Determinants of Chinese Exports to the United States: An Empirical Analysis

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Abstract

The main objective of this study is to investigate the short and the long run relationships between bilateral export performance of China to United States using variables such as the real exchange rate of dollar to yuan, the growth of per capita US GDP, the growth of per capita Chinese GDP. The annual data covers the period between 2001 and 2018. The Johansen testing approach to cointegration is performed in the estimation process. The causalities among the variables in the model are determined based on the estimated models. The empirical results reveal that the variables of interest are cointegrated. Real exchange rate has no significant effect on Chinese exports to the US, whereas the growth of per capita US GDP and the growth of per capita GDP of China have positive and significant effects. Our findings suggest that United States should concentrate on the growth of both two countries rather than focusing on the low level of Chinese domestic currency.

1 Introduction

US-China economic ties have expanded substantially since the two countries began to normalize their relationship in the late 1970s. With China's inclusion to the WTO in 2001, the interdependence between the two superpowers has accelerated to enormous levels. Recently, this pattern started to reverse causing a growing tension between the US and China leading to a trade war. U.S. trade deficit with China reached to a level which is unprecedented in modern economic history around 2010. The US Senate held many debates about the large size of imports from China and its competitive threat to U.S. manufacturers. Lately, complaints of an undervalued Chinese exchange rate and the inadequate safety regulations have led to the imposition of increasing tariffs to curb Chinese imports. Usually, experts argue that the main problem stems from the inadequate domestic investment in the US because of inadequate levels of saving in the US.

This is not a trade war, but rather a struggle for being the only superpower in terms of economic and geo-strategic dominance. Ultimately, the main reason of this trade war between China and the US is centering on technological supremacy. The catalyst for the trade war is China's "Made in China 2025" industrial strategy introduced by Beijing in 2015. The objective of this strategy is to realize China's economic transformation from a low-cost manufacturing country to a superior innovation power against the US and the rest of the world. However, such a target makes the US to retaliate to protect its' only superpower status. China's strategy is based on improving competition in 10 technologically advanced sectors, including information technology, biotech, robotics, aerospace and clean-energy vehicles (ISI, 2020) The tension in the trade war between the US and China increased significantly by two recent developments. First, the US restricted Chinese telecommunications companies Huawei and ZTE Corp. from selling their equipment and services in the United States. Second, the US put restrictions on Huawei sales to U.S. individuals and businesses due to U.S. national security and/or foreign policy interests.

On the other hand, according to US Trade Policy Agendas of 2018 and of 2019, trade policy had to focus more on the national interests of the United States and for this reason were to be in harmony with the country's national security strategy. Actually, the National Security Strategy of 2017 stated that they would focus upon fair and reciprocal economic relationships to address trade imbalances (Mildner and Schmucker, 2019).

The trade war between the US and China led to cooperation of China with the European Union. The China's Belt and Road Initiative (BRI) aims to reach to Europe eventually, which targets an improvement in China – European Union countries (EPRS, 2019).

Chinese unfair practices is what the US authorities call 'forced transfer of technology'. Forced technology transfer (FTT) policies mean to increase technology transfer that simultaneously weakens foreign innovations by contributing to technology transfer (Prud'homme et al. 2018). An example for FTT is when a US Company chooses to invest in China because it expects to make a profit, there is the requirement of transferring the information about the technology that the US Company is employing in its production process.

The objective of this paper is to analyze the determinants of exports of to China using variables such as the growth of per capita US GDP, the growth of per capita Chinese GDP and the real exchange rates between US dollar and yuan. The exsistance of long run relationship between the variables is investigated by Johansen cointegration method. Also the short run equation is estimated through vector error correction model. The annual data covers the period of 2001 and 2018.

The second section gives a brief presentation of the literature on the determinants of trade between the US and China. The third section includes the model data and emprical analysis. Finally, the fourth section serves as conclusion and policy implications.

2 Bilateral Trade between the US and China

China and the US are the largest trading partners and main investors. In 2018, bilateral trade in goods and services exceeded US$750 billion, and bilateral investment is nearly US$160 billion. Both countries have benefited from these trade and investment relations.

The trade in goods between China and the US grew from less than US$2.5 billion in 1979 to US$633.5 billion in 2018, a 252-fold increase. According to Chinese sources, in 2018, the US was China's largest export market, and the sixth largest source of imports. But according to the US sources, in 2018 China was its third largest export market, and its largest source of imports. China is the key export market for US airplanes, soybeans, automobiles, integrated circuits and cotton. During the ten years from 2009 to 2018, American exports has an aggregate growth of 73.2 percent, higher than the average growth of 56.9 percent represented by other regions in the world.

Trade in services between China and the US is widening into different sectors. The two countries have been in close cooperation in tourism, culture, and intellectual property. (USCBC, 2019)

Since 1980, two-way investment between China and the US has grown from zero to US$160 billion. According to Chinese resources by 2018 total Chinese foreign direct investment (FDI) in the US is more than US$73.17 billion. The rapid growth of Chinese FDI in the US has contributed to the US economic growth, job creation, and tax revenues. The FDI by the US in China was US$85.19 billion by 2018. In 2017, the total sales revenues of US companies in China were US$700 billion, with profits over US$50 billion. China is the greatest creditor of the United States. In December 2018, China held USD 1.124 trillion in US Treasury securities (17.9% of securities issued). The high percentage of US debt owned by China shows once again the mutual dependency of the two economies. If China sell-off the Treasury securities, that will harm both parties, as the interest on Treasuries would rise while their price would go down, thereby decreasing their value (Mildner and Schmucker (2019)).

In July 2018, the US imposed additional tariffs of 25 percent on Chinese exports worth US$50 billion, and additional tariffs of 10 percent on US$200 billion of Chinese exports then increased to 25 percent in January 2019. In addition, the US threatened further tariffs on all remaining Chinese exports, leading to economic and trade war between the two countries. China responded by imposing tariffs on imports worth US$110 billion from the US.

The US government has increased tariffs on Chinese goods exported to the US, affecting two-way trade and investment cooperation and diminishing market confidence and economic stability globally. The US tariff measures lead to a decrease in the volume of China's export to the US, which fell by 9.7 percent annually in the first four months of 2019. In addition, China has to impose tariffs as a countermeasure (General Administration of Customs of China, 2019).

Month	Exports	Imports	Balance
January 2018	9,902.6	45,765.6	-35,863.1
February 2018	9,759.9	39,020.6	-29,260.7
March 2018	12,652.1	38,327.6	-25,675.5
April 2018	10,503.8	38,303.9	-27,800.1
May 2018	10,428.2	43,965.7	-33,537.5
June 2018	10,860.1	44,612.1	-33,752.0
July 2018	10,134.6	47,120.6	-36,986.0
August 2018	9,285.9	47,869.2	-38,583.3
September 2018	9,730.0	50,015.0	-40,285.0
October 2018	9,139.9	52,202.3	-43,062.5
November 2018	8,606.2	46,500.8	-37,894.6
December 2018	9,144.9	45,972.1	-36,827.2
TOTAL 2018	120,148.1	539,675.6	-419,527.4
January 2019	7,134.3	41,603.8	-34,469.5
February 2019	8,433.6	33,194.4	-24,760.8
March 2019	10,426.5	31,175.7	-20,749.1
April 2019	7,896.3	34,798.9	-26,902.6
TOTAL 2019	33,890	140,772	-106,882

Table 1. *U.S. trade in goods with China in 2018 and 2019* ***Source****: US Census Bureau.* ***All figures are in millions of U.S. dollars on a nominal basis.***

The trade war between the US and China has several influences on the economies of both countries and the rest of the world. These influences are as follows; the tariff measures have significantly increased production costs for US companies. The tariff measures lead to price increases in the US. The tariffs affect the US economic growth and cost of living in the US. The tariffs restrain the US exports to China due to the counter tariffs imposed by

China. The US measures are against the rules and regulations set by the WTO. The US tariffs are a threat to global economic growth. The US actions make a pressure on global industrial production and its supply chains.

As of 11the December 2001 China has been accepted to WTO membership and thereby increased its trade volume. In the first three years after the acceptance, each year there has been an 30 per cent increase in export. In 2001, export was 266 billion dollars whereas in 2004 it raised to 593 billion dollar. In the meantime, its import has also increased at the same rate. In 2001, imports of China was 244 billion dollar, it reached to 560 billion dollar in 2004. Thus, China has took third place in foreign trade in terms of the world trade ranking. (Öz, 2006)

Current account imbalances of the US in 2016 is - 4,0 % of GDP in goods and 1,3 % in services sector, whereas current account imbalances of China 4.4 % of GDP in good and -2,2 % of GDP in services. Total current account balance of the US in 2018 is -2,5 percent of GDP, total current account balance of China in 2018 is 0,3 percent of GDP. (World Bank).

In July 2018 when the trade war between the US and China has been implemented, the US export to China was 10,1 billion dollars and the US import from China was 47,1 billion dollars so that the trade deficit was 37 billion dollars. In April 2019, the US export to China was 7,8 billion dollars and the US import from China was 34,7 billion dollars and eventually the trade deficit has been 26 billion dollars.

As seen in Table 2, China is the biggest trade partner of the US in 2018 with the 15,7 percent of total trade of the US. Canada is the second largest trade partner of the US in that year with 14,7 percent. Mexico, Japan and Germany follow them.

Table 3 represents the list of Chinese top 15 trading partners in its export in 2018. According to this table, the US is the largest partner of China with its 19.2 percent, Hong Kong is the biggest partner with 12.1 percent share in its exports. Japan, South Korea and Vietnam are the following countries. Over two-thirds (67.8%) of Chinese exports in 2018 were delivered to the above 15 trade partners.

In 2018 the largest group of products in the US exports to China are civilian aircraft, engines, equipment, and parts. The second and third largest group of products are semiconductors and industrial machines respectively.

On the other hand, in that year, largest group of products in the US import from China are cell phones and other household while the second and third largest group of products in the US import from China are computers and telecommunications equipment respectively that can be seen in Table 5.

Rank	Country	Exports	Imports	Total Trade	Percent of Total Trade
---	Total, All Countries	1,664.1	2,542.8	4,206.9	100.0%
---	Total, Top 15 Countries	1,183.9	1,969.9	3,153.8	75.0%
1	China	120.3	539.5	659.8	15.7%
2	Canada	298.7	318.5	617.2	14.7%
3	Mexico	265.0	346.5	611.5	14.5%
4	Japan	75.0	142.6	217.6	5.2%
5	Germany	57.7	125.9	183.6	4.4%
6	Korea, South	56.3	74.3	130.6	3.1%
7	United Kingdom	66.2	60.8	127.0	3.0%
8	France	36.3	52.5	88.8	2.1%
9	India	33.1	54.4	87.5	2.1%
10	Italy	23.2	54.7	77.9	1.9%
11	Taiwan	30.2	45.8	76.0	1.8%
12	Netherlands	49.4	24.6	74.0	1.8%
13	Brazil	39.5	31.2	70.7	1.7%
14	Ireland	10.7	57.5	68.2	1.6%
15	Switzerland	22.2	41.1	63.4	1.5%

Table 2. *Top 15 Trading Partners of the US in 2018* ***Source****: US Census Bureau.* *All figures are in millions of U.S. dollars on a nominal basis.*

Rank	Country
---	Total, All Countries
---	Total, Top 15 Countries
1	United States: (19.2% of total Chinese exports)
2	Hong Kong: $303 billion (12.1%)
3	Japan: $147.2 billion (5.9%)
4	South Korea: $109 billion (4.4%)
5	Vietnam: $84 billion (3.4%)
6	Germany: $77.9 billion (3.1%)
7	India: $76.9 billion (3.1%)
8	Netherlands: $73.1 billion (2.9%)
9	United Kingdom: $57 billion (2.3%)
10	Singapore: $49.8 billion (2%)
11	Taiwan: $48.7 billion (2%)
12	Russia: $48 billion (1.9%)
13	Australia: $47.5 billion (1.9%)
14	Malaysia: $45.8 billion (1.8%)
15	Mexico: $44.1 billion (1.8%)

Table 3. *Top 15 Trading Partners in Chinese Export 2018 (%)* ***Source:*** *US Census Bureau.* *All figures are in millions of U.S. dollars on a nominal basis.*

Goods	**Value 2011**	**Value 2012**	**Value 2013**	**Value 2014**	**Value 2015**	**Value 2016**	**Value 2017**	**Value 2018**
TOTAL	104,121,524	110,516,616	121,746,189	123,657,203	115,873,365	115,545,508	129,893,587	120,341,426
Civilian aircraft, engines, equipment, and parts	6,388,494	8,357,556	12,586,701	13,927,126	15,439,704	14,576,574	16,264,533	18,222,412
Semiconductors	4,607,132	3,892,964	4,737,314	5,510,760	5,976,385	5,955,955	6,076,509	7,117,574
Industrial machines, other	4,181,129	3,348,266	3,829,876	4,439,060	4,482,621	4,872,042	5,447,303	6,824,894
Passenger cars, new and used	5,305,700	5,698,113	8,522,223	11,178,484	9,055,568	8,843,612	10,211,268	6,652,481
Crude oil	0	0	26,785	20,734	15,354	360,620	4,400,921	5,392,481
Plastic materials	3,838,178	3,570,590	3,600,333	3,858,285	3,559,092	3,525,059	4,002,797	3,991,782
Medicinal equipment	1,913,324	2,280,353	2,360,708	2,568,222	2,886,515	3,231,618	3,453,343	3,725,666
Chemicals-other	2,656,301	2,419,337	2,673,473	2,642,444	2,414,735	2,468,688	2,983,523	3,211,211
Soybeans	10,508,369	14,879,547	13,304,176	14,485,397	10,494,079	14,212,666	12,258,835	3,154,472
Measuring, testing, control instruments	2,404,006	2,478,418	2,500,897	2,497,439	2,638,641	2,648,525	2,763,782	3,131,292
Pharmaceutical preparations	1,087,067	1,197,759	1,376,878	1,749,753	2,005,452	2,165,953	2,681,163	3,021,904
Pulpwood and woodpulp	3,995,631	3,820,870	3,634,519	3,367,854	3,424,736	3,368,432	3,359,165	2,910,952
Other parts and accessories of vehicles	899,527	937,869	1,652,499	2,099,786	1,868,383	2,328,566	2,719,751	2,864,786

Table 4. *U.S. Exports to China 2011 - 2018 (In thousands of dollars)* ***Source****: US Census Bureau*

Goods	Value 2011	Value 2012	Value 2013	Value 2014	Value 2015	Value 2016	Value 2017	Value 2018
TOTAL	399,371,233	425,619,083	440,430,020	468,474,895	483,201,655	462,542,005	505,469,954	539,503,428
Cell phones and other household goods	40,437,973	52,820,617	58,708,992	64,102,970	64,538,065	61,474,127	70,359,818	71,815,059
Computers	47,212,554	47,638,124	47,154,020	46,246,719	43,804,679	40,405,049	45,515,206	47,323,193
Telecommunications equipment	17,336,848	19,145,602	20,951,280	22,537,644	27,085,100	28,911,968	33,490,521	33,948,225
Computer accessories	27,663,608	28,418,685	28,979,113	31,191,054	30,456,135	28,244,610	31,648,577	32,562,931
Toys, games, and sporting goods	25,306,178	25,115,136	24,632,369	24,432,816	26,355,499	25,048,780	26,751,412	28,225,391
Apparel, textiles, non-wool or cotton	19,754,755	20,619,014	21,554,715	23,924,860	25,645,126	24,165,399	24,137,388	25,160,791
Furniture, household goods, etc.	13,753,109	14,779,785	15,179,327	16,052,809	17,894,345	18,633,887	20,669,126	22,700,484
Other parts and accessories of vehicles	9,029,238	11,172,211	11,681,762	13,464,650	14,867,660	14,233,616	14,406,417	16,377,154
Household appliances	10,210,570	11,145,330	12,482,507	13,244,246	14,217,862	13,718,988	14,138,581	16,021,575
Electric apparatus	12,946,856	11,590,260	12,696,414	13,333,796	13,627,422	13,123,661	14,080,858	15,928,757
Apparel, household goods - cotton	16,483,702	15,525,170	15,773,381	14,738,022	14,410,493	12,708,380	12,272,808	12,405,587
(21180) Industrial machines, other	6,566,964	7,409,261	7,694,810	8,778,141	9,075,228	8,884,321	10,585,034	11,842,836
(41200) Televisions and video equipment	11,825,184	10,764,246	9,797,117	10,628,555	10,654,484	9,260,881	10,656,467	11,730,213

Table 5. *U.S. Import from China 2011 - 2018 (In thousands of dollars)* ***Source****: US Census Bureau*

Years	Growth (%)	Years	Growth (%)
2000	8,49	2010	10,63
2001	8,33	2011	9,54
2002	9,13	2012	7,85
2003	10,03	2013	7,75
2004	10,11	2014	7,29
2005	11,39	2015	6,9
2006	12,71	2016	6,7
2007	14,23	2017	6,9
2008	9,65	2018	6,6
2009	9,4		

Table 6. *Growth Rate of China (2000 – 2018)* ***Source****: World Bank, World Development Indicators, 2019*

Years	Growth (%)	Years	Growth (%)
2000	4,1	2010	2,6
2001	1,0	2011	1,6
2002	1,7	2012	2,2
2003	2,9	2013	1,8
2004	3,8	2014	2,5
2005	3,5	2015	2,9
2006	2,9	2016	1,6
2007	1,9	2017	2,2
2008	-0,1	2018	2,9
2009	-2,5		

Table 7. US Growth Rates (2000 – 2018) *Source: The Balance website.*

With a population of 1.3 billion, China is the world's second largest economy. The country is trying to reduce poverty. China made economic reforms in 1978 by changing its centrally planned economy to a more free-market economy. Before 1978, economic growth was instable, the economy was growing in one year and shrinking in the following year. Inability to cope with famine was one of the main problems. As a result of reforms, Chinese economy experienced a rapid economic development and growth. GDP growth has an average of 10,2 % yearly between 1978 and 2000. Till 2008, China had experienced enormous growth rate, although the growth rate has decreased as a result of the global crisis, China had an annual growth rate of 8 percent during 2009- 2017. Between 2000-2017 the average growth had been 9,2 percent. From Table 6, it can be seen the slowest growth rate is observed in 2018 with 6,6 points whereas the highest growth rate is in 2007 with 14,4. After the global financial crisis in 2008, the growth rate of China decreased in many years as seen in the table above.

From Table 7, it can be seen the slowest US growth rate is observed in 2009 with - 2,5 points whereas the highest growth rate is in 2000 with 4,1 and 3,8 in 2004. After the quantitative easing (QE) following the global financial crisis, the growth rate of the US started to increase, and it reached its peak level in 2005 and in 2018 with the growth rate of 2,9 percent.

3 Literature Review

The studies on the determinants of export performance are different in terms of the data period, content, method and the findings. Studies in literature on trade concentrates in various aspects of the trade. Some of them consider the determinants of exports, imports, trade balance, trade volume in different levels such as bilateral and multilateral economic relations. Some studies focus on the performance of the export in selected sectors in the economy.

As the determinants of export volume variables such as real effective exchange rate, cost of employment, foreign income, productivity, domestic GDP, exchange rate volatility and foreign direct investment are generally used in the studies. Real exchange rate is commonly used as the main determinant of export volume. The other factors that are expected to affect export performance are capital flows including foreign direct investment and portfolio investment, distance between exporting and importing countries, transportation cost, government subsidies and other policies for exporters, domestic economic-political crises and economic conjuncture. Some government policies could be effective in the short run but not in the long run. Meanwhile foreign factors such as wars, global economic and political crises, weather conditions, international good standards, foreign governments' trade policies. Another way of analyzing the export volume is by using the elasticity concept concerning to foreign demand and income as indicated in Marshall Lerner condition. On the other hand, technology transfer is debated mostly in recent studies especially between China and the US.

The standard representation of bilateral international trade is the gravity model. In empirical tests, the standard model focuses on the sizes of the importing and exporting countries together with the distance between them. Meanwhile, some studies expanded this model by adding some variables measuring domestic and international forces.

Mildner S.A. and Schmucker C.(2019) argue that the important topics between the US and China include the large US debt held by China, cyberattacks from China, the country's impact on the global economy, the loss of US jobs to China, and the US trade deficit. In 2017 Chinese market is less open than that of the United States. In terms of the average manufacturing applied tariff rates, China's rates are approximately three times those of the United States for total trade (9.8% vs. 3.4%) and both agricultural (15.6% vs. 5.3%) and non-agricultural trade (8.8% vs. 3.1%). Differences are strongest in seven categories (China's tariff rates are ten or more percentage points higher than those of the United States): cereal and preparations, cotton, sugars and confectionary, animal products, coffee and tea, other agricultural products, and fish and fish products. In addition, market-distorting practices such as forced technology transfers, intellectual property rights violations, and state subsidies need to be addressed within the WTO. The organization, which for three decades has ensured predictable and open trade relations, is in need of reform.

Herrero (2019) investigates the impact of the US-led trade war between the US and China and its immediate consequences for the European Union. Although protectionism can never be growth enhancing, and it can have some disadvantages for the EU, there are still gains to be made by European companies from US-China trade confrontation, as they may be able to replace US exporters to China or Chinese exporters to the US. The fact that the EU feels increasingly squeezed between the United States and China in their strategic competition should push us to consider our options in the current global setup. So far, the EU's option seems to have been to support multilateralism at any cost. Unfortunately, the latter is increasingly less likely, as the United States has no intention.

Hongsheng et al. (2017) investigate the determinants of China's bilateral trade balance using international input–output data, namely trade in value-added. They pointed out the double counting issue in the re-export structure of China. Without regarding re-export feature of China, the influence of the Chinese domestic currency will be overestimated in bilateral trade calculations. The main reason of this over estimation is that the increasing production of exports may need increasing intermediate imports in global value chains. Also, they concluded that

the impact of FDI inflows on China's bilateral trade balances depends on Chinese production and finally export structure.

According to a report issued by Ministry of Commerce of China in 2017, the US and China can benefit from trade and economic cooperation. In the last decade, the average growth rate of US exports to China was three times higher than the growth rate of all US exports to the world. Meanwhile the growth rate of China's exports to the US has increased twice in that period.

Kaur (2011) analyzed the determinants of trade in services. The export performance in service sector of the US with its Asian trade partners (Japan, China, India, Singapore, South Korea and Hong Kong) is examined by taking into account geographic, economic and other features such as corruption index, openness of countries by using gravity model. Panel data between 2000 and 2008 in six countries by using panel regression method. It is found that the US has export potential in services for India and Japan. It concluded that the US had convergence in exports with three Asian countries (Hong Kong, India and Korea) and divergence with three Asian countries (Japan, China and Singapore).

Bosworth and Collins (2008) examines U.S. goods trade with China, focusing on the performance of exports. They analyze whether U.S. trade is unusual by contrasting it with trade from Japan and the EU-15. The topic is examined based on the commodity composition of exports and the determinants of trade by using gravity model. They show that the commodity composition of U.S. exports to China is similar to the exports to the world as a whole. Distance plays an important role on trade. The U.S. exports have the low level both to China and the rest of the world. They found that poor U.S. export performance is only partly related to uncompetitive real exchange rates of the US dollar. The poor U.S. export performance is a global issue not only for its relationship with China.

Ward and Hoff (2006) examined the bilateral trade for OECD countries using the gravity model of international commerce, including political as well as institutional influences. Using annual data from 1980-2001, they estimated regression coefficients and residual dependencies using a hierarchy of models in each year. The explanatory variables used are GDP of exporter, GDP of importer, distance, regime type exporter, regime type of importer, similarity of regime types and cooperation in conflict. They found that increased democratization will expand both bilateral and global trade. Additionally, they concluded that country specific factors such as exporter and importer-specific effects should not ignored in the bilateral trade analysis.

Another study analyzing the trade of China with its partners using the gravity model is by Chan and Au (2006). They analyzed the factors affecting textile exports between China and its top 10 trading partners. The data period covers from 1985 to 2004. Bilateral trade between China and its top ten partners is examined using by the gravity model. The result shows that GDP, real exchange rate, common membership of free trade agreement for bilateral trading partners, per capita GDP and population growth rate of the importers have shown statistical significance on the China's textile exports. Whereas geographical distance has no significant effect on textile trading.

Hammer (2006) examined the product groups of exports and imports of the US and China between 1995 and 2004, which can explain China's large and growing merchandise trade surplus with the United States. It is concluded that electronic machinery constituted the largest and fastest growing product category source of export and imports in bilateral trade. The formation of global electronics supply chain was analyzed in these product groups in detail. It is seen that enterprises operating in China's special incentive zones have positively influenced bilateral trade against the United States. These incentive zones are more significant in China's imports from the United States, rather than China's exports to the United States. According to this study the biggest Chinese good of import from the US is soybeans. However, in the combined goods of imports from the US, machinery imports from the United States have a higher share in China's imports from the United States.

Lai and Zhu (2004) examine a monopolistic competition model that includes asymmetric trade barriers and international differences in production costs. Estimation of nonlinear trade equation gives parameters for the elasticity of substitution and trade costs that can be considered superior over the other models. A simulation shows that trade liberalization will shift trade from rich countries to poor countries and from within continental trading partners with preferential trade agreements to intercontinental trading partners.

4 Data Source and Empirical Analysis

4.1 Data set and the model used in the analysis

This paper uses a simple model that defines the functional relationship between the growth rate of Chinese bilateral exports to US and several other exogenous macroeconomic variables of interest.

$$chinaexp = f(chinagdp, usgdp, realexc) \quad (1)$$

chinaexp stands for the growth rate of Chinese bilateral exports to US, chinagdp denotes the growth rate of Chinese per capita GDP, usgdp shows the growth rate of US per capita GDP and realexc is the log of the real exchange rate between dollar and yuan. The data is annual for the period 2001-2018. The variable to be explained is the growth rate of Chinese bilateral export to US. All the data are obtained from the Bloomberg database.

	chinaexp	chinagdp	usgdp	realexc
chinaexp	1.000	0.371	0.484	0.242
chinagdp	0.371	1.000	-0.038	0.491
usgdp	0.484	-0.038	1.000	0.231
realexc	0.242	0.491	0.231	1.000

Table 8. *The correlation coefficients between variables.*

As seen in Table 8, the growth of Chinese per capita GDP has a negative and weak correlation with the growth of US per capita GDP. That shows why these superpowers have a trade war to each other recently. On the other hand, the correlation coefficient between real exchange rate and growth rate of Chinese per capita GDP is the highest among the variables of interest even though it is not that much high. Therefore, this finding can explain the importance of cheap Yuan against higher US dollar and Chinese policy to keep its currency at as low as possible for a long time.

Unit root tests are generally used in order to investigate whether unit root exists or not. Augmented Dickey Fuller (ADF) unit root test is commonly used, which estimates the following AR(k) regression equation:

$$\Delta y_t = \alpha + \beta y_{t-1} + \sum_{i=1}^{k} \phi_i \Delta y_{t-i} + \varepsilon_t \,, \qquad (2)$$

where k shows the number of lags added to the regression model so that ε_t is a normally and independently distributed (i.i.d) error term with the assumption of zero mean and constant variance. Based on the value of the coefficient of β, stationarity of data is decided. If the process is stationary, the null hypothesis that β equals zero is rejected. On the other hand, if β is smaller than zero the null hypothesis is accepted. ADF test uses left-tailed alternative hypothesis for unit root testing. In order to determine the order of integration, Augmented Dickey Fuller (ADF) tests are applied to the levels and the first differences. The numbers in parentheses are the lags used for the ADF test, which are augmented up to a maximum of 5 lags. The choice of optimum lag for the ADF test was decided on the basis of minimizing the Schwarz information criterion. The ADF test results are given in tables 9 and 10.

	With trend and intercept		**With intercept only**	
Variables	Lags	ADF	Lags	ADF
chinaexp	0	-3.604*	0	-2.854*
chinagdp	0	-2.593	0	-1.805
realexc	1	-4.416**	0	-4.674**
usgdp	3	-2.106	3	-3.912**
The critical values for ADF test for the models with trend and intercept are -4.66, -3.73 and -3.31 for 1%, 5% and 10 % levels of significance respectively. The critical values with intercept only are -3.92, -3.06, and -2.67 for 1%, 5% and 10 % levels of significance respectively. Rejection of null hypothesis is shown with * 10 %, ** for 5 % and *** for 1 % level of significance.				

Table 9. *ADF test results for levels of variables*

The test results given in Table 9 suggest that the null hypothesis of a unit root is rejected for chinaexp and realexc at 1 % and 5 % significance levels respectively for the intercept & intercept and trend cases. The null hypothesis of a unit root is rejected for usgdp at 5 % significance for the intercept case. Chinaexp is found to be nonstationary at % 5 significance level. Realexc is found to be nonstationary at % 1 significance level.

	With constant	
Variables	Lags	ADF
Dchinaexp	0	-6.043***
Dchinagdp	1	-3.965**
Drealexc	1	-6.517***
Dusgdp	3	-3.870**
The critical values for ADF test for the models are -3.95, -3.08 and -2.68 for 1%, 5% and 10 % levels of significance respectively.		

Table 10. *ADF test results for first difference of variables*

When table 10 is examined, all variables are found to be stationary when their first differences are taken. The letter 'd' shows that the variable is differenced once.

After determining the order of integration of variables, we examine whether the variables of interest are cointegrated with each other or not. VAR-based cointegration relationship is estimated using the methodology developed by Johansen (1995) in order to specify the long run relationships between the variables. The maximum lag length of unrestricted VAR model is chosen as 5. The lag length is chosen as 2 according to the lag length

selection based on akaike information criterion. Table 11 provides the cointegration results with VAR lag length of five. According to the trace test statistics results, the existence of one cointegrating vector is not rejected at 5 percent significance level. This cointegration vector is expected to represent unit vector corresponding to the growth rate of Chinese bilateral exports to US.

H_0:Rank	Trace test statistic	Probability
None **	69.543	0.0001
At most 1	29.632	0.0522
At most 2	12.432	0.1373
At most 3	0.1075	0.7430

Statistical significance levels: ***1%; **5%; *10%

Table 11. *Trace Test Results*

The normalized cointegrating vector is given in equation (3).

$$\text{chinaexp} = 0.522\text{chinagdp} + 0.006\text{realexc} + 3.854\text{usgdp} \quad (3)$$
$$(0.061) \quad (0.005) \quad (0.169)$$

The cointegration vector given in equation (3) suggests that the growth rate of Chinese exports are positively affected by the growth rate of Chinese per capita GDP, the growth rate of the US per capita GDP and the real exchange rate for the period under study. In the long run, the growth rate of the US per capita GDP has approximately four times of a positive impact on the growth rate of Chinese exports to US which is statistically significant. In addition, the growth rate of Chinese per capita GDP is also statistically significant with a cointegration coefficient of 0.522. The surprising finding is the statistical insignificance of the real exchange rate with a low coefficient of 0.006. Therefore, our findings imply that Chinese exports are extremely dependent on US consumers whereas a policy of the appreciation of yuan to curb Chinese exports to US seems to be an ineffective policy attempt which will only cause retaliation from China in different methods. China has a bipolar domestic market. There are several small and local Chinese retailers which produce rather low quality and low price goods and commodities for the domestic market. On the other hand, China also has multinational companies like Alibaba, Huawei, Lenovo etc. which produce for the global economy with a much higher level of quality, but just a little bit higher levels of prices.

Table 12 presents the results of Granger causality tests. Considering the null hypothesis of non-existence of pairwise granger causality, it is interesting to note that Granger causality exists in one case.

Null Hypothesis:	Obs	F-Statistic	Prob.
chinagdp does not Granger Cause chinaexp	15	2.079	0.174
chinaexp does not Granger Cause chinagdp		0.537	0.477
usgdp does not Granger Cause chinagdp	15	0.074	0.788
chinagdp does not Granger Cause usgdp		4.133	**0.064**
realexc does not Granger Cause chinaexp	16	0.276	0.608
chinaexp does not Granger Cause realexc		1.195	0.294
usgdp does not Granger Cause chinagdp	15	0.087	0.772
Chinagdp does not Granger Cause usgdp		0.521	0.484
realexc does not Granger Cause chinagdp	15	0.058	0.813
chinagdp does not Granger Cause realexc		2.661	0.128
realexc does not Granger Cause usgdp	15	1.400	0.259
usgdp does not Granger Cause realexc		0.001	0.973

Table 12. *Pairwise Granger Causality Test Results*

It is found that there is a univariate granger causality from the growth rate of Chinese exports to the growth rate of US GDP as seen in Table 12. According to Granger causality test, the reason for the growth in per capita US GDP is the increase in the per capita growth of China GDP through the increase in Chinese exports. In the past, the causality was from US growth to Chinese exports. However, recently the direction of causality has changed, so that the univariate granger causality runs from the growth of Chinese exports (Chinese growth) to US growth.

This finding further emphasizes our cointegration results as the two variables that are in consideration of being in a model where there is statistical significance are the Chinese exports to US and the US per capita GDP growth rate. Therefore, we can propose that once there is a change in the US per capita GDP growth rate, we observe a positive increase in Chinese exports to US and this surge further causes an increase in the growth rate of US per capita GDP, probably due to the increase in the utility and welfare of US consumers with the Chinese exports taking over the US market. The Granger causality and cointegration test results prove that there is interdependency between these two countries growth rates. The graphs of impulse response analyses are given in figure 1.

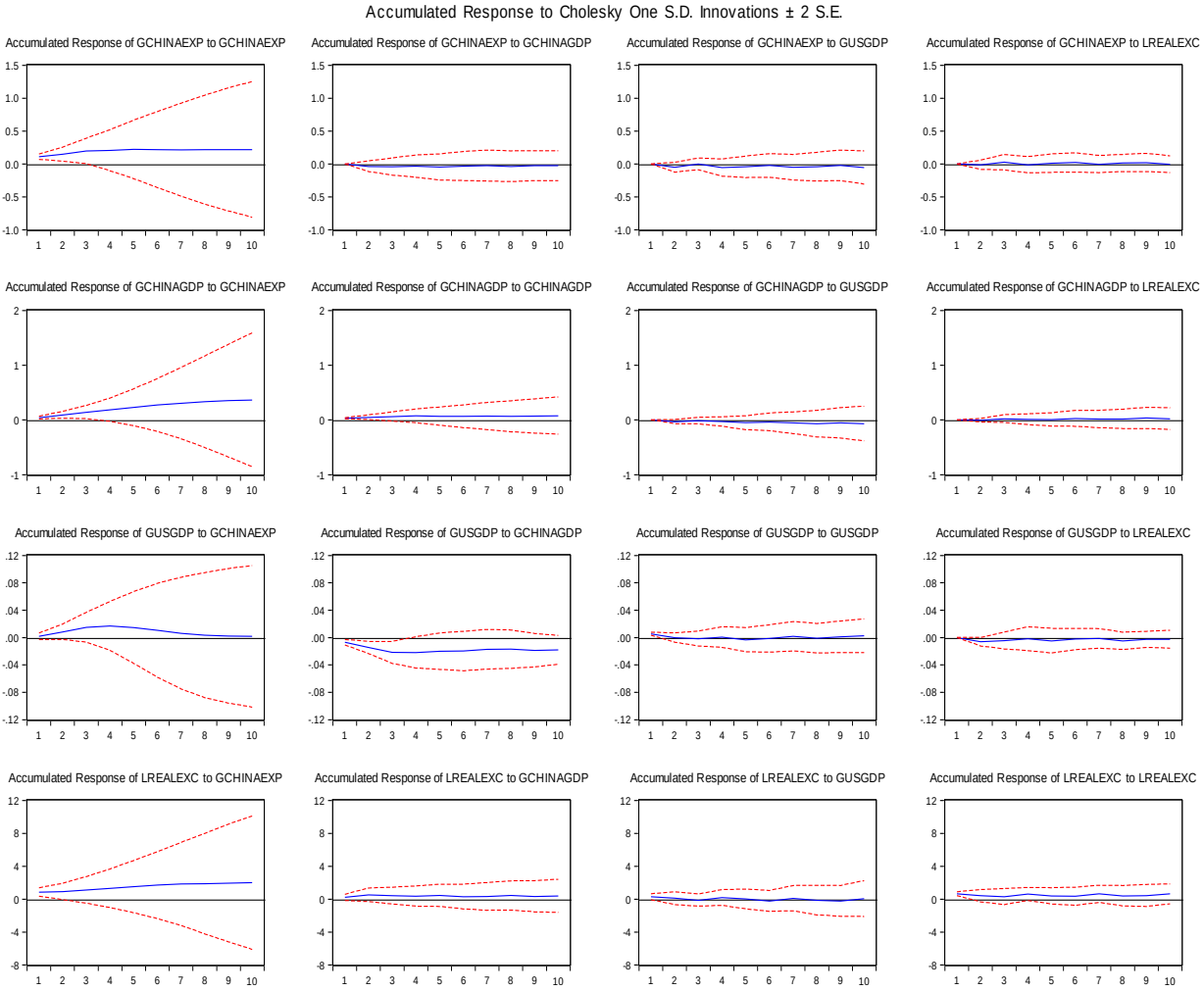

Figure 1. *Impulse Response Graphs*

Figure 1 is very important in terms of a visual representation of the relationships between our variables of interest. The impulse response functions we employ are the accumulated responses and usually terminate at a lag of 10 years which is consistent with our data set. The main reason for using accumulated responses is to observe the long run stance of the shocks to any of our variables from the variables in our model. Therefore, rather than focusing on a short period of time, we examine the end result over an interval which is long enough to provide robust empirical findings.

The response of the growth of per capita GDP of China for a one-unit shock on Chinese exports to the US shows a total accumulation of 50 percent increase in a 10-year period. This finding easily demonstrates the very high levels of GDP growth in China, especially before the Great Recession (Moderation).

One of the most striking finding in our impulse response function analysis is the response of the growth rate of per capita US GDP to the Chinese exports to US with a positive pattern of approximately 2 percent around the first 5-year period which is cancelled and reaches to zero percent at the end of 10-year period. It is important to realize that Chinese exports definitely change the consumption pattern of US households. However, this change is not as pessimistic as some of the economists argue in terms of the US production. Overall, our finding of an accumulated response of zero percent for a 10-year period approves that the adverse effects of Chinese exports to US on US production and employment is completely wiped away. Hence, it is hard to argue that US should impose tariffs on China and the end result would be beneficial for the US economy.

On the other hand, we observe the response of the growth of the US GDP to a one-unit shock in the growth of per capita Chinese GDP of 2 percent decrease around the first three-year period and this pattern continues till the end of 10-year period. This empirical finding is actually demonstrated in per capita GDP increase in China compared to a much smaller per capita increase in US over the last 18 years. This does not mean that US economy and therefore the US households are getting poorer over time because of the China effect but there is definitely a slower increase in the US per capita compared to historical averages. On the other hand, China is experiencing a higher than historical average levels of per capita through its trade with the US.

The response of the real exchange rate to a one-unit shock in the growth of Chinese exports provides an impulse response figure of very small depreciation in the Chinese yuan. There can be two reasons for that finding. The first is the competitiveness of Chinese exports force the Chinese exporters to keep their prices lower that the world average so that yuan continues to depreciate over time. Second and probably the more realistic argument is the planned economy of China controlling the yuan and letting it depreciate at very low rates over time so that the level of Chinese exports will continue to increase in the foreseeable future.

5 Conclusion

Cooperation is the only correct choice for China and the US and win-win is the only path to a better future. As to where the China-US economic and trade consultations are heading, China is looking forward, not backward. Disputes and conflicts on the trade and economic front, at the end of the day, need to be solved through dialogue and consultation. Striking a mutually beneficial and win-win agreement serves the interests of both China and the US and meets the expectations of the rest of the world. Optimistically, US can choose to go in the same direction with China and, in a spirit of mutual respect, equality and mutual benefit, manage economic and trade differences, strengthen trade and economic cooperation, and jointly advance Chinese-US relations based on coordination, cooperation and stability for the well-being of both nations and the rest of the world.

In this paper the determinants of the growth of bilateral Chinese exports to US are investigated. The cointegration analysis show that there is a long run relationship for Chinese exports to US. In this long run equilibrium, the growth of Chinese exports is affected by the growth rate of Chinese per capita GDP, the growth rate of the US per capita GDP and the real exchange rate positively. The growth rate of Chinese per capita GDP and the growth rate of the US per capita GDP are found to be statistically significant.

The world economic history has observed many conflicts in terms of trade and capital flows. We are in a new age where a global financial and economic crisis has affected most of the market economies in an adverse manner and even some of them are still being affected although many experts argued that it was over 5 years ago when the FED stared to raise the interest rates. This policy change is questioned nowadays and there is so much pressure on the FED to decrease the interest rates. These circumstances underline the sophisticated nature of the world economy with its global system functioning at a different level and possibly economic models which we are not aware of yet dominating the expectations and nowcasting leading the markets over forecasting. However, as nowcasting is so difficult with many data announced later than it actually is realized, it is getting harder to form a complete model which would be able to define the macroeconomic realities of a market economy.

To conclude, we believe that the US-China trade will not lead to positive results in the longer term although US economy is observing some positive periods in the current economic outlook. This probably is due to the quantitative easing policies that the Fed has followed, and its balance sheet has increased to unprecedented levels. Thus, the whole world has to realize the importance of production and welfare that it brings to even the remotest parts of the world, making more people live in a better standard compared to 50 years earlier. In the future studies the cost employment, industrail production, foreign direct investment, transportation and tax costs, monetary aggregates and public spending in the Unites States and China could be added to the econometric models.

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