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# Interdependence of NAFTA Capital Markets: A Minimum Variance Portfolio Approach

**Summary:** We estimate the long-run relationships among NAFTA capital market returns and then calculate the weights of a “time-varying minimum variance portfolio” that includes the Canadian, Mexican, and USA capital markets between March 2007 and March 2009, a period of intense turbulence in international markets. Our results suggest that the behavior of NAFTA market investors is not consistent with that of a theoretical “risk-averse” agent during periods of high uncertainty and may be either considered as irrational or attributed to a possible “home country bias”. This finding represents valuable information for portfolio managers and contributes to a better understanding of the nature of the markets in which they invest. It also has practical implications in the design of international portfolio investment policies.

**Key words:** NAFTA, Stock markets, International diversification, Financial integration, Optimal portfolios.

**JEL:** F36, F37, G01, G11, G15.

During the 1970s and 1980s, many empirical studies focused on the determination of the optimal parameters that portfolios of risky assets should have in the theoretical context of the mean-variance model, increasingly incorporating the effects of international diversification and reporting (in most cases) encouraging results. By investing in securities traded in different national markets, an investor enjoys the diversification effects derived not only from imperfectly correlated macro-financial contexts but also from different market-determined exchange rates.

However, more recently, as a result of free trade and the economic integration decisions observed in different geographic areas (the European Union, ASEAN countries, or NAFTA countries), as well as of lesser barriers to international financial transactions, there has been an increasing similarity in the returns of different national capital markets, and the benefits of international diversification of portfolios have gradually faded (Claire G. Gilmore and Ginette M. McManus 2004; Raj Aggarwal and NyoNyo A. Kyaw 2005; Ali F. Darrat and Maosen Zhong 2005). Also, in response to the increasing evidence that the potential benefits of international diversification declined during the 1990s, the focus has gradually shifted to previously overlooked emerging markets (Kuan-Min Wang and Hung-Cheng Lai 2013).

## 1. Literature Review

During the last two decades, there was an interest in studying the gradual reduction in diversification benefits across different national capital markets due to increasing integration and globalization of financial markets.

François Longin and Bruno Solnik (2001) used extreme value theory to study the structural dependence among national capital markets. They modeled a multivariate distribution for high yields, i.e., those that exceed a certain (positive or negative) limit, and estimated the correlation for increasing limits. They hypothesized that under the assumption of multivariate normality the correlation of beyond-the-limit high yields should converge asymptotically to zero as the limit increases. The results obtained from their estimates over 38 years of monthly observations (January 1959 to December 1996) of the five largest stock markets (USA, UK, France, Germany, and Japan) rejected that hypothesis, at least for negative returns. They reported that the correlation of highly negative returns does not converge to zero but tends to increase with the limit used, with high statistical significance. Conversely, the correlation of positive high yields tends to decrease and converge to zero as the limit used increases. Thus, they concluded that the correlation between national markets increases in bear markets but not in bull markets.

According to Robert-Paul Berben and W. Jos Jansen (2005), the growing economic importance of national capital markets during the last thirty years was accompanied by a greater degree of synchronization (co-movement) in their returns behavior, driven by factors such as the enhanced speed and reliability of electronic communications, the liberalization of capital controls in virtually all nations, and a fast increase in regional economic integration, which facilitated the transmission of impulses and information between markets. As a result, domestic markets have been increasingly affected by disturbances originated in foreign markets. Using weekly market indices and 10 industry indices, with observations between January 1980 and June 2000, the authors found that correlations between the markets of Germany, the UK, and the USA more than doubled, increasing from about 0.30 to about 0.65, during that period. However, that result was in stark contrast with the correlations between the Japanese stock market and the other three markets, which were unchanged at a level of 0.30.

Regarding the behavior of the correlations of industrial indices studied with the same methodology, Berben and Jansen reported that their results were very similar to those observed at the aggregate level. For Germany, the UK, and the USA, inter-industry cross-country correlations either increased or remained at the same level, while for Japan they remained mostly unchanged. That means that increased synchronization between international capital markets is determined not only by global factors but also by specific factors at the country and industry levels, the influence of which may be substantial.

Cristiana Tudor (2011) studied the common long-run stochastic trends and the short-term interaction mechanisms among six Central and Eastern European (CEE) stock markets and the USA stock markets, paying special attention to the effects of the 2007-2009 global financial crisis. Using Vector autoregressive (VAR) models, Cointegration tests, and Granger causality tests, the author chose the optimal number

of lags to be introduced to the models based on Sims' likelihood ratio test. In order to study the effects of the 2007-2009 global financial crisis, she split her sample into two to capture any possible time-variant stock market integration in the CEE area before and during the crisis, while paying special consideration to the starting point of the manifestations of the crisis in international stock markets.

All her tests confirmed the strong interrelations between the CEE stock markets during the crisis, meaning that diversification benefits from investing across all six countries disappeared during the financial turmoil. Nevertheless, the strong interdependencies present during crises do not necessarily imply that CEE economies share the same long-run equilibrium relationship. Hence, the permanence of increased stock market integration in the long-run at a regional level remains to be seen and, the author argued, should receive the attention of future research efforts through the introduction of a post-crisis data subsample in the analysis.

Nikola Gradojević and Eldin Dobardžić (2013) proposed that, from a portfolio diversification view, short-horizon investors are more interested in the co-movement of stock returns at higher frequencies, whereas long-term investors focus on the relationship at lower frequencies, i.e., long-term fluctuations; thus, a frequency domain analysis to obtain a better insight about the co-movement across various investment horizons is in order. By using a test for causality in the frequency domain, these authors provided a deeper insight into the relationship between the returns on regional stock market indices in Croatia (CROBEX), Slovenia (SBITOP), Hungary (CETOP), and Germany (DAX) relative to the returns on the BELEX 15 index in Serbia. Their results suggest substantial causality interactions at various frequencies.

George L. Ye (2014) studied the interactions between the USA and Chinese stock markets. Considering that these stock markets have no overlap in their trading hours, there are grounds to assume the inexistence of correlation between them. However, Ye examined the ability of the daily returns on the S&P 500 and the Dow Jones Industrial Average (DJIA) to forecast the direction of the opening of the Shanghai Composite Index (SSEC) and Shenzhen Component Index (SZCI), two benchmark indices in the China stock market, and *vice versa*; he found that the USA stock market opening did have a significant ability to forecast Chinese stock market openings but that the daily returns on the Chinese market did not show a similar ability to forecast USA stock market openings. That fact may be explained by the big difference in the relative size and global economic importance of the two markets (the USA market being significantly larger, with a listing of many global corporations).

## 2. Links between the Canadian, Mexican and USA Stock Exchanges

Several studies have analyzed the relationships between the capital markets of the NAFTA member countries (Canada, Mexico, and the USA) and confirmed the existence of a process of financial integration between them (see, for example, Aggarwal and Kyaw 2005; Darrat and Zhong 2005; Cetin Ciner 2006; Francisco López-Herrera and Edgar Ortiz 2007; López-Herrera, Ortiz, and Alejandra Cabello 2007). Notably,

and despite the abundant evidence in favor of increasing financial integration among NAFTA countries, Bradley T. Ewing, James E. Payne, and Clifford Sowell (2001) reported a nonsignificant relationship between those markets in the long-run. However, in a study using cointegration, López-Herrera, Ortiz, and Cabello (2008) reported evidence of the existence of long-term meaningful relationships between the NAFTA markets. In a previous study (López-Herrera, Ortiz, and Cabello 2007), the same authors used cointegration incorporating the presence of structural breaks in the series and reported the same result. The conflicting evidence reported by Ewing, Payne, and Sowell may be explained by the presence of structural breaks over the period of analysis, which the latter authors did not take into consideration.

Although the number of studies focused on the significance of the relationship between the stock markets of Canada, Mexico, and the USA has increased in recent years, such studies are still limited; however, research on the relationship of the volatilities of yields is still more scant. For example, López-Herrera, Ortiz, and Cabello (2009), found evidence of the existence of significant relationships at the level of the volatility of returns of the NAFTA stock markets and reported that the volatility of the USA market was the main driver of the volatility of the Mexican market.

More recently, Jesús Cuauhtémoc Téllez Gaytán and Pablo López Sarabia (2010) used different frequency observations to analyze the correlation between the Mexican stock exchange index and other Latin American stock market indices and key market indicators for the USA stock markets. Their results, based on a wavelet analysis, indicated that the correlation between the Mexican stock market and the other markets was not very intense, and only in a few cases did the correlations exceed 0.7, which calls into question whether the co-movement is as intense as that reported by other studies. It should be noted that although the correlation levels estimated by Téllez Gaytán and Sarabia for the stock markets of Mexico and the USA seem reasonable (compared with the results reported by López-Herrera, Ortiz, and Cabello 2009), these may attain higher levels during periods in which there are extraordinary market pressures (cracks or financial panics).

### 3. Methodological Aspects

Finding the minimum variance portfolio has an analytical solution when solving the following nonlinear (quadratic) optimization problem:

$$\begin{aligned} \underset{\omega_i}{\text{Min}} \frac{1}{2} \sigma_p^2 &= \frac{1}{2} \left\{ \sum_{i=1}^n \omega_i^2 \sigma_i^2 + 2 \sum_{i=1}^{n-1} \sum_{j=i+1}^n \omega_i \omega_j \sigma_{ij} \right\} \\ \text{s.t.} \sum_{i=1}^n \omega_i &= 1. \end{aligned} \quad (1)$$

Only the variances and covariances (correlations) of returns are needed to find the right combination of risky assets that would minimize the portfolio volatility. However, as mentioned earlier, there is enough evidence that both statistical parameters are time-varying; thus, if the time-varying feature is not incorporated in our attempt to model the construction of a minimum variance portfolio, we would tacitly incur a “risk of the model” problem.

The time-changing volatility of financial asset returns has been widely studied and documented. To obtain a more precise understanding of that phenomenon, some authors have proposed the use of Autoregressive conditional heteroskedasticity (ARCH) models; others have suggested the use of Generalized autoregressive conditional heteroskedasticity (GARCH), and still others different variations of ARCH (Tim Bollerslev 2008). While most of those studies focused on the dynamics of the USA capital markets, in a notable effort, Gerald Kohers, Ninon Kohers, and Theodor Kohers (2004) examined the changing volatility of twenty-four capital markets from 1980 through 2003 and reported common characteristics in their behavior. An interesting finding was that, in practically all the countries included in their sample, the volatility remained relatively stable between 1980 and 1996 but increased notably between 1997 and 2003.

Other studies have also rejected the hypothesis of constant correlations (see, for example, Robert F. Engle and Kevin Sheppard 2001; Longin and Solnik 2001; William N. Goetzmann, Lingfeng Li, and K. Geert Rouwenhorst 2002; Ryan S. Suilemann Lemand 2003; A. S. K. Wong and Peter J. G. Vlaar 2003; Geert Bekaert, Campbell R. Harvey, and Angela Ng 2005; Bekaert, Robert J. Hodrick, and Xiaoyan Zhang 2005; Lorenzo Cappiello, Engle, and Sheppard 2006). However, despite the profusion of univariate models for specifying the behavior of changing variances, the use of multivariate models has not progressed as fast. Evidently, the motivation for the development of such models is associated with the possibility of jointly estimating the volatility and the correlations among different national market returns, which are required inputs for the analysis.

We estimated a minimum variance portfolio for the NAFTA stock markets during the financial crisis by following a two-step procedure: we first estimated a multivariate GARCH model with varying conditional correlations (MGARCHVCC, originally proposed by Yiu Kuen Tse and Albert K. C. Tsui 2002), and then we used the MGARCHVCC output to estimate the optimal weights of a minimum general risk portfolio (MGRP) (i.e., a minimum variance portfolio). Our objective was to observe the changing composition of the MGRP throughout the period of analysis, with the intention to discern what effects the market turbulence of the 2007-2009 financial crisis had on its theoretical composition.

To model  $m$  variables, the Tse and Tsui model may be specified as follows:

$$\begin{aligned} r_t &= \mu + \varepsilon_t \\ \varepsilon_t &= H_t^{1/2} v_t \\ H_t &= D_t^{1/2} R_t D_t^{1/2} \end{aligned} \tag{2}$$

$$R_t = (1 - \lambda_1 - \lambda_2)R + \lambda_1 \Psi_{t-1} + \lambda_2 R_{t-1},$$

where  $r_t$  is an  $m \times 1$  vector that contains the different market returns as elements;  $H_t^{1/2}$  is the factor that results from performing Cholesky's decomposition of  $H_t$ , the time-changing conditional variances matrix; and  $D_t$  is a diagonal matrix with conditional variances:

$$D_t = \begin{pmatrix} \sigma_{1,t}^2 & 0 & \cdots & 0 \\ 0 & \sigma_{2,t}^2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & \sigma_{m,t}^2 \end{pmatrix}. \quad (3)$$

Each  $\sigma_{i,t}^2$  changes over time according to a process similar to the univariate GARCH:

$$\sigma_{i,t}^2 = \omega_i + \sum_{j=1}^{q_i} \alpha_j \varepsilon_{i,t-j}^2 + \sum_{j=1}^{p_i} \beta_j \sigma_{i,t-j}^2, \quad (4)$$

where  $\omega_i$ ,  $\alpha_j$ , and  $\beta_j$  are the parameters for estimation;  $R$  is a matrix of mean correlations to which the process of conditionally changing correlations converges:

$$\begin{pmatrix} 1 & \rho_{12,t} & \cdots & \rho_{1m,t} \\ \rho_{21,t} & 1 & \cdots & \rho_{2m,t} \\ \vdots & \vdots & \ddots & \vdots \\ \rho_{m1,t} & \rho_{m2,t} & \cdots & 1 \end{pmatrix} \quad (5)$$

$\psi_t$  is the rolling estimator of the correlations of  $\varepsilon_t$  and  $e_i$ ; and  $\lambda_1$  and  $\lambda_2$  are the parameters that govern the dynamics followed by the conditional correlations. To maintain the stability of the model, the changing correlations must fulfill the restrictions  $\lambda_1 > 0$ ,  $\lambda_2 > 0$ ;  $\lambda_1 + \lambda_2 < 1$ .

The likelihood logarithmic function based on the multivariate normal distribution of observation  $t$  is:

$$l_t = \frac{1}{2} m \log(2\pi) - \frac{1}{2} \log\{\det(R_t)\} - \log\left\{\det\left(D_t^{\frac{1}{2}}\right)\right\} - \frac{1}{2} \varepsilon_t R_t^{-1} \varepsilon_t'. \quad (6)$$

Thus, if one has the observations for  $t = 1, 2, \dots, T$ , the estimation of the model parameters can be done using the maximum likelihood method to optimize the following function:

$$\text{Max} \sum_{t=1}^T l_t. \quad (7)$$

## 4. NAFTA Stock Markets and the Minimum General Risk Portfolio

The data used to measure the integration among NAFTA markets and to estimate a minimum general risk portfolio included the Morgan Stanley Capital Indices for Canada, Mexico, and the USA during the period from March 3, 2007 through March 9, 2012, with 1,306 daily observations. The three indices were expressed in USD, eliminating potential distortions introduced by exchange rate fluctuations. Table 1 presents the estimation of the MGARCH (1,1) VCC (1,1) econometric model:

**Table 1** The MGARCH (1,1) VCC (1,1) Model

Coefficient	Mexico	Canada	USA
$\omega$	0.063537 (0.0201585)	0.0527436 (0.0138156)	0.0371239 (0.0089242)
$\alpha$	0.088642 (0.0184807)	0.078989 (0.0124889)	0.1047957 (0.0128223)
$\beta$	0.8933415 (0.0204187)	0.09018628 (0.0142757)	0.8763321 (0.0122227)
<b>Correlations model</b>			
$\lambda_1$		0.0096177 (0.0023064)	
$\lambda_2$		0.9847595 (0.0046121)	

**Note:** The values in parentheses represent robust standard errors.

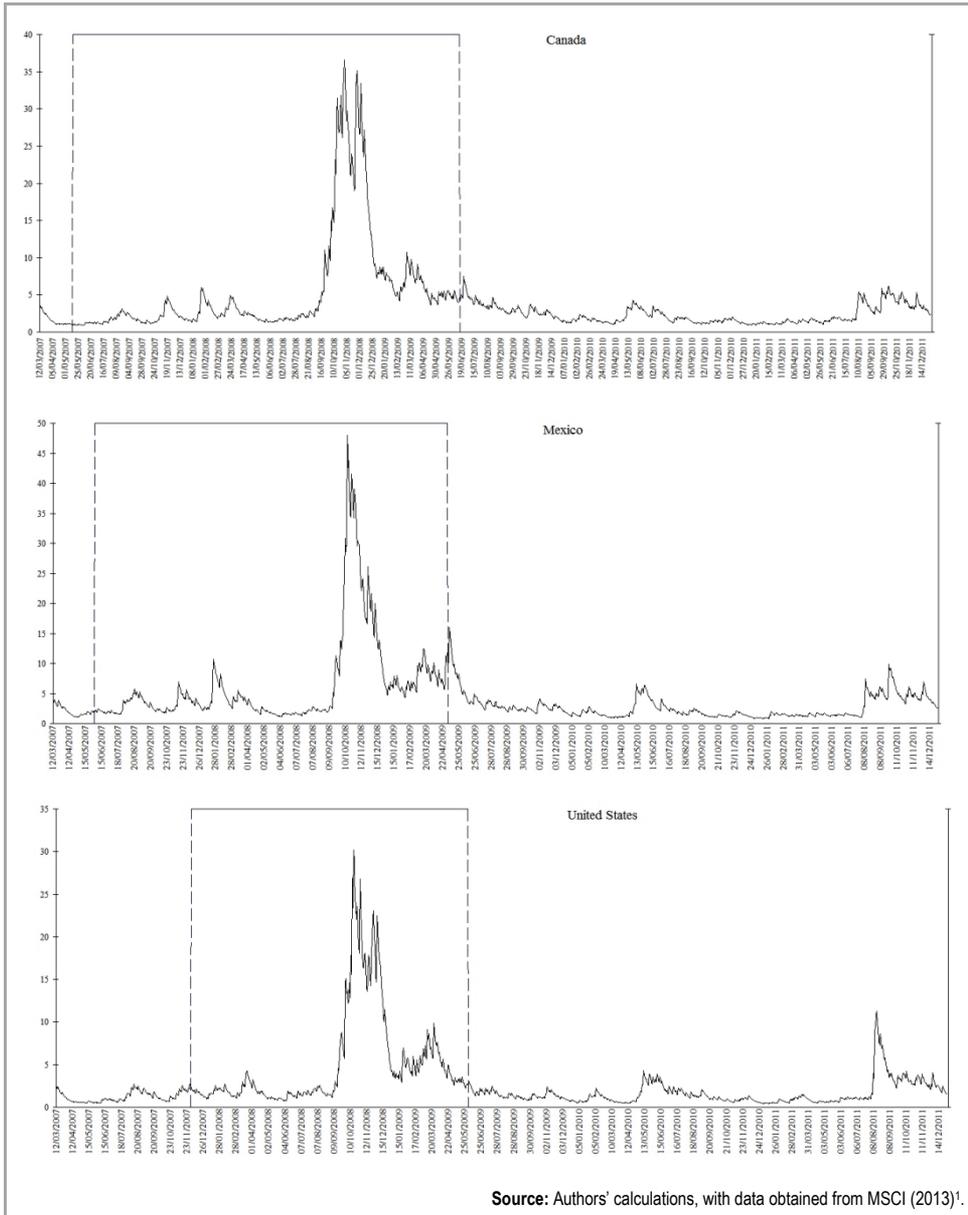
**Source:** Authors' own elaboration.

All the parameters estimated with the changing-variances model were highly significant and pertinently met the stability requirements. Also, the changing-correlations model parameters were highly significant, although their sum suggests a highly persistent correlation process.

Figure 1 presents the estimated conditional volatility obtained from the model shown in Table 1 for the market indices of the three NAFTA countries from March 12, 2007 through December 30, 2011. During the same period, the OECD reported different recessionary subperiods for each of the NAFTA countries: Canada was in a recession from May 2007 through June 2009, Mexico from June 2007 through May 2009, and the USA from December 2007 through May 2009. We highlighted with a discontinuous box frame the period from May 2007 until June 2009, during which the recessionary periods in the three countries overlapped.

The conditional volatility started increasing in moderate waves at the end of July 2007 but saw a decline in April 2008, when it went back to a level comparable with that in the before-the-crisis period. However, in September 2008 the volatility increased again, reaching maximum values during October 2008 (36% for the Canadian market, on October 30, 2008; 48% for the Mexican market, on October 14, 2008; 30% for the USA market, on October 16, 2008). During the following months the conditional variances receded but not completely, and on February 2009 there was a new escalation of volatility that faded away until August of that year.

Throughout the whole period of analysis, except for a few observations, the estimations of the conditional volatility for the Mexican market were permanently higher, showing the greater sensitivity of that market to daily news reports on the financial problems of all types of firms, as well as to announcements of new policy measures implemented mainly by the USA authorities (the Federal Reserve and the Treasury Department) to address the market turbulence.

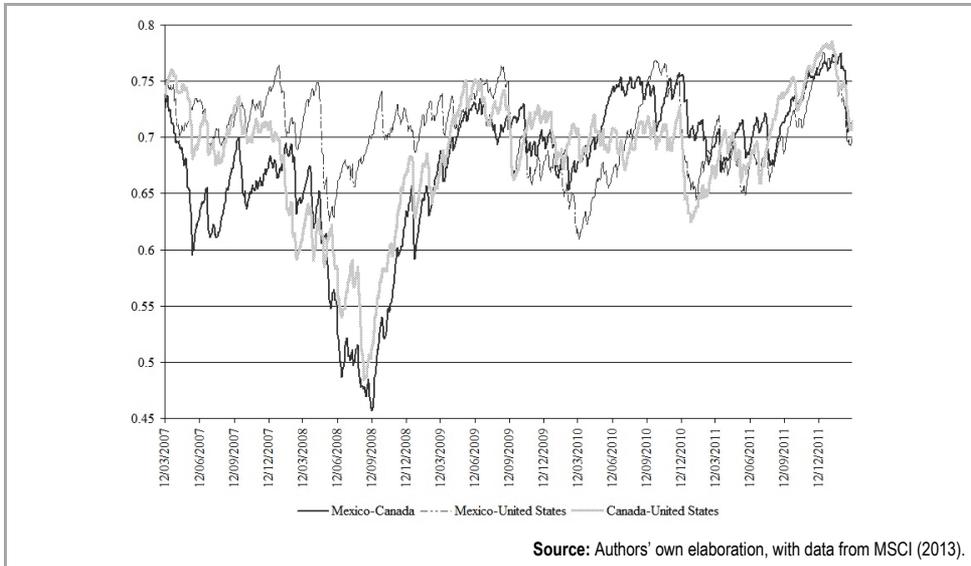


**Figure 1** Conditional Variance of NAFTA Indices

Figure 2 shows the conditional correlations estimated for the NAFTA stock market indices. The correlation between the Mexican stock exchange and the Canadian stock exchange diminished from March 19 to May 24, 2007. After a brief re-

<sup>1</sup> **Morgan Stanley Capital International (MSCI)**. 2013. MSCI Developed Markets Indexes. [http://www.msci.com/products/indexes/country\\_and\\_regional/dm/#/](http://www.msci.com/products/indexes/country_and_regional/dm/#/) (accessed March 20, 2013).

covery starting on February 11, 2008, there was another downward movement, which reached its lowest level on September 12 of the same year. In brief, there was a decrease in conditional correlations, and the conditional variances reached their peak precisely at the time when the NAFTA markets were in free fall.



**Figure 2** Conditional Correlations for NAFTA Stock Markets

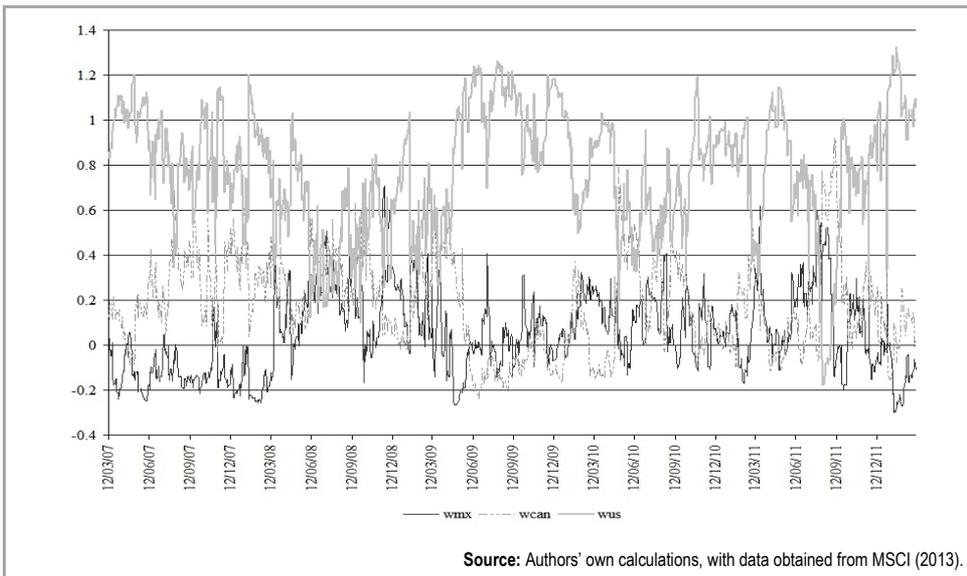
When the stock prices recovered from their lows, toward the end of April 2009, the conditional correlations returned to a level comparable with that observed at the beginning of March 2008. From that moment on, our estimations suggest that the conditional correlations remained stable, even when, toward the end of the period, there was a new surge that attained a maximum level during the first days of February 2012.

The conditional correlations between the Canadian and the Mexican markets, as well as between the Mexican and the USA markets, were higher than the levels reported by López-Herrera, Ortiz, and Cabello (2009) for a different period of observations (August 23, 1984 to December 22, 2005). In our sample, one can observe that the conditional correlations for the Mexican and USA markets followed a lateral trajectory within the range of approximately 0.70 and 0.75 during the first months; however, there was a noticeable decrease in their correlation during the period from April 18 through May 20, 2008, when the three markets were in freefall. After returning to the levels observed before August 21, 2009, the correlations started to decrease again until March 16, 2010, when they reached their lowest estimated value. Alternatively, the conditional correlations for the Canadian and Mexican markets took a deep dive around the Lehman Brothers bankruptcy announcement, in mid-September 2008, reaching their lowest level at around 0.45. Finally, the conditional correlation between the Canadian and USA markets also reached its nadir (close to 0.50) at around the same date.

## 5. Minimum Global Risk Portfolios for the NAFTA Markets during the Financial Crisis

The minimum global risk portfolios were estimated according to Mark Grinblatt and Sheridan Titman (2002)<sup>2</sup>, by replacing the constant variance and covariance parameters with our daily estimates of conditional volatilities and conditional correlations.

Figures 3 to 6 show the evolution of the MGRP weights over the period of our analysis, which was characterized by atypical volatility due to the many extraordinary events related to the financial crisis. Figure 3 shows a clear relationship with the patterns observed in the conditional variances analysis that was presented in a previous section. For example, a structural break was observed during the first months of 2008, when the crisis started taking its toll, provoking a significant rebalancing of the MGRP, and reflected in the volatile change in weights of each of the three NAFTA markets (wcan for Canada, wmx for Mexico, and wus for USA). During the first months of 2009, the weight of the USA market rose dramatically and reached more than 100% on several occasions. A similar pattern was observed from October 2010 onward in relation to the sovereign debt problems of European countries, as well as in May 2011 and toward the end of that year, and again in the first months of 2012 for the same reason.



**Figure 3** Weights of the NAFTA Markets in the MGRP

During the first stages of the financial crisis, different government-driven policy measures (by the USA government in particular) to bailout large financial and nonfinancial firms (that are too big to fail), as well as other extraordinary measures regarding monetary and fiscal policy, had a clear effect on the behavior of market

<sup>2</sup> See Chapter 4, p. 125.

volatility, which was reflected on the conditional variances and covariances of the NAFTA market returns. Because conditional variances and correlations are inputs for the estimation of the weights of the MGRP, their changes affected the composition of the latter, resulting in a decrease in the weight of the USA market and an increase in the weights of the other two markets.

After the bankruptcy announcement of Lehman Brothers (on September 15, 2008), the volatility of financial markets reached a maximum level. From that peak level, the volatility receded, resulting in a new composition of the optimal portfolio, in which the USA market weight increased again, this time reaching more than 100%, a level above its average weight (i.e., with negative or “short” positions in the other two NAFTA markets), as previously mentioned.

Finally, toward the third quarter of 2011, and as a consequence of the worsening liquidity condition of Greece, which eventually made a bailout inevitable, turbulence returned to the financial markets, which again affected the composition of the MGRP, thus increasing the weights of the Canadian and Mexican markets. During the first weeks of 2012, there were signs of more stability, and the weights of the Canadian and Mexican markets went back to their average levels.

Figures 4 to 6 provide a graphical representation of the weights of the individual NAFTA markets in the composition of the MGRP. As a reference to facilitate the interpretation of the graphs, the average weight throughout the observation period is indicated with a bold line. Figure 4 shows the MGRP weights for the Canadian stock exchange above their mean value, beginning in mid-2007 and until March 2009, corresponding to the period when the financial crisis hit the USA market. Again, the weights increased again between March and November 2010 and from July 2011 until the end of the observation period. The latter subperiod coincided with announcements about the inability of some European countries to meet their sovereign debt compromises, which provoked spikes in the volatility of world markets.

Figure 5 shows the evolution of the Mexican stock exchange weights for the NAFTA MGRP. There were two periods of increasing weights. The first, from March 2008 until May 2009, was associated with great uncertainty related to the many bankruptcies and liquidity problems faced by American companies, as well as the extraordinary measures that that country’s authorities took to respond to the financial markets instability (TARP, TARP II, etc.). The second, from March 2011 through the end of that year, was closely associated with the surge of new turbulence linked to the sovereign debt crisis of Portugal, Spain, Ireland, and Greece.

One can also identify two subperiods during which the optimal weights for the USA market remained consistently below their mean values for the whole period. The first one, between January and December 2008, was also the most turbulent period of the financial crisis. The second one was during the third quarter of 2011, when the USA market weights reached their most negative value of the whole analysis, around the 8<sup>th</sup> of August.

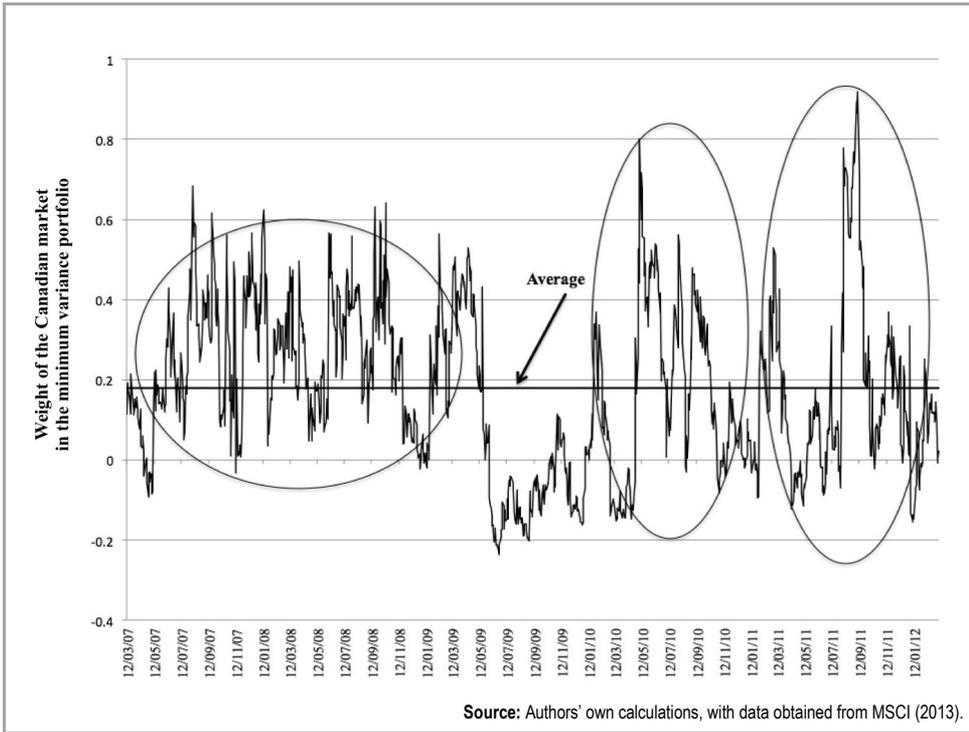


Figure 4 Weights of the Canadian Market in the Minimum Variance Portfolio, 2007-2012

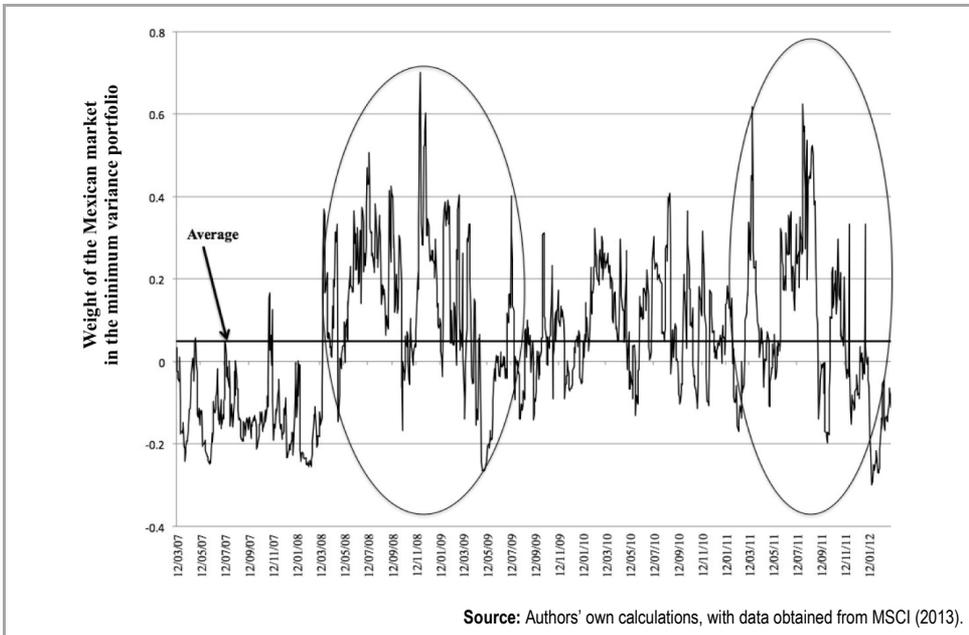
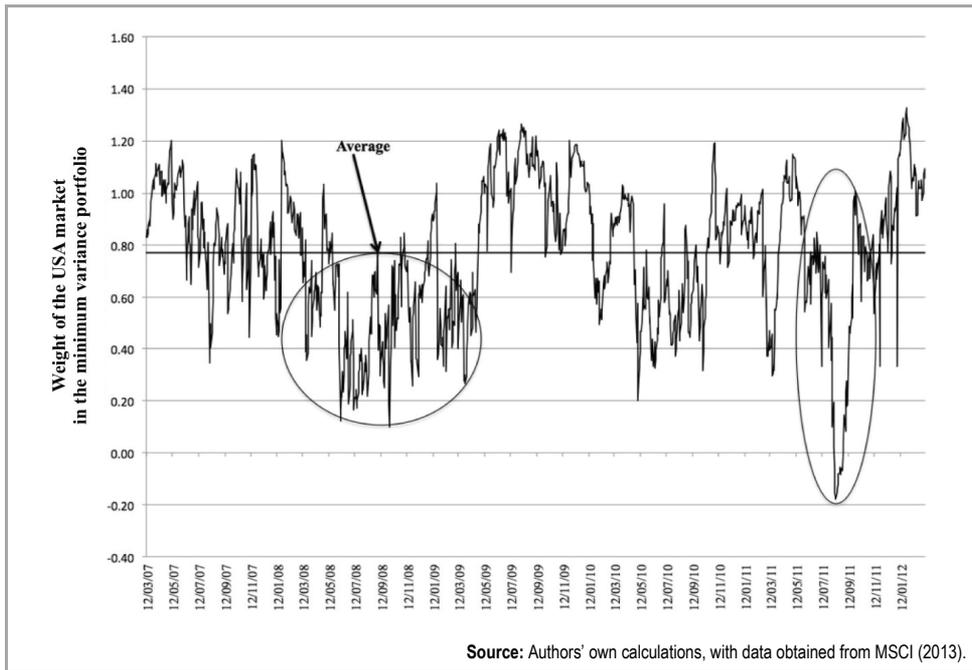


Figure 5 Weights of the Mexican Stock Exchange in the Minimum Variance Portfolio, 2007-2012



**Figure 6** Weights of the USA Stock Exchange in the Minimum Variance Portfolio, 2007-2012

Compared with the volatility observed in the weights of the USA market, the volatility in the weights of the other two NAFTA markets was significantly greater due to their smaller relative economic size.

Our findings suggest that, in the face of extreme market turbulence, the adequate investment strategy for a risk-averse investor in a NAFTA market is to constantly rebalance the MGRP in order to respond to changing domestic market return variances and cross-country covariances.

## 6. Conclusion

In this work, we analyzed the evolution of conditional variances and conditional correlations for the three NAFTA market index returns. As expected, we found notorious increases in the volatility of returns in all three NAFTA markets during the 2007-2009 global financial crisis. Those increases happened during a period in which, according to the OECD, the economies of the NAFTA countries were undergoing a recessive phase. Noticeably, the highest volatility levels were achieved only toward the second half of those recessive phases, which was closely associated with the Lehman Brothers bankruptcy and a series of important events, including the announcement of extraordinary measures to bail out the financial system (TARP, TARP II, etc.).

As reported by previous studies, in the long-run the increasing economic integration of the three NAFTA markets could explain the closer co-movements of their capital market returns. One can, however, detect some interesting exceptions to that

trend during the first months of the crisis. For example, the negative impact of the complex events that were going on in the USA was relatively mild on the Mexican market and resulted in lesser volatility than expected. Among the most logical explanations, one can mention that not many Mexican financial entities held “toxic assets” (subprime mortgage-related assets and the derivatives issued to hedge them) in their balance sheets and that the Mexican macroeconomic fundamentals (fiscal balance, external debt levels, unemployment levels, etc.) were sound.

Contrary to what has been observed and well documented in former crisis episodes, as the 2007-2009 financial crisis worsened, the levels of changing conditional correlations estimated for the three NAFTA pairs (Canada-Mexico, Canada-USA, and Mexico-USA) diminished in free fall, particularly in the Canada-Mexico and Canada-USA cases. The conditional correlation of the Mexico-USA market returns also experienced a reduction from its long-term mean values but not in the same measure as the two former pairs.

According to the optimal weights of the MGRP, investors should have increased their MSE holdings and reduced their holdings of the USA assets during the first semester of 2008. Based on the foreign portfolio investment flows reported by the Department of Economic Studies of the Banco de Mexico (Mexico’s Central Bank), the net capital inflows toward the Mexican market were still positive during that period. However, the same source revealed that during the period of more intense turbulence, between July and November of that same year, there was finally some capital flight out of Mexico (net negative foreign portfolio investment flows) but, paradoxically, at a time when the optimal weights obtained from the MGRP model (for almost the whole second half of 2008) suggested that the Mexican market could have performed as a hedge (diversification alternative).

A better understanding of the dynamics of highly integrated capital markets during turbulence periods can help international portfolio managers improve the quality of their rebalancing decisions. While portfolio managers need not be risk-averse (actually, they are not expected to be risk-averse during normal periods), during turbulence periods like the one recorded during the second semester of 2008, one could have expected a preference for less risky (minimum variance) portfolios. By contrast, our analysis shows that their behavior was not optimal. The question that naturally arises, and which delineates new research avenues, is whether such seemingly irrational behavior may be explained by “home bias” theory, herd behavior, self-fulfilling expectations, and strategies of trading based on market sentiment, as suggested by *contrarian* investors, or maybe a mix of these principles.

It is a well-documented fact that investors typically invest a large portion of their assets in domestic security markets because of a “home bias” phenomenon, further strengthened by the extra transaction costs and complexity of investing abroad, besides unfavorable international relations dynamics between countries, thereby negatively affecting the motivation for international diversification (Rizwan Mushtaq and Syed Zulfiqar Ali Shah 2014). However, it is a well-known fact that trade openness and easy access to information are two of the main reasons that have contributed to reducing home equity bias. Therefore, in the case of NAFTA countries, where trade openness and easy access to information are clearly present, the explanation for

the seemingly contradictory flow of portfolio investments toward the MSE may lie elsewhere.

Finally, the governments of emerging countries interested in attracting foreign portfolio investments into their domestic financial markets must be aware of the instability of investment flows, including frequently observed over reactions and seemingly irrational behaviors during crisis episodes. Thus, an obvious related concern is how to enhance the ability of a government to preserve investor confidence during such episodes and minimize panic sales or other irrational conducts. This issue opens up a related research avenue that is centered on the identification and implementation of economic policies that can achieve such end, representing a wide diversity of interesting questions, which we intend to explore in future studies.

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