WEP Warwick Evans Publishing

Transactions on Economics, Business and Management Research
ISSN: 2960-1789, eISSN: 2960-2254 | Volume 4
EMSD 2023

A Comparative Study on the Influencing Factors of Sino-US Trade Transactions from a Longitudinal Perspective Based on Principal Component Analysis

Meiyu Wu

School of International Business, Tianjin Foreign Studies University, Tianjin, China

scarlett520@yeah.net

Abstract. The restructuring of relations between the two global powers, China and the US, is one of the dominant elements in today's dynamic world. However, in recent years, with the intensification of mutual strategic contradictions, the restructuring of Sino-US economic and trade relations has increasingly become a consensus among all parties. In view of this, this thesis divides the Sino-US trade friction into three stages from 2002 to 2017, from 2018 to 2020 and from 2021 to 2023, and proposes a research model based on the influence factors of China-US trade exchanges based on the principal component analysis under each timeframe. Firstly, 17 tertiary indicators are selected as the influencing factors of China-US trade exchanges, and secondly, the Pearson's coefficient correlation is utilized to screen the indicators. Next, by using principal component analysis, multiple influencing factors were downscaled into 1 and 2 principal components. GDP per capita, the exchange rate of the RMB to the US dollar, the amount of Chinese OFDI in the US, and the US import/export surplus (deficit) in trade with China are identified as the crucial factors affecting the US-China trade exchange in the three time periods.

Keywords: Principal Component Analysis; Longitudinal Perspective; U.S.-China Trade; Pearson Correlation Coefficient; Influencing Factors.

1. Introduction

As the Sino-U.S. trade friction continues, there is a growing consensus to restructure the U.S.-China economic and trade relationship.2 In October 2023, General Secretary Xi Jinping sent a congratulatory letter to the National Committee on U.S.-China Relations' annual awards dinner, stating that "whether China and the U.S. can establish a correct way of getting along with each other has a major bearing on the world's peace and development as well as the future destiny of humankind," profoundly. The latest customs data show that in the first seven months of 2022, bilateral trade between China and the US saw a significant decline: China's exports to the US amounted to 281.655 billion U.S. dollars, a year-on-year decline of 18.6%, a larger drop. Imports from the U.S. amounted to $99.859 billion, also showing a negative growth of 4.7%. Total trade between China and the US amounted to $381.514 billion, a sharp drop of 15.4% year-on-year.[1] A large amount of relevant literature and data show that after China formally became a member of the WTO, the trade friction between China and the US has been deepening, and the number of frictions and the amount of money involved have been rapidly increasing. In recent years, trade disputes have intensified under the influence of negative events between China and the U.S., U.S. technological controls on China, and China's inflow of labor to the U.S., among other factors. Especially after Trump came to power in 2018, the Trump administration is bent on launching a trade war, and the trade struggle between China and the US has entered into white-hot. Therefore, an in-depth analysis of the influencing factors of China-U.S. trade will contribute to seeing the real intentions behind the U.S. strategy towards China, and will be of positive significance to further expanding opening up to the outside world, actively participating in global competition, and maintaining the stable development of foreign trade.

Based on this, this paper firstly divides the Sino-US trade friction into three stages, 2002 to 2017, 2018 to 2020 and 2021 to 2023, to find out the influencing factors affecting the Sino-US trade friction. Next uses Pearson coefficient correlation, and lastly uses principal component analysis to downsize

the influencing factors on the Sino-US trade in each stage to 1 and 2 principal components, in order to achieve the role of making suggestions for the government.

2. Literature Review

2.1. Research on the Causes of the U.S.-China Trade War

Derek Scissors [2] analyzes the essence of Sino-US trade, and he argues that Sino-US trade friction stems from China's state subsidies, intellectual property theft, and a series of non-tariff issues, to which the US only responds forcefully; XiaopingXu[3] analyzed the trade friction between China and the US from multiple perspectives , then concluded that the trade surplus between China and the US as well as the U.S. OFDI in China are the main reasons for the trade friction between them. Therefore, he put forward the suggestion that China should improve its trade structure and improve its foreign investment policy. Kammogne Josiane Sider[4], on the other hand, points out that the main reason for the trade war between China and the US is the trade imbalance and competition for global economic status, and proposes that it is necessary for the two countries to organize round-table negotiations to redefine the rights and obligations of each party. Jihong Jin and Michael Steffens[5] analyzed the causes of the trade imbalance between China and the US by taking the electronics industry as an example, and the authors pointing out that merely observing and analyzing the factors at the most macro level of the overall trade balance is not enough to paint a full picture. They argued that one ought to focus on individual products.

Based on the analytical framework of trade expectation theory, Li Bo and Liu Changming[6] explored the deep-seated causes of the economic and trade friction between China and the US, concluding that the structural contradiction between China and the US is the most fundamental reason for the reduction of U.S. trade expectations; Li Jiaxiao[7] pointed out that the political election needs of the Trump administration to realize its promises and the position of China's industrial upgrading squeezing the US are the important factors affecting the China-US trade, so we need to strengthen the construction of all-round partnership; Jiang Nan[8] analyzed the causes of trade friction between China and the US from the micro, meso and macro aspects, and found that the trade friction between the two countries mainly includes anti-dumping problems, trade development imbalance problems, agricultural trade disputes and intellectual property rights problems; Yan Xiaona[9] analyzes the trade friction between China and the US from the perspective of international political economy, and extends the generalized two-country model and proposes that the mode of economic and trade cooperation between China and the US should be the mutual adjustment of policies.

2.2. The Impact of the US-China Trade War

Deborah H. Y. Tan and Chen Chen[10] prepared a number of different scenarios, of varying intensity and duration, with varying counter policies in play, to capture the range of potential outcomes for the US, Chinese and global economies in the coming decade. They found that trade war is costly for both the US and China. While the US will impose a larger cost on China in the initial years, it will suffer a similar medium-term adverse impact on growth. Kammogne Josiane Sider[2] found that hostility between the US and China is a threat to global peace and prosperity, and it has spilled over into a broader strategic concern, one some analysts have described as the start of a new cold war. One conclusion based on Chad P. Bown 、 Euijin Jung and Zhiya Lu ‘s[11] study is that most adversely affected businesses are American-based companies dependent on imports from China to produce goods. China stands to lose very little Chinese value-added content from retaliating against the US exports it has chosen. Marc Lanteigne[12] stated that there is no evident exit ramp to resolving Sino-American trade war, and those agreements that have been made are looking ever more fragile. Marc Lanteigne indicates that the effects of divergence between Chinna and America are beginning to be observed in several economic realms, including the financial and the technological. Many other actors in the global economy have begun to experience the side effects of this completion.

Lv Jianxing, Zhang Shaohua and Qiu Caixia[13] empirically analyze the impact of the Sino-US trade friction on China's exports to the US and non-US markets based on the multi-period triple difference method, and find that the US trade boycott of China significantly inhibits China's exports to the US; Huang Hongbin, Xu Chenhui and Li Yuanyuan[14] used a generalized double difference model to test the impact of Sino-US trade friction on enterprise collaborative innovation, and the results show that: Sino-US trade friction has a significant driving effect on enterprise collaborative innovation through the role channels of exacerbating the financing difficulties and reducing the risk-taking ability; The theoretical analysis of trade friction by Wang Xiaosong and Chen Yan[15] made an analysis of the welfare effect of the trade friction between China and the US as well as the impact of mutual tariffs imposed by China and the US on the US, and put forward the suggestions of returning to the dialogue and consultation mechanism and integrating into the global value chain division of labor system; After Song Hong[16] conducted a study on the impact of Trump's trade and related policies, it was found that changes in the U.S. economic and trade policies would have a huge impact on itself, as well as on the global economy, and major trading partners.

3. Pearson Coefficient Correlation

3.1. Selection and Construction of Indicators

Through reviewing the relevant literature, this paper summarizes the relevant influencing factors of Sino-US trade exchanges, with a total of 3 secondary indicators and 14 tertiary indicators. The construction of the indicators and their interpretation is shown in the table below:

Table 1. Indicators of Factors Influencing U.S.-China Trade Transactions

Primary Indicator	Secondary Indicator	Tertiary Indicator	Indicator Explanation
total trade between China and the US	Economic factors	Level of economic development	GDP per capita (USD)
		the exchange rate of the Chinese RMB to the US dollar	the exchange rate of the Chinese Yuan to the US dollar（%）
		China's direct investment in the US	China's direct investment in the US（$ million）
		the US import/export surplus/deficit on China's trade	U.S. trade surplus (deficit) in imports and exports with China ($ million)
		the scientific and technological strength of China	Full-time equivalents of research and experimental development personnel (million)
	political factor	WTO accession or non-accession	Yes - 0 No - 1
		the bilateral relationship between China and the US	Number of negative news reports on China and the US (articles)
		the balance of the US national debt	U.S. Treasury balance (billions of dollars)
		trade openness	Imports + Exports/GDP (%)
		the Chinese holdings of the US debt	China's total U.S. debt holdings over the years ($ billion)
	social factor	US Arrivals in China	US Arrivals in China(million people)
		the US employment problem	Annual unemployed population of the US (10,000)
		the size of the population	Total population (billions)
		Per capita income	Per capita income (US$)

The above data were obtained from Chinese National Bureau of Statistics (data.stats.gov.cn), the U.S. Department of Commerce (www.commerce.gov), and the U.S. Federal Reserve Economic Database

(fred.stlouisfed.org), and the years spanning January 1, 2002, to December 31, 2023, were used for the data.

3.2. The Three Stages of U.S.-China Trade Friction

In this article, in order to better go to study the factors affecting the trade between China and the U.S., the time is divided into three periods, which are 2002 to 2017, 2018 to 2020 and 2021 to 2023.

The trade friction between the US and China during the period from 2002 to 2017 was institutional in nature. After China officially became a member of the WTO, the trade friction between China and the U.S. deepened. After the financial crisis broke out in 2008, the U.S. economy showed a trend of recession while China continued to grow rapidly, and the US-China trade friction also increased. The focus of the trade friction between the US and China has shifted to the RMB exchange rate, China's market economy system and new energy issues. At this stage, the frequency of anti-dumping and special safeguard launched by the US against China has reached an unprecedented stage. Whether it is the U.S. President or U.S. companies are constantly pressuring China, the issue of RMB appreciation has gained the attention of the world; technical barriers to trade has also become one of the main measures for the U.S. to implement trade protection.

Between 2018 and 2020, Sino-US trade friction during this period was dominated by tariff barriers. Former U.S. President Donald Trump formally launched the U.S. trade war with China in July 2018. As the largest trade war in the history of human trade to date, this set off another round of trade disputes between China and the US, and the trade war between China and the US has begun to enter a white-hot. Driven by the China "threat" theory and the imbalance of economic and trade relations, former U.S. President Trump launched a trade war against China with the aim of reducing the trade deficit, revitalizing the manufacturing industry and protecting workers' interests, increasing trade protection and sanctions against China, launching the "301 investigation" specifically targeting China, which has a strong trade protectionist flavor, and imposing tariffs with the "232".

The focus of U.S.-China trade friction during the period from 2021 to 2023 shifted to the technology sector. Under the Biden administration, U.S.-China economic and trade relations have remained generally stable, as reflected by data in the areas of trade, finance, and investment.Although the Biden administration has basically continued the Trump administration's high-tariff policy toward China, it has also actively sought readjustment in terms of concepts, means, issues, and regions. Since Biden came to power, the U.S. export control policy has shown the new features of precise export control of high-technology items, expanded discretionary power of the U.S. Department of Commerce, and ideological justification for export control of China. The future of the Biden's economic and trade policy toward China remains uncertain.

3.3. Pearson Empirical Analysis

Pearson's correlation coefficient is widely used to measure the existence of functional relationships and correlations of quantitative links between objective phenomena. Since both China and the US have acceded to the WTO, WTO accession or non-accession is not involved in the selection of variables in the Pearson correlation coefficient. The correlation coefficient takes the value: $-1<r<1$ and the formula is shown in (1) below:

$$r=\frac{\sum(X-\bar{X})(Y-\bar{Y})}{\sqrt{\sum(X-\bar{X})^2\sum(Y-\bar{Y})^2}} \tag{1}$$

The results in Table 2 show that in the period from 2002 to 2017, the Pearson correlation coefficient of U.S. trade openness and U.S. employment is less than 0.7, and the correlation is not so significant, which can be regarded as having less impact on the explanatory variables of the U.S.-China trade volume, so it will be excluded; the correlation coefficients of the remaining 15 variables are greater than 0.7, which is a high degree of correlation, so they will be retained.

Table 2. Pearson Coefficient Correlation

	Explanatory Variable	Correlation coefficient 2002-2017	Correlation coefficients 2018-2020	Correlation coefficient 2021-2023
Level of economic development in the US(X_1)	US GDP per capita (US$)	0.960**	-0.826	0.507
China's level of economic development (X_2)	China's GDP per capita (US$)	0.978**	-0.859	0.998*
Exchange rate of the RMB to the USD (X_3)	RMB to US dollar (%)	-0.915**	-1.000**	0.999*
Chinese direct investment in the US (X_4)	China's direct investment in the US ($ million)	-0.705**	0.802	0.993
U.S.-China trade surplus (deficit) (X_5)	U.S. trade with China surplus (deficit) of imports and exports ($ million)	-0.991**	-0.952	-0.995
China's scientific and technological strength (X_6)	Full-time equivalents of research and experimental development personnel (tens of thousands of person-years)	0.978**	0.860	0.657
Bilateral relations between the US and China (X_7)	Number of negative news reports on China and the US (articles)	0.816**	0.721	-0.179
U.S. Treasury balance (X_8)	U.S. Treasury balance (billions of dollars)	0.960**	0.670	0.421
U.S. Trade Openness (X_9)	Imports + Exports/GDP (%)	0.482	0.830	0.965
China's trade openness (X_{10})	Imports + Exports/GDP (%)	-0.811**	-0.960	-0.997*
China's holdings of U.S. debt (X_{11})	China's total U.S. debt holdings over the years ($ billion)	-0.942**	0.999*	-0.990
US arrivals (X_{12})	U.S. Arrivals (10,000)	-0.941**	0.863	-0.964
Employment in the US (X_{13})	Annual unemployed population of the US (10,000)	0.183	-0.464	0.966
U.S. population size (X_{14})	Total U.S. population (billions)	0.983**	-0.745	0.997*
Population size of China (X_{15})	Total population of China (billions)	0.971**	-0.955	0.678
Household Income in the US (X_{16})	Average household income (US$)	0.456	-0.939	0.964
Per capita income in China (X_{17})	Per capita income (yuan)	0.958**	-0.931	0.964

Note: ** Indicates significant correlation at the 0.01 level (two-tailed).

*At the 0.05 level (two-tailed), the correlation is significant.

For the period from 2018 to 2020, the correlation coefficient of the U.S. national debt balance and the U.S. employment problem is less than 0.7, which is smaller compared to the other 15 variables. It can be seen that its impact on the explanatory variable of the U.S.-China trade volume is small, so it is also excluded; the correlation coefficients of the rest of the 15 variables are all greater than 0.7, which is a high degree of correlation. Therefore it is retained.

Similarly, from 2021 to 2023, the correlation coefficients of the U.S. level of economic development, China's scientific and technological strength, China-U.S. bilateral relations, the U.S. national debt

balance, and China's population size are less than 0.7, and the correlation is not so significant in relative terms, so their impact on the explanatory variables of the U.S.-China trade volume is relatively small, so they are excluded; Since the correlation coefficients of the remaining 10 variables are greater than 0.7, which is a high degree of correlation, they are retained.

4. Principal Component Modeling

4.1. Validity Tests

Before the principal component analysis (PCA) of the indicator data, the validity analysis of the original data needs to be carried out, i.e., KMO and Bartlett's test need to be carried out first. Generally, when the KMO value is greater than 0.60, it means that the validity test of the data is passed and the original data can be analyzed by principal component analysis.

Table 3. KMO values and Bartlett's test of sphericity

KMO and Bartlett's test		
KMO Number of Sampling Suitability Measure.		.794
Bartlett's test of sphericity	approximate chi-square (math.)	451.291
	(number of) degrees of freedom (physics)	45
	significance	.000

As shown in the table above the probability of significance value of the raw data is 0.000, which is less than 0.005 and the original hypothesis is rejected, which means that the raw data entered can be used for principal component analysis. And the KMO value is 0.794 which is greater than 0.6, the validity test is passed, therefore, the next step of principal component analysis can be carried out.

4.2. Principal Component Analysis

4.2.1. Principles of Principal Component Analysis (PCA)

Principal Component Analysis (PCA) is a statistical method of dimensionality reduction processing, in which multiple variables in the original data are classified into a few composite indicators so as to realize the elimination of correlation between the data, and the projection of high-dimensional data with large differences into a low-dimensional space for representation. With n years of sample data, n indicators data related to the factors affecting the trade exchange between China and the US, the initial sample matrix can be obtained as:

$$X = \begin{pmatrix} x_{11} & \cdots & x_{1p} \\ \vdots & \ddots & \vdots \\ x_{n1} & \cdots & x_{np} \end{pmatrix} = (x_{ij})_{n\times p} \tag{2}$$

Here, i=(1, 2,...,n) denotes the ith row of the initial sample matrix, and j=(1, 2, ...p) denotes the j column. The interpretation of i and j in the later text are the same as here.

4.2.1.1 Calculate the Correlation Coefficient Matrix $R=(r_{ij})_{n\times p}$

where r_{ij} is calculated as:

$$r_{ij} = \frac{1}{n}\sum_{i=1}^{n} \frac{(x_{ij} - x_i)(x_{ij} - x_j)}{s} \tag{3}$$

where s denotes the variance of the sample.

4.2.1.2 Calculating the Eigenvalues and Eigenvectors of R

The values obtained can be calculated based on the expression |R-λI|=0 of the characteristic equation. Here, R denotes the correlation coefficient matrix and I denotes the unit matrix. According to the descending order of λ_1 , λ_2 ,..., λ_n , and also the individual eigenvectors a_j can be calculated.

4.2.1.3 Calculation of Contribution Rate and Cumulative Contribution Rate

$$e_i = \frac{\lambda_i}{\sum_{i=1}^{p} \lambda_i} \tag{4}$$

$$E_m = \frac{\sum_{i=1}^{m} \lambda_i}{\sum_{i=1}^{p} \lambda_i} \tag{5}$$

4.2.1.4 Calculating Principal Components

$$z_m = a_{mj} x_j \tag{6}$$

4.2.1.5 Selection of the Number of Principal Components

The number of principal components is judged by the cumulative variance contribution rate, and generally all the principal components at >90% are selected, so as to complete the extraction of principal components. Finally, based on the obtained indexes, the index system of price influencing factors is constructed.

4.2.2. Empirical Study of Principal Components

Table 4. Explanatory Table for Total Variance 2002-2017

Total Variance Explained						
ingredient	Initial eigenvalue			Extract the sum of the squares of the loads		
	(grand) total	Percentage of variance	Cumulative %	(grand) total	Percentage of variance	Cumulative %
1	12.829	85.528	85.528	12.829	85.528	85.528
2	1.303	8.684	94.213	1.303	8.684	94.213
3	.462	3.078	97.290			
4	.243	1.623	98.913			
5	.089	.591	99.504			
6	.039	.258	99.762			
7	.020	.133	99.895			
8	.008	.057	99.952			
9	.005	.031	99.983			
10	.001	.008	99.991			
11	.001	.005	99.996			
12	.000	.002	99.998			
13	.000	.001	100.000			
14	4.225E-5	.000	100.000			
15	1.153E-5	7.687E-5	100.000			

Extraction method: principal component analysis.

In this paper, Spss27.0 software was utilized using the following steps: "Analyze-Downscaling-Factor" The total variance explained table corresponding to the three parts of the time period is shown in Table 4, Table 5 and Table 6 below:

Table 5. Explanatory table for total variance 2018-2020

Total Variance Explained						
ingredient	Initial eigenvalue			Extract the sum of the squares of the loads		
	(grand) total	Percentage of variance	Cumulative %	(grand) total	Percentage of variance	Cumulative %
1	12.550	83.664	83.664	12.550	83.664	83.664
2	2.450	16.336	100.000	2.450	16.336	100.000
3	2.902E-15	1.935E-14	100.000			
4	1.497E-15	9.982E-15	100.000			
5	5.257E-16	3.505E-15	100.000			
6	3.404E-16	2.269E-15	100.000			
7	3.227E-16	2.151E-15	100.000			
8	2.373E-16	1.582E-15	100.000			
9	1.034E-16	6.891E-16	100.000			
10	5.672E-17	3.781E-16	100.000			
11	-3.847E-17	-2.565E-16	100.000			
12	-1.320E-16	-8.798E-16	100.000			
13	-2.999E-16	-1.999E-15	100.000			
14	-4.573E-16	-3.049E-15	100.000			
15	-6.522E-16	-4.348E-15	100.000			

Extraction method: principal component analysis.

Table 6. Explanatory Table for Total Variance 2021-2023

Total Variance Explained						
ingredient	Initial eigenvalue			Extract the sum of the squares of the loads		
	(grand) total	Percentage of variance	Cumulative %	(grand) total	Percentage of variance	Cumulative %
1	10.677	97.062	97.062	10.677	97.062	97.062
2	.323	2.938	100.000			
3	3.732E-15	3.393E-14	100.000			
4	1.103E-15	1.003E-14	100.000			
5	3.983E-16	3.621E-15	100.000			
6	1.698E-16	1.544E-15	100.000			
7	6.538E-18	5.944E-17	100.000			
8	-1.321E-16	-1.201E-15	100.000			
9	-1.664E-16	-1.513E-15	100.000			
10	-4.015E-16	-3.650E-15	100.000			
11	-5.035E-16	-4.577E-15	100.000			

Extraction method: principal component analysis.

Additionally, three time periods are plotted in this paper with respect to the principal component analysis of the rubble, as shown in Figure 1, and the total variance component matrix is interpreted as shown in Tables 7, 8, and 9. The higher slope of the curve in the gravel plot represents that the principal component contains more explanations and more variance, so according to the total variance explanation table and this gravel plot, two principal components can be extracted in the time periods 2002-2017 and 2018-2020,and one principal component can be extracted in the time period 2021-2023.

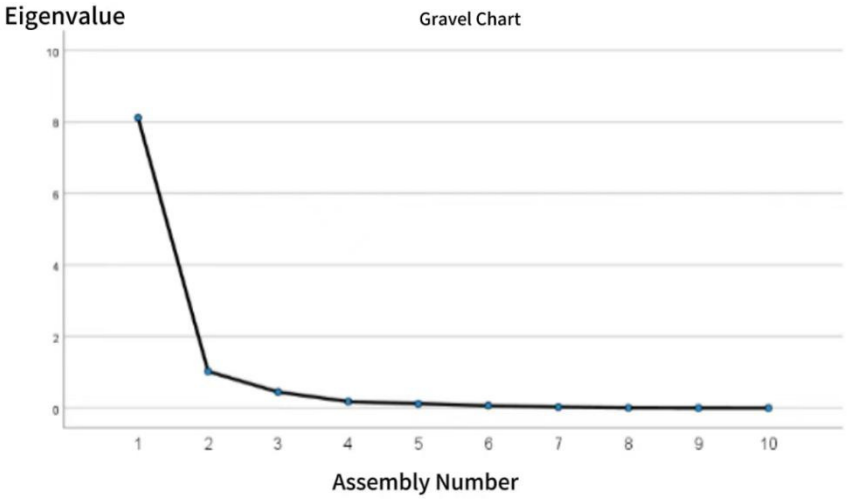

Figure 1. Gravel diagram

Table 7. 2002-2017 Component Matrix

component matrixa		
	ingredient	
	1	2
Zscore: GDP per capita (US$)	.991	.046
Zscore: GDP per capita (US$)	.991	-.023
Zscore: RMB to USD (%)	-.879	.455
Zscore: Chinese direct investment in the US ($ million)	.812	.334
Zscore: U.S. Trade Import/Export Surplus (Deficit) with China ($ million)	-.959	.091
Zscore: full-time equivalent of research and experimental development personnel (tens of thousands of person-years)	.993	-.079
Zscore: Number of negative news stories in China and the US (articles)	.906	.361
Zscore: U.S. calendar year treasury balance (billions of dollars)	.992	-.045
Zscore: imports + exports/GDP (%)	-.906	-.076
Zscore: China's total U.S. debt holdings over the years ($ billion)	.912	-.396
Zscore: U.S. arrivals (in millions)	.890	-.208
Zscore: total population (billions)	.997	-.060
Zscore: total population (billions)	.999	.018
Zscore: average household income (US$)	.547	.787
Zscore: per capita income (dollars)	.994	.075

Extraction method: principal component analysis.

a. Two components were extracted.

Table 8. 2018-2020 Component Matrix

component matrixa		
	ingredient	
	1	2
Zscore: GDP per capita (US$)	.570	-.822
Zscore: GDP per capita (US$)	.985	.171
Zscore: RMB to USD (%)	.933	-.359
Zscore: Chinese direct investment in the US ($ million)	-.535	.845
Zscore: U.S. Trade Import/Export Surplus (Deficit) with China ($ million)	.998	-.056
Zscore: full-time equivalent of research and experimental development personnel (tens of thousands of person-years)	.986	.168
Zscore: Number of negative news stories in China and the US (articles)	.921	.389
Zscore: U.S. calendar year treasury balance (billions of dollars)	.892	.453
Zscore: imports + exports/GDP (%)	-.975	-.224
Zscore: imports + exports/GDP (%)	-.997	.081
Zscore: China's total U.S. debt holdings over the years ($ billion)	-.920	.393
Zscore: U.S. arrivals (in millions)	.987	.163
Zscore: Annual U.S. unemployed population (in millions)	.750	.661
Zscore: total population (billions)	.934	.356
Zscore: total population (billions)	.998	-.064
Zscore: average household income (US$)	.753	-.658
Zscore: per capita income (dollars)	1.000	.007

Extraction method: principal component analysis.

a. Two components were extracted.

Table 9. 2021-2023 Component Matrix

component matrixa	
	ingredient
	1
Zscore: GDP per capita (US$)	1.000
Zscore: RMB to USD (%)	.996
Zscore: Chinese direct investment in the US ($ million)	.997
Zscore: U.S. trade surplus (deficit) in imports and exports with China ($ million)	-.998
Zscore: imports + exports/GDP (%)	.973
Zscore: imports + exports/GDP (%)	-.999
Zscore: China's total U.S. debt holdings over the years ($ billion)	.994
Zscore: Annual U.S. unemployed population (in 10,000)	.974
Zscore: total population (billions)	.994
Zscore: average household income (US$)	.955
Zscore: per capita income (dollars)	.955

Extraction method: principal component analysis.

a. One component was extracted.

Accordingly , the principal component formulas for 2002-2017 (a), 2018-2020 (b) and 2021-2023 (c) are shown in (7) (8) (9) below::

$$\begin{aligned} F1a &= 0.991X_1 + 0.991X_2 - 0.879X_3 + 0.812X_4 - 0.959X_5 + 0.993X_6 + 0.906X_7 + 0.992X_8 \\ &-0.906X_{10} + 0.912X_{11} + 0.890X_{12} + 0.997X_{14} + 0.999X_{15} + 0.547X_{16} + 0.994X_{17} \\ F2a &= 0.46X_1 - 0.23X_2 + 0.455X_3 + 0.334X_4 + 0.91X_5 - 0.079X_6 + 0.361X_7 - 0.045X_8 \\ &-0.076X_{10} - 0.396X_{11} - 0.208X_{12} - 0.060X_{14} + 0.18X_{15} + 0.789X_{16} + 0.075X_{17} \end{aligned} \quad (7)$$

$$\begin{aligned} F1b &= 0.570X_1 + 0.985X_2 + 0.933X_3 - 0.535X_4 + 0.998X_5 + 0.986X_6 - 0.921X_7 \\ &-0.975X_9 - 0.997X_{10} - 0.920X_{11} + 0.987X_{12} + 0.934X_{14} + 0.998X_{15} + 0.753X_{16} + X_{17} \end{aligned}$$

$$\begin{aligned} F1b &= -0.822X_1 + 0.171X_2 - 0.359X_3 - 0.845X_4 - 0.056X_5 + 0.168X_6 + 0.389X_7 \\ &-0.224X_9 + 0.081X_{10} + 0.393X_{11} + 0.163X_{12} + 0.356X_{14} - 0.064X_{15} - 0.658X_{16} + 0.007X_{17} \end{aligned} \quad (8)$$

$$\begin{aligned} F1c &= X_2 + 0.996X_3 + 0.997X_4 - 0.998X_5 + 0.973X_9 - 0.999X_{10} + 0.994X_{11} + 0.974X_{12} \\ &+0.994X_{14} + 955X_{16} + 0.955X_{17} \end{aligned} \quad (9)$$

5. Conclusion

5.1. For the Time Period 2002 to 2017:

(1) U.S. GDP per capita (0.991), China's GDP per capita (0.991), the exchange rate of the RMB against the U.S. dollar (-0.879), the amount of China's OFDI in the U.S. (0.812), the U.S. import/export surplus (deficit) on China's trade (-0.959), China's full-time equivalents of R&D personnel (0.993), the number of negative news stories on China and the U.S. (0.906), U.S. calendar year national debt balance (0.992), China's openness to foreign trade (-0.906), China's total calendar year holdings of U.S. debt (0.912), the number of U.S. arrivals (0.890), the size of the U.S. population (0.997), the size of the China's population (0.999), and China's per capita income (0.994) are the important factors affecting the volume of China-U.S. trade, among them The exchange rate of the RMB against the US dollar, the US import and export surplus (deficit) on China's trade and China's openness to foreign trade are negatively correlated with the volume of trade between China and the US.

For China, the increase of Chinese OFDI in the US, the progress of China's scientific and technological level and the increase of China's total holdings of U.S. debt provide favorable conditions for China's foreign trade industry. For both sides, the increase in the number of negative news reports between China and the U.S. is an increase in the attention of consumers on both sides to the other country, thus significantly affecting the import and export of China-U.S. trade. However, against the backdrop of multi-directional fluctuations and tightening volatility in the trade balance between China and the US, the exchange rate adjustment policy based on the traditional exchange rate pass-through theory has failed.

(2) While the average household income of the US (0.547) is not so significant on the import and export of trade between China and the US, this is due to the fact that at this stage, the U.S. GDP shows a stable growth situation, and considerable intra-industry trade exists in the United States, which enriches consumer choice.

5.2. For the 2018 to 2020 Time Period:

(1) China's per capita GDP (0.985), the exchange rate of the yuan against the U.S. dollar (0.933), the U.S. import and export surpluses (deficits) on China's trade with the U.S. (0.998), China's full-time equivalents of R&D personnel (0.986), the number of negative U.S.-China news stories (0.921), the U.S. national debt balance in the calendar year (0.892), the U.S. openness to foreign trade (- 0.975), China's openness to foreign trade (-0.906), China's total U.S. debt holdings over the years (-0.920), U.S. arrivals (0.987), U.S. annual unemployed population (0.750), U.S. population size (0.934), China's population size (0.998), U.S. average household income (0.753) and China's per capita income (1.000) have a significant impact on the volume of U.S.-China trade, of which, U.S. openness

to foreign trade, China's openness to foreign trade, and China's total U.S. debt holdings over the years have a significant negative impact on the volume of U.S.-China trade.

The above results can be explained as follows: on the Chinese side, China's GDP has maintained a stable growth rate; clear and transparent exchange rate policy and active and prudent foreign exchange management measures have played a positive role in the development of the RMB foreign exchange market; on the U.S. side, At the same time, the balance of the US national debt is also growing, influenced by the stimulus program to address unexpected events and financial market instability.

The openness of trade between China and the US and the total amount of U.S. debt held by China over the years have a negative impact on the volume of U.S.-China trade, which can be explained by the fact that openness to trade in goods has some inverse dampening effect on economic growth in the short run; The purchased U.S. debt basically doesn't hit China's foreign exchange reserves too hard, but it doesn't do the U.S. any favors at all.

(2) U.S. GDP per capita (0.570) and China's FDI in the U.S. (-0.535) had little impact on U.S.-China economic and trade relations. The increase in U.S. GDP per capita in this period has raised its demand structure, thus suppressing U.S. exports; on the other hand, it may lead to the country's domestic production substituting for foreign products. While this phase of Chinese outward FDI was enough to help increase the sequence and brand recognition of Chinese companies, it also caused a U.S. boycott of the Chinese side.

5.3. For the Time Period 2021- to 2023:

During this period, China's per capita GDP (1.000), the exchange rate of the RMB to the US dollar (0.996), the amount of Chinese OFDI in the US (0.997), the US import/export surplus (deficit) on China's trade (-0.998), the degree of openness of the US to foreign trade (0.973), the degree of openness of China's foreign trade (-0.999), the total amount of Chinese holdings of US debt over the years (0.994), average annual U.S. unemployment rate (0.974), U.S. population size (0.994), average U.S. household income (0.955), and China's per capita income (0.955) have a very significant impact on U.S.-China trade volume. Among them, the U.S. import and export surplus (deficit) on China's trade and China's openness to foreign trade show a negative correlation on the volume of trade between China and the US.

Thanks to the joint implementation of the first phase of the agreement between the U.S. and China, the recurrence of the new crown epidemic and the structural complementarity of the U.S. and China's economies, U.S.-China economic and trade relations have remained stable in general; however, the large U.S. surplus in China's trade and import/export and the degree of China's openness to foreign trade during this period have had a particularly significant negative impact on the relationship between China and the U.S. China has achieved significant results in the globalization of its supply chain, which has consolidated China's role as the "factory of the world". But China's trade surplus with the U.S. has caused the U.S. to restrict trade with China..

6. Recommendation

6.1. Strengthening Scientific and Technological Cooperation and Jointly Exploring Solutions to Major Global Issues

Science and technology innovation, as a fundamental driving force for changes in the international landscape, has become the core of trade friction due to the intertwining of technological, industrial and political factors[17]. China and the US, as major countries in scientific and technological innovation, should further strengthen scientific and technological cooperation, promote scientific and technological innovation to solve major global problems. Firstly, it is necessary to put an end to the various practices of politicization of scientific and technological issues and to further promote the reciprocal sharing of scientific and technological achievements. Secondly, a mechanism for

communication and cooperation in science and technology innovation should be established to promote the formation of transparent, fair and reasonable common norms by the international community on issues such as technical standards and data security. Finally, science and technology and humanities exchanges should be strengthened to stimulate the vitality of innovation and creativity throughout the world.

6.2. Maintaining Positive Interactions with the US and Telling the "China Story" Scientifically.

Both China and the US should guide their people to adopt a friendly attitude towards the relationship between the two countries, not to be radical, not to exaggerate the so-called "threats" and not to cater to the demands of a few interest groups. Chinese scholars should learn to make their voices heard in the U.S. mainstream media, strengthen exchanges with influential think tanks in the U.S. and form a public opinion environment conducive to the normal development of economic and trade relations between the two countries.[18] As long as China insists on running its own affairs well, maintaining sustained and stable economic development, and continuously expanding its opening to the outside world, it will manage to withstand various serious challenges from the outside, including dealing with the contradictions in the Sino-US relationship, and will have the confidence to make the economic and trade relations between the two countries emerge from the predicament and move forward.

6.3. Playing the Function of Economic Construction and Actively Striving for the Status of Market Economy

The issue of non-market economy status puts Chinese enterprises at a disadvantage in responding to U.S. anti-dumping complaints. China still has difficulties in fighting for market economy status[19] . Firstly, the non-market economy status provisions have a solid foundation in national law and are clearly stipulated in China's WTO accession legal documents. Secondly, the determination of market economy status is determined by the domestic legislation of each member country, and China has no legal basis to ask other countries to grant market economy status. Additionally, there are indeed inadequacies in China's market economy, and there are still obvious gaps, particularly in the exchange rate and labor-management aspects. Therefore, the Government should take a down-to-earth approach in accordance with the general laws of the market economy, and reform and adjust the way it manages the operation of the economy, so as to provide a favourable market environment for the operation of enterprises.

6.4. Utilizing WTO Rules to Maintain the Credibility of the Multilateral Trade Order

China and the US are both members of the WTO. In dealing with trade friction with the US, the use of the WTO Trade Dispute Settlement Mechanism is still an effective way to safeguard China's legitimate economic rights and interests, and is also conducive to maintaining the authority and credibility of the WTO [20]. For China, the use of effective multilateral trade rules to restrain the trade protection behavior of developed countries represented by the U.S. can resolve the international trade friction that China frequently encounters.To this end, first, strengthening the monitoring of the U.S. economic situation and trade policy changes, and encourage China's enterprises to actively respond to the defense under the framework of the WTO dispute settlement mechanism. Secondly, Utilizing the U.S.-China High-Level Dialogue mechanism to maintain communication on economic and trade policies, and striving to resolve trade disputes through consultation and dialogue.

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