

AN INVESTIGATION OF THE EQUITY MARKET VOLATILITY: EVIDENCE FROM USA, CANADA, GERMANY AND CHINA

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ABSTRACT

In this paper, we study return volatilities across different equity markets. Our sample includes USA and Canada from North America; Germany from Europe and China from Asia. We investigate whether the co-movements of return volatilities across the sample countries are significant, whether they are changing (increasing or decreasing) over time and the implications for international investors for such movements. The findings indicate that the markets are sufficiently integrated so that each market responds to both current and historical news generated in the other markets. The integration is much more complete among the markets of the US, Canada and Germany and to a lesser extent when we include China. Collectively the findings imply that investment and fund managers with access to news on other markets may react to changes faster than those who do not.

INTRODUCTION

The paper which studies international portfolio diversification continues our previous research utilizing data from various equity markets in North America, Europe and Asia. Rezayat and Yavas [1] concluded that even though interdependencies among the major markets are significant there is still room for investors to diversify their portfolios to reduce risk. Like many other studies, the Rezayat and Yavas article utilized broad market indices, like S&P 500, DAX 30, CAC 40 and FTSE 100 to reach their conclusions.

The second article by Yavas and Rezayat [2] investigated the same research question but utilized data on Exchange Traded Funds (ETFs). The idea was to 1) avoid difficulties associated with using asynchronous data and 2) utilize the instruments easily used by investors since they trade on the stock exchanges in the US. Similar findings were obtained in that ETFs provide useful vehicle for investors to diversify their portfolios across different countries.

Additionally, both studies applied event methodology to test the hypothesis of changing correlations among equity markets in response to exogenous shocks. Findings indicated that (1) correlations among the major stock market indices do change after an exogenous shock and (2) the direction of the change depends on the specific event studied in terms of how it is perceived to affect different countries.

After the great recession of 2008-2010, the interest has shifted to the concept of return volatility. Closer observers of the equity markets have been paying a lot of attention to volatility measures such as VIX index. On average, investors turn bullish when they think a stock is headed higher and bearish when they fear that all is lost. The trouble with this strategy is that during these extremes in sentiment they often lose. While conventional financial theory suggests that markets behave rationally (efficient market hypothesis), not accounting for the emotional aspect of the trade often leads to the wrong entry and exit points. That is the reason why traders turn their attention on the VIX indicator to assess whether or not the current market sentiment is excessively bullish or bearish.

In this paper, we study return volatilities across different equity markets. Our sample includes USA and Canada from North America; Germany from Europe and China from Asia. We have chosen these countries because 1) they represent the major markets in their respective continents and 2) previous research has indicated that they tend to move together (especially, US, Canada and Germany)---that is, they are highly correlated. We investigate whether the co-movements of return volatilities across the sample countries are significant, whether they are changing (increasing or decreasing) over time and the implications for international investors for such movements. The main objective is to contribute to and expand upon the literature on the linkages among international equity markets. In examining the co-movements of American, Canadian, German and Chinese equity markets, we seek to identify diversification opportunities for international investors and investigate the stability of the relationships among these markets. The focus of the paper is on country diversification, and not on whether industry international diversification constitutes a better off portfolio strategy.

LITERATURE REVIEW

There is a body of empirical evidence that indicates that a diversified portfolio of securities, for example 20 randomly selected stocks, holds much less risk (measured by the standard deviation of returns) than an individual security. This follows because 1) the standard deviation of returns from a single stock in a portfolio is much larger than the standard deviation of the entire portfolio and 2) the standard deviation of returns on a portfolio declines as the number of stocks in the portfolio rises towards 20. An important result of holding a diversified portfolio is that a diversified portfolio follows the market very closely, while an individual stock or a portfolio of stocks from a single industry may not closely follow the overall market.

In a similar manner, worldwide diversification, adding some international stocks to the portfolio, may further reduce risk, if 1) movements in international stock markets are not perfectly correlated and 2) correlations of the returns between international stock markets are positive; investors can benefit by spreading their investments across multiple markets. However, when we examine the recent data, it appears that the global equity markets have steadily become more correlated. In fact, anyone who follows financial headlines closely may note that one any given day a sell-off in the US the day before has spread to Asia and Europe. It is argued that 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) Abolishment of foreign exchange controls.

The fundamental rationale for international portfolio diversification is that it expands the opportunities for gains from portfolio diversification beyond those that are available through domestic securities. However, if international stock market correlations are higher than normal in bear markets, then international diversification will fail to yield the promised gains just when they are needed most. The motivation to study return volatility relationships stems from the fact that global financial crisis that started in 2008 in the USA has spread to the rest of the world during the period under study in this paper resulting in considerable volatility in international equity markets.

Much of the earlier research concentrated exclusively on spillover of the first moment, that is, co-movement among the returns. However, more recent research has demonstrated that that much of the information would be revealed in the volatility of stock prices. In other words, studying the transmission of stock market movements is a joint study of the spillover of prices as well as the volatility of prices. Therefore, volatility linkages are another significant aspect of international financial relations. Several studies, such as [3] have pointed out that much of the information would be revealed in the volatility of stock prices.

Unlike only return co-movement, studies examining the spillover of information both in terms of return and volatility include [4], [5], and [6]. These studies found intra-regional volatility spillovers to be more significant than the inter-regional spillovers. Studies like [7], [8], and Johnson [9] have focused also on the factors affecting the spillover of information across the national equity markets. Also, Pretorius [8] found that bilateral trade, inflation rate differential, industrial production growth differential, interest rate differential, stock market size and volatility, region etc. are some of the important factors that can affect the spillover of information among the markets.

DATA AND METHODOLOGY

Our long term aim is to utilize both equity market indices and Exchange traded Funds (ETFs) and compared the results obtained from both sets of data. However, the present study utilizes the ETF data. Designed to mimic the movements of MSCI indices, ETF securities provide an easy pool of international diversification products for the investor. As such they allow us to conduct an analysis of the sample equity markets volatility devoid of problems associated with trading restrictions, exchange rates fluctuations and non-synchronous trading. The following ETFs are used in this study:

US: SPY: The SPDR S&P 500 ETF

Canada: EWC: The iShares MSCI Canada Index Fund.

China: GXC China Index Fund.

Germany: EWG: The iShares MSCI Germany Index Fund.

This study uses data for the period of January 2008-December 2010. To calculate the daily volatility we employed the Garman Glass historical volatility estimator. It assumes Brownian motion with zero drift. This is currently the preferred version of open-high-low-close volatility estimator for zero drift.

$$V_t = (\ln(C_{t-1}/O_t))^2 + 0.5 (\ln(H_t/L_t))^2 - (2\ln(2)-1)(\ln(C_t/O_t))^2 \quad (1)$$

Where O_t , H_t , L_t , C_t are respectively open, high, low and close price for the day t .

To examine the short-term linkages between the daily volatility of the indices, we sliced the data into 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–March. The second segment contains daily data for February–April. Thus, in every two successive segments a two-month data overlap exists. This two-month overlap not only smooth the causal relationship, but it also helps identify the month in which a change has occurred and possibly helps to isolate the source of the change.

RESEARCH FINDINGS

Three month moving correlations are used to analyze the trend and interdependence of markets movement in volatility. For the analysis we use the SPSS for Windows. We first present the data in terms of calculated volatilities over the sample period: 2008-2010. Due to space limitations, we do not present the figures. However, suffice it to say that there is considerable volatility of returns in the US market (SPY), Canada (EWC) and Germany (EWG) during the sample period. In comparison, volatility of returns in China (GXC) appears to be lower than the others. If the data are analyzed annually, we note that early 2008 and late 2010 are associated with higher volatility whereas 2009 appears to be less volatile except one brief period in the middle of the year. It appears that equity market volatility goes hand in hand with economic news which includes announcements by the FED on quantitative easing, Euro zone debt crisis and unemployment statistics.

After observing the volatility of returns over, we next calculate the bivariate correlation coefficients and conduct the following tests of hypotheses to study whether they are statistically significant.

$$H_0: \rho_{ij}=0; H_1: \rho_{ij} \neq 0; \text{ for all } i,j \quad (2)$$

Where $i \& j = \text{SPY, EWG, EWC, GXC}$,

Table 1 summarizes our results. The upper bound and lower bound on each figure identify the results of the tests at the 5% level of significance.

Table 1- Summary of Three Month Moving correlations

Period	REWC&EWG	REWC&SPY	REWC&GXC	REWG&SPY	REWG&GXC	RSPY&GX
Jan-Mar 08	.937 (0.000)	.869 (0.000)	0.951 (0.000)	.923 (0.000)	0.950 (0.000)	0.902 (0.000)
Feb-Apr 08	0.547 (0.000)	0.566 (0.000)	0.535 (0.000)	0.740 (0.000)	0.516 (0.000)	0.694 (0.000)
Mar-May 08	0.680 (0.000)	0.580 (0.000)	0.536 (0.000)	0.841 (0.000)	0.698 (0.000)	0.738 (0.000)
Apr-Jun 08	0.256 (0.000)	0.258 (0.000)	0.258 (0.000)	0.504 (0.000)	0.018 (0.885)	0.295 (0.018)
May-Jul 08	.116 (0.361)	.479 (0.000)	0.145 (0.252)	0.368 (0.003)	-0.014 (0.912)	0.297 (0.017)
Jun-Aug 08	0.094 (.461)	0.298 (.017)	-0.016 (0.898)	0.345 (0.005)	0.070 (0.584)	0.448 (0.000)
Jul-Sep 08	0.978 (0.000)	0.755 (0.000)	0.682 (0.000)	0.796 (0.000)	0.682 (0.000)	0.796 (0.000)
Aug-Oct 08	0.701 (0.000)	0.863 (0.000)	0.787 (0.000)	0.863 (0.000)	0.746 (0.000)	0.743 (0.000)
Sep-Nov 08	0.660 (0.000)	0.780 (0.000)	0.630 (0.000)	0.827 (0.000)	0.607 (0.000)	0.614 (0.000)
Oct-Dec 08	0.608 (0.000)	0.785 (0.000)	0.626 (0.000)	0.827 (0.000)	0.600 (0.000)	0.627 (0.000)
Nov08-Jan09	0.611 (0.000)	0.793 (0.000)	0.493 (0.000)	0.678 (0.000)	0.479 (0.000)	0.603 (0.000)
Dec08-Feb09	0.223	0.320	0.240	0.221	0.074	0.347

	(0.084)	(0.012)	(0.063)	(0.087)	(0.573)	(0.006)
Jan-Mar 09	0.088 (.502)	0.255 (0.047)	0.119 (0.361)	0.064 (0.622)	0.025 (0.622)	0.087 (0.504)
Feb-Apr 09	0.114 (0.378)	0.358 (0.004)	0.197 (0.125)	0.126 (0.329)	0.094 (0.468)	0.148 (0.251)
Mar-May 09	0.214 (0.093)	0.703 (0.000)	0.234 (0.065)	0.210 (0.098)	0.169 (0.186)	0.314 (0.012)
Apr-Jun 09	0.320 (0.011)	0.519 (0.000)	0.202 (0.112)	0.218 (0.086)	0.142 (0.266)	0.195 (0.126)
May-Jul 09	0.327 (0.008)	0.547 (0.000)	0.177 (0.161)	0.288 (0.021)	0.175 (0.167)	0.181 (0.153)
Jun-Aug 09	0.212 (0.090)	0.588 (0.000)	0.332 (0.007)	0.313 (0.011)	0.135 (0.283)	0.341 (0.005)
Jul-Sep 09	0.693 (0.000)	0.629 (0.000)	0.490 (0.000)	0.723 (0.000)	0.499 (0.000)	0.338 (0.005)
Aug-Oct 09	0.628 (0.000)	0.299 (0.017)	0.596 (0.000)	0.389 (0.001)	0.610 (0.000)	0.267 (0.033)
Sep-Nov 09	0.924 (0.000)	0.601 (0.000)	0.854 (0.000)	0.643 (0.000)	0.836 (0.000)	0.560 (0.000)
Oct-Dec 09	0.936 (0.000)	0.633 (0.000)	0.871 (0.000)	0.664 (0.000)	0.884 (0.000)	0.642 (0.000)
Nov09-Jan 10	0.952 (0.000)	0.886 (0.000)	0.900 (0.000)	0.907 (0.000)	0.891 (0.000)	0.864 (0.000)
Dec09-Feb 10	0.583 (0.000)	0.682 (0.000)	0.690 (0.000)	0.756 (0.000)	0.668 (0.000)	0.674 (0.000)
Jan-Mar 10	0.626 (0.000)	0.716 (0.000)	0.705 (0.000)	0.758 (0.000)	0.649 (0.000)	0.626 (0.000)
Feb-Apr 10	0.648 (0.000)	0.764 (0.000)	0.766 (0.000)	0.820 (0.000)	0.709 (0.000)	0.783 (0.000)
Mar-May 10	0.974 (0.000)	0.982 (0.000)	0.983 (0.000)	0.991 (0.000)	0.929 (0.000)	0.941 (0.000)
Apr-Jun 10	0.970 (0.000)	0.975 (0.000)	0.983 (0.000)	0.985 (0.000)	0.926 (0.000)	0.933 (0.000)
May-Jul 10	0.967 (0.000)	0.975 (0.000)	0.983 (0.000)	0.984 (0.000)	0.926 (0.000)	0.936 (0.000)
Jun-Aug 10	0.633 (0.000)	0.735 (0.000)	0.651 (0.000)	0.725 (0.000)	0.538 (0.000)	0.670 (0.000)
Jul-Sep 10	0.411 (0.000)	0.428 (0.000)	0.260 (0.038)	0.735 (0.000)	0.748 (0.000)	0.645 (0.000)
Aug-Oct 10	0.469 (0.000)	0.469 (0.000)	0.348 (0.000)	0.689 (0.000)	0.646 (0.000)	0.562 (0.000)
Sep-Nov 10	0.362 (0.004)	0.419 (0.001)	0.245 (0.053)	0.684 (0.000)	0.480 (0.000)	0.485 (0.000)
Oct-Dec 10	0.619 (0.000)	0.701 (0.000)	0.505 (0.000)	0.710 (0.000)	0.511 (0.000)	0.540 (0.000)

The results indicate that the Moving Correlation Coefficients (MCC) of R_{EWC} and R_{EWG} (Canada and Germany) are significant for most of the segmented data. There are three brief periods during which return volatilities between the two markets are not significant. They are: May-August 2008; December

2008- May 2009 and June-August 2009. When the MCC of the Canadian market (EWC) are studied together with the American market (SPY) we note that all of the correlations are significant, that is, volatility spillovers between Canada and the US are significant throughout the 3 year sample period (2008-2010). Finally, we note that the volatility of returns between Canada (EWC) and China (GXC) are correlated significantly except during the following periods: April-August 2008, December 2008-July 2009 and September-November 2010. Also, we note that the correlations between US (SPY) and Germany (EWG) are outside the lower and upper bounds indicating significant correlations. The only exception is the period between December 2008 and June 2009. Similarly, Germany (EWG) and China (GXC) daily volatilities are highly correlated except the following periods: April-August 2008 and December 2008-August 2009. US (SPY) and China (GXC) daily volatilities are significantly correlated except during the period of January- July, 2009.

What are the implications of our findings?

These findings suggest that the markets are sufficiently integrated so that each market responds to both current and historical news generated in the other markets. The integration is much more complete among the markets of the US, Canada and Germany and to a lesser extend when we include China. Collectively the findings imply that investment and fund managers with access to news on other markets may react to changes faster than those who do not. In addition, the results also imply that investors should not only rely on current news to guide their investment decisions but also take into consideration international news for there are spillovers.

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