RCSPY_t + e_t$	$RCEWT_t = 1.04\ RCEWA_t + e_t$

Table 1 (cont.). Summary of findings on linkages among the exchange-traded funds (January 2001-December 2004)

	2003	2004
May -Jul	$RCEWA_t = .41\ RCEWP_t + e_t$	$RCEWA_t = .32\ RCEWP_t + .16RCEWT_t + .36RCEWO_t + e_t$
	$RCEWO_t = .35\ RCEWP_t + e_t$	$RCEWO_t = .29\ RCEWA_t + e_t$
Jun-Aug	$RCSPY_t = .35\ RCEWP_t + .20\ RCEWT_t + e_t - .31\ e_{t-1}$	$RCSPY_t = .17\ RCEWT_t + .15\ RCEWO_t + e_t$
	$RCEWP_t = .575RCSPY_t + e_t$	$RCEWP_t = .41\ RCSPY_t + .49\ RCEWA_t + e_t - .45e_{t-1}$
	$RCEWT_t = 1.45\ RCSPY_t + e_t$	$RCEWT_t = 1.17\ RCSPY_t + .73\ RCEWP_t + e_t$
	$RCEWA_t = .178RCEWT_t + e_t$	$RCEWA_t = .471RCEWP_t + .225RCEWO_t + e_t$
	$RCEWO_t = .29\ RCEWA_t + e_t - .54e_t$	$RCEWO_t = .57\ RCSPY_t + .39\ RCEWA_t + e_t$
Jul-Sep	$RCSPY_t = .39\ RCEWP_t + .19\ RCEWT_t + e_t$	$RCSPY_t = .24\ RCEWP_t + .15Rcewt_t + e_t$
	$RCEWP_t = .63\ RCSPY_t + e_t$	$RCEWP_t = .33RCSPY_t + .18Rcewt_t + .22RCEWA_t + e_t$
	$RCEWT_t = 1.63\ RCSPY_t + e_t$	$RCEWT_t = .79\ RCSPY_t + .69\ RCEWP_t + e_t$
	$RCEWA_t = .34\ RCEWP_t + .35\ RCEWO_{t-1} + e_t$	$RCEWA_t = .45\ RCEWP_t + e_t$
	$RCEWO_t = 34\ RCSPY_t + e_t$	$RCEWO_t = .70RCSPY_t + e_t$
Aug-Oct	$RCSPY_t = .31RCEWP_t + .19\ RCEWT_t + .16RCEWO_t + e_t$	$RCSPY_t = .33\ RCEWP_t + .17\ RCEWT_t + e_t$
	$RCEWP_t = .49\ RCSPY_t + .31RCEWA_t - .38RCEWP_{t-1} + e_t$	$RCEWP_t = .58\ RCSPY_t + .20\ RCEWO_t + e_t$
	$RCEWT_t = 1.28\ RCSPY_t + e_t$	$RCEWT_t = .94\ RCSPY_t + .50RCEWP_t + e_t$
	$RCEWA_t = .30\ RCEWP_t + e_t$	$RCEWA_t = .31\ RCEWP_t + .13\ RCEWT_t + e_t$
	$RCEWO_t = .315\ RCSPY_t + e_t$	$RCEWO_t = .43RCEWP_t - .20\ RCEWT_{t-1} + e_t$
Sep-Nov	$RCSPY_t = .275\ RCEWP_t + .20\ RCEWT_t + e_t$	$RCSPY_t = .28\ RCEWP_t + .18\ RCEWT_t + e_t$
	$RCEWP_t = .54RCSPY_t + .40RCEWA_t + .25RCEWO_t - .57RCEWP_{t-1} + e_t$	$RCEWP_t = .643RCSPY_t + .48RCEWO_t + e_t$
	$RCEWT_t = 1.17\ RCSPY_t + .45\ RCEWA_t + e_t$	$RCEWT_t = 1.32\ RCSPY_t + .52\ RCEWO_t + e_t$
	$RCEWA_t = .37\ RCEWP_t + e_t$	$RCEWA_t = .37\ RCSPY_t + .28\ RCEWP_t + e_t$
	$RCEWO_t = .375\ RCEWP_t + e_t$	$RCEWO_t = .53\ RCEWP_t + e_t$
Oct-Dec	$RCSPY_t = .22\ RCEWT_t + .22\ RCEWO_t + e_t$	$RCSPY_t = .25\ RCEWP_t + .22\ RCEWT_t + e_t$
	$RCEWP_t = .47RCSPY_t + .38\ RCEWA_t + .39\ RCEWO_t + e_t - .49e_{t-1}$	$RCEWP_t = .388RCSPY_t + .491\ RCEWO_t + e_t$
	$RCEWT_t = 1.14\ RCSPY_t + e_t - .43\ e_{t-1}$	$RCEWT_t = 1.3\ RCSPY_t + e_t$
	$RCEWA_t = .40\ RCEWP_t + e_t$	$RCEWA_t = .49\ RCEWO_t + e_t$
	$RCEWO_t = .53\ RCEWP_t + e_t - .33\ e_t$	$RCEWO_t = .79\ RCEWP_t + e_t$
Nov-Jan	$RCSPY_t = .16\ RCEWT_t + .16\ RCEWO_t + e_t$	
	$RCEWP_t = .17\ RCEWT_t + .28\ RCEWA_t + .46\ RCEWO_t + e_t$	
	$RCEWT_t = .95\ RCSPY_t + e_t - .35\ e_{t-1}$	
	$RCEWA_t = .50\ RCEWP_t + e_t$	
	$RCEWO_t = .71\ RCEWP_t + e_t$	
Dec-Feb	$RCSPY_t = .15\ RCEWT_t + .19\ RCEWA_t + e_t$	
	$RCEWP_t = .41\ RCEWA_t + .48\ RCEWO_t + e_t$	
	$RCEWT_t = 1.04\ RCSPY_t + e_t - .38e_{t-1}$	
	$RCEWA_t = .65\ RCEWP_t + e_t$	
	$RCEWO_t = .65\ RCEWP_t + e_t$	

Note: Coefficients reported (significant at the 5% level) indicate how the returns on a single ETF are affected by other ETF returns.

We first note that during the sample period, the US market (RCSPY) can be explained as a function of the Spanish (RCEWP) and the Taiwanese (RCEWT) markets. Only in year 2004 we do find Australia (RCEWA) entering into the picture to affect the US market. The result should not be surprising because we earlier found the correlation between US (RCSPY) and Austria (RCEWO) and Australia (RCEWA) to be lower than that of the U.S. and Taiwanese (RCEWT) markets.

Turning next to the European markets and starting with Spain, we note that Spanish market behavior may be explained by the U.S. market and to a lesser extent, by the Austrian market, but not by the Taiwanese market. The main implication of this finding is that both Spanish and Taiwanese investors can invest in each others' markets for effective portfolio diversification. However, diversification benefits for Spanish investors are greatly diminished if they invest only in the U.S. in addition to their own markets.

The Austrian market (RCEWO) is explained by the Spanish market (RCEWP), but the influence of the other markets including the US is minimal. In fact, during the 46 periods examined over four years, the RCSPY appeared in the equation only four times. The same is true for the remaining markets – Australia and Taiwan. Therefore, Austria appears to be a very good market for American, Taiwanese and Australian investors for portfolio diversification. It should be noted, however, that even the Austrian market moved toward more integration with the other markets toward the end of the sample period in 2004.

Turning to Asian markets and starting with Taiwan we note the considerable influence of the US market – RCSPY appearing 44 times out of 46 in the equation as being a significant determinant. It may be recalled that the correlation analysis conducted earlier confirms this strong relationship, implying that the US and Taiwanese markets are closely integrated reducing diversification opportunities for American investors. However, European investors (Spanish and Austrian) can continue to realize diversification benefits if they invest in Taiwan. RCEWP (RCEWO) representing Spain (Austria), appeared as significant only 4 (8) times out of 46 periods studied.

Australian and Austrian markets do not seem to be correlated. The same can be said of the Australian and Taiwanese markets. We found it surprising that the Australian market seemed to be much more integrated with the Spanish than it is with the US market. RCEWP (Spain) appeared in the equation 28 out of 46 times while RCSPY (US) appeared only 18 times. The implications include Australian market being a good place to invest for diversification by Austrians, Taiwanese and to a lesser extent, by the Americans, but not by Spaniards. It may be noted that these findings are very much in line with the findings of other researchers in the field: Cochran and Mansur (1991) find that the international equity markets are not completely integrated.

4. Effect of the Iraq war on co-movements among markets

Finally, we utilized event methodology to study the effect of the Iraq war on the equity market co-movement. Longin & Solnik (1995), Karolyi & Stulz (1996) and Edwards & Susmel (2001) are examples of the studies that find that the correlations between the major stock markets increase after global shocks. To see if data used in this study could provide support for the above hypothesis, we study the effect of the Iraq war on the co-movement of markets. The Iraq war, following the September 11, 2001 terrorist attacks in New York in Washington, DC, is an important event to study not only because of its implications for future conflicts (the Bush doctrine) and oil prices but also because it has created rifts in important long-term alliances in the world.

It should be noted that one drawback of using event study methodology is that an event study approach does not help to identify the particular channel through which the specific events studied are transmitted. The second drawback of the event study methodology is that it is useful in analyzing short-run linkages. If the period of investigation following the event is too long, then other events may have occurred which affect the variables under examination, thereby making clear identification of separable events difficult or even impossible.

To investigate the effect of the Iraq war (March 20, 2003) on the stability of the interdependence of the markets, we utilized both the Fisher Z (Stuart & Ord, 1987) and the Jennrich (1970) tests of correlations along with F-tests of variances. The null hypotheses were that the correlations would remain stationary over the adjacent sub-periods. For maximum gain in relative efficiency when testing the correlations of two different samples, it is recommended that the period before the event should exceed the period after the event (Srivastava and Bancroft, 1967). Accordingly, we chose sample sizes of twenty-seven weeks (137 trading days) before and thirteen weeks (65 trading days) after the Iraq war.

To determine whether the change in the correlations resulted from the change in the volatility of the ETF or the change in the interdependence of markets, we used the F-tests. The null hypotheses were that variances remain stationary over the adjacent sub-periods.

5. The findings

The findings indicate that the Iraq war does have a significant effect on some (but not all) of the correlation coefficients of the ETF. Interestingly, most of the correlation coefficients increased in magnitude,

a result consistent with the previous findings in the literature. However, both tests of significance indicate that only the change in correlation between Spain and Australia increased significantly. Also found to be significant is the decline in the correlation coefficient between US and Austria. Thus, our results do support the hypothesis that the correlations change significantly after an exogenous and unexpected shock. Nevertheless, when examining the results of the F-tests, we note that variances have all changed significantly (Table 2.2). The changes of variances suggest that the results obtained earlier may be in question. In other words, the F-test results suggest that the change in the above correlations may be a result of the change in volatility (in the sense of changing variances) rather than the result of the changes in the interdependence among markets.

An example should help clarify this issue. Earlier it was indicated that the correlation coefficient between US and Austria significantly declined. Also, the F-tests revealed that the variances of the both country ETF changed significantly. Together these findings imply that the decline in the correlation coefficient of US and Austria may not be associated with the change of interdependence of markets, but may instead be due to the change in the volatility (in the sense of change in variance) in the respective country ETF. Similarly, the correlation coefficient between Spain and Australia (RCEWP and RCEWA) significantly increased after the Iraq war. However, since the results of the F-test indicate that the variances of both of these ETF have significantly changed (Table 2.2), it would be incorrect to claim that these markets became more interdependent after the war. The fact that the correlation coefficient between the two markets increased may be the result of the greater volatility (change in variance) within one or both markets as opposed to increasing interdependence between the two markets. In short, changing variances in a market between the pre- and post-periods of an event do not allow us to reach unambiguous conclusions based only on changes in the inter-market correlations.

Table 2.1. The effect of the Iraq war on correlations

	Before Iraq war (n=137)	After Iraq war (n=65)	Jennrich χ^2	Fisher Z transfer
RCSPY&RCEWP	.569	.616	.174	-.469
RCSPY &RCEWT	.511	.583	.292	-.677
RCSPY &RCEWA	.436	.415	.029	.172
RCSPY &RCEWO	.099	-.362	9.404***	3.119***
RCEWP & RCEWT	.380	.499	.708	-.958
RCEWP & RCEWA	.227	.463	2.644	-1.781*
RCEWP & RCEWO	.194	-.036	2.416	1.514
RCEWT & RCEWA	.290	.339	.118	-.360
RCEWT & RCEWO	-.055	-.123	.206	.448
RCEWA & RCEWO	.036	.009	.032	.177

Notes: Figures represent correlation coefficients before and after the Iraq war. The last two columns report the results of two different tests of significance. *** – significant at $\alpha = .01$, ** – significant at $\alpha = .05$, * – significant at $\alpha = .1$.

Table 2.2. Variances before and after the Iraq war

	Before Iraq war (n=137)	After Iraq war (n=65)	F Statistics
RCSPY	2.66	1.91	1.39**
RCEWP	3.46	1.98	1.75***
RCEWT	8.68	4.72	1.84***
RCEWA	1.85	1.60	1.60***
RCEWO	2.07	3.74	1.81***

Notes: Figures represent variances before and after the Iraq war. The last column reports the results of the F-test, indicating whether the changes in the variances are significant. *** – significant at $\alpha = .01$, ** – significant at $\alpha = .05$, * – significant at $\alpha = .1$.

In summary, while it is difficult to interpret these findings without going into a more detailed analysis of the data, it appears that correlations among the countries (as measured by their respective ETF) studied here do increase (8 out of 10) after an exogenous shock but that this does not necessary have directional implications because they may be caused by intra-market volatility as opposed to market interdependence.

Summary and conclusions

International equity portfolio diversification has been recommended on the basis of the low correlation between national stock markets. Clearly, this recommendation makes a lot of sense if the correlation among the national markets remains low and stable. On the other hand, if, as some recent studies have shown, the correlation is increasing due perhaps to the growing interdependence among the international markets, then benefits of international portfolio diversification may be overstated.

Last decade has seen the removal of many of the impediments to international trade and perhaps more importantly to foreign direct investment thanks to the efforts of GATT and later WTO. Along with increases in international trade and investment flows, there have been tremendous increases in international flow of financial assets. Therefore, more integrated economies may imply that most firms are now international and therefore more influenced by global factors.

In investigating the short-term co-movements among the emerging markets of Europe (Austria and Spain), Asia (Australia and Taiwan) and the U.S, our findings indicate that there is statistically significant correlation among markets measured by respective ETF. However the level of correlation varies and is less than perfect. Therefore, it is possible to reduce portfolio risk by including ETF of foreign market with relatively low correlation with the investor's home market. Combining both correlation and MARMA (and regression) results, an American investor holding a portfolio of domestic stocks will have better diversification and risk reduction benefit by investing in either the Austrian or the Australian market ETF or both. Similarly, Austrian investors can invest in the US, Australia and Taiwan but not in Spain. This is so because Austria-Spain combination will yield less diversification benefits than others since Austrian and Spanish markets have higher correlation than the others. Also found were both Taiwanese and Spanish investors can invest in each others' markets for effective portfolio diversification. However, diversification benefits for both groups are greatly diminished if they invest only in the US besides their own markets.

Also, risk premium on the world market portfolio will increase along with the increases in the cost of capital for individual firms (Karolyi & Stulz, 1996). Indeed, some recent studies have shown that the international correlation increases in periods of high volatility when global factors dominate national ones. Examples include oil shocks, major terrorist events and wars. There is also evidence that markets could be more highly correlated when they go down rather than up (Longin & Solnik, 1995). Comparison of pre and post correlations after the Iraq war revealed that change in correlations among the markets may be due to increasing volatility within markets as opposed to increasing interdependence among them. This conclusion is based on the significant changes in market volatility (as evidenced by the F-tests) as well as changes in the inter market correlations.

References

1. Arshanapalli, B., Doukas, J., 1993. International stock market linkages: evidence from the pre- and post October 1987 period. *Journal of Banking and Finance* 17, 193-208.
2. Ball, A.C., Torous, W. N., 2000. Stochastic correlation across international stock markets. *Journal of Empirical Finance* 7, 373-388.
3. Barari, M.B., Lucey, M. and Voronkova, S., 2005. Integration among G7 equity markets: Evidence from iShares. *IIIS Discussion Paper* No. 78.
4. Bracker, B., Koch, P.D., 1999. Economic determinants of the correlation structure across international equity markets. *Journal of Economics and Business* 51, 443-456.
5. Chen, G.M., Firth, M., Rui, O.M., 2002. Stock market linkages: evidence from Latin America. *Journal of Banking and Finance* 26, 1113-1140.
6. Choudhry, T., 1997. Stochastic trends in stock prices: evidence from Latin American markets. *Journal of Macroeconomics* 19, 285-304.
7. Cochran, S J., Mansur, I., 1991. The interrelationships between U.S. and foreign equity market yields: Tests of Granger causality. *Journal of International Business Studies* 22, 723-736.
8. Cosset, J.C., Suret, J.M., 1995. Political risk and the benefits of international portfolio diversification. *Journal of International Business Studies* 26, 301-318.
9. Durand, R.B., Scott, D., 2003. IShares Australia: A clinical study in international behavioral finance. *International Review of Financial Analysis* 12, 223-239.
10. Forbes, K., Rigobon, R., 1999. No contagion, only interdependence: measuring stock market co-movements. NBER Working Paper No. 7267.
11. Francis, B.B., Leachman., 1998. Superexogeneity and the dynamic linkages among international equity markets. *Journal of International Money and Finance* 17, 475-494.
12. Gastineau, G.I. 2003. The Exchange-Traded Funds Manual, Wiley: New York.
13. Grubel, H.G. 1968. Internationally diversified portfolios: Welfare gains and capital flows. *The American Economic Review* 58 (5): 1299-1314.

14. Jennrich, R., 1970. An asymptotic chi-square test for the equity of two correlation matrices. *Journal of the American Statistical Association* 65, 904-912.
15. Kaplanis, E.C. 1988. Stability and forecasting of the co-movement measures of International stock market Returns. *Journal of International Money and Finance* 8, 63-75.
16. Karolyi, A., Stulz, R.M., 1996. Why do markets move together? An investigation of U.S.-Japan stock return comovements. *Journal of Finance* 51, 951-986.
17. Kasa, K. 1992. Common stochastic trends in international stock markets. *Journal of Monetary Economics* 29, 95-124.
18. Kose, A.M., Prasad, S.E. and Terroncs, M.E., 2003. Volatility and co movement in a globalized world economy: An empirical exploration. International Monetary Fund, IMF working papers 03/246.
19. Levy, H. and L. Sarnat., 1970. International diversification of investment portfolios. *The American Economic Review* 60 (4), 668-675.
20. Longin, F., Solnik, B., 1995. Is the correlation in international equity returns constant: 1960-1990? *Journal of International Money and Finance* 14, 3-26.
21. Madura, J., 2003. International Financial Management. South-Western: Cincinnati, OH.
22. Manning, N., 2002. Common trends and convergence? South East Asian equity markets. *Journal of International Money and Finance* 21, 183-2002.
23. Makridakis, S., S.C. Wheelwright; and V.C. McGee., 1983. Forecasting Methods and Applications 2nd ed., Wiley.
24. Meric, I., Meric, G., 1997. Co-movements of European equity markets before and after the 1987 crash. *Multinational Finance Journal* 1, 137-154.
25. Olienyk, J.P., R.G. Schwebach., Zumwalt, 1999. WEBS, SPDRs, and country funds: an analysis of international co-integration, *Journal of Multinational Financial Management* 9, 217232.
26. Ratner, M., 1992. Portfolio Diversification and the Intertemporal Stability of International Indices, *Global Finance Journal* 3, 67-78.
27. Rezayat, F., Yavas, B., 2003. Short-term Linkages Among the US, UK, French, German and the Japanese Stock Markets during 1999-2001, *Proceedings of the Global Business and Technology Association*, Budapest, Hungary: July 10-14.
28. Rezayat, F., Yavas, B.F, 2006. International portfolio diversification: A study of linkages among the US, European and the Japanese equity markets, *Journal of Multinational Financial Management*, 2006. – №. 16. – pp. 440-458.
29. Saunders, L.A. "Best Ideas for 2007 and Beyond: Be the Smart Money." Schwab Investing Insights, 21 December 2006.
30. Solnik, B., Boucrelle, C., Fur, Y.L., 1996. International market correlation and volatility. *Financial Analysis Journal* 52, 17-34.
31. Srivastava, S.R., Bancroft, T.A., 1967. Inferences concerning a population correlation coefficient from one or possibly two samples subsequent to a preliminary test of significance. *Journal of the Royal Statistical Society* 29, 282-291.
32. Stuart A., Ord, J.K., 1987. Kenall's Advanced Theory of Statistics. John Wiley: New York.
33. Yavas, B., Rezayat, F., Bilici, H., 2004. A study of correlation between international equity markets using exchange traded funds. *Journal of Asia Pacific Business* 5, 67-82.
34. Economic Affairs. Encyclopedia Britannica. Retrieved June 4, 2003, from Encyclopedia Britannica Online.<http://search.eb.com/eb/article?eu=369445>

Appendix

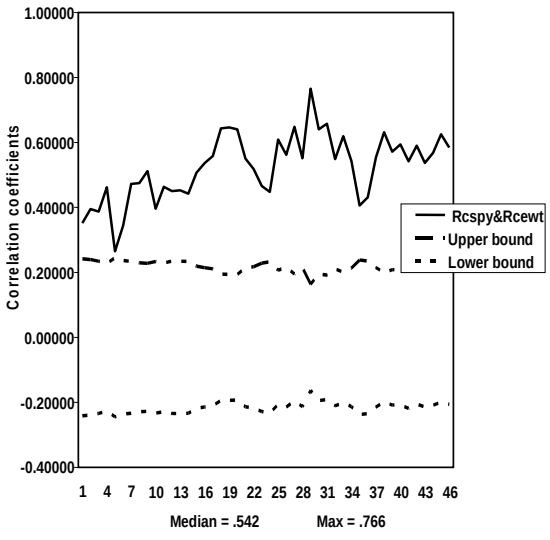


Fig. 1. Moving correlation coefficients between Rcspy & Rcewt

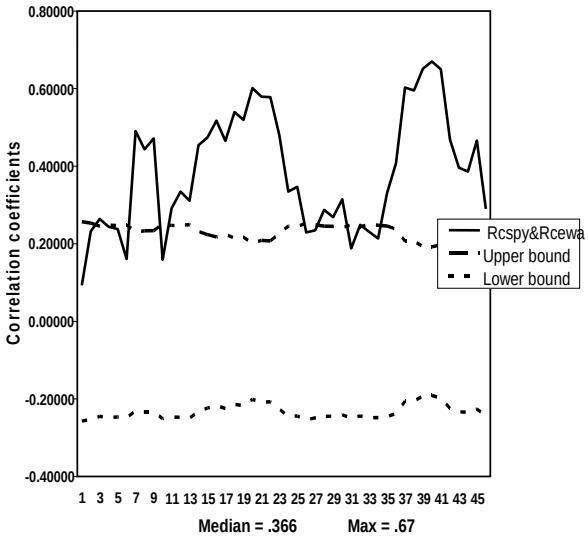


Fig. 2. Moving correlation coefficients between Rcspy & Rcewa

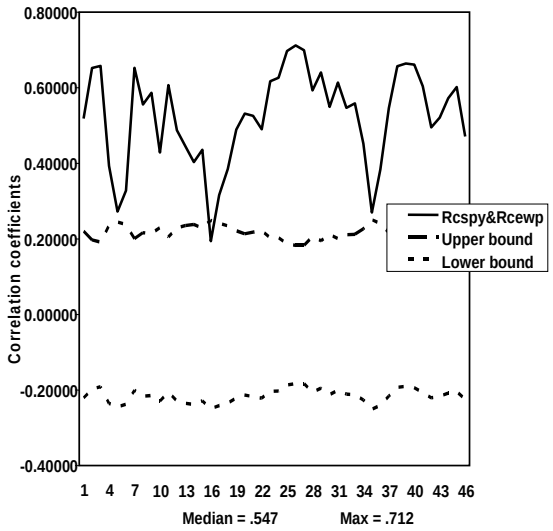
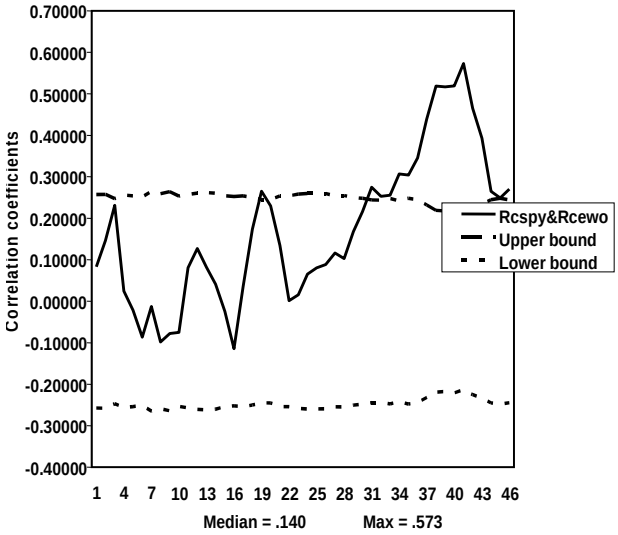


Fig. 3. Moving correlation coefficients between Rcspy & Rcewp



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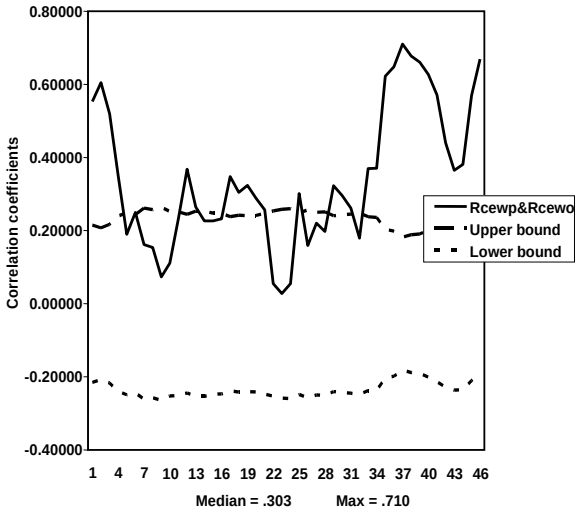


Fig. 5. Moving correlation coefficients between Rcewp & Rcewo

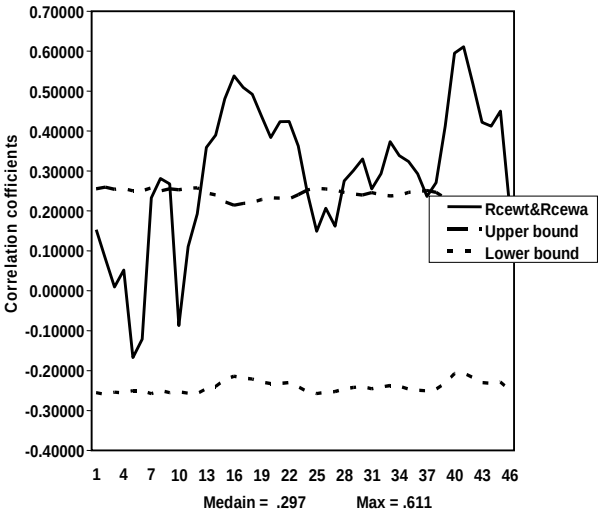


Fig. 6. Moving correlation coefficients between Rcewt & Rcewa

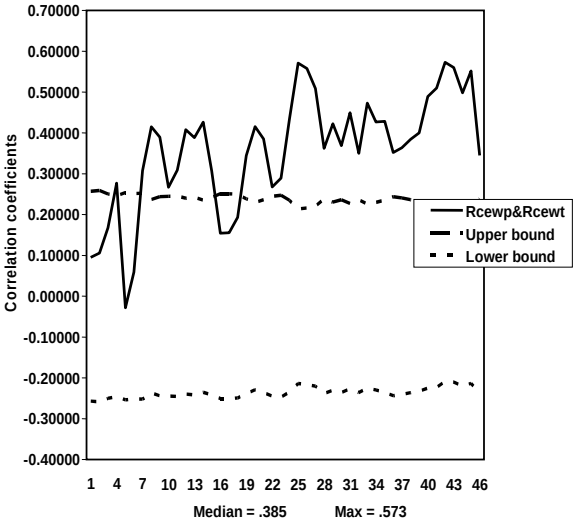
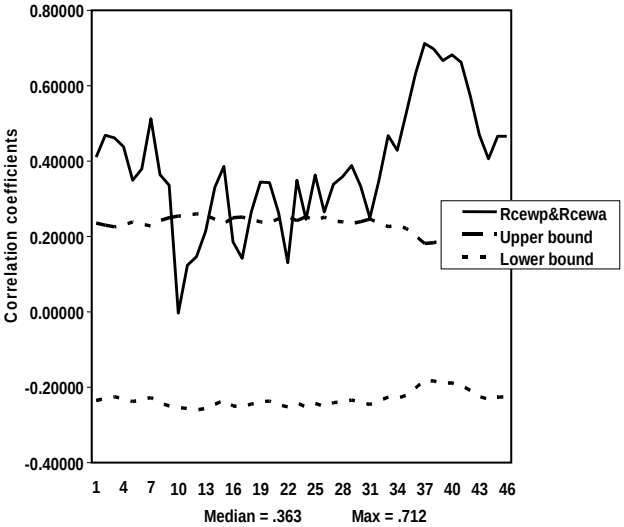


Fig. 7. Moving correlation coefficients between Rcewt & Rcewp



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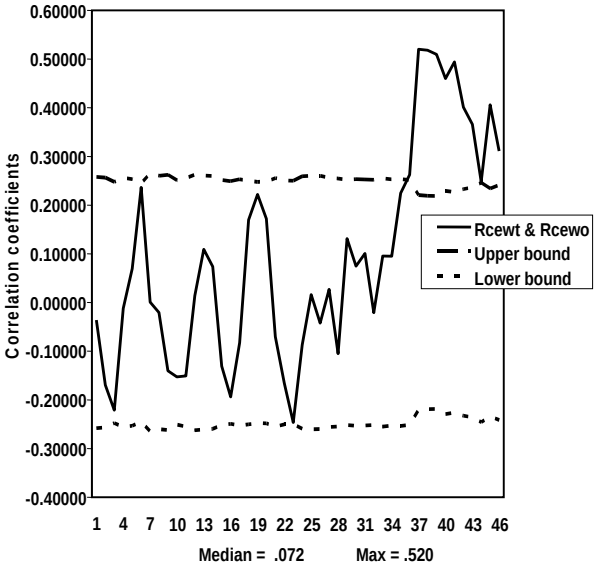

Fig. 9. Moving correlation coefficients between Rcewt & Rcewo

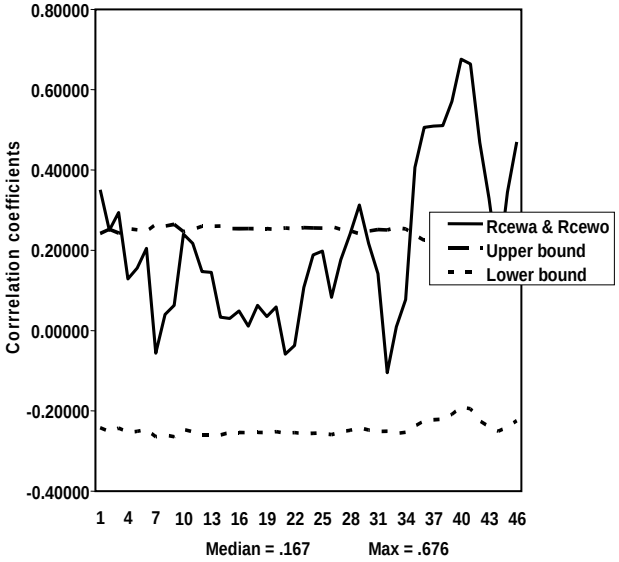

Fig. 10. Moving correlation coefficients between Rcewa & Rcewo