The USMCA: A Bad Deal for Most

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ABSTRACT

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This study investigates the impact of the USMCA on the stock market returns of the U.S., Canada, and Mexico. We also analyze the impact of USMCA on volatility spillover across the markets. Our research design consists of two parts. First, we examine the market and sectorial indices returns using an Event study methodology. Second, we use the BEKK-GARCH model to study the spillover between the three markets. The event study results show that most sectors across the three countries had a negative abnormal return with Canada suffering a relatively bigger loss. The multivariate GARCH results show that the U.S. market historically has the most influential impact on the volatilities of the Canadian and Mexican markets. We also find that USMCA had a negative impact on the mean returns of the Canadian and Mexican stock markets. Besides, we find no significant evidence of change in volatility spillover post-USMCA. Overall, our analysis shows that the USMCA was a bad deal for most.

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1. Introduction

How did USMCA affect the equity market returns of U.S., Canada, and Mexico? Was it a win-win situation for all the sectors? Did USMCA impact the linkages of the North American markets? These are the questions that this study tries to analyze. The answers to these questions are pertinent for both researchers and investors.

In the last few decades, equity markets around the globe have become increasingly interdependent (e.g. Eun & Shim (1989); Kasa (1992); Karolyi & Stulz (1996)). Most free trade agreements agreed on terms that allowed the free movement of capital across borders (Daelemans, Daniels, & Nourzad, 2018). The reasoning behind these agreements was that the liberalization of the capital market in conjunction with open trade would allow an optimal allocation of scarce resources. This liberalization in trade and capital markets flow leads to financial integration and interdependence across countries (Aggarwal & Kyaw, 2005). With the simultaneous advancement of technology and information processing, dissemination of international news in domestic markets became prompt. This increase in trade growth led to the formation of regional trade groups such as the Association of Southeast Asian Nations (ASEAN), the European Union (EU), and The North American Free Trade Agreement (NAFTA).

The NAFTA came into force on January 1, 1994. At the time, NAFTA was the most comprehensive free trade agreement and had numerous unconventional provisions. The agreement established new rules and regulations that laid the foundations for future free trade agreements. It addressed issues such as the protection of intellectual property, dispute settlement, labor provisions, environmental regulations, services trade, and cross-country investment. NAFTA eventually abolished many trade restrictions and formed the basis for tariff-free trade across the three nations. However, in 2016 the Trump administration expressed their concerns over NAFTA, calling it the “worst deal ever”.

Consequently, after the results of the Presidential Election of 2016, there was an expectation of changes being made to tax and trade policies as per Trump's campaign. Wagner, Zeckhauser, & Ziegler (2018) analyze the impact of these expected changes on stock price reactions following the election. Their analysis shows that changes in expectations about policies rather than the change itself can lead to significant movements in returns and volatilities of stock markets.

Hence, it becomes important to identify the implication of the changes in regional agreements on stock market returns, asset pricing, hedging strategies, and portfolio diversification. Stock market diversification plays an important role in constructing asset portfolios[1]. Therefore, it is vital to identify the linkages between stock markets, as changes in integration can hinder the benefits of portfolio diversification (Ewing, Payne, & Sowell, 1999). The existing research on equity market linkages can be broadly classified into two categories. Firstly, studies have used cointegration techniques such as the Johansen (1988) and Johansen & Juselius (1990) models to identify if there exists a long-run stochastic trend across stock markets. Secondly, scholars have used ARCH/GARCH models[2] to study integration. Empirical evidence shows that ARCH models have been successful in fitting univariate time series data and thus these models were extended to multivariate settings.

Cointegration analysis can only provide us with a binary answer i.e., markets are either segmented or integrated. But market integration is a complex and dynamic process. Therefore, multivariate GARCH models are preferred while identifying integration and capturing volatility dynamics among the time series (Sephton & Larsen, 1991). The MGARCH model, unlike the cointegration approach, measures integration through both the first and second moments of the returns and analyses the multilateral feedback between the equity markets.

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[1] Grubel (1968), Ripley (1973), Panton , Lessig, & Joy (1976), and Hilliard (1979) among others

[2] These models were pioneered by Engle (1982) and Bollerslev (1986)

In order to find solutions to the three questions proposed at the beginning of this study: we conduct an Event study to analyze stock market reactions and use a BEKK[3]-GARCH model to estimate the conditional variance and covariances as well as explore volatility transmission among the markets. The rest of the study is divided as follows. Section 2 provides an overview of the existing literature that helps us validate the theoretical motivation as well as identify the appropriate methodology for this study. Section 3 describes the data, Section 4 explains the empirical methodology employed, and Section 5 presents the results of the analysis. Section 6 provides an overall look at the results and presents the conclusion.

1.1. Brief History of USMCA

During the first 100 days of the Trump administration, it was a make-or-break situation for NAFTA as the US president had clear intentions of renegotiating the existing agreement. President Trump's mercantilist approach to trade policy and the U.S. government's preference for bilateral agreements served as a backdrop for these negotiations. Twenty-five years after the approval of NAFTA, in 2016, the regional scenario could be described as two different bilateral interactions rather than a trilateral agreement. Before the existence of NAFTA, Mexico had proposed a bilateral trade agreement with the U.S., like the one Canada already had i.e., the Canada-U.S. Free Trade Agreement (CUSFTA). At that time, Canada proposed a trilateral agreement to ensure that Mexico does not get a better deal. The Trump administration was pursuant to establish bilateral agreements instead of NAFTA, although this would severely impact regional supply chains, especially in the automotive sector, and reduce the competitiveness of North American manufacturers in the global market.

The timeline for the USMCA[4] is as follows.

[3] Baba-Engle-Kroner-Kraft model developed by Engle & Kroner (1995) and further modified by Kroner & Ng (1998)

[4] The following articles have been used as reference for the dates: Thomson Reuters: TIMELINE-The long bumpy road from NAFTA to USMCA (2020) and Congressional Research Service: U.S.-Mexico-Canada (USMCA) Trade Agreement, (2023)

- May 17, 2017: An official notification from the U.S. President's office was sent to Congress expressing the intent to renegotiate NAFTA.
- August 16, 2017: The official renegotiation began among the three countries. Talks aimed at modernizing NAFTA began in Washington, and a second round took place in September in Mexico.
- August 27, 2018: Several rounds of discussions over a period of one year failed to produce a deal. The U.S. and Mexico resolved their differences to come to common ground and this put Canada under pressure to agree to the new terms.
- September 30, 2018: Negotiations concluded to salvage a trilateral pact. The draft text of the deal was released the next day. However, the deal would still have to be ratified in each country.
- November 30, 2018: The official trade agreement was signed by the delegates of the nations.
- December 10, 2019: The amended version of USMCA is accepted and signed. Members of Congress had voiced concerns over clauses regarding labor and environmental provisions, intellectual property rights, dispute settlement, and rules of origin for steel and aluminum sourced by the automotive industry. This led to certain provisions of USMCA being amended and modified.
- December 19, 2019: The USMCA is approved by the House of Representatives.
- January 16, 2020: The USMCA is approved by the U.S. Senate.
- July 1, 2020: The USMCA formally takes effect.

1.1.1. Highlights of the Agreement

The USMCA would have a broad impact on all kinds of trade between the three nations. Some of the most important provisions are as follows[5]:

[5] Highlights are taken from a report published by ResearchFDI (2023)

- Dairy and Agriculture – The amount of dairy goods that can be imported to Canada tariff-free was raised and would now allow U.S. farmers to access 3.6% of the Canadian market.
- Automobile – New trade regulations for automobiles and automotive parts were one of the most important provisions of USMCA. Under NAFTA, vehicles could be sold tariff-free if at least 62.5% of the components were produced in one of the three nations, this number was increased to 75% under USMCA. Furthermore, the regulation establishes minimum wages of USD 16 per hour for laborers working on these vehicles and requires that 40-45% of the work be accomplished by workers earning the stipulated minimum wage.
- Pharmaceuticals – Originally, the USMCA included provisions to extend the eight-year data protection period for a specific class of drugs called 'biologics' to ten years. This would prevent companies from producing generic versions of the drug leading to higher prices. However, this provision was later retracted when the USMCA was amended on December 10, 2019.
- Intellectual Property – The updated agreement increases the copyright period to 70 years after the death of the creator. New items that did not exist in the list when NAFTA was created were also included. The agreement forbids tariffs on digital music, e-books, and other digital products.
- Sunset provision – The USMCA is set to expire in 16 years unless renewed and joint reviews are to be conducted every 6 years.
- Labor – The agreement establishes an investigatory panel that has the authority to investigate breaches in workers' rights and to halt shipments from culpable factories. Mexico assures to enact labor reforms enabling workers to unionize and protect themselves. These rules will eventually increase wages in Mexico and level the playing field between U.S. and Mexican factories.

1.1.2. Impact of the Agreement

Trade has bounced back to pre-Covid levels, averaging an increase of 6% from 2019 to 2021 (Wayne & Bitar, 2022). Since USMCA was implemented on July 1, 2020, trade levels have been consistent. Trade among North American countries surpassed USD 1.3 trillion in 2021. From January 2021 to May 2021, the trade in the area totaled USD 642.6 billion which is a 23.15% increase from the same period in 2021 (Reuters) (Ludwikowski & Lopez, 2022).

However, there have also been reports of disputes among the countries over the past 2 years. USMCA dispute panels have been set up to address issues related to the Canadian dairy tariffs, the duty on U.S. solar panels, and more recently for the rules of origin requirements for the automobile industry (ResearchFDI, 2023).

2. Literature Review

The motivation for this study is primarily dependent on the literature that links trade agreements and stock market returns and volatility.

Eun & Shim (1989) used daily stock market data for nine countries over a period of 5 years from January 1980 to December 1985. They conduct a nine-way vector autoregression analysis to identify if innovation in one market is transmitted to the others over time. They find that there exists a significant interdependence among the sample stock markets. They also report that the impact of innovations in the U.S. stock market on other stock markets was the most predominant.

The United Kingdom exchange control act was abolished in October 1979. Taylor & Tonks (1989) test for the impact of the abolition on the cointegration of the UK market with 4 other major stock indices i.e., West Germany, Netherlands, Japan, and the United States. They use monthly data spanning from January 1973 to June 1986 and employ the Granger Causality test. They report that the cointegration between the UK stock market and those of West Germany, the Netherlands, and Japan has increased due to the relaxation of capital control.

Karolyi & Stulz (1996) study the fundamental factors that can have an impact on the stock return correlations among countries. They use transaction data spanning from 1988 to 1992 and construct a portfolio of Japanese ADRs and a matched sample portfolio of U.S. stocks. They report that macroeconomic announcements or shocks to the forex rate and treasury bill returns do not have a significant influence on return correlation even while controlling for industry effects. Albeit shocks to country indices like the S&P 500 or the Nikkei Stock Average have a positive effect on co-movement.

Furthermore, Hassan & Naka (1996) use daily data to analyze the stock market linkages between U.S., Germany, U.K., and Japan. While using the Johansen & Juselius (1990) cointegration model for analysis they report a significant presence of both short-run and long-run cointegrating relationships among the 4 stock markets. Therefore, it can be inferred from the studies discussed previously that during periods of high volatility, international diversification might not be efficient at mitigating risk.

On the contrary, Chan, Gup, & Pan (1992) while examining the relationship between Asian markets and the U.S. using cointegration tests report that there is no cointegration among the markets and that investors can effectively diversify their portfolios to reduce unsystematic risk across their sample countries. Their findings were robust for both daily and weekly data. In a subsequent study, covering 18 countries over a period of 32 years from 1961 to 1992. They find that there does exist some evidence of cointegration among a handful of countries. However, before the stock market crash of October 1987, the cointegration increases suggesting that their results are in line with the market segmentation hypothesis (Chan, Gup, & Pan, 1997).

Similarly, the findings of Arshanapalli & Doukas (1993) are incongruent with research that provides evidence of interdependence among stock markets prior to the October 1987 crash. They use daily stock price data covering a period of almost 11 years. Their cointegration analysis shows that the interdependence among stock markets significantly changed post the crash. However, for the pre-crash period, they find that the European markets are not related to the U.S. stock markets, these findings are inconsistent with that of previous studies[6].

Richards (1995) has argued that previous significant findings of co-movement among stock markets are not very accurate as the use of asymptotic critical values in the Johansen (1988) cointegration test might be severely inapt. The author reports evidence supporting the predictability of relative returns among the sample stock markets and identifies that stock market indices contain 3 components i.e., a common world component, a permanent country-specific component, and a transitory country-specific component. Hence, it can be inferred that in the long-run investors can benefit from international portfolio diversification.

The vast literature analyzing the cointegration between markets is not in agreement. Although some studies have shown that international portfolio diversification is beneficial, others show that this might not be true. The literature discussed below focuses on analyzing the impact of trade agreements specifically in the North American markets and how these agreements can impact stock returns and linkages among these markets.

Thompson (1994) analyses the impact of the Canada - United States Free Trade Agreement. The author conducts an event study and reports that the market reacted positively to the news of the agreement. The Cumulative Abnormal Return (CAR) for industry portfolios is also estimated to analyze the impact on each sector but does not produce any significant results.

Aggarwal, Long, Moore, & Ervin (1998) also look at the differential impact on equity returns based on the sector of the firm. To analyze the impact of NAFTA on various industries,

[6] Schöllhammer & Sand (1985) and Eun & Shim (1989) among others have reported significant interdependence among the European and U.S. stock markets for that period.

the authors use SIC codes for classification and conduct an event study for a sample of 1471 firms. They document that overall NAFTA significantly increased returns for the sample firms. However, firms in the automotive and telecommunications sector experience negative CARs around the announcement date even though these industries were likely to benefit from NAFTA.

Similarly, Rodriguez (2003) looks at the impact of NAFTA on industries and tries to identify variables that can explain the differential impact among industries. The author conducts a regression analysis to explain the excess returns using the labor-capital ratio as a measure of factor intensity of production. The results show that the labor-capital ratio is a significant determinant of the excess returns of industry portfolios. These findings are congruent with the basic factor proportions theory and suggest that high factor intensity provides a comparative advantage to specific industries.

Contemporaneously it is important to look at how NAFTA impacted the integration between the U.S., Canada, and Mexico stock markets. Aggarwal & Kyaw (2005) examine the integration between the three major North American stock markets pre and post-NAFTA. They use daily, weekly, and monthly data spanning over a period of 14 years from January 1988 to December 2001. The estimated correlation coefficients for the post-NAFTA period are higher and the cointegration tests provide evidence of increased integration within the three markets after NAFTA[7].

Conversely, Ewing, Payne, & Sowell (1999) do not detect any presence of cointegration in the post-NAFTA period. They use monthly data spanning from November 1987 to March 1997 and conduct the Johansen & Juselius (1990) multivariate cointegration to test the co-movement of the North American stock markets after the implementation of NAFTA. The study

[7] Darrat & Zhong (2005) and Fern ndez-Serrano & Sosvilla-Rivero (2003) also use cointegration models to examine the stock market linkages among the American stock markets.

suggests that although NAFTA has improved economic ties it has not affected the integration among the markets. However, in a later study, while using ARCH and VAR models, Ewing, Payne, & Sowell (2001) find that post-NAFTA there was an increase in the degree of integration between the three markets.

The discrepancy in findings of the previous studies suggests that using a Vector Error Correction Model and Cointegration to analyze integration among the markets may not be the appropriate methodology. Sephton & Larsen (1991) suggest that results from the cointegration and error correction models should not be considered conclusive and should be thoroughly analyzed for robustness. Instead of using co-integration techniques that analyze whether time series move together in the long run, several studies[8] have used an MGARCH framework to analyze the time-varying process of integration. If the integration between markets is to be measured as the relation in the first and second moments of the stock indices, an MGARCH model that allows for time-varying covariance and variance is the most suitable methodology (Lahrech & Sylwester, 2013).

Chou, Jin-Lung, & Chung-shu (1999) analyze the stock market integration for the U.S. and Taiwanese stock markets. They use a BEKK-GARCH model to measure the spillover effects and find that there is a significant linkage between the U.S. and Taiwan stock markets. Their results support the conventional belief that volatility spills from developed markets to emerging markets.

Doukas & Switzer (2000) conduct joint tests to analyze the impact of dual listings in the U.S. and Canada. They study the change in market integration due to changes in the regulatory environment over time. The time-varying linkages between markets is modeled using a bivariate ARCH process. The analysis shows no evidence of an increase in market integration

[8] Heimonen (2010) provides a review of the existing literature on stock market integration and discusses the various methodologies used in these studies.

due to regulatory changes, which could potentially reduce the benefits of cross-listing. However, the authors surmise that international listings increase the investor base of the firms which could eventually have a beneficial impact on the cost of capital.

Furthermore, Worthington & Higgs (2004) examine the spillover of volatility and equity returns among nine Asian stock markets using an MGARCH model. They use weekly data from January 1988 to October 2000 for their analysis. The results suggest that all nine markets are highly integrated. However, it is to be noted that cross-volatility spillovers are lower than own-volatility spillovers for all markets, especially for emerging markets.

Maghyereh & Al-Zuobi (2005) explore the impact of the U.S.-Jordan Free Trade Agreement (UJFTA) on the degree of linkages between the two markets. They use the DCC-GARCH model developed by Engle (2002) and further modified by Cappiello, Engle, & Sheppard (2006) to conduct their analysis. They report that the UJFTA significantly increased the volatility correlations and conditional correlations confirming that direct trade flows have a direct impact on cross-country stock market linkages[9].

Similarly, Lahrech & Sylwester (2013) use a DCC-GARCH model to analyze the impact of NAFTA on the stock markets of U.S., Canada, and Mexico. They use weekly data from December 1988 to July 2006 to test for the stock market linkages between the countries. They extend the model proposed by Cappiello, Engle, & Sheppard (2006) to include a structural break that coincides with the enactment of NAFTA. The conditional correlations estimated using the modified model help to identify the linkages between the stock markets. They report an increase in conditional correlations, post the implementation of NAFTA for Canada – Mexico and U.S. – Mexico. However, for U.S. – Canada, they do not find similar results.

[9] Li & Zou (2008), Kenourgios, Samitas, & Paltalidis (2009), and Van Dijk, Munandar, & Hafner (2005) are among the other studies that use the DCC-GARCH model to study the impact of policy changes or other global developments on stock market linkages.

On the other hand, Li (2007) uses a BEKK-GARCH model proposed by Engle & Kroner (1995) to study the linkages between the stock markets of China, Hong Kong, and the U.S. They use the daily prices for the 4 markets from January 2000 to August 2005. They report that the markets of Shanghai and Shenzhen are linked with the stock market of Hong Kong, however, there is no linkage of these two markets with the U.S. stock market. Although there is evidence of volatility spillover from Hong Kong to the markets in mainland China, the magnitude is very small. Hence, the authors infer that overseas investors would benefit from diversification by adding Chinese stocks to their portfolios and reducing their total portfolio risk.

Canarella, Miller, & Pollard (2009) conducts a thorough analysis of the change in market linkages in the U.S., Canada, and Mexico stock markets due to NAFTA. They conduct a three-step analysis to study the integration among the three markets. They first use the Johansen & Juselius (1990) cointegration model to analyze the long-run equilibrium relationships and did not find any relationships. Second, they use the generalized impulse response analysis proposed by Pesaran & Shin (1998) to analyze the short-run relationships. They find that although responses are significant, they are not long-lasting and tend to subside within a few days. It is also interesting to note that U.S. market leads the other markets but is not entirely independent or autonomous. Lastly, they use a VAR (3) asymmetric BEKK-GARCH model[10] to estimate the returns and volatility. The evidence from the model shows significant transmission of volatility amongst the markets.

After carefully reviewing the studies that use MGARCH models to analyze stock market integration, we realize that both DCC-GARCH and BEKK-GARCH models have been used for estimations. Huang, Su, & Li (2010) compare the BEKK and DCC specifications for estimation

[10] Haroutounian & Price (2001), Khalfaoui, Boutahar, & Boubaker (2015), Liu (2016), and Vardar & Aydogan (2019) among others have also used the BEKK-GARCH model to study the return and volatility spillover effect among time-series data.

of covariances and variances. They find that the BEKK model performs better as it relatively has a larger number of parameters which provides an advantage in explaining hidden information in the time-series data. Similarly, Caporin & McAleer (2012) report that the BEKK model is optimal and preferred over the DCC model to estimate conditional covariances. Based on the inferences of these studies we select the BEKK-GARCH specification for our analysis.

In this study, we first conduct an event study to identify the impact of USMCA on the stock market returns of the 3 countries. We also look at the impact on industrial sectors within the 3 countries in order to identify the sectors that were affected the most. After that, we employ a VAR(1) asymmetric BEKK-GARCH model to estimate the conditional volatility of the three stock markets and compare the correlation between the estimated conditional volatilities of the stock markets for the Pre-USMCA and Post-USMCA periods.

3. Data

We use the daily closing price of market indices for our study, the S&P 500 is used for the U.S., the S&P/TSX Composite is used for Canada, and the S&P/BMV IPC index is used for Mexico. We also collect data for 11 sectorial indices for USA and Canada and 9 sectorial indices for Mexico to identify the impact across each sector. The indices used for each country are shown in Table (1).

Insert Table (1) here.

Data for all these indices is obtained from the Thomson Refinitiv DataStream database. The data for the market indices spans over a period of 28 years from November 8, 1991, to February 28, 2020. The World Health Organisation (WHO) declared COVID-19 as a pandemic on March 11, 2020[11], hence we do not consider data after February 2020 in order to control for the impact of the pandemic on the returns and volatility of the sample indices. In tandem with

[11] World Health Organisation (2020)

previous studies[12], we clean the data for missing values on dates with no trading activity for each market and retain data only if the information is available on that trading day for each market. This gives us a total of 6773 observations for each market index. Data for the sector indices is collected only from January 1, 2016, onwards for the purpose of the Event Study. To conduct a preliminary analysis of the market indices using summary statistics, we divide the data into the following three periods.

- Full Sample – 11th November 1991 to 28th February 2020 - 6773 Obs
- Pre-USMCA – 4th February 2015 to 15th August 2017 - 608 Obs[13]
- Post-USMCA – 16th August 2017 to 28th February 2020 - 608 Obs

As shown in equation (1) below, we calculate the daily returns as the first difference of the logarithmic closing prices multiplied by 100[14]. R_t is the daily logarithmic return and P_t is the daily closing price.

$$R_t = ln(P_t/P_{(t-1)}) * 100 \tag{1}$$

3.1. Summary Statistics

Insert Figure (1) here.

Insert Tables (2) and (3) here.

Figure (1) shows the time plot of the logarithmic returns of the S&P 500 index (panel (A)), the S&P/TSX Composite index (panel (B)), and the S&P/BMV IPC index (panel (C)) respectively from January 2015 to February 2020. The first difference of the logarithmic prices shows properties of volatility clustering which is commonly found in index returns. It is

[12] For instance, Li (2007) and Canarella, Miller, & Pollard (2009)

[13] For the purpose of having a balanced time period for comparison, we only take 608 observations for the pre-USMCA period.

[14] Brooks (2019) suggest that the returns should be scaled by 100, especially for multivariate models due to the larger numerical challenge they pose during estimation.

important to note that the clustering across markets seems to be simultaneous, which can indicate the presence of spillover.

Table (2) reports the summary statistics for the country indices. We have divided the sample into three different periods. Panel A shows the summary statistics for the Full sample period, Panel B for the Pre-USMCA period, and Panel C for the post-USMCA period. In order to draw comparable inferences, we only take 608 observations in the pre-USMCA period as we only had 608 observations for the post-USMCA period.

The mean returns and the standard deviation for the full sample period are relatively higher for the Mexican index. The Canadian index is the least volatile of all with a standard deviation of 1.01 and mean returns of 0.02. This risk-return relationship seems to be in congruence with the general finance theory. None of the indices exhibit properties of normality. We also see that all three indices are negatively skewed and are leptokurtic. From panels (B) & (C), we can see that the standard deviation for both U.S. and Mexico are higher in the post-USMCA period, indicating higher volatility in that period. The skewness and kurtosis are relatively higher for all three indices in the post-USMCA period.

Table (3) reports the summary statistics of the industry indices in each country. The mean returns are highest for the IT sector in Canada followed by that of the U.S. The mean returns are lowest for the Canadian Healthcare sector (-0.16), which also exhibits the highest volatility amongst all sectors across countries with a standard deviation of 3.29. In contrast, 5 out of the 11 Canadian sectors exhibit the lowest volatility which is also the lowest across all three countries. Returns for most sectors across the countries is negatively skewed and leptokurtic. None of the sector returns exhibit the property of normality.

3.1.1. Augmented Dickey Fuller (ADF) unit root tests

The ADF unit root test was applied to check for stationarity in the returns of the sample indices. Non-stationary data can lead to spurious results and hence it is appropriate to conduct this test prior to any further analyses (Dickey & Fuller, 1979). Tables (2) and (3) report the ADF test results for the three market indices and the sector indices respectively. All the indices are stationary at the first difference, this indicates that they follow a random walk (Ewing, Payne, & Sowell, 1999).

3.1.2. Covariance and Correlation Matrix for Returns of Market Indices

Insert Table (4) here.

The covariance and correlation among the returns of country indices offer preliminary insight into the impact of USMCA on market linkages. However, these results should not be used to make any concrete inferences. Panel (A) in the table (4) shows the covariance and correlation between the three countries for the full sample period. The correlation between the U.S. and Canadian stock market returns is the highest followed by the correlation between the U.S. and Mexican stock market returns. From panels (B) & (C) in table (4), we can see that the covariance among markets has reduced in the post-USMCA period. Similarly, the correlation between the markets has also reduced except for the correlation between U.S. and Canada.

4. Methodology

4.1. Event Study

This study uses the event study methodology applied to the sectorial indices of U.S., Canada, and Mexico to estimate the daily average abnormal returns (AAR) and the cumulative average abnormal returns (CAAR) around four dates identified as key events for USMCA. The abnormal returns (AR) are calculated as per the Fama French Five-Factor model (FF model)[15]. The FF model mitigates the issue related to the CAPM model and hence provides robust estimations for event studies (Schimmer, Levchenko, & Müller, 2014). The returns of the S&P

[15] The Fama French Five-Factor Returns are obtained from the Kenneth R. French - Data Library (2022). The Daily U.S. Fama/French 5 Factors are used for the U.S. market, the Daily Developed ex US Fama/French 5 Factors are used for the Canadian market, and Monthly Emerging Fama/French 5 Factors are used for the Mexican market. The monthly factors for the emerging markets are decompounded to obtain the daily factors.

500 are used as a proxy for U.S. market returns, the S&P/TSX Composite is used as a proxy for the Canadian market, and the S&P/BMV IPC index is used as a proxy for the Mexican market. The ARs are calculated based on an estimation window of (-221,-21) i.e., a minimum estimation length of 200 days. The model used for each of the sectors that comprise the equity markets in each country is shown below –

$$E(R_{it}) = R_f + \beta_{m,i}(R_m - R_f) + \beta_{s,i}(R_{SMB}) + \beta_{h,i}(R_{HML}) + \beta_{r,i}(R_{RMW}) + \beta_{c,i}(R_{CMA}) \quad (2)$$

In equation (2), $E(R_{it})$ is the expected return of Sector index 'i' at time 't'. R_f is the risk-free rate and R_m is the market return, $\beta_{m,i}$ represents the sensitivity of sector index 'i' to the market factor. R_{SMB} is the return on the Small – Big stock portfolio, $\beta_{s,i}$ represents the sensitivity of sector index 'i' to the size factor. R_{HML} is the return on the High – Low growth portfolio, $\beta_{h,i}$ represents the sensitivity of sector index 'i' to the growth factor. R_{RMW} is the return on the Robust – Weak operating profitability portfolio, $\beta_{r,i}$ represents the sensitivity of sector index 'i' to the operating profitability factor. R_{CMA} is the return on the Conservative – Aggressive investment portfolio, $\beta_{c,i}$ represents the sensitivity of sector index 'i' to the investment factor.

The Abnormal returns (AR) and the Cumulative abnormal returns (CAR) for each event date are estimated as follows –

$$AR_{i,\tau} = R_{i,\tau} - E(R_{i\tau}) \quad (3)$$

$$CAR_i(\tau_1, \tau_2) = \sum_{\tau=\tau_1}^{\tau_2} AR_{i,\tau} \quad (4)$$

In equations (3) and (4) above, 'i' is the event, and 'τ' is a day in the event window (τ = 0 is the event date). $R_{i,\tau}$ is the return on the event day 'τ' and $E(R_{i\tau})$ represents the expected return which is calculated using the Fama/French Five Factor model.

We take the average of the estimated ARs and CARs for the various sectors examined to compute the average abnormal returns (AAR) and the cumulative average abnormal returns (CAAR) for the overall market in each country as shown below.

$$AAR_\tau = \frac{1}{N}\sum_{i=1}^{N} AR_{i,\tau} \tag{5}$$

$$CAAR\ (\tau_1, \tau_2) = \sum_{\tau=\tau_1}^{\tau_2} AAR_\tau \tag{6}$$

Based on the timeline of the implementation of USMCA as explained in Section (1.1) of this study, we identify four key dates as follows:

- 16^{th} August 2017 – As mentioned earlier, the negotiations began on this date. Henceforth we will refer to this event date as “USMCA Negotiation” for the purpose of this study.
- 1^{st} October 2018 – The official USMCA document was published. Henceforth we will refer to this event date as “USMCA Published”.
- 30^{th} November 2018 – The USMCA was ratified by the delegates of the three countries on this date. Henceforth we will refer to this event date as “USMCA Ratified”.
- 10^{th} December 2019 – The amended version was signed. Henceforth we will refer to this event date as “USMCA Amended”.

The null hypothesis is that the AAR and the CAAR are equal to zero for all the key dates i.e., there is no impact of USMCA on the market and sector index returns of the U.S., Canada, and Mexico:

$$H_0\colon AAR, CAAR = 0 \tag{7}$$

We then calculate various parametric and non-parametric z-statistics and t-statistics as suggested by Schimmer, Levchenko, & Müller (2014), to verify the robustness of our results.

These test statistics help us to confirm that the estimated ARs are statistically significant. Jarc (2019) infers that while performing an event study several issues can create an estimation bias and lead to an over-rejection of the null hypothesis. Hence it is important to conduct these tests. The issues in reference are listed below:

- The abnormal returns might suffer from cross-sectional correlation as we focus on an event that occurs on the same day and creates an impact across markets.
- If the events are clustered or occur too close to each other it might cause distortions in volatility that are event-induced.

4.2. Multivariate GARCH

4.2.1. Volatility Spillover

Volatility often represents the rate of information flow in a market and clusters in volatility can increase the volatility of returns (Ross, 1989). Hence, analyzing volatility spillover can help us to understand the way information is disseminated across markets. In the absence of volatility transmission, it can be inferred that changes in market fundamentals are the drivers of volatility and would impact the volatility for only that market. However, in the presence of volatility transmission, Hong (2001) implies that a single shock can impact the volatility of various markets.

4.2.2. ARCH/GARCH models

Engle (1982) developed the autoregressive conditional heteroskedasticity model (ARCH) which was later generalized by Bollerslev (1986) and became the most preferable method to model volatility (Canarella, Miller, & Pollard, 2009). As per Brooks (2019) the GARCH model lets us estimate conditional variances as a function of previous lags of the error term. The univariate model is further developed into a multivariate version by Bollerslev, Engle, & Wooldridge (1988) to simultaneously model the volatility of returns of multiple time series.

4.2.3. Multivariate GARCH models

Bauwens, Laurent, & Rombouts (2006) explains that there are several advantages to using MGARCH models over their Univariate versions. These advantages as collated by Canarella, Miller, & Pollard (2009) are listed below:

- They eliminate the multi-step estimation procedure by accounting for interdependencies in the conditional variance and the conditional mean equations.
- They boost the effectiveness and power of tests for cross-market spillovers.
- As per Bollerslev, Chou, & Kroner (1992), MGARCH models can be used to analyze several issues in portfolio diversification and asset pricing.
- As per Bera & Higgins (1993), MGARCH models integrate covariances in the estimation procedure which helps to identify the inter-relatedness and response to innovation among variables.

However, Bauwens, Laurent, & Rombouts (2006) highlight that a large number of parameters need to be estimated in multivariate models, which is referred to as the "curse of dimensionality". Several scholars have discussed another interesting property i.e., asymmetry in variances and covariances of the error term. Black (1976) and Christie (1982) define this property as the "leverage effect". As per Ding, Granger, & Engle (1993), negative innovation generally leads to higher volatility in the following period, relative to positive innovation, this is defined as asymmetry.

In light of the aforementioned points and the previous literature[16] that compares the efficiency of various Multivariate GARCH models. We arrive at the resolution that the VAR(1) Asymmetric BEKK GARCH specification is the most appropriate for this study.

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[16] see Huang, Su, & Li (2010) and Caporin & McAleer (2012)

4.2.4. VAR(1) Asymmetric BEKK GARCH model

The model used for analyzing the return and volatility transmission between the U.S., Canadian, and Mexican stock markets can be divided into two parts. The first part is the Mean model which is described as a VAR(1) process. We estimate the Schwarz Information Criterion to select the optimal VAR length that fits best to our data[17] . The equation for the VAR(1) process is shown below:

$$R_t = \mu + \Gamma_i R_{t-i} + \varepsilon_t \tag{8}$$

Equation (8) can be extended as follows:

$$\begin{bmatrix} r_t^{US} \\ r_t^{CAN} \\ r_t^{MEX} \end{bmatrix} = \begin{bmatrix} \mu^{US} \\ \mu^{CAN} \\ \mu^{MEX} \end{bmatrix} + \begin{bmatrix} \gamma_{11} & \gamma_{12} & \gamma_{13} \\ \gamma_{21} & \gamma_{22} & \gamma_{23} \\ \gamma_{31} & \gamma_{32} & \gamma_{33} \end{bmatrix} \begin{bmatrix} r_{t-1}^{US} \\ r_{t-1}^{CAN} \\ r_{t-1}^{MEX} \end{bmatrix} + \begin{bmatrix} \varepsilon_t^{US} \\ \varepsilon_t^{CAN} \\ \varepsilon_t^{MEX} \end{bmatrix} \tag{9}$$

In equation (9) above, $R_t$is a 3x1 vector of daily returns, where r_t^{US} represents the returns of the S&P 500 index, r_t^{CAN} represents the returns of the S&P/TSX Composite index, and r_t^{MEX} represents the returns of the S&P/BMV IPC index. μ is a 3x1 vector of constants, Γ_i is a 3x3 matrix of parameters and ε_t is a 3x1 vector of error terms or innovation also commonly referred to as "news". The Γ_i matrix provides elements that represent the spillover terms. The diagonal elements represent the own spillover returns i.e., the impact of 't-1' returns on returns of 't'. The off-diagonal elements capture the impact of return spillover across the markets.

The second part of the GARCH framework is the Covariance model. We model the variance-covariance matrix as proposed by Kroner & Ng (1998). This specification imposes quadratic forms on the coefficients' matrix which ensures a positive definite H_t. Although computationally challenging, the asymmetric BEKK model does not require the estimation of

[17] The results to the VAR lag selection criteria test are shown in Table 5. The Schwarz Information Criterion (SIC) also known as the Bayesian Information Criterion is a statistical method used to compare different models and select the optimal one. The test considers both the goodness of fit and the model complexity. The criterion helps to avoid overfitted models by selecting the model with the lowest SIC value.

many parameters and allows interaction between conditional variances and covariances (Canarella, Miller, & Pollard, 2009). The asymmetric BEKK model can be written as follows:

$$H_t = C'C + A'\varepsilon_{t-1}\varepsilon'_{t-1}A + B'H_{t-1}B + G'\eta_{t-1}\eta'_{t-1}G \tag{10}$$

The expanded form of equation (10) can be written as follows:

$$\begin{aligned}
H_t &= \begin{bmatrix} c_{11} & 0 & 0 \\ c_{21} & c_{22} & 0 \\ c_{31} & c_{32} & c_{33} \end{bmatrix}' \begin{bmatrix} c_{11} & 0 & 0 \\ c_{21} & c_{22} & 0 \\ c_{31} & c_{32} & c_{33} \end{bmatrix} \\
&+ \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix}' \begin{bmatrix} \varepsilon_{1,t-1}^2 & \varepsilon_{1,t-1}\varepsilon_{2,t-1} & \varepsilon_{1,t-1}\varepsilon_{3,t-1} \\ \varepsilon_{2,t-1}\varepsilon_{1,t-1} & \varepsilon_{2,t-1}^2 & \varepsilon_{2,t-1}\varepsilon_{3,t-1} \\ \varepsilon_{3,t-1}\varepsilon_{1,t-1} & \varepsilon_{3,t-1}\varepsilon_{2,t-1} & \varepsilon_{3,t-1}^2 \end{bmatrix} \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \\
&+ \begin{bmatrix} b_{11} & b_{12} & b_{13} \\ b_{21} & b_{22} & b_{23} \\ b_{31} & b_{32} & b_{33} \end{bmatrix}' \begin{bmatrix} h_{11,t-1} & h_{12,t-1} & h_{13,t-1} \\ h_{21,t-1} & h_{22,t-1} & h_{23,t-1} \\ h_{31,t-1} & h_{32,t-1} & h_{33,t-1} \end{bmatrix} \begin{bmatrix} b_{11} & b_{12} & b_{13} \\ b_{21} & b_{22} & b_{23} \\ b_{31} & b_{32} & b_{33} \end{bmatrix} \\
&+ \begin{bmatrix} g_{11} & g_{12} & g_{13} \\ g_{21} & g_{22} & g_{23} \\ g_{31} & g_{32} & g_{33} \end{bmatrix}' \begin{bmatrix} \eta_{1,t-1}^2 & \eta_{1,t-1}\eta_{2,t-1} & \eta_{1,t-1}\eta_{3,t-1} \\ \eta_{2,t-1}\eta_{1,t-1} & \eta_{2,t-1}^2 & \eta_{2,t-1}\eta_{3,t-1} \\ \eta_{3,t-1}\eta_{1,t-1} & \eta_{3,t-1}\eta_{2,t-1} & \eta_{3,t-1}^2 \end{bmatrix} \begin{bmatrix} g_{11} & g_{12} & g_{13} \\ g_{21} & g_{22} & g_{23} \\ g_{31} & g_{32} & g_{33} \end{bmatrix}
\end{aligned} \tag{11}$$

In equation (10) above, H_t is a 3x3 matrix of variance-covariance, and *C* is a 3x3 lower triangular matrix of constants. In matrices *A* and *B,* the diagonal elements measure the impact of (t-1) shocks and (t-1) volatility of market ‘i’ on the conditional variance of the market ‘i’, whereas the off-diagonal elements measure the cross-market impact of shocks and volatility also referred to as the volatility spillover terms. In matrix *D*, the diagonal parameters measure the impact of own lagged negative shocks whereas the off-diagonal elements measure the impact of negative shocks in other markets also referred to as the cross-market asymmetric responses. ε_t is a vector of error terms obtained from the VAR(1) model and η_t is a vector that contains the Glosten, Jagannathan, & Runkle (1993) series, which is defined as $\eta_{it} = min[\varepsilon_{it}, 0]$, where $\eta_{it} = \varepsilon_{it}$ if $\varepsilon_{it} < 0,$ and 0 otherwise. In simple terms, the model structures the covariances between successive GARCH terms by loading the next period volatilities when the error is negative.

Kroner & Ng (1998) affirm that the efficient way to estimate the BEKK model is to use the maximum-likelihood method. The log-likelihood function can be estimated as follows:

$$L = \sum_{t=1}^{T} L_t \tag{12}$$

$$L_t = \frac{n}{2}\ln(2\pi) - \frac{1}{2} ln|H_t| - \frac{1}{2}\varepsilon'_t H_t^{-1}\varepsilon_t \tag{13}$$

We estimate a total of three variations of the BEKK GARCH models for our analysis. First, it is the one explained in equation (10), second, we introduce a dummy variable for USMCA in the mean model and third we introduce a dummy variable for USMCA in both the mean and covariance equations. The results of these models have been explained in Section (5.2) of this paper.

5. Results

5.1. Event Study

Insert Table (6) here.

Table (6) shows the cumulative average abnormal returns estimated using the Fama French Five-Factor model. As described earlier we will be examining abnormal returns around 4 key event dates i.e., USMCA Negotiation, USMCA Published, USMCA Ratified, and USMCA Amended. Panel (A) shows the CAAR (-2,+2) for the event, USMCA Negotiation. When the negotiations for the USMCA began, we see that both USA and Mexico markets had a significantly negative abnormal return, Canada is the only exception for this event. For the second event shown in panel (B), i.e., USMCA Published, we see that all 3 markets had a significantly negative CAAR (-2,+2) with the U.S. at -3.64%, followed by Mexico at -5.28%, and Canada at -5.93% was at a comparatively bigger loss than the two other countries.

Similarly, from panel (C) we see that when the USMCA was ratified, Canada lost the most at -4.06%, followed by the U.S. at -3.99% and Mexico at -0.2%. Furthermore, in panel (D) we see that when the USMCA was amended, Canada again suffered with a significant CAAR(-2,+2) of -4.4% and the USA at -2.28%. Mexico had a positive CAAR(-2,+2) of 0.12%, although statistically insignificant. Test results of several parametric and non-parametric tests are reported in Table (6) along with the abnormal returns for each event to confirm the robustness of these estimations.

Insert Figure (2-5) here.

Figures (2), (3), (4), and (5) plot the Average Abnormal Returns (AAR) in panel (A) and the Cumulative Average Abnormal Returns (CAAR) in panel (B) for the four key events across a (-10,+10) window. Similar to the results shown in the previous section, we see that there was no response across Canadian market sectors as a whole when the USMCA negotiations began, while both USA and Mexico sectors saw negative returns. However, for the next three events, Canada suffered greater losses. It is important to note that post amendment of USMCA, Canada's negative abnormal return is almost twice that of the U.S. and Mexico.

Insert Table (7) here.

We now move on to analyzing the Cumulative Abnormal Returns for each sector in the three countries. Panel (A) shows the results for the U.S. sector indices, panel (B) for Canadian sector indices, and panel (C) for the Mexican sector indices. We see from the abnormal returns of the sector indices that the Real Estate sector suffered the most across all countries, followed by the Consumer Discretionary sector. The tariffs that were imposed by the Trump administration on Canadian steel and lumber hamper the growth of the real estate sector. Although the USMCA would stimulate industrial activity and eventually lead to a reduction in those tariffs, the uncertainty surrounding these tariffs causes the real estate sector to suffer the most. Furthermore, as requirements for the automobile industry were increased, this had a direct negative impact on the returns of the Consumer Discretionary sector. Most sectors across countries reported negative cumulative abnormal returns showing that the USMCA was a bad deal for most. As seen previously with the country-wise market returns, the Canadian sectors suffered the most.

5.2. Multivariate GARCH model

This section reports the estimated coefficients obtained from our MGARCH models. We use the BFGS algorithm to estimate the second moments in our models. We also report the log-likelihood statistics and the multivariate test results for the Ljung-Box Q statistic for the standardized residuals up to 24 lags.

5.2.1. VAR(1) BEKK-GARCH (1,1) w/o USMCA Dummy

Insert Table (8) here.

From Table (8) we see that the U.S. index returns does not depend on its own lag. The lagged returns of the Canadian and the Mexican index also seem to have no impact on mean returns for the U.S. index. For the Canadian index we see that own lagged returns as well as the lagged returns of the U.S. and Mexican indices have a positive and significant impact. Lastly, for the Mexican index, we see that own lagged returns and lagged returns of the Canadian index have a significant and positive impact on the mean returns. It is surprising to note that the U.S. lagged returns seem to have no impact on the mean returns of the Mexican index.

While interpreting the results of the BEKK parametrization, it is important to note that all the squared coefficients will always have a positive effect on the return variance in the next period. Therefore, we focus on the other coefficients to interpret the results of these models. Also due to a large number of parameters, we will only focus on interpreting the results of coefficients that are statistically significant.

We can infer the following from the variance equation. From the ARCH coefficients, we can see that shocks in the Canadian index have a positive and significant impact on the covariance with the returns of the U.S. and Mexican indices in the next period. We further see a significant presence of cross-country GARCH effects for U.S. and Canadian indices. The coefficients of the asymmetry terms show that negative news in the U.S. market significantly impacts the covariance of the U.S. market with both the Canadian and Mexican markets. We see a similar impact of negative news in the Mexican market, i.e., an increase in its covariance with the two other countries. However, we do not see any significant impact of negative news in the Canadian market on its covariance with the two other markets. This could be due to asymmetry in economic factors among the three countries or due to an industry composition effect.

Insert Figure (6) here.

Figure (6) shows the time plot of the conditional volatilities of the S&P 500 index, the S&P/TSX Composite index, and the S&P/BMV IPC index respectively from January 2015 to February 2020. The estimated conditional volatilities for each index are obtained from the VAR(1) BEKK GARCH model. We can see from the graphs that conditional volatility for all three indices increased simultaneously in October 2018 when the USMCA document was published.

Insert Figure (7) here.

A similar impact can be seen on the conditional covariances among the markets from the figure (7). We can also see a sharp rise in conditional covariances of the index pairs at the end of February, just before COVID-19 was officially declared as a pandemic by WHO.

Insert Figure (8) here.

Figure (8) shows the conditional correlations. We are unable to make any specific inferences regarding USMCA from this plot as we can see that the conditional correlations for all three index pairs have been widely fluctuating throughout the period plotted on the figure.

5.2.2. Covariance/Correlation Matrix of Conditional Volatility

Insert Table (9) here.

Table (9) presents the covariance and correlation matrix of the conditional volatilities estimated from the VAR(1) BEKK GARCH model. The covariance and correlation in conditional volatility offer insight into the impact of USMCA on volatility spillover between the markets. However, these results should not be used to make any concrete inferences. Panel (A) in the table (9) shows the covariance and correlation for the full sample period. The correlation between the U.S. and Canadian index return volatilities is the highest followed by the correlation between the U.S. and Mexican markets. From panels (B) & (C) in table (9), we see that the covariance of return volatilities has increased for the pairs of U.S. and Mexico as well as for Canada and Mexico. The covariance between the conditional volatility of the U.S. and Canadian indices has reduced in the post-USMCA period. These results further motivate us to test the impact of USMCA on market volatilities and so we introduce a dummy for USMCA in the mean equation (Table (10)) and the variance equation (Table (11)).

5.2.3. VAR(1) BEKK-GARCH (1,1) w/ USMCA Dummy in Mean Eq.

Insert Table (10) here.

From the mean equations in Table (10) we see that the U.S. index returns does not depend on its own lag. The lagged returns of the Canadian and Mexican indices also seem to have no impact on mean returns for the U.S. index. The lagged returns of the U.S., Canada, and Mexico have a positive and significant impact on the returns of the Canadian index. We also see that the USMCA dummy has a negative and significant coefficient, indicating that mean returns for the Canadian index are lower in the post-USMCA period. We also find a positive and significant impact of lagged returns, except for U.S. lagged returns, on the returns of the Mexican index. The USMCA also had a significant and negative impact on the mean returns of the Mexican index.

The variance equations show that negative news in the U.S. market significantly increases the volatilities of both the Canadian and Mexican indices. Furthermore, negative news in the Mexican market also increases the volatility of the Canadian index but has no impact on the U.S. index.

5.2.4. VAR(1) BEKK-GARCH (1,1) w/ USMCA Dummy in Mean & Variance Eq.

Insert Table (11) here.

In Table (11), from the mean equations, we see that USMCA has a significant and positive impact on the mean returns of the U.S. index, whereas the coefficient for the USMCA dummy is negative and significant for the Mexican index. The USMCA dummy does not have a significant impact on the mean returns of the Canadian index. In the variance equation, we see that the asymmetry term is only significant for spillover from the U.S. index to the Canadian index and is unidirectional. For the GARCH terms, we see that an increase in covariance between the U.S. and Canadian indices causes a statistically significant decrease in the volatility of the Canadian index in the next period. We also see that an increase in covariance between the U.S. and Mexican indices causes a statistically significant decrease in the volatility of the Mexican index in the next period. Thereafter, introducing the USMCA dummy in the variance equation helps us to carefully extract the impact of USMCA on volatility spillover between the markets. Most of the coefficients of the USMCA dummy are negative, but not significant. The USMCA dummy is negative and significant only for the one-period lag of the Canadian index.

6. Conclusion

This study focuses on analyzing three questions pertinent to investors and researchers in the context of the USMCA. First, what was the impact of USMCA on the stock market returns of the U.S., Canada, and Mexico? Second, which economic sectors were affected the most, and was it a win-or-lose situation for them? Lastly, did the USMCA have an impact on volatility spillover across the markets?

Our study uses two different methodologies to find answers to these questions. First, we use an Event Study methodology to identify the impact on the returns of the stock markets and the sectors. We collect data for sectorial and market indices from the Thomson Refinitiv DataStream database. We use the Fama French Five-Factor model to estimate the abnormal returns with a minimum estimation window of 200 days. The result of our analysis shows that for 3 out of the 4 key dates identified, Canada saw the largest negative abnormal returns, followed by the U.S. The result of the sector indices shows that Real Estate suffered the most. This could be because of the uncertainty regarding import tariffs on lumber and steel. The second biggest losing sector was Consumer Discretionary, possibly due to the tightening of requirements on the import of automobiles. Most sectors across countries had a negative abnormal return on the key event dates identified.

Lastly, we use a multivariate GARCH model to study the impact of USMCA on linkages between the three markets. We analyze data over a period of 28 years from November 8, 1991, to February 28, 2020. A VAR(1) Asymmetric BEKK GARCH(1,1) parametrization is used to estimate the conditional volatilities. Three variations of this model are estimated i.e., one without a USMCA dummy, one with a USMCA dummy in the mean equation, and lastly, one with the USMCA dummy in the mean and variance equations.

We see from the results of the mean and variance equations of the BEKK GARCH models, that the U.S. market historically has the most influential impact on the returns and volatilities of the two other markets. These results are consistent with that of the previous literature[18]. We also find the presence of cross-country spillover in returns for Canada and Mexico. The mean returns for both Canada and Mexico were negative and statistically significant in the post-USMCA period. We do not find any significant evidence of change in volatility spillover across the markets post-USMCA. Overall, our analysis shows that the USMCA had a negative effect on the returns of the country and sectorial indices, but it does not cause a significant change in the volatility linkages of the three markets.

7. References

Aggarwal, R., & Kyaw, N. (2005). Equity market integration in the NAFTA region: Evidence from unit root and cointegration tests. *International Review of Financial Analysis, 14*(4), 393-406.

Aggarwal, R., Long, M., Moore, S., & Ervin, D. (1998). Industry differences in NAFTA's impact on the valuation of U.S. companies. *International Review of Financial Analysis, 7*(2), 137-152.

Arshanapalli, B., & Doukas, J. (1993). International stock market linkages: Evidence from the pre- and post-October 1987 period. *Journal of Banking and Finance, 17*(1), 193-208.

Bauwens, L., Laurent, S., & Rombouts, J. (2006). Multivariate GARCH models: a survey. *Journal of applied econometrics, 21*(1), 79-109.

Bera, A., & Higgins, M. (1993, December). ARCH models: Properties, estimation, and testing. *Journal of Economic Surveys, 7*(4), 305-366.

Black, F. (1976). Studies in price volatility changes. *Proceedings of the 1976 meeting of the business and economics statistics section* (pp. 177-181). American Statistical Association.

Bollerslev, T. (1986). Generalized autoregressive conditional heteroskedasticity. *Journal of Econometrics, 31*(3), 307-327.

Bollerslev, T., Chou, R., & Kroner, K. (1992). ARCH modeling in finance: A review of the theory and empirical evidence. *Journal of Econometrics, 52*(1-2), 5-59.

Bollerslev, T., Engle, R., & Wooldridge, J. (1988). A Capital Asset Pricing Model with Time-Varying Covariances. *Journal of Political Economy, 96*(1), 116-131.

Brooks, C. (2019). *RATS Handbook: Introductory econometrics for finance.* Cambridge University Press.

Canarella, G., Miller, S., & Pollard, S. (2009). Dynamic Stock Market Interactions between the Canadian, Mexican, and the United States Markets: The NAFTA Experience. *Nova Science Publishers, Inc., 4th Quarter*.

[18] For instance, Eun & Shim (1989)

Caporin, M., & McAleer, M. (2012). Do We Really Need Both BEKK and DCC? A Tale of Two Covariance Models. *Journal of Economic Surveys, 26*(4), 736-751.

Cappiello, L., Engle, R., & Sheppard, K. (2006, September). Asymmetric Dynamics in the Correlations of Global Equity and Bond Returns. *Journal of Financial Econometrics, 4*(4), 537-572.

Chan, K., Gup, B., & Pan, M.-S. (1992, May). An Empirical Analysis of Stock Prices in Major Asian Markets and the United States. *The Financial Review, 27*(2), 289-307.

Chan, K., Gup, B., & Pan, M.-S. (1997, July). International Stock Market Efficiency and Integration: A Study of Eighteen Nations. *Journal of Business Finance & Accounting, 24*(6), 803-813.

Chou, R., Jin-Lung, L., & Chung-shu, W. (1999). Modeling the Taiwan stock market and international linkages. *Pacific Economic Review, 4*(3), 305-320.

Christie, A. (1982, December). The stochastic behavior of common stock variances: Value, leverage and interest rate effects. *Journal of Financial Economics, 10*(4), 407-432.

Daelemans, B., Daniels, J., & Nourzad, F. (2018). Free Trade Agreements and Volatility of Stock Returns and Exchange Rates: Evidence from NAFTA. *Open Economies Review, 29*, 141-163.

Darrat, A., & Zhong, M. (2005). Equity market linkage and multinational trade accords: The case of NAFTA. *Journal of International Money and Finance, 24*(5), 793-817.

Dickey, D. A., & Fuller, W. A. (1979, June). Distribution of the Estimators for Autoregressive Time Series with a Unit Root. *Journal of the American Statistical Association, 74*(366), 427-431.

Ding, Z., Granger, C. W., & Engle, R. F. (1993). A long memory property of stock market returns and a new model. *Journal of Empirical Finance*, 83-106.

Doukas, J., & Switzer, L. (2000). Common stock returns and international listing announcements: Conditional tests of the mild segmentation hypothesis. *Journal of Banking & Finance, 24*, 471-502.

Engle, R. (1982, July). Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdom Inflation. *Econometrica, 50*(4), 987-1007.

Engle, R. (2002). Dynamic conditional correlation: A simple class of multivariate generalized autoregressive conditional heteroskedasticity models. *Journal of Business & Economic Statistics, 20*(3), 339-350.

Engle, R., & Kroner, K. (1995, March). Multivariate Simultaneous Generalized Arch. *Econometric Theory, 11*(1), 122-150.

Esposito, A. (2020, July). TIMELINE-The long bumpy road from NAFTA to USMCA. *Thomson Reuters*.

Eun, C., & Shim, S. (1989, June). International Transmission of Stock Market Movements. *The Journal of Financial and Quantitative Analysis, 24*(2), 241-256.

Ewing, B. T., Payne, J. E., & Sowell, C. (1999, September). NAFTA and North American stock market linkages: An empirical note. *North American Journal of Economics and Finance, 10*, 443-451.

Ewing, B., Payne, J., & Sowell, C. (2001, November). Transmission of Conditional Stock Return Volatility Across North American Markets: Evidence from Pre- and Post-NAFTA. *The International Trade Journal, 15*(4), 409-427.

Fern ndez-Serrano, J., & Sosvilla-Rivero, S. (2003, August). Modelling the linkages between US and Latin American stock markets. *Applied Economics, 35*(12), 1423-1434.

Glosten, L., Jagannathan, R., & Runkle, D. (1993, December). On the Relation between the Expected Value and the Volatility of the Nominal Excess Return on Stocks. *The Journal of Finance, 48*(5), 1779-1801.

Grubel, H. (1968, December). Internationally Diversified Portfolios: Welfare Gains and Capital Flows. *The American Economic Review, 58*(5), 1299-1314.

Haroutounian, M., & Price, S. (2001). Volatility in the transition markets of Central Europe. *Applied Financial Economics, 11*(1), 93-105.

Hassan, M., & Naka, A. (1996). Short-Run and Long-Run Dynamic Linkages among International Stock Markets. *International Review of Economics and Finance, 5*(4), 387-405.

Heimonen, K. (2010, October). Stock market integration: evidence on price integration and return convergence. *Applied Financial Economics, 12*(6), 415-429.

Hilliard, J. (1979, March). The Relationship Between Equity Indices on World Exchanges. *The Journal of Finance, 34*(1), 103-114.

Hong, Y. (2001, July). A test for volatility spillover with application to exchange rates. *Journal of Econometrics, 103*(1-2), 183-224.

Huang, Y., Su, W., & Li , X. (2010). Comparison of BEKK GARCH and DCC GARCH Models: An Empirical Study. *Advanced Data Mining and Applications: 6th International Conference, ADMA 2010* (pp. 99-110). Chongqing, China: Springer Berlin Heidelberg.

Jarc, L. (2019). An analysis of the US president Trump's impact on the financial markets through Twitter posts: master's thesis. *(Doctoral dissertation, Univerza v Ljubljani, Ekonomska fakulteta)*.

Johansen, S. (1988, June). Statistical analysis of cointegration vectors. *Journal of economic dynamics and control, 12*(2-3), 231-254.

Johansen, S., & Juselius, K. (1990). Maximum likelihood estimation and inference on cointegration—with applications to the demand for money. *Oxford Bulletin of Economics and statistics, 52*(2), 169-210.

Karolyi, G., & Stulz, R. (1996, July). Why Do Markets Move Together? An Investigation of U.S.-Japan Stock Return Comovements. *The Journal of Finance, 51*(3), 951-986.

Kasa, K. (1992, February). Common stochastic trends in international stock markets. *Journal of Monetary Economics, 29*(1), 95-124.

Kenneth R. French - Data Library. (2022). Retrieved from https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

Kenourgios, D., Samitas, A., & Paltalidis, N. (2009, June). Financial market dynamics in an enlarged European Union. *Journal of Economic Integration, 24*(2), 197-221.

Khalfaoui, R., Boutahar, M., & Boubaker, H. (2015, May). Analyzing volatility spillovers and hedging between oil and stock markets: Evidence from wavelet analysis. *Energy Economics, 49*, 540-549.

Kroner, K., & Ng, V. (1998, October). Modeling Asymmetric Comovements of Asset Returns. *The Review of Financial Studies, 11*(4), 817-844.

Lahrech, A., & Sylwester, K. (2013). The impact of NAFTA on North American stock market linkages. *North American Journal of Economics and Finance, 25*, 94-108.

Li, H. (2007). International linkages of the Chinese stock. *Applied Financial Economics, 17*(4), 285-297.

Li, X.-M., & Zou, L.-P. (2008, March). How do policy and information shocks impact co-movements of China's T-bond and stock markets? *Journal of Banking & Finance, 32*(3), 347-359.

Liu, C. (2016). Spillover Effects in Major Equity Markets: A GARCH BEKK Approach. *Open Access Library Journal, 3*(e2160).

Ludwikowski, M., & Lopez, A. (2022). *Still friends? Review of U.S.-Mexico-Canada trade two years under the 'New NAFTA'.* Reuters. Retrieved from https://www.reuters.com/legal/legalindustry/still-friends-review-us-mexico-canada-trade-two-years-under-new-nafta-2022-08-11/

Maghyereh, A., & Al-Zuobi, H. (2005). Free trade agreements and equity market integration: the case of the US and Jordan. *Applied Financial Economics, 15*(14), 995-1005.

Panton , D., Lessig, V., & Joy, O. (1976, September). Comovement of International Equity Markets: A Taxonomic Approach. *The Journal of Financial and Quantitative Analysis, 11*(3), 415-432.

Pesaran, H., & Shin, Y. (1998, January). Generalized impulse response analysis in linear multivariate models. *Economics Letters, 58*(1), 17-29.

ResearchFDI. (2023, January 17). What you need to know about the USMCA Trade Agreement. Retrieved from https://researchfdi.com/resources/articles/what-you-need-know-about-the-usmca-trade-agreement/

Richards, A. (1995). Comovements in National Stock Market Returns: Evidence of Predictability, but Not Cointegration. *Journal of Monetary Economics, 36*(3), 631-654.

Ripley, D. (1973, August). Systematic Elements in the Linkage of National Stock Market Indices. *The Review of Economics and Statistics, 55*(3), 256-361.

Rodriguez, P. (2003, February). Investor Expectations and the North American Free Trade Agreement. *Review of International Economics, 11*(1), 206-218.

Ross, S. (1989, March). Information and Volatility: The No-Arbitrage Martingale Approach to Timing and Resolution Irrelevancy. *The Journal of Finance, 44*(1), 1-17.

Schimmer, M., Levchenko, A., & Müller, S. (2014). EventStudyTools (Research Apps), St.Gallen. Available on: http://www.eventstudytools.com. Accessed on: 06.05.2021.

Schöllhammer, H., & Sand, O. (1985). The Interdependece among the Stock Markets of Major European Countries and the United States: An Empirical Investigation of Interrelationships among National Stock Price Movements. *Management International Review, 25*(1), 17-26.

Sephton, P., & Larsen, H. (1991). Tests of exchange market efficiency: fragile evidence from cointegration tests. *Journal of International Money and Finance, 10*(4), 561-570.

Taylor, M., & Tonks, I. (1989, May). The Internationalisation of Stock Markets and the Abolition of U.K. Exchange Control. *The Review of Economics and Statistics, 71*(2), 332-336.

Thompson, A. (1994). Canada-United States Free Trade and Investment. *World Economy, 17*(1), 63-74.

Van Dijk, D., Munandar, H., & Hafner, C. (2005). The Euro Introduction and Non-Euro Currencies. *Tinbergen Institute Discussion Paper. (No. 05-044/4).* Tinbergen Institute, Amsterdam and Rotterdam.

Vardar, G., & Aydogan, B. (2019). Return and volatility spillovers between Bitcoin and other asset classes in Turkey: Evidence from VAR-BEKK-GARCH approach. *Euromed Journal of Business, 14*(3), 209-220.

Villarreal, M. (2023). *U.S.-Mexico-Canada (USMCA) Trade Agreement.* Congressional Research Service. Retrieved from https://crsreports.congress.gov

Wagner, A., Zeckhauser, R., & Ziegler, A. (2018). Company stock price reactions to the 2016 election shock: Trump, taxes, and trade. *Journal of Financial Economics, 130*, 428-451.

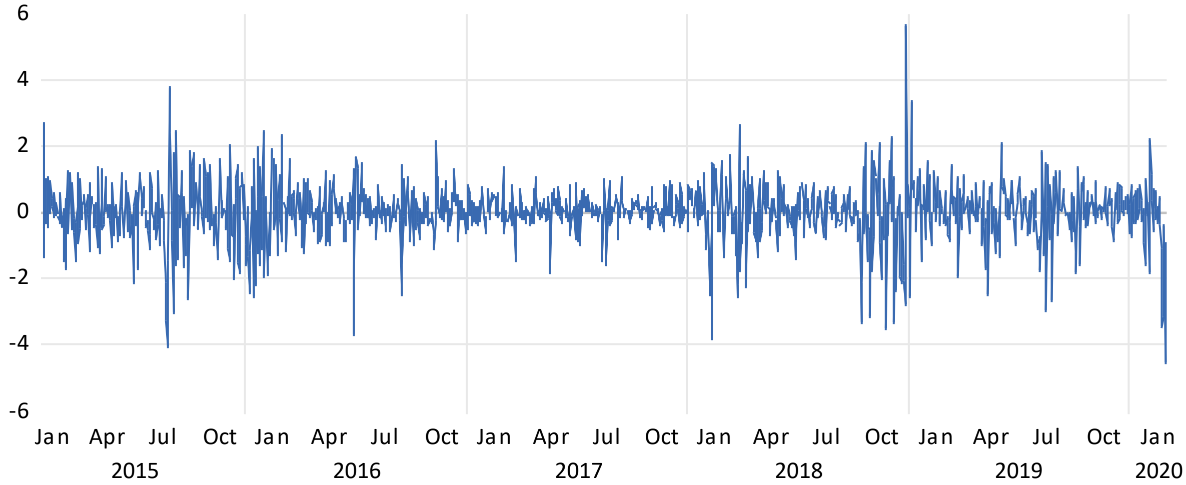
Wayne, E., & Bitar, D. (2022). *USMCA at Two: How to measure North American success?* Wilson Center. Retrieved from https://www.wilsoncenter.org/article/usmca-two-how-measure-north-american-success#:~:text=Under%20USMCA%2C%20trade%20has%20bounced,the%20US's%20largest%20export%20markets.

World Health Organisation. (2020, March 11). Retrieved from https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020

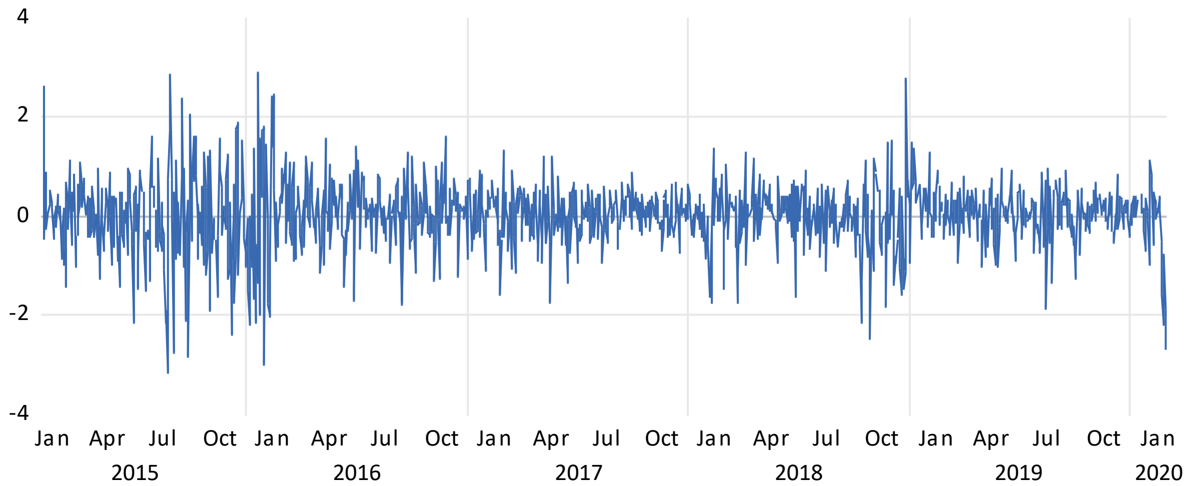
Worthington, A., & Higgs, H. (2004, November). Transmission of equity returns and volatility in Asian developed and emerging markets: a multivariate GARCH analysis. *International Journal of Finance & Economics, 9*(1), 71-80.

Figure 1: Daily Logarithmic Returns

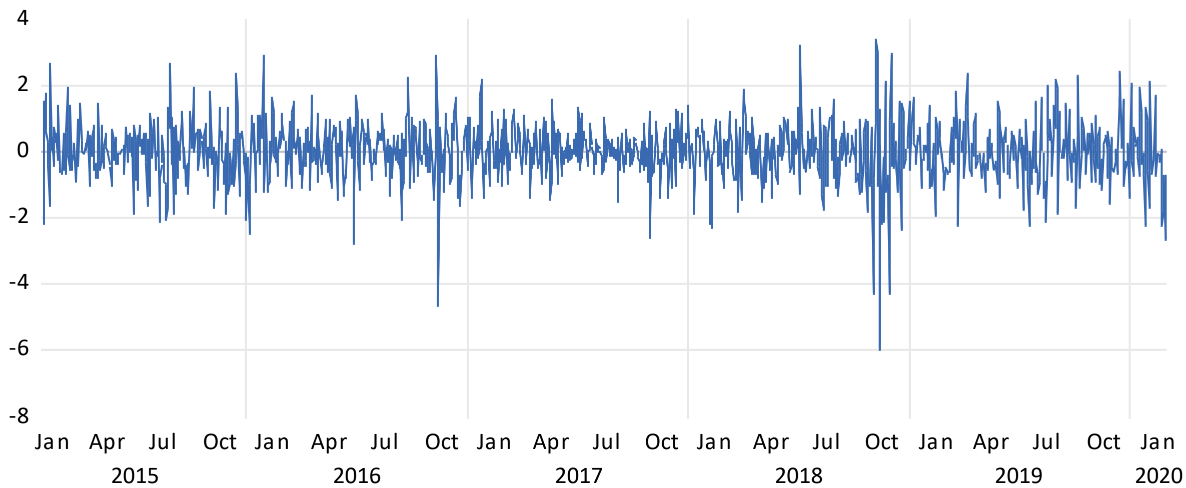
Panel A : S&P 500 Daily Returns



Panel B : S&P/TSX Composite Daily Returns

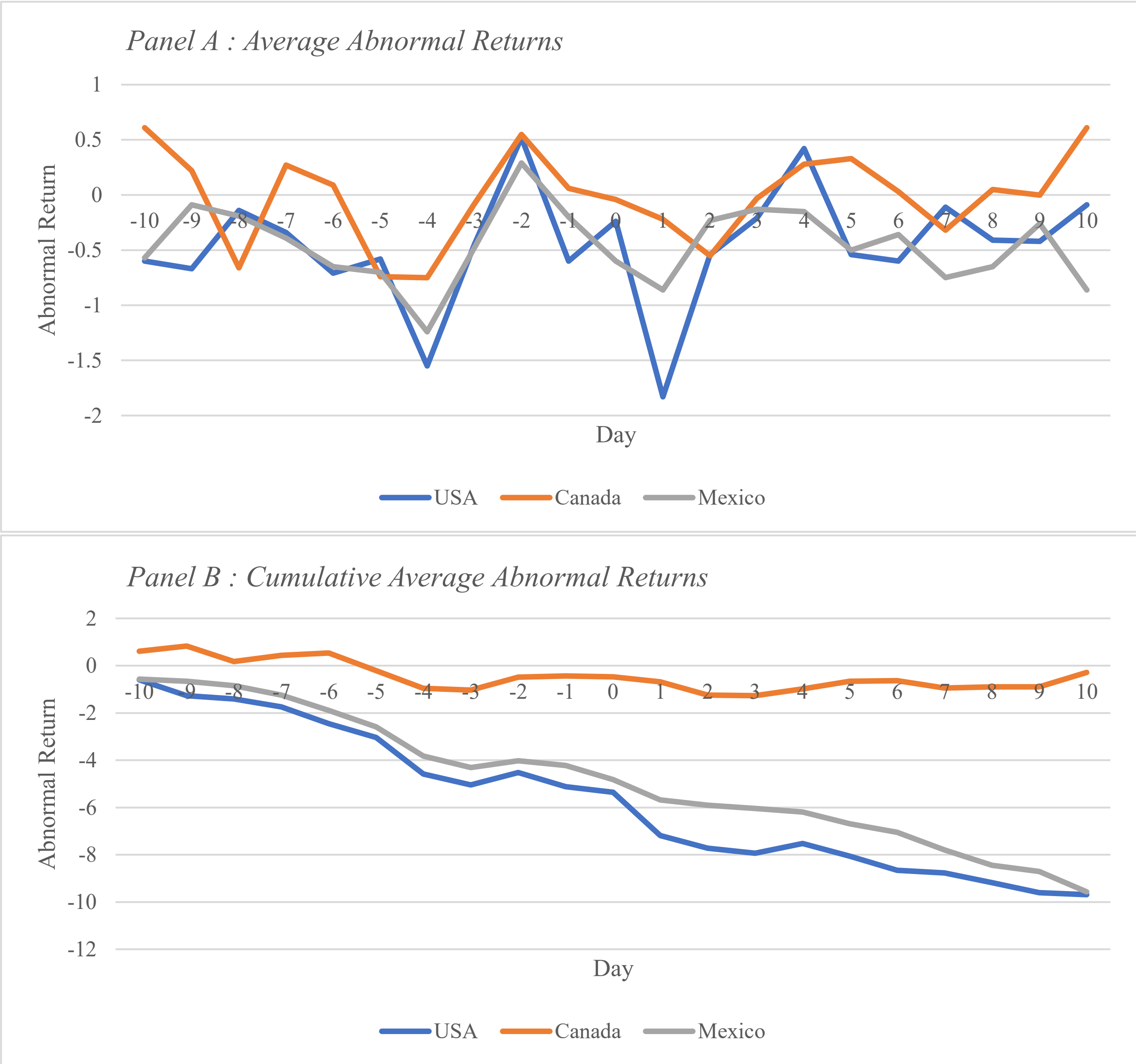


Panel C : S&P/BMV IPC Daily Returns



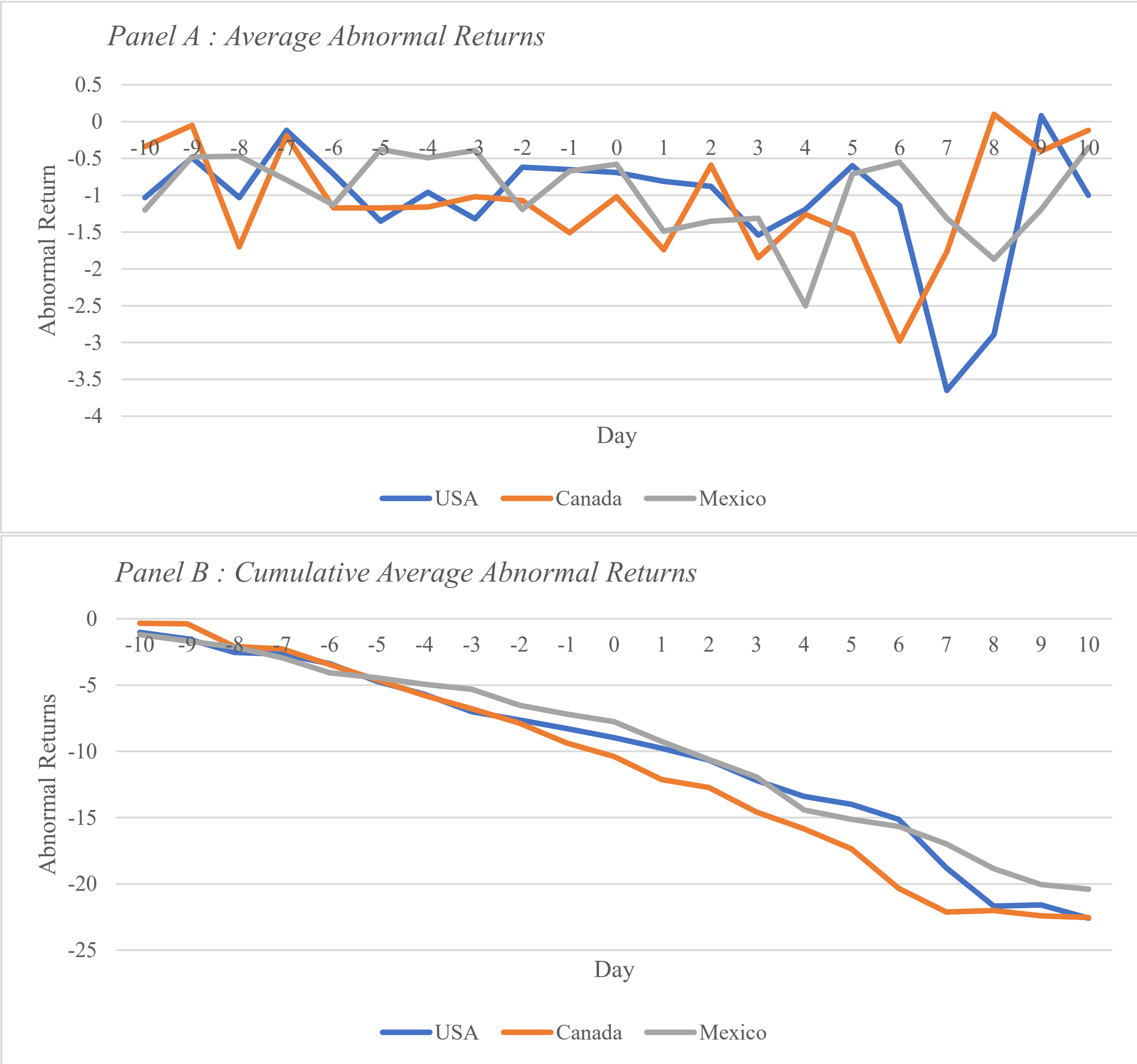
Note: Figure 1 shows the plot of the daily logarithmic returns for the S&P 500, S&P/TSX Composite and the S&P/BMV IPC index from January 2015 to January 2020. The daily logarithmic returns are calculated as follows: $R_t = ln(P_t/P_{(t-1)}) * 100$, where R_t is the daily logarithmic return and P_t is the daily closing price. The time-period is plotted on the X-Axis and the daily logarithmic returns on the Y-Axis.

Figure 2: Event – USMCA Negotiation



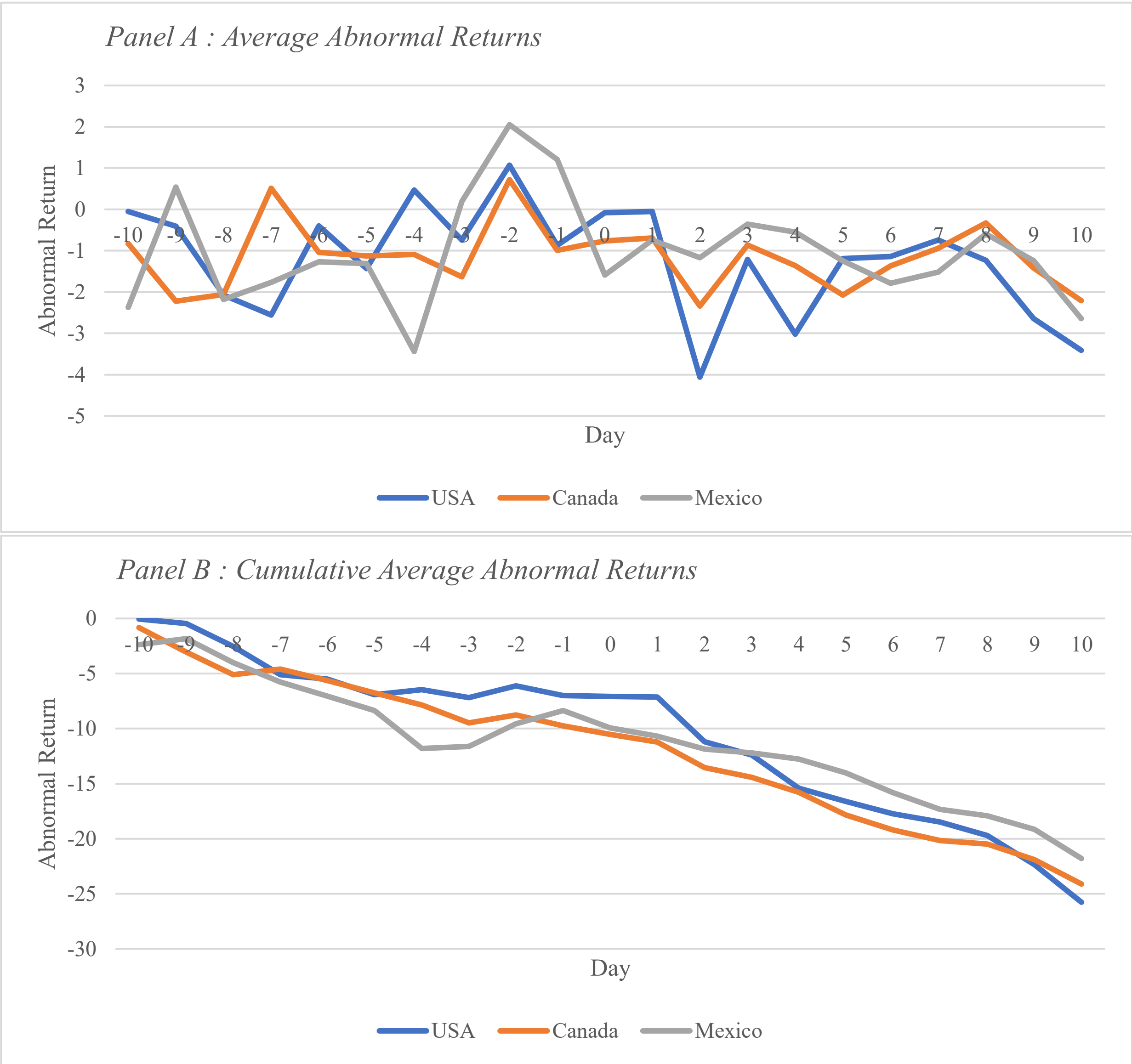
Note: This figure shows the plot of the average abnormal returns (AAR) in panel A and the cumulative average abnormal returns (CAAR) in panel B for the event: USMCA Negotiation, plotted across a (-10,+10) window. The AAR and CAAR are calculated as per the Fama and French Five-Factor Model. The Day is plotted on the X-Axis and the abnormal returns on the Y-Axis.

Figure 3: Event – USMCA Published



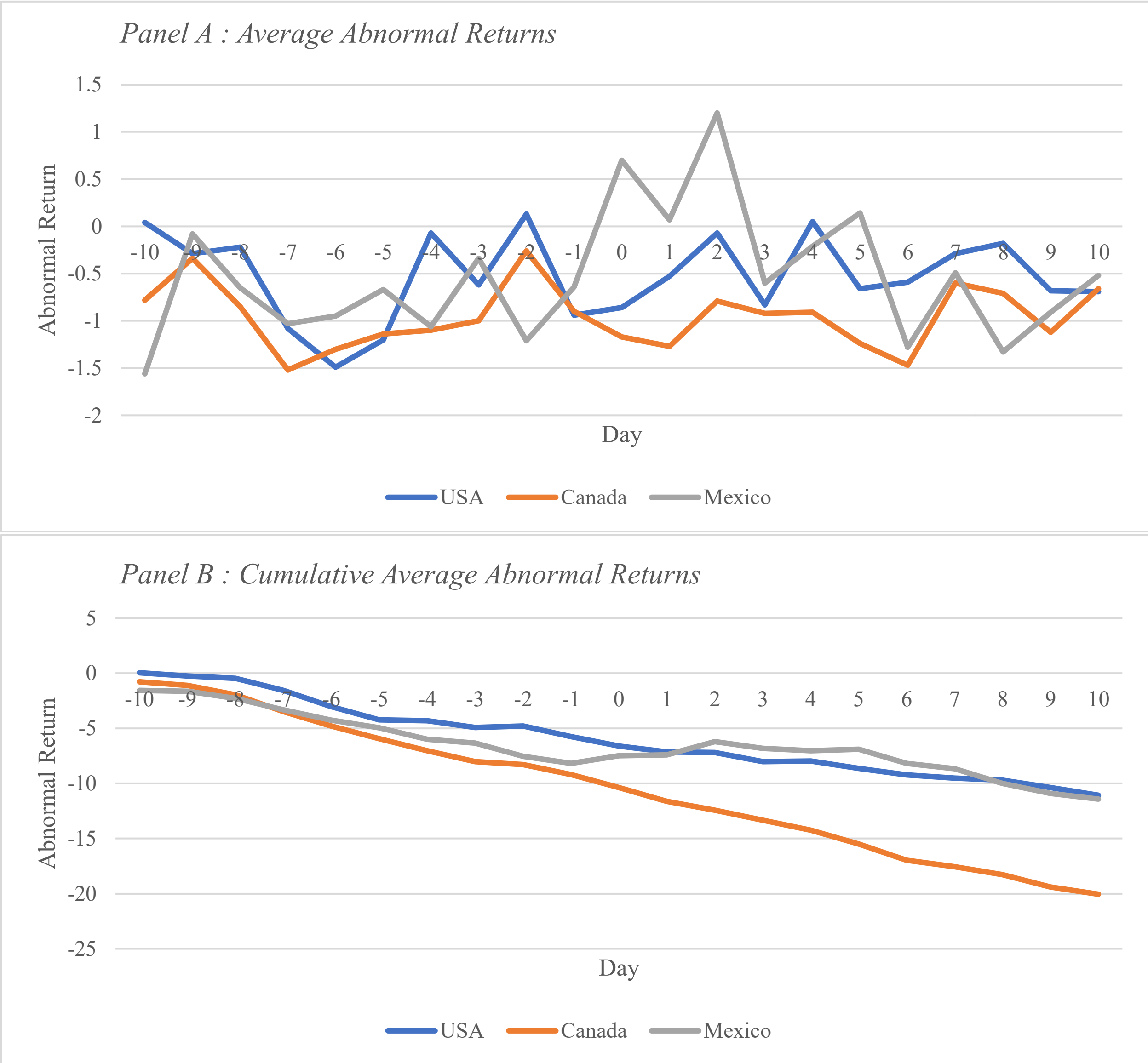
Note: This figure shows the plot of the average abnormal returns (AAR) in panel A and the cumulative average abnormal returns (CAAR) in panel B for the event: USMCA Published, plotted across a (-10,+10) window. The AAR and CAAR are calculated as per the Fama and French Five-Factor Model. The Day is plotted on the X-Axis and the abnormal returns on the Y-Axis.

Figure 4: Event – USMCA Ratified



Note: This figure shows the plot of the average abnormal returns (AAR) in panel A and the cumulative average abnormal returns (CAAR) in panel B for the event: USMCA Ratified, plotted across a (-10,+10) window. The AAR and CAAR are calculated as per the Fama and French Five-Factor Model. The Day is plotted on the X-Axis and the abnormal returns on the Y-Axis.

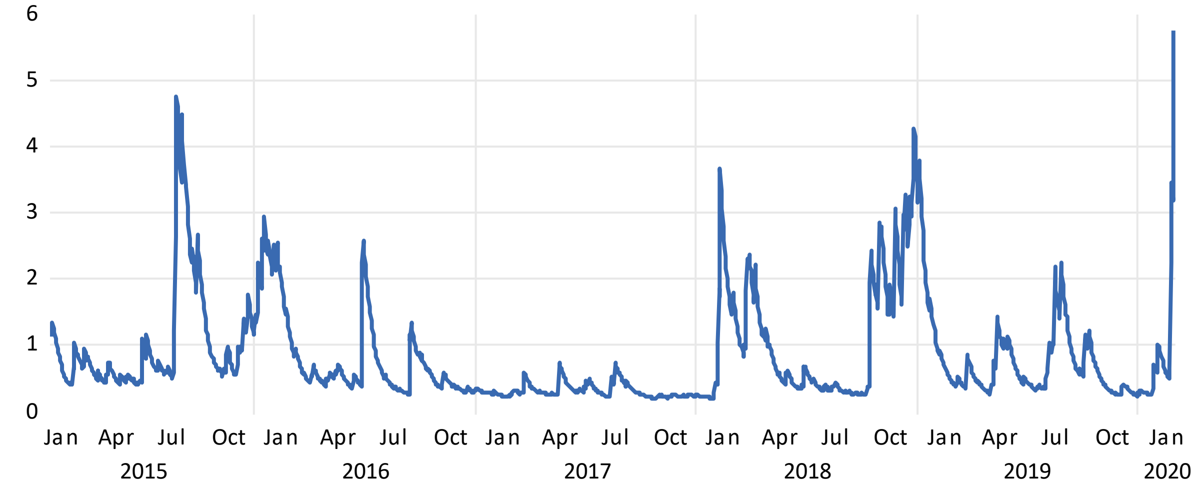
Figure 5: Event – USMCA Amended



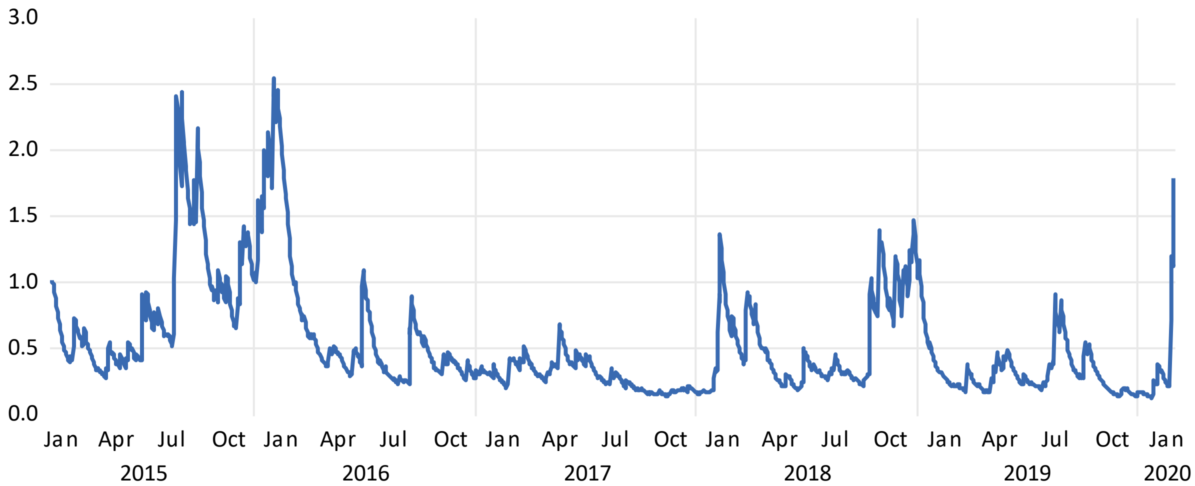
Note: This figure shows the plot of the average abnormal returns (AAR) in panel A and the cumulative average abnormal returns (CAAR) in panel B for the event: USMCA Amended, plotted across a (-10,+10) window. The AAR and CAAR are calculated as per the Fama and French Five-Factor Model. The Day is plotted on the X-Axis and the abnormal returns on the Y-Axis.

Figure 6: Conditional Volatility

Panel A : S&P 500 Conditional Volatility



Panel B : S&P/TSX Composite Conditional Volatility

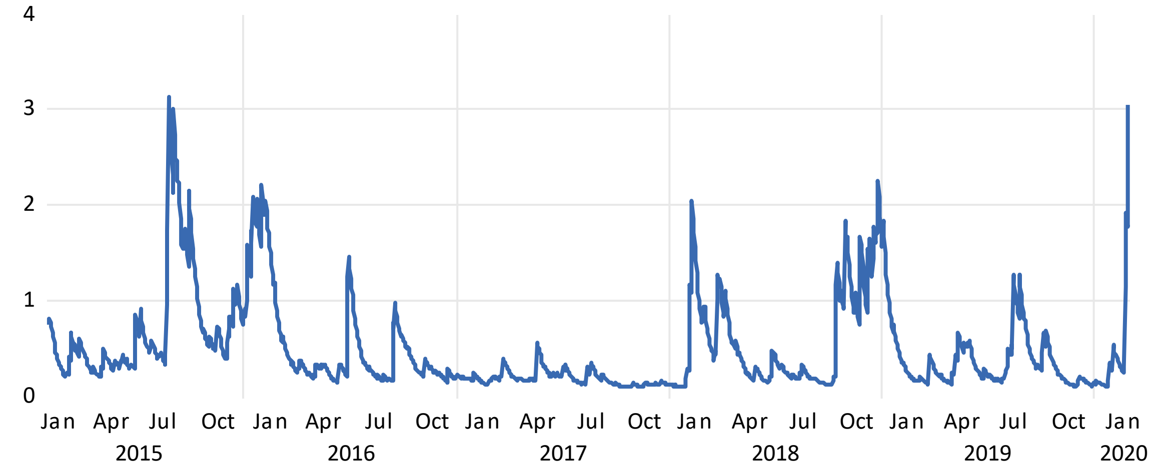


Panel C : S&P/BMV IPC Conditional Volatility

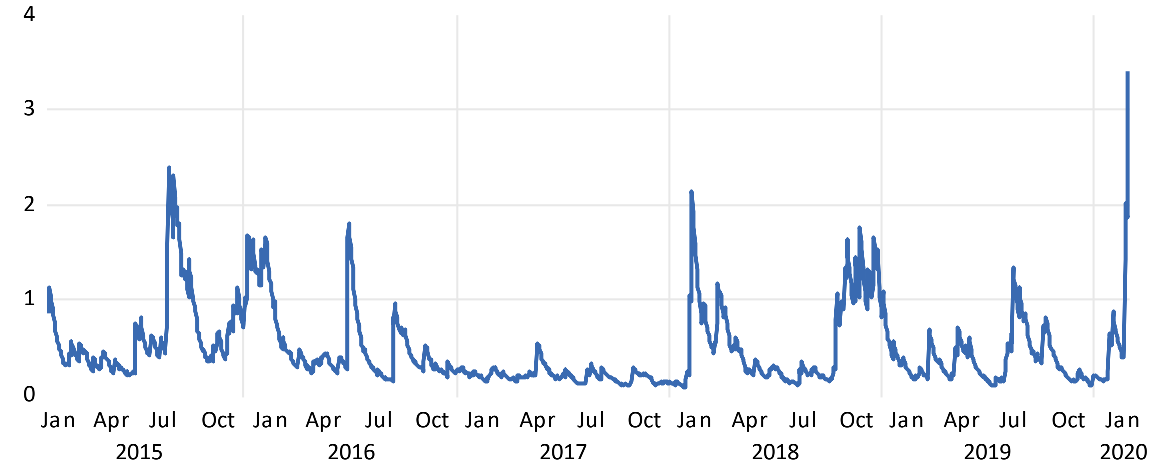
Note: This figure shows the plot of the conditional volatility for the S&P 500, S&P/TSX Composite and the S&P/BMV IPC index from January 2015 to January 2020. The conditional volatility is estimated using the VAR(1) BEKK-GARCH (1,1) w/o USMCA Dummy model. The time-period is plotted on the X-Axis and the conditional volatility on the Y-Axis.

Figure 7: Conditional Covariance

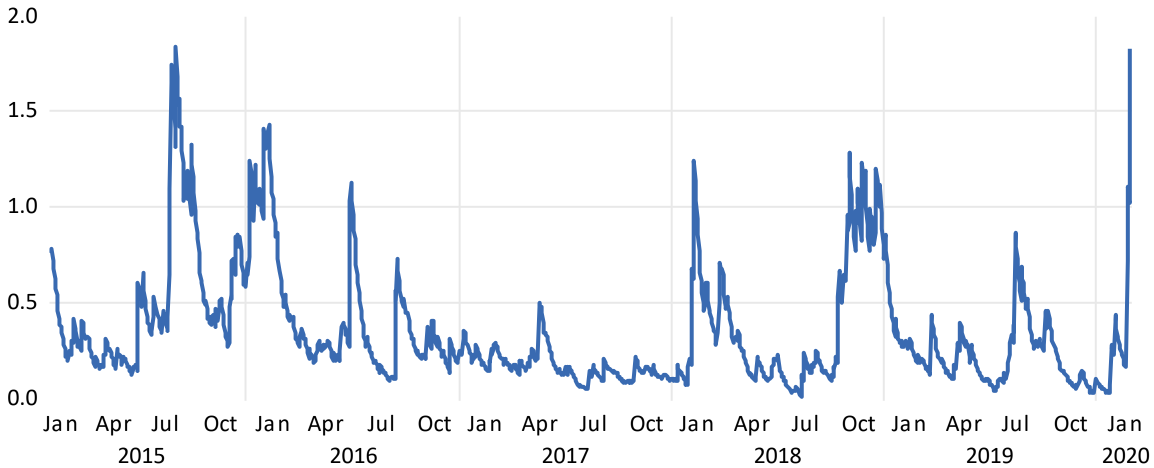
Panel A : S&P 500 & S&P/TSX Composite Conditional Covariance



Panel B : S&P 500 & S&P/BMV IPC Conditional Covariance



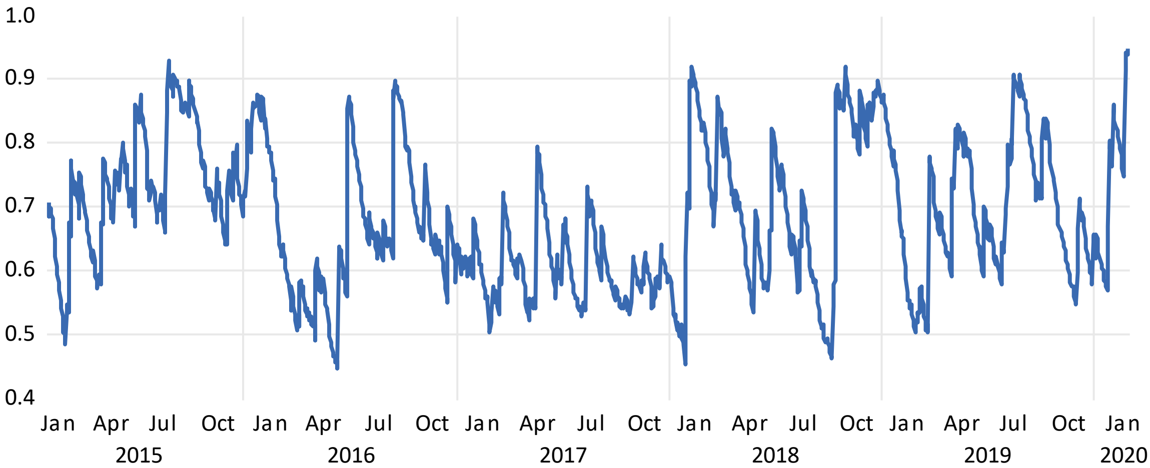
Panel C : S&P/TSX Composite & S&P/BMV IPC Conditional Covariance



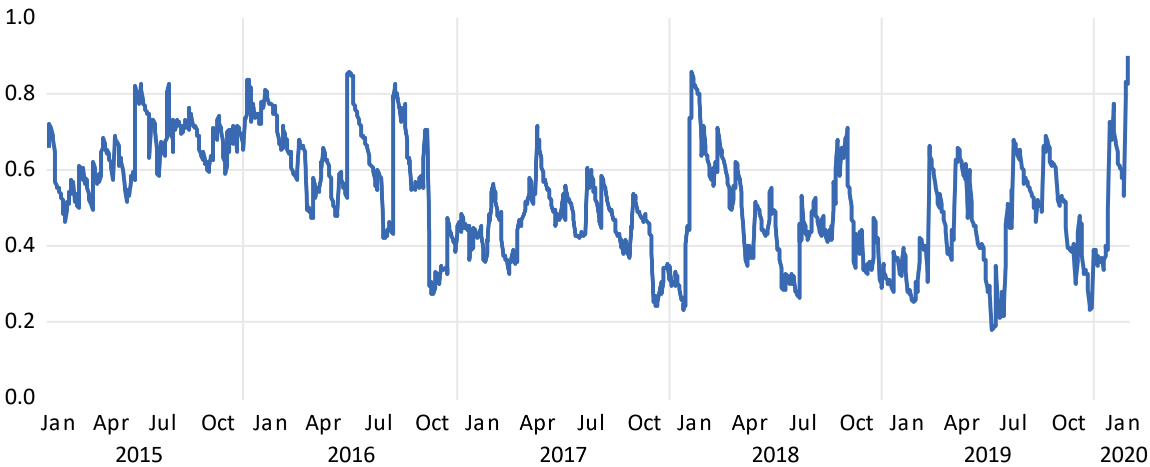
Note: This figure shows the plot of the conditional covariance for the following pairs: S&P 500 & S&P/TSX Composite, S&P 500 & S&P/BMV IPC index, and S&P/TSX Composite & S&P/BMV IPC index from January 2015 to January 2020. The conditional covariance is estimated using the VAR(1) BEKK-GARCH (1,1) w/o USMCA Dummy model. The time-period is plotted on the X-Axis and the conditional covariance on the Y-Axis.

Figure 8: Conditional Correlations

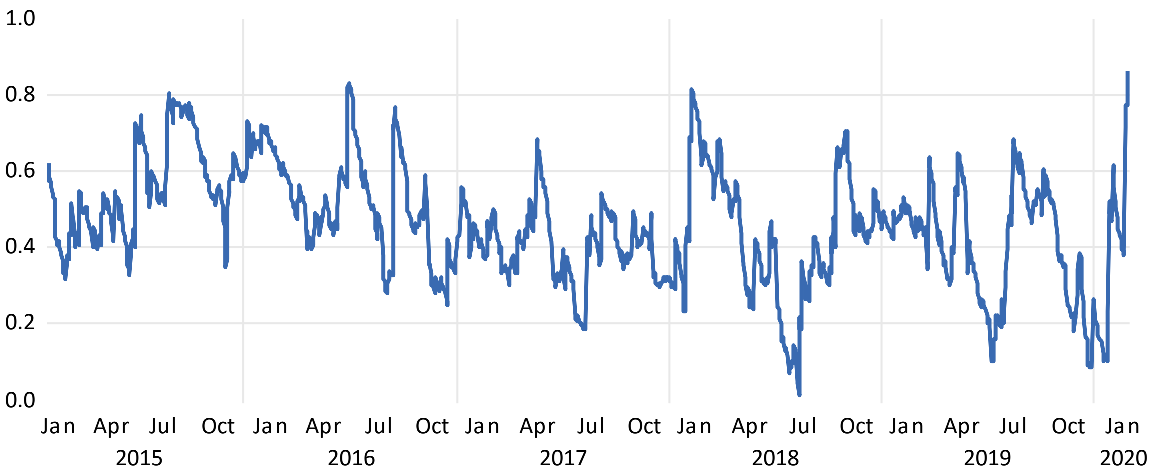
Panel A : S&P 500 & S&P/TSX Composite Conditional Correlation



Panel B : S&P 500 & S&P/BMV IPC Conditional Correlation



Panel C : S&P/TSX Composite & S&P/BMV IPC Conditional Correlation



Note: This figure shows the plot of the conditional correlation for the following pairs: S&P 500 & S&P/TSX Composite, S&P 500 & S&P/BMV IPC index, and S&P/TSX Composite & S&P/BMV IPC index from January 2015 to January 2020. The conditional correlation is estimated using the VAR(1) BEKK-GARCH (1,1) w/o USMCA Dummy model. The time-period is plotted on the X-Axis and the conditional correlation on the Y-Axis.

Table 1: Sectorial Indices for USA, Canada, and Mexico

Industry	Country	Index Name	Index Mnemonic	Index Code
Cons. Disc.	USA	S&P TMI CONS DISCR	S&PTCD1	100734
	Canada	S&P/TSX COMP CONS DISCR	TSX3CD1	48319
	Mexico	S&P/BMV CONS DISCR	MXI1CDS	128773
Cons. Stap.	USA	S&P TMI CONS STAPLES	S&PTCS1	100735
	Canada	S&P/TSX COMP CONS STAPLES	TSX3CS1	48332
	Mexico	S&P/BMV CONS STAPLES	MXI1SPS	128772
Financials	USA	S&P TMI FINANCIALS	S&PTFN1	100737
	Canada	S&P/TSX COMP FINANCIALS	TSX3FN1	48370
	Mexico	S&P/BMV FINANCIAL SVS	MXI1FNS	128770
Healthcare	USA	S&P TMI HEALTH CARE	S&PTHC1	100738
	Canada	S&P/TSX COMP HEALTH CARE	TSX3HC1	48384
	Mexico	S&P/BMV HEALTH CARE	MXI1HCE	128771
Industrials	USA	S&P TMI INDUSTRIALS	S&PTID1	100739
	Canada	S&P/TSX COMP INDUSTRIALS	TSX3ID1	48410
	Mexico	S&P/BMV INDUSTRIALS	MXI1IND	128774
Materials	USA	S&P TMI MATERIALS	S&PTM11	100741
	Canada	S&P/TSX COMP MATERIALS	TSX3M11	48427
	Mexico	S&P/BMV MATERIALS	MXI1MTR	128775
Real Estate	USA	S&P TMI REAL ESTATE	S&PTR11	140551
	Canada	S&P/TSX COMP REAL ESTATE	TSX3R11	140573
	Mexico	S&P/BMV HOUSING	MXHABIT	40783
Telecom	USA	S&P TMI T/CM SVS	S&PTT11	100744
	Canada	S&P/TSX COMP COMM. SERVICES	TSX3T11	48495
	Mexico	S&P/BMV TELECOM SVS	MXI1TLS	128769
Utilities	USA	S&P TMI UTILITIES	S&PTU11	100745
	Canada	S&P/TSX COMP UTILITIES	TSX3U11	48512
	Mexico	DJGL MEXICO UTILITIES	D1MXU1L	132735
Energy	USA	S&P TMI ENERGY	S&PTE11	100736
	Canada	S&P/TSX COMP ENERGY	TSX3E11	48350
IT	USA	S&P TMI IT	S&PTIT1	100740
	Canada	S&P/TSX COMP IT	TSX3IT1	48419

Note: This table shows the indices used for each country in our study. Data for all these indices is obtained from the Thomson Refinitiv DataStream database. The table shows the name, mnemonic code, and the index code for all the sectorial indices.

Table 2: Summary Statistics of Daily Logarithmic Returns of Country Indices

Panel A: Full Sample

	USA	Canada	Mexico
Mean	0.0298	0.0224	0.0498
Median	0.0574	0.0653	0.0469
Maximum	10.4236	9.3703	12.1536
Minimum	-9.4695	-9.7880	-14.3145
Std. Dev.	1.1372	1.0133	1.4760
Skewness	-0.2783	-0.6691	-0.0062
Kurtosis	11.4186	13.7265	9.8152
Observations	6773	6773	6773
Jarque-Bera	20088.35	32975.71	13107.65
P-Value	0.0000	0.0000	0.0000
ADF	-34.9762	-31.7836	-31.7056
P-Value	0.0000	0.0000	0.0000

Panel B: Pre-USMCA

	USA	Canada	Mexico
Mean	0.0303	0.0004	0.0347
Median	0.0170	0.0544	0.0496
Maximum	3.8291	2.8965	2.8779
Minimum	-4.0211	-3.1739	-4.6789
Std. Dev.	0.8248	0.7910	0.8112
Skewness	-0.4078	-0.3007	-0.2929
Kurtosis	6.1659	4.7985	5.3580
Observations	608	608	608
Jarque-Bera	270.76	91.11	149.54
P-Value	0.0000	0.0000	0.0000

Panel C: Post-USMCA

	USA	Canada	Mexico
Mean	0.0298	0.0122	-0.0357
Median	0.0840	0.0617	-0.0492
Maximum	5.6929	2.7557	3.3660
Minimum	-4.5168	-2.7433	-5.9884
Std. Dev.	0.9157	0.5673	0.9323
Skewness	-0.6187	-0.8079	-0.5325
Kurtosis	8.4205	6.3836	7.2555
Observations	608	608	608
Jarque-Bera	783.12	356.17	487.50
P-Value	0.0000	0.0000	0.0000

Note: This table describes the distribution of the daily logarithmic returns for the S&P 500 (USA), S&P/TSX Composite (Canada), and the S&P/BMV IPC (Mexico) indices. The daily logarithmic returns are calculated as follows: $R_t = ln(P_t/P_{(t-1)}) * 100$, where R_t is the daily logarithmic return and P_t is the daily closing price. Panel A shows the summary statistics for the Full sample period, Panel B for the Pre-USMCA period, and Panel C for the post-USMCA period. We only take 608 observations in the pre-USMCA period as we only had 608 observations for the post-USMCA period. We also provide the T-statistics and the P-values for the ADF test, which is estimated to check the stationarity of the index daily returns.

Table 3: Summary Statistics of Daily Logarithmic Returns of Sectorial Indices

Panel A: Cons. Disc.

	USA	**Canada**	**Mexico**
Mean	0.0367	0.0099	0.0345
Median	0.1051	0.0232	-0.0187
Maximum	5.9914	3.2937	5.6354
Minimum	-4.3702	-3.5087	-11.6760
Std. Dev.	0.9472	0.8422	1.0180
Skewness	-0.5145	-0.3994	-1.1336
Kurtosis	7.1712	4.5459	24.2700
Observations	1045	1043	1045
Jarque-Bera	803.70	131.59	19922.65
P-Value	0.0000	0.0000	0.0000
ADF	-31.6667	-30.5164	-27.3804
P-Value	0.0000	0.0000	0.0000

Panel B: Cons. Stap.

	USA	**Canada**	**Mexico**
Mean	0.0138	0.0231	0.0021
Median	0.0408	-0.0101	0.0250
Maximum	2.8380	3.0693	3.0037
Minimum	-4.0867	-3.1739	-5.2488
Std. Dev.	0.7251	0.7623	0.8406
Skewness	-0.7710	-0.1184	-0.5578
Kurtosis	6.0602	4.0983	6.4983
Observations	1045	1043	1045
Jarque-Bera	511.29	54.86	587.06
P-Value	0.0000	0.0000	0.0000
ADF	-31.4941	-30.5666	-21.2583
P-Value	0.0000	0.0000	0.0000

Panel C: Financials

	USA	**Canada**	**Mexico**
Mean	0.0308	0.0246	-0.0138
Median	0.0689	0.0661	0.0215
Maximum	4.4846	3.3524	4.9095
Minimum	-4.9997	-2.7842	-8.9211
Std. Dev.	1.0363	0.6621	1.1174
Skewness	-0.5509	-0.4372	-1.0222
Kurtosis	5.8978	6.0631	10.5669
Observations	1045	1043	1045
Jarque-Bera	418.49	440.97	2675.12
P-Value	0.0000	0.0000	0.0000
ADF	-31.8404	-27.9509	-23.9760
P-Value	0.0000	0.0000	0.0000

Panel D: Healthcare			
	USA	**Canada**	**Mexico**
Mean	0.0284	-0.1679	0.0074
Median	0.0765	-0.1005	0.0000
Maximum	4.6102	16.1423	5.3856
Minimum	-4.5272	-54.6017	-4.3883
Std. Dev.	0.9319	3.2921	0.9512
Skewness	-0.4854	-4.2585	0.2139
Kurtosis	5.4906	75.2204	6.5782
Observations	1045	1043	1045
Jarque-Bera	311.14	229821.60	565.46
P-Value	0.0000	0.0000	0.0000
ADF	-32.1281	-31.0242	-30.4496
P-Value	0.0000	0.0000	0.0000

Panel E: Industrials			
	USA	**Canada**	**Mexico**
Mean	0.0311	0.0491	-0.0105
Median	0.0805	0.0819	-0.0294
Maximum	4.6492	3.3979	4.6061
Minimum	-4.6014	-5.0863	-5.8501
Std. Dev.	0.9711	0.8286	0.8371
Skewness	-0.7091	-0.4073	-0.2374
Kurtosis	6.0901	5.7111	7.3202
Observations	1045	1043	1045
Jarque-Bera	503.35	348.26	822.48
P-Value	0.0000	0.0000	0.0000
ADF	-31.0550	-31.7730	-23.1010
P-Value	0.0000	0.0000	0.0000

Panel F: Materials			
	USA	**Canada**	**Mexico**
Mean	0.0195	0.0340	0.0013
Median	0.0708	0.0523	-0.0037
Maximum	4.3901	6.2565	4.2108
Minimum	-4.6988	-6.9492	-4.2274
Std. Dev.	1.0402	1.3890	1.1020
Skewness	-0.4696	-0.1847	-0.0810
Kurtosis	5.0860	5.3992	3.7583
Observations	1045	1043	1045
Jarque-Bera	227.88	256.09	26.18
P-Value	0.0000	0.0000	0.0000
ADF	-31.4848	-32.5093	-27.6340
P-Value	0.0000	0.0000	0.0000

Panel G: Real Estate			
	USA	**Canada**	**Mexico**
Mean	0.0102	0.0240	-0.0695
Median	0.0700	0.0626	-0.0633
Maximum	3.3507	4.1012	8.8977
Minimum	-5.4864	-3.7547	-6.4156
Std. Dev.	0.8543	0.6459	1.3077
Skewness	-0.8100	-0.3771	0.1890
Kurtosis	6.2060	7.3813	7.2652
Observations	866	1043	1045
Jarque-Bera	465.58	858.95	798.34
P-Value	0.0000	0.0000	0.0000
ADF	-27.6454	-29.0000	-33.9802
P-Value	0.0000	0.0000	0.0000

Panel H: Telecom			
	USA	**Canada**	**Mexico**
Mean	0.0149	0.0163	0.0010
Median	0.0806	0.0597	-0.0093
Maximum	5.2009	2.4068	6.1103
Minimum	-4.9802	-5.0582	-7.8634
Std. Dev.	1.0388	0.6288	1.2291
Skewness	-0.3826	-1.0085	-0.0937
Kurtosis	5.6951	9.3950	5.8808
Observations	1045	1043	1045
Jarque-Bera	341.75	1954.10	362.87
P-Value	0.0000	0.0000	0.0000
ADF	-32.1822	-30.9271	-30.8122
P-Value	0.0000	0.0000	0.0000

Panel I: Utilities			
	USA	**Canada**	**Mexico**
Mean	0.0348	0.0345	0.0153
Median	0.1125	0.0586	0.0545
Maximum	2.5356	3.4637	6.6523
Minimum	-4.7628	-4.9046	-7.4283
Std. Dev.	0.8363	0.6282	1.5194
Skewness	-0.8834	-0.7278	-0.1341
Kurtosis	6.0307	11.0232	5.1856
Observations	1045	1043	1045
Jarque-Bera	535.85	2889.58	211.13
P-Value	0.0000	0.0000	0.0000
ADF	-30.7343	-26.4493	-21.5418
P-Value	0.0000	0.0000	0.0000

Panel J: Energy		
	USA	**Canada**
Mean	-0.0315	-0.0023
Median	-0.0201	0.0226
Maximum	6.3053	5.3181
Minimum	-5.6561	-4.6375
Std. Dev.	1.3689	1.1905
Skewness	-0.1881	0.0674
Kurtosis	4.6452	4.8925
Observations	1045	1043
Jarque-Bera	124.01	156.44
P-Value	0.0000	0.0000
ADF	-32.6617	-32.8487
P-Value	0.0000	0.0000

Panel K: IT		
	USA	**Canada**
Mean	0.0737	0.0847
Median	0.1483	0.1191
Maximum	5.8389	5.2188
Minimum	-5.2543	-5.0994
Std. Dev.	1.1513	1.2022
Skewness	-0.6989	-0.4654
Kurtosis	6.3581	4.8705
Observations	1045	1043
Jarque-Bera	576.10	189.71
P-Value	0.0000	0.0000
ADF	-33.7642	-31.5860
P-Value	0.0000	0.0000

Note: This table describes the distribution of the daily logarithmic returns for the sectorial indices for USA, Canada, and Mexico. The daily logarithmic returns are calculated as follows: $R_t = ln(P_t/P_{(t-1)}) * 100$, where R_t is the daily logarithmic return and P_t is the daily closing price. We also provide the T-statistics and the P-values for the ADF test, which is estimated to check the stationarity of the index daily returns.

Table 4: Covariance/Correlation Matrix of Daily Logarithmic Returns

Panel A: Full Sample

	USA	Canada	Mexico
USA	1.2930	0.7450	0.5830
Canada	0.8584	1.0267	0.5283
Mexico	0.9785	0.7901	2.1784

Panel B: Pre-USMCA

	USA	Canada	Mexico
USA	0.6792	0.7468	0.6081
Canada	0.4864	0.6246	0.5751
Mexico	0.4062	0.3684	0.6569

Panel C: Post-USMCA

	USA	Canada	Mexico
USA	0.8372	0.7850	0.4270
Canada	0.4071	0.3213	0.3966
Mexico	0.3639	0.2094	0.8678

Note: This table reports the covariance and correlation matrix of the daily logarithmic returns of the S&P 500 (USA), S&P/TSX Composite (Canada), and the S&P/BMV IPC (Mexico) indices. Panel A shows the matrix for the Full sample period, Panel B for the Pre-USMCA period, and Panel C for the post-USMCA period. We only take 608 observations in the pre-USMCA period as we only had 608 observations for the post-USMCA period. The diagonal values in each matrix represent the own variance, the values above the diagonal values are the correlations and the off-diagonal elements in the lower triangular portion of the matrix are the covariances.

Table 5: VAR Lag Selection Criteria

Lags	SIC
0	8.3229351
1	8.2790115*
2	8.2823995
3	8.2897924
4	8.2988405
5	8.3083094

Note: This table shows the results of the Lag length selection criteria. We use the Schwarz Information Criterion to select the lags for the BEKK GARCH Model.

Table 6: CAAR (-2,+2) for Key USMCA Dates – Country-wise comparison

Panel A: USMCA Negotiation

	USA	Canada	Mexico
CAAR(-2,+2)	-2.69	-0.20	-1.61
Precision Weighted CAAR	-2.84	-0.08	-1.38
pos:neg CAR	0:11	5:6	0:9
Patell Z	-9.93	-0.34	-2.41
	(0.0000)	(0.7317)	(0.0159)
Adjusted Patell Z	-16.53	-0.38	-2.50
	(0.0000)	(0.7011)	(0.0125)
Adjusted StdCSect T	-9.87	-0.63	-4.74
	(0.0000)	(0.5422)	(0.0015)
Generalized Rank T	-7.14	-0.26	-3.71
	(0.0000)	(0.7936)	(0.0003)
Generalized Rank Z	-4.69	-0.24	-3.65
	(0.0000)	(0.8071)	(0.0003)

Panel B: USMCA Published

	USA	Canada	Mexico
CAAR(-2,+2)	-3.64	-5.93	-5.28
Precision Weighted CAAR	-3.84	-6.29	-5.15
pos:neg CAR	0:11	0:11	0:9
Patell Z	-12.45	-15.41	-9.26
	(0.0000)	(0.0000)	(0.0000)
Adjusted Patell Z	-23.28	-17.44	-10.65
	(0.0000)	(0.0000)	(0.0000)
Adjusted StdCSect T	-11.51	-7.41	-9.97
	(0.0000)	(0.0000)	(0.0000)
Generalized Rank T	-8.14	-5.13	-5.45
	(0.0000)	(0.0000)	(0.0000)
Generalized Rank Z	-4.75	-4.79	-4.97
	(0.0000)	(0.0000)	(0.0000)

Panel C: USMCA Ratified

	USA	Canada	Mexico
CAAR(-2,+2)	-3.99	-4.06	-0.25
Precision Weighted CAAR	-4.25	-4.35	-0.46
pos:neg CAR	0:11	0:11	3:6
Patell Z	-11.85	-9.76	-0.81
	(0.0000)	(0.0000)	(0.4159)
Adjusted Patell Z	-24.09	-11.94	-0.93
	(0.0000)	(0.0000)	(0.3548)
Adjusted StdCSect T	-10.47	-6.18	-0.53
	(0.0000)	(0.0001)	(0.6125)
Generalized Rank T	-8.19	-4.94	-0.76
	(0.0000)	(0.0000)	(0.4469)
Generalized Rank Z	-4.51	-4.33	-0.71
	(0.0000)	(0.0000)	(0.4798)

Panel D: USMCA Amended			
	USA	Canada	Mexico
CAAR(-2,+2)	-2.28	-4.40	0.12
Precision Weighted CAAR	-1.89	-5.38	0.07
pos:neg CAR	1:10	1:10	4:5
Patell Z	-7.35	-13.35	0.02
	(0.0000)	(0.0000)	(0.9807)
Adjusted Patell Z	-13.93	-18.84	0.03
	(0.0000)	(0.0000)	(0.9763)
Adjusted StdCSect T	-10.80	-6.20	0.09
	(0.0000)	(0.0001)	(0.9319)
Generalized Rank T	-7.75	-5.00	-0.15
	(0.0000)	(0.0000)	(0.8771)
Generalized Rank Z	-4.41	-3.84	-0.13
	(0.0000)	(0.0001)	(0.8949)

Note: This table presents the cumulative average abnormal returns (CAAR) for a (-2+2) window estimated as per the Fama French Five-Factor Model. The event day is denoted as day 0. The estimation window is (-21,-221) with a minimum length of 200 days. Panel A shows the estimated CAAR's around the "USMCA Negotiation" event, Panel B for the "USMCA Published" event, Panel C for the "USMCA Ratified" event, and Panel D for the "USMCA Amended" event. The key events have been explained in detail in the methodology section. P-values for parametric and non-parametric significance tests are provided in parenthesis.

Table 7: CAR (-2,+2) for Key USMCA Dates – Sector-wise comparison

Panel A: USA				
Industry	**Negotiation**	**Published**	**Ratified**	**Amended**
Cons. Disc.	-3.90***	-5.95***	-3.19***	-1.49**
Cons. Stap.	-2.04**	-4.58***	-4.60***	-3.28***
Financials	-2.54***	-4.21***	-6.94***	-0.80
Healthcare	-2.69***	-3.43***	-2.71***	-2.46***
Industrials	-3.29***	-2.91***	-4.89***	-1.34
Materials	-1.75**	-4.91***	-3.93***	-1.11
Real Estate	-1.86	-4.67***	-3.81**	-6.20***
Telecom	-3.84**	-3.37*	-4.79**	-3.27***
Utilities	-0.88	-1.87	-2.57	-4.27***
Energy	-4.81***	-1.53	-3.60**	0.53
IT	-1.97**	-2.63***	-2.84***	-1.34*
Panel B: Canada				
Industry	**Negotiation**	**Published**	**Ratified**	**Amended**
Cons. Disc.	-0.05	-7.18***	-3.17**	-4.54***
Cons. Stap.	0.29	-6.66***	-2.25	-6.23***
Financials	-0.01	-6.69***	-5.27***	-5.08***
Healthcare	-0.18	-4.62	-6.73	2.89
Industrials	-0.93	-6.20***	-6.24***	-3.86***
Materials	-0.58	-4.92***	-1.27	-3.85*
Real Estate	0.86	-7.02***	-5.09***	-8.91***
Telecom	0.13	-6.44***	-4.65***	-5.38***
Utilities	0.20	-5.88***	-3.17***	-6.00***
Energy	-2.21	-2.41	-3.10**	-2.19
IT	0.27	-7.25***	-3.72*	-5.26**
Panel C: Mexico				
Industry	**Negotiation**	**Published**	**Ratified**	**Amended**
Cons. Disc.	-3.87	-2.66	-1.67	-2.72*
Cons. Stap.	-1.10	-5.16***	-1.86	-0.83
Financials	-2.21	-4.56***	3.69***	1.04
Healthcare	-2.74	-5.17***	-3.50**	-1.31
Industrials	-1.20	-4.13***	-1.65	2.73**
Materials	-0.67	-6.08***	-0.35	0.13
Real Estate	-2.55	-5.18**	-0.18	-2.89
Telecom	-0.09	-8.15***	1.38	-0.24
Utilities	-0.02	-6.46**	1.91	5.18

The symbols *, **, *** denote statistical significance at the 0.10, 0.05, 0.01 levels, respectively.
Note: This table presents the cumulative abnormal returns (CAR) for a (-2+2) window estimated as per the Fama French Five-Factor Model. The event day is denoted as day 0. The estimation window is (-21,-221) with a minimum length of 200 days. Panel A shows the estimated CAR's for USA's sectorial indices for the four key event dates, Panel B for Canada's sectorial indices, and Panel C for Mexico's sectorial indices. The key events have been explained in detail in the methodology section.

Table 8: Estimates of VAR(1) BEKK-GARCH (1,1) w/o USMCA Dummy

Variable	Coeff.	Std. Error	T-Stat.	Prob.
Mean Model(USA)				
Constant	0.0360	0.0044	8.1915	0.0000
USA {1}	-0.0168	0.0140	-1.1993	0.2304
CAN {1}	0.0058	0.0156	0.3737	0.7086
MEX {1}	0.0017	0.0051	0.3276	0.7432
Mean Model(CAN)				
Constant	0.0231	0.0064	3.6288	0.0003
USA {1}	0.0539	0.0109	4.9519	0.0000
CAN {1}	0.0382	0.0167	2.2831	0.0224
MEX {1}	0.0133	0.0040	3.3487	0.0008
Mean Model(MEX)				
Constant	0.0423	0.0109	3.8723	0.0001
USA {1}	0.0169	0.0166	1.0161	0.3096
CAN {1}	0.0326	0.0188	1.7383	0.0822
MEX {1}	0.0811	0.0089	9.1103	0.0000
Variance Model				
C(1,1)	0.1193	0.0085	13.9772	0.0000
C(2,1)	0.0567	0.0076	7.4381	0.0000
C(2,2)	0.0415	0.0112	3.7171	0.0002
C(3,1)	0.0550	0.0121	4.5612	0.0000
C(3,2)	-0.0148	0.0146	-1.0145	0.3104
C(3,3)	0.0885	0.0153	5.7807	0.0000
A(1,1)	0.0293	0.0338	0.8670	0.3859
A(1,2)	-0.0815	0.0143	-5.6827	0.0000
A(1,3)	-0.1574	0.0217	-7.2471	0.0000
A(2,1)	0.1225	0.0236	5.1909	0.0000
A(2,2)	0.1873	0.0245	7.6475	0.0000
A(2,3)	0.1286	0.0154	8.3408	0.0000
A(3,1)	-0.0007	0.0062	-0.1198	0.9046
A(3,2)	-0.0061	0.0059	-1.0340	0.3012
A(3,3)	0.2139	0.0197	10.8617	0.0000
B(1,1)	0.9580	0.0052	185.4675	0.0000
B(1,2)	-0.0112	0.0044	-2.5371	0.0112
B(1,3)	-0.0054	0.0070	-0.7740	0.4389
B(2,1)	-0.0106	0.0036	-2.9256	0.0034
B(2,2)	0.9720	0.0052	187.9982	0.0000
B(2,3)	-0.0028	0.0067	-0.4178	0.6761
B(3,1)	0.0000	0.0019	-0.0075	0.9940
B(3,2)	-0.0011	0.0017	-0.6314	0.5278
B(3,3)	0.9627	0.0067	143.9405	0.0000
G(1,1)	0.3678	0.0333	11.0280	0.0000
G(1,2)	0.0971	0.0313	3.1001	0.0019
G(1,3)	0.1214	0.0393	3.0897	0.0020
G(2,1)	-0.0169	0.0369	-0.4585	0.6466
G(2,2)	0.1978	0.0482	4.1010	0.0000

G(2,3)	-0.0584	0.0575	-1.0166	0.3094
G(3,1)	0.0035	0.0099	0.3571	0.7210
G(3,2)	0.0232	0.0073	3.1637	0.0016
G(3,3)	0.2206	0.0315	6.9986	0.0000
Log Likelihood	-23970.35			
LB Q(24) test			235.39	0.1741

Note: This table provides the estimates of the VAR(1) Asymmetric BEKK GARCH (1,1) model. We use the BFGS algorithm to estimate the second moments in our models. This table also reports the log-likelihood statistics and the multivariate test results for the Ljung-Box Q statistic for the standardized residuals up to 24 lags. The sample period is from 11th November 1991 to 28th February 2020. The data used is collected from the Thomson Refinitiv DataStream database.

Table 9: Covariance/Correlation Matrix of Conditional Volatility

Panel A: Full Sample			
	USA	**Canada**	**Mexico**
USA	4.7158	0.9447	0.5814
Canada	3.7631	3.3646	0.6070
Mexico	3.1918	2.8148	6.3914
Panel B: Pre-USMCA			
	USA	**Canada**	**Mexico**
USA	0.5308	0.9077	0.5761
Canada	0.3241	0.2402	0.5198
Mexico	0.1829	0.1110	0.1898
Panel C: Post-USMCA			
	USA	**Canada**	**Mexico**
USA	0.6665	0.9675	0.6358
Canada	0.2250	0.0811	0.6691
Mexico	0.4883	0.1793	0.8852

Note: This table reports the covariance and correlation matrix of the conditional volatilities of the S&P 500 (USA), S&P/TSX Composite (Canada), and the S&P/BMV IPC (Mexico) indices. The conditional volatility is estimated using the VAR(1) BEKK-GARCH (1,1) w/o USMCA Dummy model. Panel A shows the matrix for the Full sample period, Panel B for the Pre-USMCA period, and Panel C for the post-USMCA period. We only take 608 observations in the pre-USMCA period as we only had 608 observations for the post-USMCA period. The diagonal values in each matrix represent the own variance, the values above the diagonal values are the correlations and the off-diagonal elements in the lower triangular portion of the matrix are the covariances.

Table 10: Estimates of VAR(1) BEKK-GARCH (1,1) w/ USMCA Dummy in Mean Eq.

Variable	Coeff.	Std. Error	T-Stat.	Prob.
Mean Model(USA)				
Constant	0.0383	0.0083	4.6219	0.0000
USA{1}	-0.0176	0.0136	-1.2970	0.1946
CAN{1}	0.0061	0.0147	0.4174	0.6764
MEX{1}	0.0017	0.0050	0.3301	0.7413
USMCA	0.0034	0.0237	0.1444	0.8852
Mean Model(CAN)				
Constant	0.0309	0.0077	3.9877	0.0001
USA{1}	0.0532	0.0114	4.6749	0.0000
CAN{1}	0.0386	0.0136	2.8422	0.0045
MEX{1}	0.0130	0.0043	2.9941	0.0028
USMCA	-0.0311	0.0185	-1.6876	0.0915
Mean Model(MEX)				
Constant	0.0593	0.0112	5.2987	0.0000
USA{1}	0.0169	0.0167	1.0100	0.3125
CAN{1}	0.0330	0.0157	2.1005	0.0357
MEX{1}	0.0796	0.0082	9.6692	0.0000
USMCA	-0.1233	0.0370	-3.3317	0.0009
Variance Model				
C(1,1)	0.1196	0.0110	10.9052	0.0000
C(2,1)	0.0571	0.0081	7.0135	0.0000
C(2,2)	0.0422	0.0099	4.2514	0.0000
C(3,1)	0.0561	0.0141	3.9851	0.0001
C(3,2)	-0.0140	0.0121	-1.1511	0.2497
C(3,3)	0.0901	0.0150	6.0004	0.0000
A(1,1)	0.0320	0.0357	0.8941	0.3712
A(1,2)	-0.0788	0.0234	-3.3636	0.0008
A(1,3)	-0.1574	0.0258	-6.1110	0.0000
A(2,1)	0.1206	0.0241	5.0106	0.0000
A(2,2)	0.1806	0.0406	4.4535	0.0000
A(2,3)	0.1244	0.0268	4.6476	0.0000
A(3,1)	-0.0007	0.0056	-0.1297	0.8968
A(3,2)	-0.0059	0.0069	-0.8460	0.3976
A(3,3)	0.2160	0.0218	9.9006	0.0000
B(1,1)	0.9577	0.0074	129.6024	0.0000
B(1,2)	-0.0110	0.0061	-1.8004	0.0718
B(1,3)	-0.0054	0.0084	-0.6448	0.5191
B(2,1)	-0.0104	0.0076	-1.3640	0.1726
B(2,2)	0.9720	0.0075	130.3175	0.0000
B(2,3)	-0.0023	0.0095	-0.2399	0.8104
B(3,1)	0.0000	0.0016	0.0039	0.9969
B(3,2)	-0.0012	0.0020	-0.6056	0.5448
B(3,3)	0.9622	0.0060	159.9443	0.0000
G(1,1)	0.3659	0.0358	10.2277	0.0000
G(1,2)	0.0943	0.0297	3.1728	0.0015

G(1,3)	0.1196	0.0357	3.3531	0.0008
G(2,1)	-0.0143	0.0369	-0.3867	0.6990
G(2,2)	0.2023	0.0481	4.2092	0.0000
G(2,3)	-0.0554	0.0535	-1.0350	0.3007
G(3,1)	0.0032	0.0085	0.3804	0.7037
G(3,2)	0.0240	0.0131	1.8243	0.0681
G(3,3)	0.2206	0.0333	6.6302	0.0000
Log Likelihood	-23960.16			
LB Q(24) test			236.17	0.1651

Note: This table provides the estimates of the VAR(1) Asymmetric BEKK GARCH (1,1) model. We use the BFGS algorithm to estimate the second moments in our models. This table also reports the log-likelihood statistics and the multivariate test results for the Ljung-Box Q statistic for the standardized residuals up to 24 lags. The sample period is from 11th November 1991 to 28th February 2020. The data used is collected from the Thomson Refinitiv DataStream database. In this model, we add a dummy variable for USMCA in the mean equation. The USMCA dummy is a binary variable defined as 1 for all dates after 16th August 2017 and 0 otherwise.

Table 11: Estimates of VAR(1) BEKK-GARCH (1,1) w/ USMCA Dummy in Mean & Variance Eq.

Variable	Coeff.	Std. Error	T-Stat.	Prob.
Mean Model(USA)				
Constant	0.0323	0.0070	4.5995	0.0000
USA{1}	-0.0212	0.0112	-1.8987	0.0576
CAN{1}	0.0037	0.0098	0.3795	0.7043
MEX{1}	0.0035	0.0053	0.6624	0.5077
USMCA	0.0411	0.0170	2.4155	0.0157
Mean Model(CAN)				
Constant	0.0285	0.0067	4.2754	0.0000
USA{1}	0.0513	0.0095	5.4100	0.0000
CAN{1}	0.0371	0.0121	3.0520	0.0023
MEX{1}	0.0161	0.0050	3.2337	0.0012
USMCA	0.0086	0.0139	0.6212	0.5345
Mean Model(MEX)				
Constant	0.0492	0.0107	4.5904	0.0000
USA{1}	0.0130	0.0157	0.8243	0.4098
CAN{1}	0.0352	0.0181	1.9394	0.0524
MEX{1}	0.0756	0.0097	7.7709	0.0000
USMCA	-0.0887	0.0334	-2.6592	0.0078
Variance Model				
C(1,1)	0.1437	0.0133	10.8273	0.0000
C(2,1)	0.0528	0.0100	5.2577	0.0000
C(2,2)	0.0620	0.0119	5.2191	0.0000
C(3,1)	0.0755	0.0130	5.8043	0.0000
C(3,2)	0.0290	0.0132	2.1880	0.0287
C(3,3)	0.0820	0.0145	5.6687	0.0000
A(1,1)	0.0795	0.0365	2.1776	0.0294
A(1,2)	-0.0125	0.0272	-0.4596	0.6458
A(1,3)	-0.0115	0.0292	-0.3927	0.6946
A(2,1)	0.0138	0.0427	0.3239	0.7460
A(2,2)	0.2008	0.0496	4.0503	0.0001
A(2,3)	-0.0093	0.0648	-0.1437	0.8858
A(3,1)	-0.0038	0.0071	-0.5283	0.5973
A(3,2)	-0.0048	0.0064	-0.7427	0.4577
A(3,3)	0.1668	0.0308	5.4179	0.0000
B(1,1)	0.9359	0.0103	90.6402	0.0000
B(1,2)	-0.0209	0.0085	-2.4602	0.0139
B(1,3)	-0.0179	0.0102	-1.7460	0.0808
B(2,1)	0.0173	0.0110	1.5805	0.1140
B(2,2)	0.9788	0.0107	91.9031	0.0000
B(2,3)	0.0061	0.0118	0.5173	0.6050
B(3,1)	0.0007	0.0018	0.4204	0.6742
B(3,2)	-0.0015	0.0012	-1.2535	0.2100
B(3,3)	0.9681	0.0063	153.1830	0.0000
G(1,1)	0.3680	0.0345	10.6685	0.0000

G(1,2)	0.1254	0.0392	3.1987	0.0014
G(1,3)	0.0184	0.0394	0.4674	0.6402
G(2,1)	0.0304	0.0337	0.9021	0.3670
G(2,2)	0.1170	0.0706	1.6590	0.0971
G(2,3)	0.0631	0.0515	1.2240	0.2210
G(3,1)	-0.0038	0.0085	-0.4527	0.6508
G(3,2)	0.0170	0.0115	1.4825	0.1382
G(3,3)	0.2610	0.0257	10.1516	0.0000
USMCA(1,1)	-0.0194	0.0155	-1.2506	0.2111
USMCA(2,1)	-0.0047	0.0139	-0.3361	0.7368
USMCA(2,2)	-0.0304	0.0086	-3.5505	0.0004
USMCA(3,1)	-0.0184	0.0199	-0.9254	0.3548
USMCA(3,2)	-0.0327	0.0204	-1.6086	0.1077
USMCA(3,3)	0.0149	0.0160	0.9317	0.3515
Log Likelihood	-23919.32			
LB Q(24) test			228.77	0.2628

Note: This table provides the estimates of the VAR(1) Asymmetric BEKK GARCH (1,1) model. We use the BFGS algorithm to estimate the second moments in our models. This table also reports the log-likelihood statistics and the multivariate test results for the Ljung-Box Q statistic for the standardized residuals up to 24 lags. The sample period is from 11th November 1991 to 28th February 2020. The data used is collected from the Thomson Refinitiv DataStream database. In this model, we add a dummy variable for USMCA in the mean and variance equation. The USMCA dummy is a binary variable defined as 1 for all dates after 16th August 2017 and 0 otherwise.