An Empirical Study on Volatility of the US Stock Market and Co-movement between Stock Markets in the NAFTA Countries in the Context of Sino-US Trade Friction

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Abstract: In this paper, an optimal GARCH model conforming to a single market is selected from the GARCH family models, and based on this model, the change in the volatility trend of the US stock market during the Sino-US trade friction is observed. Then, the DCC-GARCH parameter model is employed to conduct an empirical study on the co-movement of daily return rates in the stock markets of three countries in the North American Free Trade Area (NAFTA), based on which the following conclusions are drawn: During the intensified Sino-US trade friction, firstly, the US stock market was not significantly affected by key events, and therefore the investors in the US stock market could lower their expectation of the impact of Sino-US trade friction on the short-term stock price volatility when assessing the investment risks. Secondly, there was an observable difference in the co-movement between any two of the stock markets of the United States, Canada, and Mexico. The stock market co-movement between the United States and Canada is high. As a result, investment diversification in Canada stock market is not ideal in spreading investment risk for the U.S market; And the co-movement between the United States and Mexico and that between Canada and Mexico are relatively low. Thirdly, with the impact of the intensified Sino-US trade friction on economic uncertainty, the dynamic co-movement between the stock markets of the United States and the NAFTA countries is increasing, and key events will have a significant impact on the dynamic co-movement between the stock markets.

1. Introduction

It is generally believed that the uncertainty of economic and trade relations between important trading partners caused by political instability will exert an impact on these countries' economy and market sentiment, thus affecting the stability of the stock markets and the financial markets and possibly enhancing the systemic risk of the financial markets. Indeed, Knite has shown in his works that risk and uncertainty cannot be equated with each other [1], but in literature with topics of the connection between political development and economy as well as financial market, the two terms are almost used interchangeably. Carney includes geopolitical risk, economic policy uncertainty and political risk in the "Uncertainty Triangle" that may have a significant adverse impact on the economy [2]. In the 2017 Economic Bulletin of the European Central Bank and the World Economic Outlook of International Monetary Fund (IMF) published in April 2017, geopolitical uncertainty is highlighted as a major risk to the economic outlook. Further, Hartwell has studied the influence of informal (i.e., internal/external conflicts; Fernandez,2007 [3]) political unrest, which he has reported had a significant negative impact on the level of stock returns [4].

At present, the United States and China, as the world's first and second largest economies, are experiencing an unprecedented period of trade friction. In terms of international trade, China and the United States take a particularly prominent share in the global trade. The total trade volume of China and the United States alone accounts for over 20%, and the respective share of the two countries is

slightly different from each other. According to the statistics of the World Trade Organization (WTO) in 2018, the total trade volume of the world was about 39 trillion US dollars, with China and the United States accounting for 11.75% and 10.87%, respectively. On March 22, 2018, the United States proposed to impose tariffs on the Chinese imports worth 50 billion US dollars, after which China repeatedly said that they would retaliate by imposing tariffs of the same scale. The Sino-US trade conflict has officially started and continues till now.

According to the trend of the Chinese stock market and the development trend of the key events of Sino-US trade friction, we find that the uncertainty of Sino-US trade friction has an obvious impact on the Chinese stock market during this period, which intensifies the volatility of the Chinese stock market. On March 23, 2018, the second day after the official start of the trade conflict between China and the United States, the Shanghai Composite Index of China's A-share suffered a low-gap opening and a slump in closing price by 3.39% [5]. On June 18, the United States announced an additional 10% tariff on the Chinese imports worth 200 billion US dollars based on the tariff increase on the Chinese imports worth 50 billion US dollars. The next day, around 1000 shares in China's A-share market hit limit down. With the Sino-US trade friction, the sanctions, and anti-sanctions between the two countries become more intense and frequent, followed by continued volatility, and drop in China's stock index market. On December 1, 2018, leaders of the two countries met in Argentina and reached important consensus. The next day, the two sides reached an agreement to suspend tariff increase, and the A-share market began to rebound gradually. Since then, the two sides had held six rounds of negotiations. Since the trend became relaxed, the Chinese stock market index rose steadily, and the Shanghai Composite Index soared to 3200 in April 2019.In May 2019, the two countries entered the stage of intense friction once again, and on May 9, the US Department of Commerce announced a tariff increase from 15% to 20% on Chinese imports, which are worth 200 billion US dollars. After the release of the news, Shanghai Composite Index fell by 1.48%. On May 17, the United States included Huawei, and its 68 affiliated companies in the Entity List, and the Shanghai Composite Index fell by 2.48% the next day. On August 5, the United States named China as a "Currency Manipulator", and the next day the Shanghai Composite Index fell to a new low of 2733.92, down 1.56%. However, on January 15, 2020, China and the United States officially signed the first-phase agreement, which reduced the uncertainty of economic fundamentals and helped restore confidence in the financial market. From December 2019 to January 2020, the Shanghai Composite Index has been rising steadily with the easing of bilateral relations.

Based on the observation of events, every release of trade friction information corresponds to the irrational volatility of the Chinese stock market. Besides, there are also relevant empirical studies. For example, Wang Zuoteng made use of such data as daily volatility of Shanghai Composite Index, Shanghai Interbank Offered Rate (SHIBOR),Federal Funds Rate and central parity of RMB; and based on the characteristics autoregression of these financial data, he adopted ARMAGARCH model to conducted an empirical analysis on the above transmission mechanism and scientifically verified the actual effect of the trade war on the Chinese stock market; and then he drew the conclusion that in the context of trade friction, the interest rate and exchange rate are negatively correlated to China's share price [6]. For another example, Wang Ruting, based on HAR - RV event development model and intra-day jump Logistic model, made a quantitative analysis of the effect of Sino-US trade friction on China's Shanghai and Shenzhen 300 Index and industry index affected by increased tariffs, and found that the Sino-US trade friction had a quick and temporary impact on these indexes, and that the introduction of trade friction event can strengthen the internal and external prediction effect of Volatility Model samples [7].

Considering the facts, from both event observation and academic research, that the intensified uncertainty of bilateral economic and trade relations between China and the United States is positively correlated to the Chinese stock market volatility, the investors are likely to suppose that the Sino-US trade friction will also exert a similar impact on the US stock market. This paper focuses on whether the Sino-US trade friction will exert an impact on the US stock market similar to that on China's, and hopes to verify the hypothesis of such correlation through an empirical study so as to accurately provide the US stock investors with the impact degree of risk event and help them prevent financial

risk. In the context of such conflict, this article further pays attention to the regional markets – co-movements of stock markets between countries in the North American Free Trade Area (NAFTA), identifies if there is co-movement between the stock markets of the three countries and if there is, explains the co-movement characteristics with the law of economics, hoping to provide the investors with suggestions on how to avoid financial risk based on the discussion about the co-movement between regional markets when the hypothesis that the Sino-US trade friction does exert an effect on the US stock market volatility stands. This paper will be developed as follows: Method, Results, Discussion and Conclusion. Section 2 introduces the data and econometric modelling approach. Section 3 presents the empirical output. Section 4 shows the analysis we get from the result. Section 5 provide a brief conclusion.

2. Method

In order to study the impact of the Sino-US trade friction on the stock markets of NAFTA countries - the United States, Mexico and Canada, we first adopted single GARCH model to build models for volatility of their stock markets, and added dummy variables with the time of intensified trade friction in 2017 as the node to preliminarily test whether the friction exerted an impact. This paper is just the first part of the studies on co-movement of the Sino-US trade friction on the stock markets of the United States, Canada and Mexico, we want to not only preliminarily judge whether there is an impact, but also to provide attempts and guidance for modeling co-movement between detailed segment groups and the study on lag order. Therefore, although Var model is more intuitive and concise in judging impact, we selected Garch family model and got the dynamic process of the corresponding co-movement change. In this process, we chose GARCH model, which is more appropriate by modeling single volatility; secondly, we used the DCC-GARCH model to model the co-movement between each pair of the three stock markets and observed the impact of Sino-US trade friction on the relationships of these three stocks as well as the dynamic change of the co-movement to conduct the preliminary analysis.

In terms of the data source, this paper used the Bloomberg database which is widely accepted in research of the financial industry, selected the daily data of American Dow Jones Industrial Average (DJI), Mexico Stock Index (IPC) and Canadian Stock Index (TSX) of 550 days from January 3, 2010 to July 19, 2020, and adopted the calculated logarithmic return rate for study. After the original data was compared with Yahoo Finance and confirmed to be accurate, the empirical substitution was carried out.

2.1 GARCH Model

GARCH, PARCH and EGARCH models were selected to model the volatility of a single market, and the estimated effects of these models were compared. The general GARCH model is mainly composed of conditional mean equation and conditional variance equation. For the relatively general GARCH model, its conditional variance equation is mainly affected by the lagged terms and residual terms of conditional variance. When the GARCH model is built, it is necessary to assume the distribution of standardized residual. In this paper, we assume that standardized residuals follow the student-T distribution. The specific form of GARCH model is as follows: r_i represents the return rate; ε_i represents the residual term; σ_i represents the conditional variance; φ_i represents the standardized residual term.

Equation of the Garch model is:

$$r_i = \mu + \varepsilon_i$$

$$\sigma_i = \omega + \alpha\sigma_{i-1} + \beta\varepsilon_{i-1}^2 \quad (1)$$

$$\varepsilon_i = \sigma_i * \varphi_i$$

Equation of the PARCH model is：

$$\sigma_i^{\delta} = \omega + \sum_{n=1}^{m} \alpha_n (|\varepsilon_{i-n}| - \gamma_n \varepsilon_{i-n})^{\delta} + \sum_{j=1}^{k} \beta_j \delta_{i-j}^{\delta} \quad (2)$$

Equation of the EGARCH model is：

$$(1 - \alpha B)\ln\sigma_i^2 = (1 - \alpha)\sigma_{t-1} + g(\varepsilon_{t-1}) \quad (3)$$

2.2 DCC-GARCH Model

Based on the GARCH model for a single market, DCC-GARCH model was used to analyze the co-movement between the three markets. To estimate the co-movement between variables in DCC-GARCH model, there are mainly two steps. The first step is to build the GARCH model for a single variable. The second step is to calculate the conditional correlation, which is estimated based on the standardized residual term obtained in the first step. The form of DCC-GARCH model is as follows:

$$\begin{aligned} Q_t &= (1 - a - b)Q' + aQ_{t-1} + b\theta_{t-1}\theta_{t-1}^{'} \\ \rho_t &= J_t Q_t J_t \end{aligned} \quad (4)$$

Here, θ_{t-1} is the standardized residual matrix;Q_t is its covariance matrix, and J_t is the diagonal matrix of Q'. The parameters a and b determine the dynamic correlation, and a + b should be less than 1.

In addition, in order to identify whether the tension between China and the United States has an impact on the stock markets of the NAFTA represented by the US stock market to some extent, we added dummy variables to the above model for preliminary verification. Since it is difficult to quantify the change of the situation in China and the United States as an abstract political and economic concept, we chose to add dummy variables to make a preliminary analysis, and at the beginning of the experiment, we made a strategy to guide the next analysis according to the actual coefficient of dummy variables. We added dummy variables with the beginning of 2017, 2018 and 2019 as the nodes, so as to improve the accuracy of nodes where dummy variables were added; and the results of multiple segments were used to support our following analysis.

3. Results

3.1 Descriptive Statistics

As described above, in order to study whether the tension between China and the United States has an impact on the stock markets of the NAFTA represented by the US stock market as well as the co-movement of the three stock markets, we chose the daily data of American Dow Jones Industrial Average (DJI), Mexico Stock Index (IPC) and Canadian Stock Index (TSX) of 550 days from January 3, 2010 to July 19, 2020, and adopted the logarithmic return rate for study. As can be seen from the descriptive statistics in the table below, the skewness and kurtosis of the return rates of the three stock markets are significantly different from those of the normal distribution, so it is appropriate to select the student-t distribution.

Table 1 Descriptive Statistics of Logarithmic Return Rate of the Three Stock Markets

	DJI	IPC	TSX
Mean	0.001686	0.000180	0.000548
Median	0.003256	0.001560	0.002413
Maximum	0.120840	0.075307	0.090697
Minimum	-0.189978	-0.105566	-0.164881
Std. Dev.	0.023260	0.021394	0.020182
Skewness	-1.316303	-0.371360	-1.946783
Kurtosis	15.92740	5.124114	17.17322
Observations	550	550	550

Since the Sino-US trade friction started after 2017, we took 2017 as the first segment node to examine the changes in the correlation between each pair of the three stock markets before and after 2017. With the dummy variables, the node before the Sino-US trade friction happened in 2017 was set as 0, and that after 2017 was set as 1.

Besides, the following two tables (Table 2 and Table 3) show the correlation coefficients between the three markets, from which it can be seen that the correlation between the US stock market and the Canadian stock market increased after 2017, while the correlation between the US stock market and the Mexican stock market, and that between the Mexican stock market and the Canadian stock market have weakened to some extent.

Table 2 Correlation Coefficient of Return Rates between each pair of the three stock markets before 2017

	DJI	**IPC**	**TSX**
DJI	0.000362		
	1.000000		
IPC	0.000268	0.000440	
	0.671853	1.000000	
TSX	0.000256	0.000242	0.000331
	0.741006	**0.633464**	1.000000

Table 3 Correlation Coefficient of Return Rates between each pair of the three stock markets after 2017

	DJI	**IPC**	**TSX**
DJI	0.000889		
	1.000000		
IPC	0.000409	0.000488	
	0.621922	1.000000	
TSX	0.000618	0.000328	0.000554
	0.880140	0.631310	1.000000

Firstly, the GARCH model was used to model a single market, and the optimal GARCH model conforming to a single market was selected from the GARCH, PARCH and EGARCH models. Meanwhile, dummy variables were added to the model as exogenous variables.Table 4 gives the estimated results of the model, from which it can be seen that the dummy variables are not significant in most cases, indicating that the impact of dummy variables is limited, but in the Mexican stock market, the estimated coefficient of the dummy variables is significant at 5% Sig. level, so dummy variables have a limited influence, but there is still certain influence.

Later, in order to optimize the time node of adding dummy variables, we tried to examine the values around 2018 and 2019 with the same model, finding that the significance of the dummy variable became lower in the three markets at 5% significance level, and the impact was negative.

Through LogLikelihood and AIC criteria, ARMA (1,1)-PARCH (1,1)- STD model was selected for DJI; ARMA (1,1)-EGARCH (1,1)- STD model was selected for TSX and IPC. But for the convenience of further research, ARMA (1,1)-EGARCH (1,1)-std was determined as model for all the three markets. From the result of model, it also can be seen that the estimate efficiency of EGARCH model is better, as most coefficients can be significant.

Table 4 Comparison of Parameters of Garch Family Models

	DJI			TSX			IPC		
	GARCH	*PARCH*	*EGARCH*	*GARCH*	*PARCH*	*EGARCH*	*GARCH*	*PARCH*	*EGARCH*
mu	0.00316*	0.00232*	0.00251*	0.00238*	0.00151***	0.00144***	0.00197*	0.00105	0.00108
ar1	-0.09368**	-0.06761	-0.07414	-0.04354	-0.03415	-0.02858	-0.09434*	-0.08903***	-0.08500**
Time	0.00137	0.00159	-0.00136*	-0.00081	-0.00021	-0.00012	-0.00212	-0.00167	-0.00226
omega	0.00005*	0.00018	-1.356334*	0.00004*	0.00034	-0.87140*	0.00005*	0.00049	-0.716674*
alpha1	0.27187*	0.15744	0.35666*	0.24055*	0.12424	0.19000*	0.12522 *	0.09730	0.07885
beta1	0.642111*	0.74604	-0.21925*	0.68768*	1.00000	-0.26923*	0.77129*	1.00000	-0.23396 *
Time	-0.00001	-0.00003	-0.01430	-0.00002	-0.00013	-0.05603**	-0.00001	-0.00002	0.00114
eta11		0.68891*	0.86493*		0.76152*	0.91286*		0.81627*	
gamma1		1.67910 *			1.41207*			1.32303*	0.91741*
shape	5.395338*	5.69114*	5.71568*	5.79096*	6.443814*	6.785508*	7.80049*	10.75097	11.39393 *
LogLikelihood	1423.387	**1431.535**	1429.663	1498.654	1508.876	**1511.237**	1368.271	1381.945	**1384.284**
AIC	-5.156238	**-5.17863**	-5.17546	-5.43043	-5.46038	**-5.47263**	-4.95545	-4.997979	**-5.01014**

3.2 DCC-GARCH Model

DCC-GARCH model was used to model the correlation between each pair of the three stock markets, and the parameters obtained are shown in Table 5. It can be seen from the table that the parameters a+b of the three pairs of dynamic dependencies are all less than 1, indicating that the model has a good estimation effect. At the same time, both parameters a and b are significant at the 1% Sig. level, indicating that these two parameters can be used to reasonably measure the dependencies between the three markets.

Table 5 Dynamic Correlation Coefficient

	a	**b**
DJI-TSX	0.062867*	0.864884*
DJI-IPC	0.034295*	0.932057*
IPC-TSX	0.036694*	0.921958*

According to the parameters obtained from the DCC-GARCH model, the dynamic dependencies between each pair of the three stock markets are analyzed. The three pictures below show the change trend of dependency with time between the US stock market and Canadian stock market, the US stock

market and Mexican stock market, and the Mexican stock market and Canadian stock market. It can be seen from them that there were some fluctuations in the dependency between the US stock market and Canadian stock market before 2017, a downtrend around 2017 and a rising trend after 2017; especially after the Sino-US trade friction was intensified in 2019, the relationship between

them rose and the correlation is enhanced. However, the dependency between the US stock market and Mexican stock market had been falling for some time after 2017, then began to rise after 2019. One possible reason for this is that in the early stage of the Sino-US trade conflict, it had little impact on the dependency between the US stock market and the Mexican stock market. However, after the Sino-US trade conflict was intensified, the United States needed to strengthen its relations with the American countries, so the relationship between the US stock market and the Mexican stock market increased. For the Mexican stock market and Canadian stock market, it can be seen from the figures demonstrating unchanged relationship between them much around 2017.

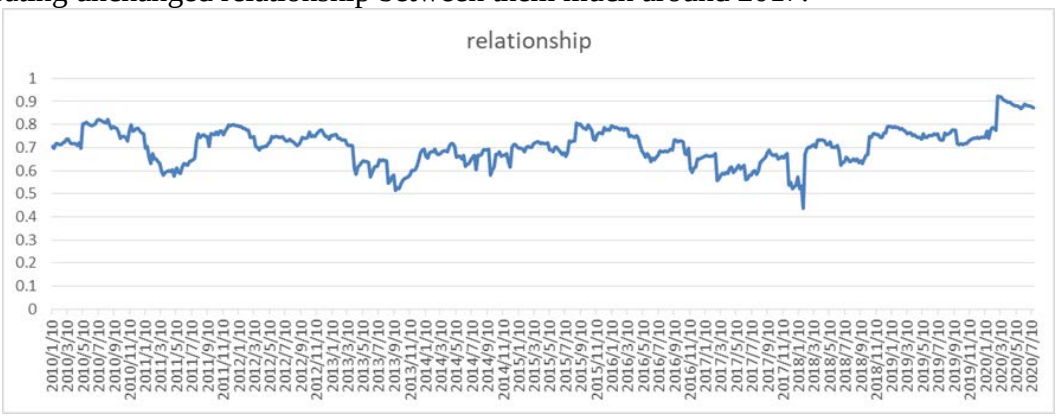

Fig 1 Change Curve of Relationships of Logarithmic Return Rate between Each Pair of Stock Indexes DJI-TSX

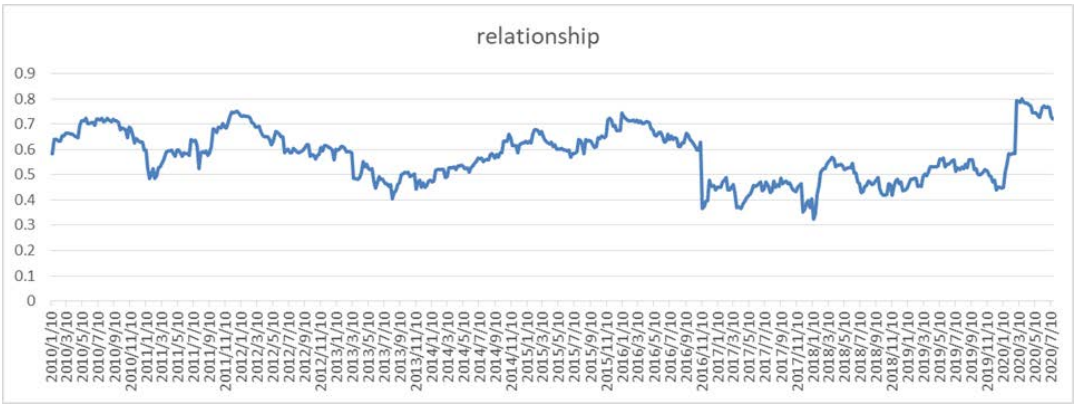

Fig 2 Change Curve of Relationships of Logarithmic Return Rate between Each Pair of Stock Indexes DJI-IPC

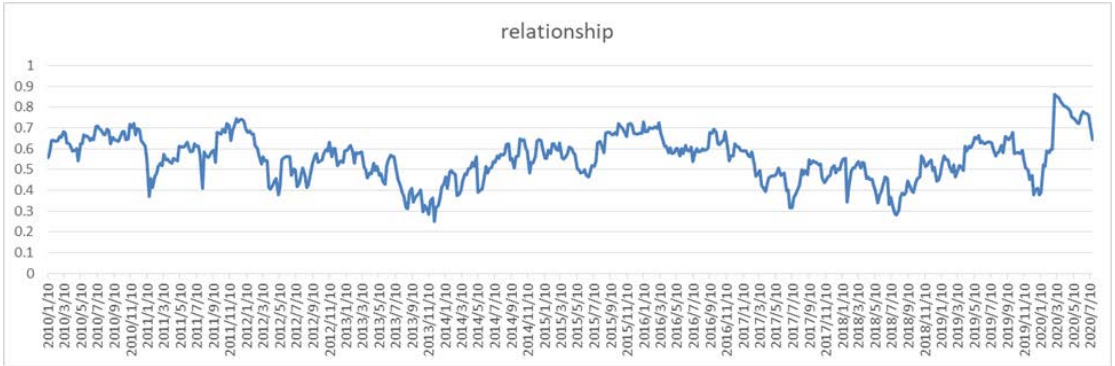

Fig 3 Change Curve of Relationships of Logarithmic Return Rate between Each Pair of Stock Indexes IPC-TSX

As can be seen from the average, the correlation between the US stock market and the Canadian stock market strengthened after the Sino-US trade friction in 2017, while the correlation between the US stock market and the Mexican stock market and that between the Mexican stock market and the Canadian stock market weakened after 2017. By contrast, the Sino-US trade conflict has a greater impact on the correlation between the US stock market and Mexican market, and that between the US stock market and Canadian stock market, and the changes in the relationship between the US stock market and Mexican market, and that between the US stock market and Canadian stock market are also different. Overall, the Sino-US trade conflict has strengthened the link between US stock market and Canadian stock market.

Table 6 Dynamic Correlation Coefficient

	Before 2017	**After 2017**
DJI-TSX	0.704610529	0.712103327
DJI-IPC	0.607603493	0.510939874
IPC-TSX	0.572675505	0.529902628

4. Discussion

Based on the above empirical study, the following several findings can be drawn through the analysis on the correlation of mean spillover and volatility spillover. In This section, we will provide relevant discussions of the empirical results and findings.

4.1 Weak Impact of the Sino-US Trade Friction

The Sino-US trade friction does not have such a dramatic impact on the US stock market as previously assumed, but they still have some impact. We have the following views on why the Sino-US trade friction can cause great volatility in China's stock index, while does not have a great impact on the trend of the U.S. stock index.

4.1.1 Distinct Industrial Competitiveness:

China and the United States differ in industrial competitiveness. In 2011, WTO, OECD and other international organizations have put forward the “Trade-in-value-added” calculation method to analyze the actual status and benefits of various countries' participation in the international division of labor, and established the World Input-Output Database. The accounting of trade-in-value-added means that the value-added part of each production link of export products is divided into different countries, and that the export products of each country only reflect the increment of this country. This method can be used to track the value-added of each country in the product production chain and reflect the economic and trade relations among countries from the perspective of newly-increased value [8]. As for China, processing trade accounts for a large proportion in its foreign trade, and there will be a big deviation if China's foreign trade is measured by the traditional import and export volume. Therefore, in many studies, various calculations and analyses on China's foreign trade are made based on the trade-in-value-added. Li Xin found that according to value-added , China's total trade in 2002 and 2007 was14.1% and 20.5%, lower than the total trade in customs clearance statistics, and its trade surplus was also lower than the total trade surplus of 20.3% and 24.9% in customs clearance statistics [9]. Furthermore, since the United States is China's main trading partner, the Sino-US trade has also become the research focus. Ge Ming et al. found that 23% of the export value, 13% of the import value and 25% of the trade balance between China and the United States were created by value transfer in Japan, South Korea, Taiwan, Canada, Mexico and other countries and regions [10]. Li Feng found that China's exports to the United States accounted for less than 70% of its domestic value-added, while the United States’ exports to China accounted for over 80% of its domestic value-added [11].

In January 2013, WTO officially began to implement the trade-in-value-added statistics, and on January 16, 2013, WTO and the Organization for Economic Cooperation and Development jointly released the first TiVA Database based on value-added statistics after further sorting out and

processing the data based on the original World Input-Output Tables (WIOTs). The database, which covers data on value-added from 61 major countries and economies, can be used to distinguish local value-added from foreign value-added of export products, but also can distinguish the specific sources of foreign value-added. If the value-added of the manufacturing industry of China and the United States is decomposed by its source, China's domestic value shows an obvious rising trend in both its absolute amount and its ratio over the total export value. This shows that the level and ability of China's manufacturing industry to earn foreign exchange are significantly improving. However, through a horizontal comparison with the United States, we can find that the proportion of foreign value-added contained in the export products of the United States remains below 22%, which is far lower than the level of 40-50% in China [12]. This shows that the manufacturing industry of the United States is in a favorable position in the upstream of the international industrial chain, that the export products contain less foreign value-added, and its manufacturing industry has a better ability to earn foreign exchange than China.

The database also gives the ranking of Chinese and American manufacturing industries in the global value chain. By comparing the positions of Chinese and American manufacturing industries in the global value chain, it is not difficult to find that the Chinese manufacturing industry ranks far below the United States in the world as a whole, and its status index in the global value chain maintains below 0, indicating that the Chinese manufacturing industry is in the lower reaches of the industry as a whole. In terms of subdivided industries, the domestic value-added rate of China's low-tech industries is higher than that of high-tech industries. In particular, the domestic value-added rate of the electrical and optical equipment manufacturing industry, which represents that the high-tech industries, is significantly low, which was only 27.36% in 1995. Although it has grown over the years, it was still only 46.19% in 2011, far below the level of other industries. The above data once again indicate that although the total value-added created by China's high-tech manufacturing industries is large, its efficiency is low. Only a small part of the value-added of export products comes from domestic production, and the core competitiveness of the industry is weak. On the other hand, the domestic value-added rate of the American manufacturing industry is far better than that of China, both in terms of the whole industry and the subdivided industries. This shows that the overall strength of the American manufacturing industry is still relatively strong. Although China occupies the position of the world's largest trading country, the sustainable profitability and core competitiveness of the American manufacturing industry far surpass China, making it a real manufacturing trading power.

4.1.2 Distinct Market Operating Characteristics:

China and the United States differ in stock market operating characteristics. First of all, the Chinese stock market is dominated by retail investors, while the US stock market is dominated by institutional investors. The investor structure and investment behavior are important factors determining the volatility of the stock market [13]. It is generally believed that institutional investors are more rational than individual investors, and the stock market with a high proportion of institutional investors dominated by rational value runs more stably. In terms of investor structure, the institutional investors account for 80% ~ 90% while the retail investors account for 10% ~ 20% in the US stock market, so it is a typical market dominated by institutional investors. In China, the retail investors account for 80% ~ 90% while the institutional investors only account for 10% ~ 20%, so it is a typical market dominated by retail investors.

Secondly, the turnover rate in China's stock market shows a cyclical uptrend, while that in the US stock market keeps declining. Turnover rate refers to the frequency of stock turnover in the stock market within a certain period, and it is an important index reflecting the strength of stock liquidity and the activity level of market trading. Since Dow Jones Index and Shanghai Composite Index focus on the listed companies of traditional industry that are in the stage of mature development, and NASDAQ and Shenzhen Component Index focus on the listed companies of emerging industries, in accordance with the principle that the similar are comparable, we compared the turnover rates of Dow Jones Index and Shanghai Composite Index and those of NASDAQ and Shenzhen Component Index, finding that the turnover rate in China's stock market is much higher than that of the United States

[14]. The Chinese stock market volatility is higher than that of the United States. From 1993 to August 2018, the Chinese stock market volatility was much higher than that of the US stock market [15].

4.1.3 Distinct Stock Market Regulatory System:

China and the United States differ in maturity of stock market regulatory system. According to the institutional theory of the western new institutional economics and the international comparative research result on institutional factors of the stock market based on LLSV-based “micro institutional indexes”, whether a country's stock market regulatory system can be reasonably arranged and effectively implemented affects the level of systemic risk in the market to a certain extent [16]. The scholars all over the world have reached a consensus on the reasonable requirements for the concept and system of stock market regulation, which provides a theoretical basis for this paper to discuss the causes of stock market volatility from the perspective of stock market regulation.

First, the delisting system of the US stock market is more perfect and efficient than that of China’s stock market. In the United States, there are clear order-of-magnitude rules on the number of public shareholders of a listed company, its going-concern ability and whether it violates the listing agreement. For example, the New York Stock Exchange stipulates that in case of any of the regulations, the company will be forced to delist. The delisting system of China's listed companies is quite complex, and the delisting regulations of the Chinese stock market have also made some quantitative provisions, but they should be finalized by the CSRC after comprehensive consideration of various factors, such as the regulation concept, market distribution, support and protection for underdeveloped areas, etc. A perfect and efficient delisting system can strengthen the external supervision of the company, force the company to improve its corporate governance, indirectly protect the interests of shareholders of the listed companies, and it is also an important way to realize the survival of the fittest and the effective allocation of resources in the market.

Secondly, there are significant differences between China’s stock market and the US stock market in trading management systems. Unlike the US stock market with greater trading freedom, China’s stock market has different trade restrictions and more restrictions. The two countries' trading systems are different in the following aspects: price limit, timeliness of stock trading, short mechanism, and method and intensity of relevant regulations.

In terms of price limit, the US stock market has no limit on stock price. In contrast, China's Shanghai and Shenzhen Stock Exchanges set a limit to the trading price of A-share, stipulating that the daily trading price rise-fall range for the common stocks should be 10%; that for the stocks with special risk warnings should be 5%; and if the price rise-fall range deviates from the rise-fall range of stock market by 20% (15% for ST stock) for three consecutive trading days, the listed companies should give the reasons for the abnormal stock price fluctuations publicly.As for Timeliness of stock trading, the US stock market adopts the T+0 mechanism, which means that the stocks can be bought and then sold on the same trading day. the Chinese stock market adopts the T+1 system, which means that after buying stocks, the traders cannot sell the stocks on the same time but should sell them on the second trading day or later. Therefore, the US stock market has a better liquidity, and the investors can be trade stocks more freely and flexibly.

Another difference lies in short mechanism. Short selling is a very important external monitoring mechanism in the stock market. Most of the stocks in the three major US stock exchanges have short mechanism. For example, the well-known short-seller Muddy Waters, by uncovering the listed companies with financial or information disclosure fraud, short-sells their stocks, and gains profits when the stock price falls, so as to lead the investors to find the listed companies with problems and form a powerful external monitoring over the finance and information disclosure of the listed companies. But in China, there is no short mechanism.

Furthermore, China and the United States differ in method and intensity of regulation over the listed companies. The US stock market began in 1811 and has a history of more than two hundred years. Relevant laws, regulations and regulatory mechanisms have been constantly improved and are quite sound now. In the United States, once a listed company is found of financial fraud, it will be severely punished. For example, in the United States, after the financial fraud case of Enron Corporation broke

out in 2002, this company with assets worth hundreds of billions of US dollars went bankrupt within a few weeks, was removed from the Dow Jones Index, and paid tens of billions of US dollars of compensation for damages to the investors; and its CEO was sentenced to 24 years in prison. In the "Sarbanes-Oxley Act" of the United States, it is specially stipulated that the criminal penalty for those who compose illegal financial reports can be a fine of as much as 5 million US dollars or as many as 20 years in prison; that for those who tamper with a document can be as many as 20 years in prison; that for securities fraud can be as many as 25 years in prison, and that for retaliation against the whistleblower can be as many as 10 years in prison. Apart from raising the illegal cost of financial fraud of listed companies at the legal level, the United States also has set up a prize for reporting fraud of listed companies, in which the whistleblower can get a bonus of 10% ~ 30% of the fine.

Chinese stock market was established at the end of 1990, and since then it has been 30 years. Restricted by imperfect market economic mechanism and other factors, the stock market regulator system of China has been constantly improving and developing rapidly. The Securities Law of China was adopted on December 29, 1998 and took effect on July 1, 1999. After three revisions, the latest version in 2017 stipulates that a "fine" of 1% ~5% of the funds raised illegally for issuing securities by deception and makes simple but impractical regulations on civil compensation. The General Principles of the Civil Law of China has general provisions on compensation for damages, but it lacks corresponding provisions on the particularity of securities disputes. The criminal liability of listed companies is clearly stipulated in the Criminal Law and the Securities Law, but there is few practices of law enforcement, and few cases where the offender is investigated for criminal liability. In the Securities Law, it is stipulated that if the issuer, listed company, or other information disclosure obligors do not disclose information in accordance with the relevant provisions, or the disclosed information is false records or misleading statements or has major omissions, including the financial fraud of listed companies, they shall suffer a fine of 300,000 ~ 600,000 Yuan and the relevant responsible people shall suffer a fine of less than 200,000 Yuan and lifelong ban from entering the market. Compared with the illegal gains, the penalty is too minor and does not have sufficient deterrence, which leads to the repeated failure to prohibit illegal and even fake information disclosure in China's stock market.

By comparing the regulatory system of China's stock market and the US stock market, we can see that there is a great gap between China and the United States in rationality of institutional arrangement and implementation effectiveness of the A-share market; and that it is hard for the regulatory system of A-share market to realize the goal of reducing the systemic risk. By contrast, the mature market system is better in resisting the systematic risk [17].

4.1.4 Other influencers:

On March 9, March 12, March 16 and March 18, 2020, there were four consecutive circuit breakers in just 10 days. The circuit-breaker mechanism is a system that suspends trading for a period when prices fluctuate beyond a certain range in the stock trading. The circuit-breaker mechanism gives a buffer period to the market; and during the period of suspending trading, the investors have a chance to think calmly and the order of the stock market can be maintained, so as to prevent severe turbulence in the stock market caused by excessive trading in the market. The key influences include asset bubbles, inversion of US treasury bond yield, the COVID-19 pandemic, and the oil price war between Saudi Arabia and Russia.

One of the main affects is asset bubbles. The US stock market has been in a relatively long bull market since 2009. In recent years, although the US economy has been developing well, the growth rate is not large, but the stock market rises rapidly, which is a result of political, social, and other reasons. To stimulate the stock market, the US government repeatedly used interest rate cuts and other means, such as the four rounds of quantitative easing monetary policy after the financial crisis. But in the long run, the stock market has the character of value return. Buffett indicator is usually used to measure the degree of bubbles in the capital market, so as to measure whether the stock market can represent the level of economic development. Buffett indicator = the total market value of stocks/GDP,

and if this indicator is above 120%, it means a serious asset bubble state. Not long ago, the Buffett indicator in the United States was above 150%, indicating the bubble was very serious.

Also, inversion of US treasury bond yield plays a part. The US economy has been essentially weak in recent years, and the recent boom in US stock market is driven by money in some ways. When people tend to put money into low-risk treasury bond, it is a sign that other funds in the market is not betting on the future economic situation [18]. The interest rate inversion means that short-term interest rate is higher than long-term interest rate. Affected by the COVID-19 pandemic, the market is filled with panic, and people turned their attention to the low-risk treasury bond market. As the demand increased, the bond price rose, and thus, the bond yields fell. On March 9, the yield on the US 10-year treasury bond fell to an historic low of 0.3182% and the yield on its 30-year treasury bond fell to 0.7%.

In addtion, COVID-19, the unforeseen and the unpredictable pandemic have certain effects on the topic. Due to the rapid spread of COVID-19 abroad, the economies of all countries are generally affected. The United States itself is a country whose economy is mainly driven by spending, so the impact of the pandemic is obviously greater, and thus, the forecast for 2020 economic growth is lowered. IMF initially predicted that the global economic growth rate would be 3.3%, but it seems not easy to maintain a growth rate of 2% this year, let alone 3.3%. In the context of the sharp drop in global economic prospect, the stock market is under great pressure.

Another influencer is the oil price war between Saudi Arabia and Russia. The first circuit breaker in the US stock market this year was partly caused by the breakdown of negotiations between Saudi Arabia and Russia and the start of an oil price war. Saudi Arabia's production increase and price cut directly affected American shale oil companies, so the stock price of American oil companies dropped sharply. A slump in the oil prices was one trigger for the slump in US stock prices. The oil prices affected energy stocks and shale-oil-related companies in the United States, and the cost of oil producers fell below the cost line because of the oil war, cause a slump in US stock prices. The Black Swan Event was seen by many economists as a technical correction for the US stock market.

4.2 Strengthened Stock Market Correlation

In the context of the intensified Sino-US trade friction, the co-movements between each pair of the US stock market, Canadian stock market and Mexican stock market differ. The correlation between the US stock market and Canadian stock market has strengthened after the Sino-US trade friction happened, while the correlation between the US stock market and Mexican stocks, and that between the Mexican stock market and Canadian stock market become weak in such a context.

The impacts of stock market correlation include multiple aspects, including macroeconomic level, market development level and individual behavior, etc. From the perspective of macro-economy, the formulation of national policies, development of economic trade, and foreign investment will have an impact on the stock market co-movement between different countries. From the market level, the development degree, openness, regulatory degree, and capital flow of the stock market itself will also exert an impact. And from the perspective of individual behavior, investor sentiment, behavior and knowledge reserve will also be influential [19]. Because this paper mainly studies the co-movement of stock markets amongst different countries, in order to provide a more thorough understanding of the topic, we decided to discuss from different perspectives: openness of stock markets, capital flows between stock markets, and economic cooperation and trade contacts between different countries.

In terms of openness, with the development of economic globalization, the economies of various countries have become inseparable, and the flow of international funds has accelerated the opening of the stock markets. The improvement of openness of the stock market can enhance the co-movement between the stock markets. There is no doubt that the US stock market is the most developed in the world. It ranks first in terms of stock issuing market or stock circulation market, number of varieties of issued stocks or that of traded stocks, stock market capacity or market development degree. In the Canadian stock market, the companies listed in TSX come from a variety of global sectors, including mining industry, oil, natural gas, forest products and mineral extraction and other resource companies, and companies of industry, biotechnology, transportation, communications, raw materials and financial services. As a global stock exchange, the Toronto Stock Exchange is highly valued by

investors in North America, Europe, Asia, and Latin America because of its emphasis on risk and operation specifications. Therefore, the volatility of the Canadian stock market and the US stock markets will affect the countries with more open capital markets in a timely manner. According to Markowitz's Portfolio Investment Theory, the diversified investment can meet the conditions of risk diversification. The risks of various assets have an hedging effect on each other, and reasonable asset allocation is an important means to reduce financial risks. The experimental results show that among the three NAFTA countries, the stock market co-movement between the United States and Canada is relatively high, and Canada is becoming weak in spreading risk for the United States. The possibility of risk entering each other's stock markets is increasing, so the investors should be cautious of risk transmission when conducting cross-market transactions between the two countries. As the only developing country in the NAFTA, the Mexican stock market has a relatively short history and low openness. The experimental results show that the stock market co-movement between the United States and Mexico and that between Canada and Mexico are relatively weak. Besides, even if the occurrence of risk impact events will eventually be transmitted between the three countries as a regional economic union, it can be seen that there are still regional differences in response speed, especially between Mexico and the United States and between Mexico and Canada. Therefore, when market investors follow the risk diversification principle, they should realize the importance of these three countries in diversifying investment risk and realizing diversified investment, so as to reduce the overall risk of the investment portfolio.

Also, it is worthwhile considering that now, the main basis for economic cooperation and coordination among the NAFTA countries is the USMCA (United States-Mexico-Canada Agreement), which covers automobile manufacturing, intellectual property rights, digital trade, labor rights, financial services, agricultural products and other sectors, and it also contains tariff reductions for commodity trade, liberalization of service trade, changes in rules of origin and enhanced protection for producers [20]. Through the USMCA, the United States tries to establish a regional trading system where the United States' interests prevail and strong foreign trade barriers in order to achieve the strategic purpose of rebuilding the North American regional value chain with the United States as the center. From this perspective, the economic cooperation and trade among the member countries under this agreement will also be largely influenced by the United States. According to the experimental results, it can also be seen that with the impact of the intensified Sino-US trade friction on the economic uncertainty, the dynamic co-movement trend of the stock markets between the United States and other NAFTA countries is increasing, and key events will have a significant impact on the dynamic co-movement between the stock markets. In the DCC-GARCH model, by observing the dynamic correlation coefficient graph, it can be found that in the context of large-scale risk events such as the Sino-US trade friction, the time-varying correlation coefficients between the United States and the other two countries increase, which reflects the overall uptrend of the stock market co-movement between each pair of the NAFTA countries. When making investment in stock market, it is necessary to set up the preparatory firewall mechanism in advance, and the investors in different regions should form the "risk early warning" thinking from the regional perspective, so as to guard against the impact of fluctuations on the stock markets of regional alliance countries in the event of extreme financial events.

5. Conclusion

The Sino-US trade friction does not have such a dramatic impact on the US stock market as previously assumed, but they still have some impact. The correlation between the US stock market and Canadian stock market has strengthened after the Sino-US trade friction happened, while the correlation between the US stock market and Mexican stocks, and that between the Mexican stock market and Canadian stock market become weak in such a context.

In the next stage, we will continue to use the Garch model to conduct an empirical analysis on the co-movement channel and the role of the economic system of the NAFTA stock markets in the current context.

References

[1] Knight, F. H. (1921). Risk, uncertainty, and profit. Boston. MA: Hart, Schaffner and Marx; Houghton Mifflin Company.

[2] Carney. Uncertainty, the economy, and policy [M]. Bank of England, 2016

[3] Fernandez, V. (2007). Stock market turmoil: Worldwide effects of middle east conflicts. Emerging Markets Finance and Trade,43 (3), 58–102.

[4] Hartwell, C. A. (2017). The effect of political volatility on capital markets in EU accession and neighborhood countries. Journal of Economic Policy Reform, 1–22.

[5] Sina Finance and Economics Daily K-line chart of Shanghai Stock Index from December 2017 to February 2020.

[6] Sato Wang. The Impact of Sino-us Trade Frictions on Chinese Stock Market [J]. China Business, 2020(03).

[7] Ruting Wang, Wenqi LI, Yirong HUANG. Trade frictions, intraday jumps, and Stock market volatility -- Empirical evidence based on High-frequency data from China [J]. International Finance Studies.2019(12).

[8] Liping Liu.Global Value Chains and Value-added trade accounting [J]. International Economic Review, 2013 (4).

[9] Xin Li. Statistical Research on Value Added of Total Trade and Balance of Trade [J]. Statistical Research, 2012(10): 15-22

[10] Ming Ge, Suping Zhao, Ling Lin. Deconstruction of China-us Bilateral Trade Benefit Distribution Pattern -- From the Perspective of GVC decomposition [J]. World Economic Studies,2016(2): 46-57, 136

[11] Feng Li. Bilateral Trade Revenue accounting under the division of global value chain: A Case study of Sino-Us trade [J]. Southern Economy, 2015(8): 77-91. http://www.oecd-ilibrary.org/trade/data

[12] DongYong, Jingle Wang.Are Chinese Institutional Investors Really Stabilizing the Market? [J]. Economic research, 2014,49 (12).

[13] Source: Special statistics about Shanghai and Shenzhen Stock Market and special statistics about the US stock market provided by WIND Info

[14] Source: Special statistics about Shanghai and Shenzhen Stock Market and special statistics about the US stock market provided by WIND Info

[15] Hong Ouyang. International Comparison of Institutional Factors of Stock Market and Its Enlightenment [J]. Journal of Capital University of Economics and Business, 2007(2):54-59

[16] DongYong, Jingle Wang.Are Chinese Institutional Investors Really Stabilizing the Market? [J]. Economic research, 2014,49 (12)

[17] Yuzhen Liu, Upside down Yield of US Stocks: Leading Indicators of Recession and Outlook of US Bond trend [J]. International Finance, 2019 (02)

[18] Jing Huang.A Study on the Linkage of Stock Markets among Regional Cooperative countries [D]. Guangdong University of Foreign Studies, 2018

[19] David A. Gantz. An Introduction to the United States-Mexico-Canada Agreement: Understanding the New NAFTA