

Financial Market Integration Between Stock Market From North American Free Trade Agreement (Nafta) Member

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Abstract

Economic recession or crisis could show a higher possibility of financial crisis transmission in an integrated stock market. Integration between financial markets is a channel of spreading the devastating effects of the crisis. The objective of this study is to detect significant interactions among the stock markets of countries that are members of the North American Free Trade Agreement (NAFTA). NAFTA is a regional partnership with members from the United States, Canada and Mexico that are committed to reducing trade and investment barriers between member countries. The methodology of this research with VAR VECM model consists of three stages, the first analysis of the presence impact of the stock market index using the Granger Causality Test. Second, analyze the speed of response of an index to a change / shock in another index using the Impulse Response Function (IRF). The third stage analyzes the impact of changes / shocks from one index to other indices by using Variance Decomposition. From the 5 sets of stock market data for NAFTA countries, the results of the study show that there is only one cointegration. When viewed in the cointegration process of each of the two data series, cointegration occurs between the Nasdaq index with TSE and Nasdaq with MSE. Whereas TSE and MSE did not find any cointegration.

Keywords: Stock market, Cointegration

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1. INRODUCTION

Regional cooperation consisting of several countries has many benefits for its members. The existence of this cooperation can encourage the progress of a country both in terms of economy and investment. The North American Free Trade Agreement (NAFTA) is a regional cooperation consisting of the United States, Canada and Mexico which is committed to reducing trade and investment barriers between member countries, where the implementation of NAFTA is on January 1st, 1994. Today, the NAFTA partners exchange about US\$2.6 billion in goods each day.

The reduction of barriers to investing from association members provides an illustration that these conditions can affect the capital market of each member. And with this convenience, it is possible that the capital markets of NAFTA members have integration with each other.

Theoretical Review

Bekaert, Harvey and Ng (2005) found that the European market is more integrated into the world than the American market. Dumitru-Cristian Oanea (2015) research result shows that financial crisis had a significant impact on the capital market from this region, especially on Bulgarian capital market, Hungarian capital market and Slovakian capital market. In fact, for the analyzed period the annual average turn of these three markets were negative. Many researches found a significant increase in the cointegration of the market spots crisis. In the emerging stock markets, seem to be more vulnerable to the effects of contagion (Horobet and Lupu, 2009). The effect of crisis period over the financial market integration is also pointed out by Lee, Shie and Chang (2012), which shows the presence of co-movement patterns during the crisis period. Yang, Lee, and Shie (2014) research result shows that the similarity of background and business cooperation

are main factors for determining the price patterns by using equal variance test. From the results of those study, it is very interesting to test further whether the low level of integration of the US market with the European or the World markets also occurs between the American markets. The issues discussed in this study focused into the following question is there Cointegration between NAFTA member capital markets.

2. METHODOLOGY

The methodology of this research with VAR VECM model consists of three stages, the first analysis of the presence impact of the stock market index using the Granger Causality Test. Second, analyze the speed of response of an index to a change / shock in another index using the Impulse Response Function (IRF). The third stage analyzes the impact of changes/ shocks from one index to other indices by using Variance Decomposition.

According to Dumitru-Cristian Oanea (2015), first we apply the Augmented Dickey-Fuller (ADF) test on the natural logarithm of each market index price values, based on the equation below:

$$\Delta \ln P(x)_t = \alpha + \beta \cdot t + \mu \cdot \ln P(x)_{t-1} + \sum_{i=1}^p \phi_i \cdot \Delta \ln P(x)_{t-1} + \varepsilon_t$$

where $P(x)_t$ is the price value for index x for period t, and p is the maximum lag length selected based on Schwert(1989) criterion known as Schwarz or Bayesian Information Criterion (BIC).

Engle and Granger (1987) conclude that differencing non-stationary variables may change important information regarding the relationship between the initial variables. For this cause a linear combination of non-stationary series can become stationary if there is a long run relationship. So the next step is to employ the Johansen (1988) maximum likelihood test and also to estimate a K-dimensional vector error correction model (VECM) described by equation below:

$$\Delta y_t = v + \Pi y_{t-1} + \sum_{i=1}^p \Gamma_i \cdot \Delta y_{t-1} + \varepsilon_t$$

where y_t is a $K \times 1$ vector of natural logarithm of market index price values, v is a $K \times 1$ vector of parameters, $\Pi = \sum_{j=1}^p A_j - I_K$, $\Gamma = \sum_{j=1}^p A_j$, A_j is $K \times K$ matrix of parameters, I_K is unit matrix of size K and ε_t is a $K \times 1$ vector of errors being independent and

identical distributed overtime. In our case $K=5$, because we are analyzing 5 market indices, so we will have a 5-dimensional (5×1) vector error correction model.

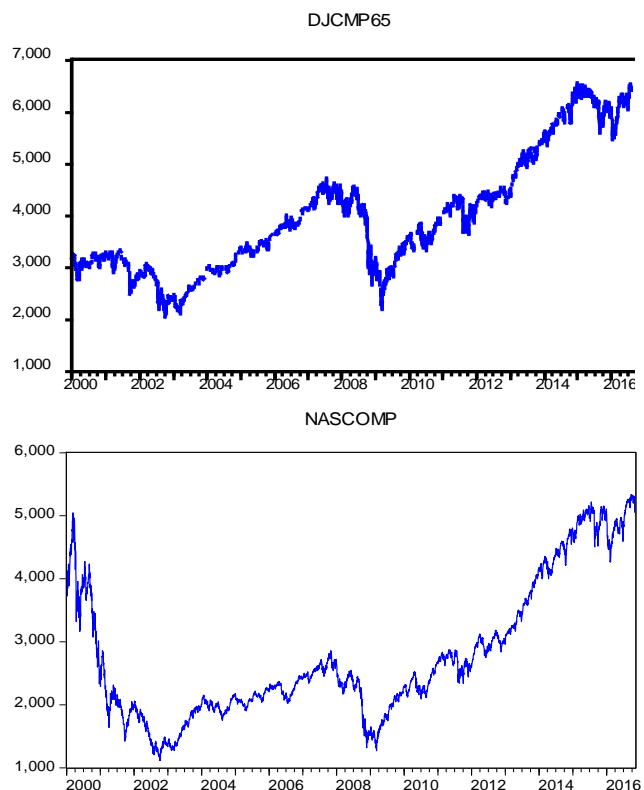
Data And Descriptive statistics

The data used in this study chosen from five stock market indices in three countries (taken from the Datastream) for period 2000 - 2016. The data we used are historical daily price values of stock market indices. Indices denominated in USD.

Table 1. Data

No	Index Code	Index	Country
1	DJCMP65	Dow Jones	United States
2	NASCOMP	Nasdaq	United States
3	NYSEALL	NYSE (New York Stock Exchange)	United States
4	TOTMCN\$	TSE (Toronto Stock Exchange)	Canada
5	TOTMMX\$	MSE (Mexican Stock Exchange)	Mexico

The Capital Market Index data from the data source above, has a movement that is described in the price evolution index for the period 2000 - 10 November 2016 showed below.



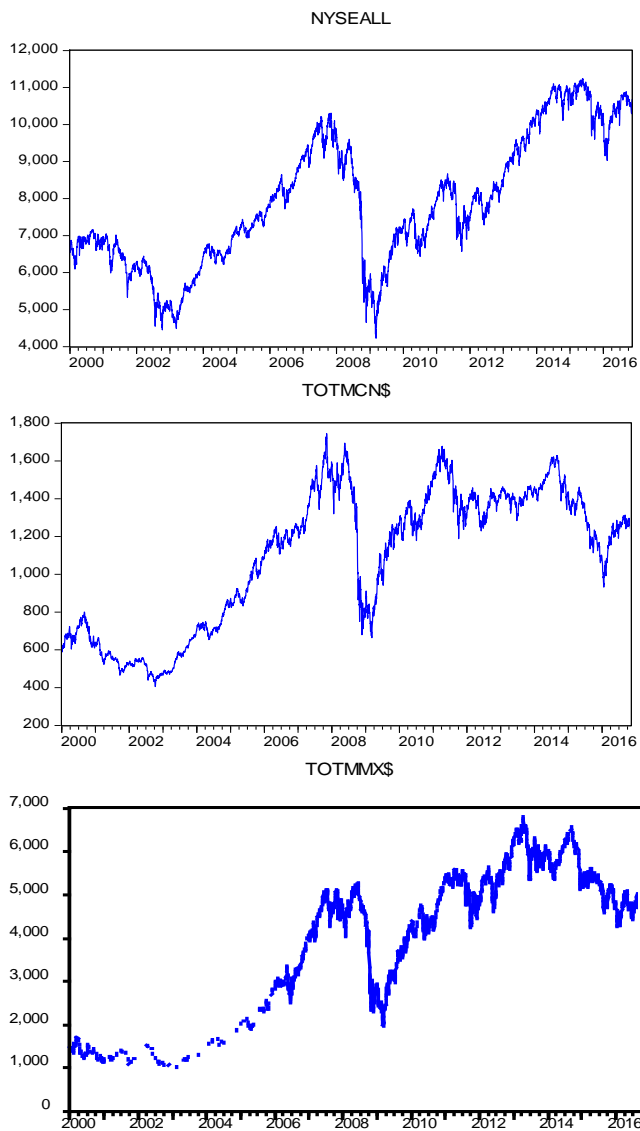


Figure 1. Index price evolution periode 2000 – 2016 (USD)

Table 2. Descriptive statistic for daily, weekly and monthly index price

Daily	Mean	Median	Maximum	Minimum	Std. Dev.
DJCMP65	4,030.31	3,810.28	6,574.59	2,033.44	1,170.97
NASCOMP	2,789.16	2,427.71	5,339.52	1,114.11	1,091.55
NYSEALL	7,892.55	7,597.04	11,239.66	4,226.31	1,743.69
TOTMCN\$	1,090.48	1,210.23	1,745.43	405.75	363.68
TOTMMX\$	3,611.48	4,133.28	6,806.90	1,008.56	1,773.65
Weekly	Mean	Median	Maximum	Minimum	Std. Dev.
DJCMP65	4028.38	3808.92	6560.91	2169.92	1171.00
NASCOMP	2789.48	2424.16	5312.00	1139.90	1092.56
NYSEALL	7891.61	7626.15	11228.35	4284.49	1744.19
TOTMCN\$	1090.65	1211.13	1724.03	422.77	364.24
TOTMMX\$	3611.15	4129.23	6743.26	1016.30	1776.20
Monthly	Mean	Median	Maximum	Minimum	Std. Dev.
DJCMP65	4030.82	3822.27	6473.60	2200.40	1173.34
NASCOMP	2793.90	2415.40	5312.00	1172.06	1098.43
NYSEALL	7897.38	7532.80	11062.79	4617.03	1748.23
TOTMCN\$	1092.28	1198.68	1728.19	440.14	367.56
TOTMMX\$	3605.80	4087.03	6582.39	1027.44	1781.30

It can be seen from the data chart used in this study above, the NYSE index is the highest index, while the lowest is Canada's TSE index. Another thing that we can observe is that during the period before the crisis in 2008-2009, the stock index experienced relative growth and began to fall during the crisis which affected stock price movements in all indices. Then, after the crisis period, it was seen that there was a positive movement again experienced by all indexes where the movement of the increase in the index tended to be higher than in the pre-crisis period.

The following is a descriptive statistic of each index which is divided into three data frequencies, namely daily, weekly and monthly data.

In the statistical description table, in daily data, the stock index that has the highest index is the NYSE index with a mean price of 7,892 followed by the Dow Jones index which has a mean price of 4,030. In addition, the index with the highest standard deviation is MSE with a number of 1,773 and followed by NYSE of 1,743. The same condition applies to the weekly and monthly price indexes.

3. RESULTS

Stationarity Test

One of the procedures that must be done in estimating the economic model with time series data is to test whether the time series data is stationary or not. Stationary data is time series data that does not

contain unit roots, stationary time series data has the following characteristics:

1. $E(X_t) = \text{constant for all } t$,
2. $\text{Var}(x_t) = \text{constant for all } t$,
3. $\text{Cov}(X_t, X_{t+k}) = \text{constant for all } t$,

Table 3. Unit Roots (Stationarity)

Country (Daily)	Index	ADF Test		PP Test	
		Level	1st diff	Level	1st diff
United States	DJCOMP65	-0.20	-70.55***	0.00	-71.27***
United States	NASCOMP	-0.64	-67.07***	-0.50	-67.24***
United States	NYSEALL	-1.22	-70.36***	-1.07	-70.98***
Canada	TOTMCN\$	-1.68	-61.37***	-1.61	-61.18***
Mexico	TOTMMX\$	-1.41	-58.73***	-1.35	-58.33***

Country (Weekly)	Index	ADF Test		PP Test	
		Level	1st diff	Level	1st diff
United States	DJCOMP65	-0.367	-31.73***	-0.2005	-31.82***
United States	NASCOMP	-0.761	-31.42***	-0.6974	-31.39***
United States	NYSEALL	-1.281	-31.31***	-1.2053	-31.32***
Canada	TOTMCN\$	-1.648	-30.27***	-1.6286	-30.27***
Mexico	TOTMMX\$	-1.315	-31.64***	-1.2958	-31.59***

Country (Monthly)	Index	ADF Test		PP Test	
		Level	1st diff	Level	1st diff
United States	DJCOMP65	0.11	-13.06***	-0.07	-13.08***
United States	NASCOMP	-0.49	-14.05***	-0.49	-14.07***
United States	NYSEALL	-0.94	-12.50***	-1.23	-12.58***
Canada	TOTMCN\$	-1.55	-13.15***	-1.72	-13.27***
Mexico	TOTMMX\$	-1.18	-12.56***	-1.28	-12.64***

Stationary data at a glance can be seen from data fluctuations. Data can be said to be stationary if it moves and fluctuates around the average, while data that is not stationary will move with an average that changes over time. In general, stochastic trends can be eliminated by differencing ways. Differencing was done to produce stationary data.

In the daily data stationarity test, it shows that all stock index data are not stationary at the level data using the ADF and Philips-Perron tests. Then the data is tested again in first difference and the results show that the data is stationary. The same thing happened to the weekly and monthly index price data for all indices in America, Canada and Mexico which were only stationary in the first difference.

Johansen Cointegration Test

To find cointegration in data, you can go through the Johansen Cointegration test. Based on the table data above, it shows that the daily and weekly data of all the indexes (5 stock indices) tested did not find any cointegration between stock indices. However, using

monthly data, there is a cointegration. This may be due to the high frequency of daily and weekly data so there is a lot of disruption in these data.

Then, because daily and weekly data were not found cointegration between the tested stock indices, this research was continued by using the Variance Autocorrelation (VAR) analysis, while the monthly data proved that there was cointegration, the next analysis could use the Vector Error Correction Model (VECM).

Table 4. Johansen Cointegration Test

Data Trend: (daily)	None	None	Linear	Linear	Quadratic
Test Type	No Intercept	Intercept	Intercept	Intercept	Intercept
	No Trend	No Trend	No Trend	Trend	Trend
Trace	0	0	0	0	0
Max-Eig	0	0	0	0	0

Data Trend: (weekly)	None	None	Linear	Linear	Quadratic
Test Type	No Intercept	Intercept	Intercept	Intercept	Intercept
	No Trend	No Trend	No Trend	Trend	Trend
Trace	0	0	0	0	0
Max-Eig	0	0	0	0	0

Data Trend: (monthly)	None	None	Linear	Linear	Quadratic
Test Type	No Intercept	Intercept	Intercept	Intercept	Intercept
	No Trend	No Trend	No Trend	Trend	Trend
Trace	1	1	1	1	1
Max-Eig	1	1	1	1	0

*Critical values based on MacKinnon-Haug-Michelis (1999)

Vector Auto Regression (VAR) on daily and weekly index data

Vector Auto Regression (VAR) is usually used to project a system of time series variables and to analyze the dynamic impact of the disturbance factors contained in the variable system. Basically, VAR analysis can be matched with a simultaneous equation model, because in VAR analysis we consider several endogenous variables together in a model. The difference with the usual simultaneous equation model is that in the VAR analysis each variable is not only explained by its past value, but is also influenced by the past values of all other endogenous variables in the observed model. In addition, in VAR analysis there

are usually no exogenous variables in the model.

Optimum Lag Test

Before carrying out the VAR test, determining the optimal lag is very important in order to get good results. Testing the optimal lag length is very useful for eliminating autocorrelation problems in the VAR system, so that by using the optimal lag, it is hoped that autocorrelation problems will no longer arise. From the results of the lag determination test, it shows that the optimal lag falls on lag five (see the * sign) in the table below. In this study using a lag length Wald test, with the following results (Table 5):

Table 5. Lag Length Wald Test

(Daily)	D(DJCMP65)	D(NASCOMP)	D(NYSEALL)	D(TOTMCNS)	D(TOTMMXS)	Joint
Lag 1	42.39111 [4.91e-08]	23.38133 [0.000285]	43.68776 [2.68e-08]	126.3570 [0.000000]	106.1153 [0.000000]	654.3498 [0.000000]
Lag 2	14.54281 [0.012505]	11.74678 [0.038427]	13.48228 [0.019255]	4.484503 [0.481960]	6.840324 [0.232789]	69.99554 [0.000003]
(Weekly)	D(DJCMP65)	D(NASCOMP)	D(NYSEALL)	D(TOTMCNS)	D(TOTMMXS)	Joint
Lag 1	7.065440 [0.215819]	4.196247 [0.521521]	5.975010 [0.308658]	3.943045 [0.557645]	8.832769 [0.115923]	38.73738 [0.039133]
Lag 2	5.402261 [0.368782]	7.659077 [0.176053]	7.106605 [0.212832]	9.140452 [0.103591]	5.539222 [0.353664]	34.80927 [0.091711]
Df	5	5	5	5	5	25

The results In daily data, the optimum lag length is lag 2, while the weekly data is lag 1.

Granger Causality Test

After getting the optimum lag length test, the Granger Causality test was carried out (see table 6) to see the short-term relationship between the tested indices. In daily data there is a short-term relationship on the NYSE index with the Dow Jones index at a significance of 10%, the TSE index with the NYSE at a significance of 1%, the MSE index with TSE at a

significance of 10%, the NYSE index with MSE at a significance of 5%, the index The Dow Jones with the TSE at a significance of 10%, the NYSE, Nasdaq and Dow Jones with the MSE at a significance of 1%. In the weekly data there is a short-term relationship on the Mexican Stock Exchange index with the Dow Jones index and the NYSE at the significance of both of 10%.

Table 6. Granger Causality Test

Index (Daily)	Excluded					
Dependent	DJCMP65	NASCOMP	NYSEALL	TOTMCNS	TOTMMXS	ALL
DJCMP65	-	0.7646	0.1408	0.0536	0.0001	0.0002
NASCOMP	0.5106	-	0.3513	0.3410	0.0007	0.0002
NYSEALL	0.0930	0.3278	-	0.0214	0.0000	0.0000
TOTMCNS	0.5762	0.3149	0.0003	-	0.3257	0.0000
TOTMMXS	0.1096	0.8130	0.1923	0.0501	-	0.0000
Index (Weekly)	Excluded					
Dependent	DJCMP65	NASCOMP	NYSEALL	TOTMCNS	TOTMMXS	ALL
DJCMP65	-	0.1201	0.9064	0.4419	0.3113	0.4504
NASCOMP	0.3741	-	0.6176	0.6647	0.5256	0.865
NYSEALL	0.6013	0.1686	-	0.4928	0.2197	0.4104
TOTMCNS	0.8360	0.5411	0.3155	-	0.2117	0.5626
TOTMMXS	0.0545	0.4316	0.0902	0.7824	-	0.2454

Impulse Response

An impulse response test to see if a shock that occurs in one index affects another index. These results are shown in a graph, as follows:

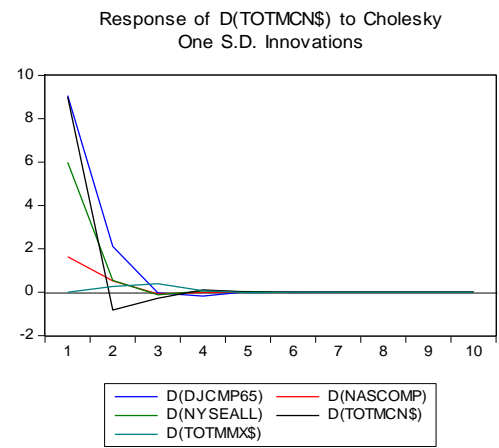
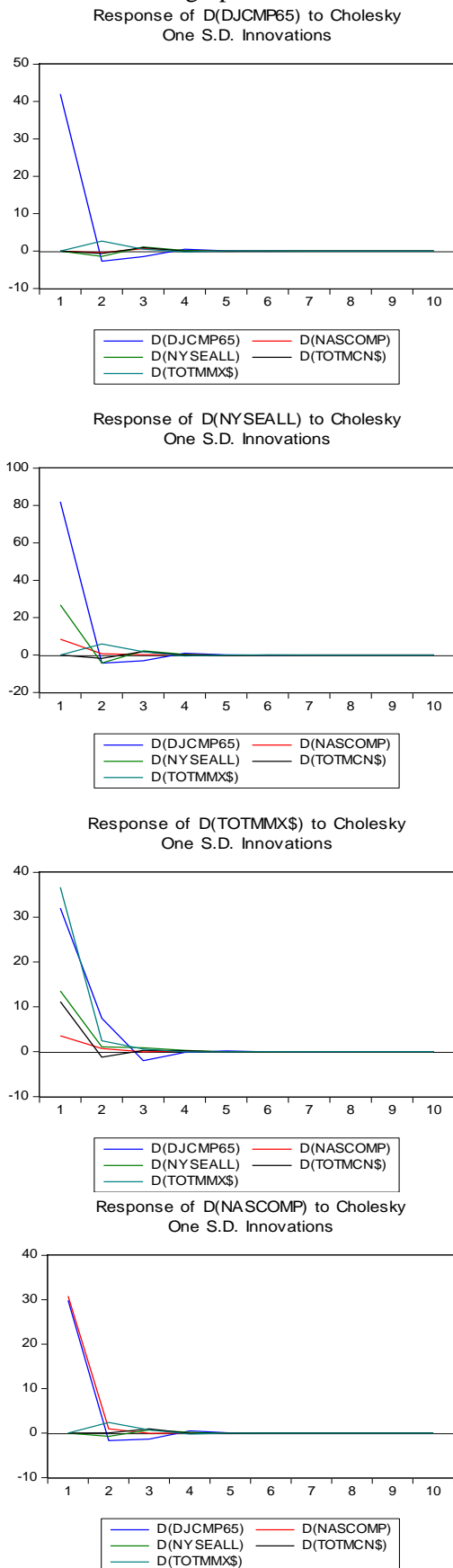


Figure 2. Daily Index Impulse Response

Variance Decomposition

Variance Decomposition can explain how the variance contribution of the shock variable to other endogenous variables. Based on the results of the variance decomposition of daily data listed in the table below (see Table 7) which is obtained through the decomposition of the variance of the impulse response function, it appears that the Dow Jones index response is more due to shocks to the Dow Jones itself with a proportion of 99.45080%. Meanwhile, the response of the Dow Jones index was caused by the Nasdaq shock with the proportion of 48.48255%. Still more of 51.51745% was caused by the Nasdaq shock itself. The Dow Jones index response was caused by the NYSE shock with the proportion of 89.50572%. Meanwhile, the NYSE index response was caused by the NYSE shock itself with the proportion of 9,544106%. The Dow Jones index response was caused by the TSE shock with a proportion of 40.72427%. The TSE index response was caused by the TSE shock itself with a proportion of 40,17220, the rest was due to the NYSE shock of 17,78320%. The Dow Jones index response was caused by the MSE shock with the proportion of 38.12787%. The MSE index response was caused by the MSE shock itself, with the remaining 49.93292% of the NYSE and TSE.

Vector Error Correction Model(VECM)

On monthly index data VECM is an approach used to determine the long-term relationship of each time series data at the level (index). In the cointegration test on daily and weekly data frequencies there is no long-term relationship which indicates that the integration at the data level (I (0)) is not stationary and the same thing occurs when the time series error is not stationary. Different conditions in

the monthly frequency data indicate the presence of stationary data for the five indexes that are the object of observation, but the error level shows stationary. The following is a chart showing the cointegration of several groups of time series data.

4. CONCLUSION

Based on the chart below, it can be seen that a cointegration occurs when there is a Nasdaq index in the cointegration analysis. This occurs in all five time series data, four, three or two time series data. Because this study uses the index of countries that are members of NAFTA, the next cointegration analysis will involve three time series data at monthly frequencies, namely Nasdaq (United States), Toronto SE (Canada), and Mexican SE (Mexico).

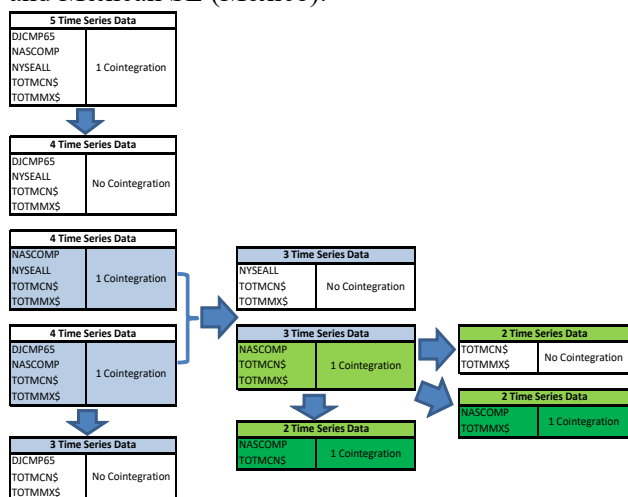


Figure 3. Cointegration in NAFTA

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.110639	34.01271	29.79707	0.0154
At most 1	0.043074	10.79679	15.49471	0.2243
At most 2	0.010445	2.079046	3.841466	0.1493

Table 7. Johansen Cointegration Test

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Based on the table above, it shows that there is only one cointegration. And when viewed from the cointegration process of each of the two data series,

cointegration occurs between the Nasdaq index with TSE and Nasdaq with MSE. Meanwhile, the TSE and MSE did not find any cointegration.

5. REFERENCES

Bekaert, G., Harvey, C. R., & Ng, A. (2005). *Market integration and contagion*. Journal of Business, 78, 1–32.

Dickey, D. A., & Fuller, W. A. (1979). *Distribution of the estimators for autoregressive time series with a unit root*. Journal of the American Statistical Association, 74(366a), 427–431.

Dimpfl, Thomas. (2014). *A note on cointegration of international stock market indices*. International Review of Financial Analysis Vol. 33, Pages 10–16.

Dumitru-Cristian Oanea. 2015. *Financial markets integration: A vector error-correction approach*. The Journal of Economic Asymmetries 12 (2015) 153–161.

Engle, R. F., & Granger, C. W. (1987). *Co-integration and error correction: representation, estimation, and testing*. Econometrica: Journal of the Econometric Society, 55, 251–276.

Lee, Shie, F. S., & Chang, C. Y. (2012). *How close a relationship does a capital market have with other such markets? The case of Taiwan from the Asian financial crisis*. Pacific-Basin Finance Journal, 20(3), 349–362.

Yang, F. (2012). *A note on cointegration methodology in studying stock markets integration*. Applied Economics Letters, 19(16), 1583–1586.

Yang, L., Lee, C., & Shie, F. S. (2014). *How close a relationship does a capital market have with other markets? A reexamination based on the equal variance test*. Pacific-Basin Finance Journal, 26, 198–226.

Zhou, Xinmiao., Qiana, Huanhuan., Pérez-Rodríguez, Jorge. V., López-Valcárcel, Beatriz González. *Risk dependence and cointegration between pharmaceutical stock markets: The case of China and the USA*. The North American Journal of Economics and Finance Vol. 52, 2020, 101175.