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Post COVID-19 International Economy Recovery: Forecasting Bilateral Trade Between U.S. and China

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Abstract: This paper aims to use an empirical analysis to study and forecast the bilateral trade between the United States of America and the People's Republic of China in the post-pandemic era. This study was conducted from three perspectives: aggregate demand (import), supply (export), and trading potentials. In sections of import and export analysis, the paper focuses on analyzing the aggregate behavior by households with Schmitt-Groh´e, Uribe, Woodford's risk-averse demand model in an open economy and the firm production optimization model by Giovanni, Kalemli-Özcan, Silva, and Yildirim. In the analysis of the bilateral trade potentials, a gravity model of trade with one least square regression was applied and subsidized with the test method from Liu. From the study, it was found that the bilateral import and export between the U.S. and China are facing challenges from stringent policies, fragmentation of global value chains, and the residual effects of the pandemic on consumption. Thereby, the trading potential between the U.S. and China is restrained to an intermediate level, which is not beneficial for the robust growth of bilateral trade in the future.

Keywords: macroeconomics, international trade, post-pandemic economy

1. Introduction

From 2019 to 2022, the global pandemic of COVID-19 has not only raised significant health issues in the world but also addressed extra burdens to international economies. During the pandemic, the world economy stagnated in its growth with a low GDP growth rate, high unemployment rate, and shortage of labor. In late 2022, as the vaccination rate climbed up, most countries gradually reopened their borders, and the Chinese government laid down its three-year pandemic mandatory lockdown measures, the era of COVID-19 finally came to an end and many expected that the worldwide post-pandemic economy recovery is now under progress. The economic recovery paths of the United States and China, the world's two largest economies, have been closely watched. The U.S. economy has faced significant pressure due to the financial strains caused by the pandemic, with the fiscal deficit reaching 5.8% of the annual GDP in 2022. The Federal Reserve's policy also resulted in a consistently hiking interest rate and created uncertainty over the stability of the financial market, which has been further exacerbated by the collapse of three significant category IV banks within a single month. For China, the government's strict policies in containing the pandemic, such as the mandatory quarantine and nucleic acid tests for all nationals, disproportionally affected the wage, labor supply, and production [1]. Concurrently, lingering issues, such as the stagnant real estate

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market and the pessimistic job market, continue to place pressure on the economy [2]. Thus, the road to recovery for these two economies remains a topic of global concern.

In examining various factors that will shape post-pandemic economic recovery, international trade occupies a pivotal role. The United States and China are not just global powerhouses; they are also top trading partners for each other, as measured by trade volume. Additionally, China stands as the world's largest exporter. Consequently, the conditions of bilateral trade between the U.S. and China can serve as a barometer for the health and resilience of each nation's economy. However, the future trajectory of the U.S.-China trade relationship is clouded with uncertainties. This paper aims to scrutinize the import and export behavior from the perspective of households to project the trend of the bilateral trading relationship between the U.S. and China in the post-pandemic era.

2. Demand (Import) Analysis

To start with analyzing and forecasting the bilateral trading relationship between the U.S. and China, this section aims to focus on the household consumption preferences in each country to conduct the analysis of export goods demand. In this section, the two-period small open economy model with a perfectly competitive market will be employed to analyze the domestic consumption preferences in each country. According to Schmitt-Groh´e, Uribe, and Woodford, the model makes the following assumptions: (1) identical households populate the economy in two periods; (2) households are eligible to save and borrow in a bond-traded market; (3) households are prudent and risk-averse [3]. Therefore, the household's budget constraint:

$$C_1 = Q_1 + B_1, C_2(s) = Q_2(s) - (1 + r) B_1 \quad (1)$$

In formula (1), C1 C2 (s) is the household's consumption in the two periods, and Q1 Q2 (s) is the household's endowment at the beginning of the two periods. B1 is the household's initial borrowing (debt) and r is the interest rate. (s) is denoted as the stage of the economy, where s ∈ {boom, recession}, From formula (1), the household's preferences will be expressed as:

$$max_{C_1, C_2(s), B_1} U = u(C_1) + \beta \sum_s P(s)\, u\big(C_2(s)\big) \text{ subject to (1)} \quad (2)$$

In formula (2), P(s) denotes the possibility of the occurrence of the scenario of the economy (s). By taking the Lagrange for optimization, the first-order condition and can conclude the Euler equation can be obtained. By replacing C1 and C2(s) with Q and B with respect to (1),

$$u'(Q_1 + B_1) = \beta (1 + r) \sum P(s)\, u'[Q_2(s) - (1 + r) B_1] \quad (3)$$

Given the assumption (3) of the model from the beginning of this section, it is assumed that the representative domestic households are prudent and risk-averse, then the marginal utility will be convex and the borrowing at the beginning of the two periods B1 < 0, thus by Jensen's inequality

$$\sum P(s)\, u'[Q_2(s) - (1 + r) B_1] > u'\{\sum P(s)\, u'(Q_2(s) - (1 + r) B_1)\} = u'(Q_1 + B_1) \quad (4)$$

From the equations concluded above, a relationship between the household's preferences and the stage of recession and boom for a certain economy can be observed. In this case, the model can be applied in characterizing consumers' behavior in the post-pandemic period with respect to their behavior during the recession era led by COVID-19 and expected attitudes toward the coming economic recovery.

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2.1. Case of Chinese Import

For China, during this pandemic, in cities with dense populations, high-income, and productive industries, the Zero-COVID policy forced shops, restaurants, and factories to shut down and citizens to stay at home to prevention the pandemic. This measure has greatly limited the consumption power of the households, which in turn decreased the households' borrowing amount and significantly increased the households' savings. The data from the People's Bank of China, the Chinese central bank, indicated that the aggregate household savings increased by $2.5 Trillion, which can serve as an important drive for the recovery of the household's consumption in the post-pandemic recovery process [4].

A strong trend of economic recovery has also been observed since the end of the government's Zero-COVID policy. In June 2023, China's six state-owned commercial banks cut the deposit interest rate from 0.25% to 0.2% following the central bank's cut of the one-year loan prime rate by 50 bases in May [5]. Referring to the formula (1), households' consumption power for commodities will reach to a higher level given the sufficient amount of endowment, limited borrowing during the pandemic, and a recently adjusted low-interest rate. Also, the rising PMI and decreasing unemployment rate shows $s \in \{boom\}$ in the short-term, thus the diminishing marginal utility will be observed from the formula (4), indicating households in China will expand their consumption with a higher magnitude in the short-term.

However, the higher demand estimated among Chinese consumers does not imply a significantly stronger aggregate demand for foreign goods in the international trade system. The lingering shock of the pandemic has made Chinese consumers cautious of making large expenditures on commodities, that are exported from the U.S. and are generally considered expensive. At the same time, the sluggish real estate market and the local government's large deficits have stalled credit growth and domestic construction plans, further limiting the need for foreign supplies [2]. More importantly, the depreciation of the Chinese Yuan (CNY) against the US Dollars (USD) and the government's policy of decreasing the country's dependence on imports further discourage the consumption and demand for foreign goods [6]. Therefore, the Chinese aggregate import from the U.S. is unlikely to achieve significant growth in the future.

2.2. Case of the U.S. Import

In the United States, households are at a high consumption level. In 2022 Q4, the total household debt increased by $254 billion, and the credit card balance increased by $61 billion to $986 billion, surpassing the pre-pandemic highest level of $927 billion. In addition, according to the U.S. Bureau of Economic Analysis, the personal saving rate in the U.S. reached 4.6% in February 2023 compared to 30% at the beginning of the pandemic. The decline in the saving rate suggests a potentially increased financial strain on households. On the labor front, the average weekly working hours for all employees in the U.S. private nonfarm sector shrank to 34.3 hours in May 2023, retreating to the lowest level since May 2020, and a downturn in the average working duration has also been observed starting in 2023. This scenario could signify a weakening in the U.S. labor market, potentially forecasting a decrease in future household earnings.

In this case, combing these factors and referring to the formula (1), the U.S. household's consumption in the future is unlikely to experience healthy and robust growth. As the households' debt is incredibly high in the current stage, the continuously increasing interest rate will further the burden of debt repayment in the future. Meanwhile, with the diminishing household endowment, people's consumption power will correspondently drop as well and negatively impact the aggregate demand for merchandise. By referring to the formula (4), it is observed that the B_1 (household borrowing/debt) > 0 in this case. This is a scenario contradictive to the prudence analysis conducted

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before that u′(c) is convex and $B_1 < 0$ when consumers are prudent and risk averse. This finding could be explained by the fact that the recovery of the U.S. economy started earlier than the Chinese economy did since the U.S. was performing a relatively loose pandemic control policy.

Additionally, the remaining impacts of the U.S. – China trade war also are distorting the U.S. imports of Chinese goods. Although U.S. imports of Chinese merchandise saw a 6% increase in 2022 compared to 2021, reaching a new peak since the trade war's inception in 2018, this growth was mainly seen in products that were not subjected to trade war tariffs. The imports of goods subject to 7.5% and 25% tariffs remained below pre-trade war levels [7]. Besides the impacts of the trade war, the reallocation of foreign direct investment (FDI) has contributed to the fragmentation of the global value chain (GVC), providing importing countries with a broader array of choices for sourcing foreign goods. Under this trend, the U.S. will further decrease its dependence on Chinese merchandise and turn to a "China +1" import mode to both mitigate the country's trade deficit with China and seek lower-cost goods under the novel GVC structure in the future [8].

3. Supply (Export) Analysis

The COVID-19 pandemic has asserted a negative impact on the labor market and various factors used for production, resulting in declines in the country's aggregate output and distortion in export behavior. As the impact of the pandemic on the market is now being eased with the gradual recovery of the labor market and normalization of the production process, major issues in projecting the country's export can be characterized as (1) Whether the country's aggregate supply can meet the international demand? (2) Is the country's product competitive or preferable in the international market or not? To study the above questions, this section recalls the method for firm production optimization from Giovanni, Kalemli-Özcan, Silva, and Yildirim [9]. It will employ the following production model to characterize the country's sectoral output:

$$Y_n = A_n(I)\, F_n(L_n, \boldsymbol{K}_n) \tag{5}$$

Where n stands for a single product category such that $n \in$ {agriculture, semiconductor, etc.}. Fn is the production function. Ln is denoted as the labor input. Kn is the capital input and Kn = (kn1, kn2, …, knm). Kn in this case expresses the intermediate goods used for production. An (I) is the productivity function of investment I, which is from both FDI and domestic investment. Therefore, the country's sectoral production problem can be expressed as follows.

$$min_{L_n,K_n}(P_m k_{nm} + w_n L_n)\ subject\ to\ Y_n = A_n(I)F_n(L_n, \boldsymbol{K_n}) \tag{6}$$

wn refers to the wage and Pm is the price of intermediate goods. In equilibrium, it is assumed that the price of the product is equal to the marginal cost of the product, where $P_n = MC_n(A_n(I), w_n L_n, \boldsymbol{K_n})$. By taking logarithm differentiation, the following relationship will be obtained.

$$\mathrm{dlog}P_n = \sum_{m=1}^{N} \rho_{nm} \frac{w_n L_n}{P_n y_n}\, \mathrm{dlog}w_m - \sum_{m=1}^{N} \rho_{nm}\, dlogA_m(I) \tag{7}$$

In the formula (7), ρ_{nm} refers to the production in sector n using all intermediate goods from sector m. From this method to express the production optimization in terms of wage and productivity, it can be observed that, in an industry relying on intermediate goods for production, the price of products has is positively correlated to the price of the intermediate good, and the higher the productivity of in sector m, the lower the price of product n will be.

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3.1. Case of Chinese Import

Historically China holds the position as the largest export entity in the world and its export merchandise occupies most of the imported goods by the U.S. In the country's trade with the U.S., the exported goods concentrated on manufacturing products from large machinery to commodities for daily use. These merchandises use intermediate goods for production and their competitiveness relies on the level of domestic aggregate output for good quality, cheaper price, and the ability to meet the import demand.

In the early stage of the pandemic from late 2019 to 2021, due to the strict pandemic control policy by the government, China's domestic job market, domestic aggregate output, and global export remained strong. However, due to a stricter Dynamic Zero Covid-19 policy initiated in late 2021, the labor market in the manufacturing sector was severely distorted with the Manufacturing PMI index dropping to 46 in April 2022 following a full national-level lockdown. After the abolishment of the pandemic control policy in late 2022, the Manufacturing PMI index recovered to 50.9 in May 2023, 3% higher than the report from April. The growth country's aggregate output reached 11-month accompanying a 2-year high new order growth and the unemployment rate dropped to 5.2%, a 7-month low. These data displayed robustness in the recovery of China's manufacturing sector which is beneficial in backing the export market. In addition to the growing stronger domestic production that ensures the meet of demand. The loose monetary policy recently performed by the Chinese central bank is also benefiting the Chinese export market by causing the depreciation of the CNY against the USD. The increase in the currency purchasing power will ease the effect of high tariffs from the trade war in the short term and facilitate the Chinese export to the U.S. [2].

However, in the long term, the reshoring effect, diversification of the GVC, and the 'China + 1' import mode will impose significant challenges on the Chinese export strategy. The effect of deglobalization, local trade protectionism, and increasing labor costs in China are generating reshoring effects among foreign firms and reallocation of FDI within international investors. By formula (5), the magnitude of productivity A(I) has a positively correlated with the level of FDI and domestic investment. Combining the condition of stagnation in credit growth and lack of internal drive and confidence in the Chinese domestic market, domestic investors will also be reluctant to further finance local industries. Thus, cross-sectoral productivity in China is unlikely to experience satisfying growth in the short term.

Furthermore, the annual average wage in the manufacturing sector rose to $13,650, which would increase firms' burden on labor payments. Combing these factors and referring to formula (7), the price of the product is unlikely to decrease due to expensive production using intermediate goods with higher labor costs and stagnated productivity. Such a circumstance will lead to a higher price of the merchandise and intermediate goods and limit the favorability of Chinese products to both U.S. households and firms.

3.2. Case of the U.S. Export

Over years from the start of the U.S. – China trade war in 2018, the U.S. trade deficits in bilateral trade with China are decreasing due to a steady rise in its export to China. Even during the pandemic, the U.S. export to China grew from $124.6 billion in 2020 to $153.84 billion in 2022. However, given the shift in the U.S. foreign policy and changes that China will implement in its economic development strategies, the U.S. export to China will also face challenges in the future.

Among the manufacturing goods that are being exported to China, electronic equipment; optical, technical apparatus; and machinery occupy more than 30% of this section. These goods are considered vital to the development of the Chinese semiconductor industry and, in October 2022, The Department of Commerce's Bureau of Industry and Security (BIS) implemented export controls to

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limit the flow of advanced computing and semiconductor manufacturing items into China [10]. With the effort from BIS, the trading volume in the categories described above will experience a significant drop. Due to a tense international political environment and rising geopolitical conflicts between the U.S. and China, the export control policy shows consistency over the long term and imposes continuous negative effects on bilateral trade.

The domestic condition in China also makes the U.S. export eludes to healthy growth in the long-term. On one hand, the Chinese government is promoting the internal drive for economic development within the country to decrease its dependence on foreign products in certain industries [2]. Taking the agriculture industry as an example, oil seed, grain, and fruits occupy the largest portion of the U.S. export to China. While the Chinese government has been expanding fiscal support to the agriculture sector over the years to stimulate production and productivity and has initiated measures on converting certain protected forests into farmlands to further elevate the growth of agriculture production. Under such circumstances, U.S. agriculture export is likely to fall in addition to the export of highly valued advanced electronic products.

On the other hand, over the course of increasing economic collaborations between the U.S. and China, the cheap intermediate goods from China and higher export demand caused real-wage growth in 75% of American workers [11]. With the effect of high unemployment benefits during the pandemic and the government's efforts in subsiding the job market, the average wage in the U.S. continues to grow. By formula (7) and referring to the information from above, the price of the U.S. product will increase due to a higher labor cost and a projected increasing cost in importing the intermediate goods from China. Considering the additional effect of the gap of increasing exchange rates, consumers in China will lose the incentive of purchasing more expensive U.S. goods. Therefore, raising further risk in the U.S. export to China.

4. Analysis of Bilateral Trade Potential Based on the Gravity Model of Trade

Following the analysis of the import and export of China and the U.S. in their bilateral trade relationship, this section aims to conduct an aggregate analysis of the trade protentional between the two countries in the long term. To quantitatively support the analysis in this section, the Gravity Model of Trade with one least square regression will be employed. In this section, to consider the aggregate bilateral trade behavior between the U.S. and China, variables of annual aggregate trade volume, annual GDP, distance, annual inflation rate, the currency exchange rate (USD to CNY), and the annual average tariff rate on imports will be used. The gravity model of trade will be expressed as

$$ln\,(trade\ volume) = \mu + \mu_1\,ln\,(GDP_{US}) + \mu_2\,ln(GDP_{CN}) + \mu_3 ln(distance) + \mu_4 ln(inflation_{US}) + \mu_5 ln(inflation_{CN}) + \mu_6 ln(tariff_{US}) + \mu_7\,ln\,(tariff_{CN}) + \mu_8\,ln\,(exchange\ rate). \quad (8)$$

Using Python with numpy, panda, and statsmodels packages to perform the one least square regression regarding these variables, the following result is concluded in Table 1.

Table 1: One least square regression result from the gravity model of trade.

	Coefficient	S.D.	t	P > | t |	[0.025	0.975]
Intercept	-0.1066	0.063	-1.697	0.112	-0.241	0.028
ln (GDP_{US})	0.9046	0.572	1.581	0.136	-0.323	2.132
ln(GDP_{CN})	0.4408	0.205	2.149	0.050	0.001	0.881
ln($inflation_{US}$)	0.0428	0.022	1.984	0.067	-0.003	0.089
ln($inflation_{CN}$)	0.1894	0.413	0.459	0.653	-0.696	1.074

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Table 1: (continued).

ln (exchange rate)	0.1894	0.413	0.459	0.653	-0.696	1.074
ln(distance)	-0.9360	0.552	-1.697	0.112	-2.119	0.247
$\ln(\text{tariff}_{US})$	-0.2567	0.145	-1.772	0.098	-0.567	0.054
$\ln(\text{tariff}_{CN})$ l	-0.0868	0.164	-0.529	0.605	-0.439	0.265

The result of Table 1 is considered reliable. In this result, the P-value is less than 0.05 and F-statistic is 97.17. These numbers show that the regression model is statistically significant at the common confidence level. The R-squared value of 0.977 confirms the regression model has a good fit for the data. From the result, the following observations are made: (1) the GDP of the U.S. and China are of high significance in the bilateral trade relationship. Holding all the other factors consistent, a 1% change in the economic scale of the U.S. and China will bring a positive change of 0.9046% and 0.4408% in the trading scale respectively; (2) the inflation rate of China and the USD to CNY exchange rate are of high significance in. affecting the trade volume, and the inflation rate of the U.S. is of intermediate significance. An increased currency exchange rate will make China more competitive in the export market and the inflation rate is an internal driver for the shift in exchange rate and indirectly impact consumers' import and export behavior; (3) the U.S. tariff on Chinese merchandise is of high significance while the import tariff by. China is imposing a less significant impact due to the trading relationship determining that China is the exporter and the U.S. is the importer in terms of the trading volume.

According to Liu (2003), the international trading relationship can be categorized with respect to the $R = \frac{ln\,(Real\ Trade\ Volume)}{ln\,(Trade\ Volume\ with\ Gravity\ Model\ Forecast)}$ as (1) R < 0.8, countries have high trading potentials; (2) 0.8 < R < 1.2, countries have intermediate trading potentials; (3) R > 1.2, countries have low trading potentials [12]. To forecast the U.S. and China trading potential, this section uses the data from 2023 Q1 for the empirical analysis.

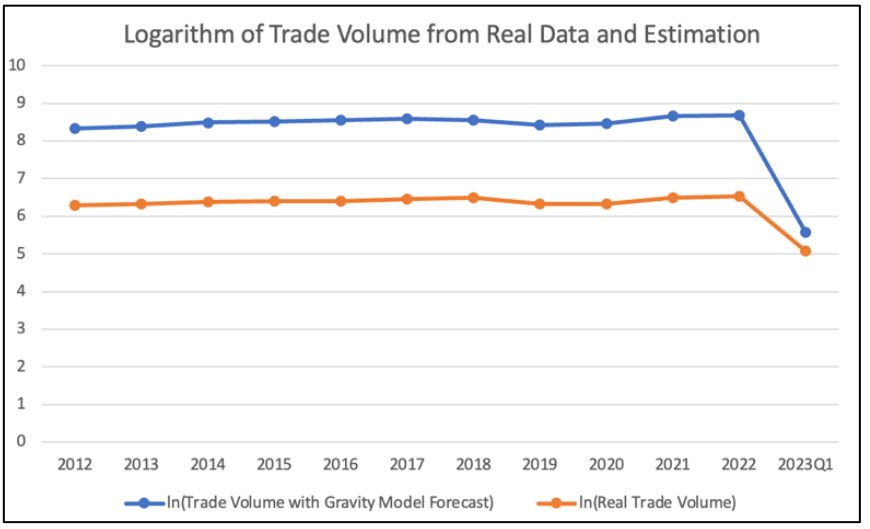

Figure 1: Comparison of 10-year logarithm of trade volume from real data.

In this case, R (2023 Q1) ≈ 0.91, falling within the range of [0.8, 1.2] and indicates that the bilateral trade between China and the U.S. is of intermediate trading potentials and the significant developments of the trading relationship between the two countries are limited in the future. Comparing the 10-year logarithm of trade volume both from the real data and the gravity model estimation in Figure 1, it is found that the prediction gap significantly dropped in the first quarter of

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2023. Consequently, a strong increasing trend of the trading potential test result can be seen in Figure 2.

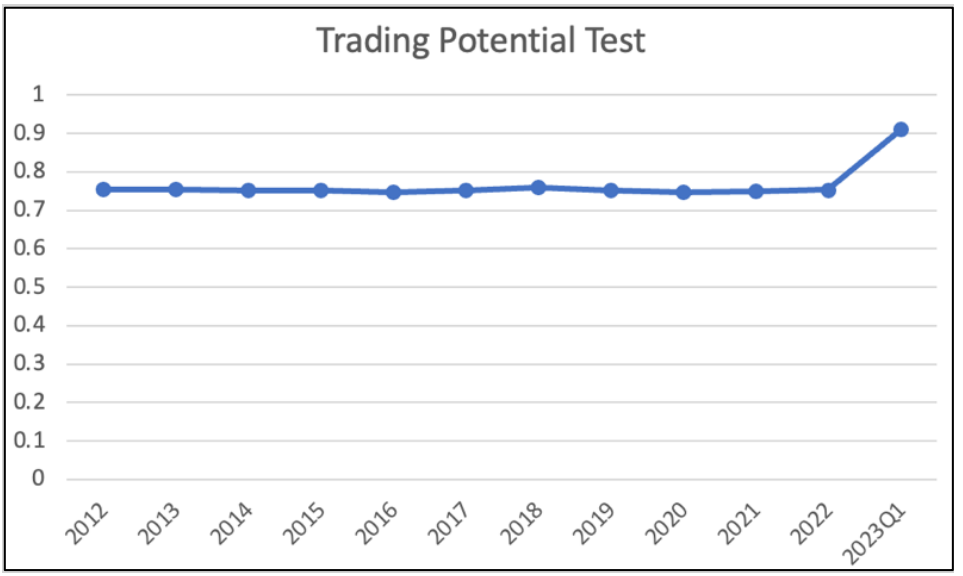

Figure 2: 10-year trading potential test.

These data indicate that the bilateral trade growth between the U.S. and China is reaching a position of bottleneck and the trading relationship between the two countries is in an unhealthy situation compared to previous years' behavior. In section 3 and section 4, it has been observed that both countries' behavior in import and export are constrained due to changes to conservative policies and international relations; shifts in consumer preferences; and diversification and fragmentation of GVCs. These factors all contribute to a non-robust trading growth between the two largest economies in the post-pandemic world.

5. Conclusion

From the study above, it can be observed that the bilateral trade between the US and China for each country with respect to the other. In the analysis of imports, the paper studied the consumption behavior of each country's households using the risk-averse household consumption model from Schmitt-Grohé et al.'s paper. It has been found that the Chinese import volume will be limited by the under-developing consumption power and the diminishing currency purchasing power. The government's policy toward promoting the internal economy drive and decreasing dependence on foreign goods also discourages the growth of the import. For the U.S., the consumption power of households is challenged by high levels of individual debt and interest rates, and the increasing U.S. dollar purchasing power could be offset by the trade war tariff. Meanwhile, the fragmentation of global value chains and the 'China + 1' import mode is offering more choices to consumers. Therefore, each country's import of goods from the other is most likely unable to experience satisfying growth.

For the export market, the paper adopts the production optimization model by Giovanni et al. This section discovered that export of both countries will be negatively impacted and shrink in the future. In the case of China, the reshoring effect of production and reallocation of FDI under the change in the geopolitical relationship and the increasing labor cost is making the export products more expensive and less favorable in both the aggregate and intermediate goods traded markets. Under considerations of geopolitics and trade protectionism by the U.S., a large portion of advanced industrial products become forbidden from trading with China. Combined with domestic policies to reduce reliance on imports and the growing USD to CNY currency exchange rate, a further decline

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in U.S. export to China is expected. By conducting the gravity model of trade and the testing methodology from Liu (2003), the fifth section conducted the analysis of the bilateral trading potential between China and the U.S. in the post-pandemic era. The reliable results from the regression model indicate that the trading potential between the two countries is limited to an intermediate level. Such a finding further confirms the trade hardship that the two largest economies will experience with stagnation in growth.

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