

## TECHNOLOGICAL, ECONOMIC AND TRADE COMPETITION BETWEEN US AND CHINA

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### ABSTRACT

This paper analyses the historical competition between the United States and China during the last 34 years; the essay covers three sectors: Technology, economy, and trade. Both countries have been investing heavily in artificial intelligence (AI), 5G networks, and quantum computing; the United States has taken steps to reduce China's rise in this sector by imposing limits to their 5G network access. The economic competition reveals accusations from both countries regarding the manipulation of currency impacting the global economy, but since ever, US's GDP has surpassed the China's GDP; and about the commercial competition, currently both countries have imposed mutually tariffs to reduce the dependence of each other's industries on the trade market; where the US shows a negative trade balance since its imports exceed its exports; on the other hand, China appears to be better positioned in the global trade field, since its exports exceed its imports.

**Keywords:** Top 10 ranked technology corporations, gross domestic product (GDP), exports, imports, ANOVA technique.

### 1. INTRODUCTION

The United States and China have been rivals since the end of the Cold War. The competition between both countries has increased significantly over the past decade as the race to dominate in technology, economics, and trade competition tightens. Additionally, the United States and China are two of the largest economies in the world. Their relationships as partners and enemies required understanding economics, history, and current conflict. Each country attempts to outperform the other as tensions increase. China's emergence as a superpower leaves the United States vulnerable due to its reliance on China's economy. As both countries battle for dominance, the increased competition in technology, economy, and trade will require a path forward where compromises in all three areas are needed.

The intense competition between China and the United States has stemmed since the previous century; before 1980, China was predominately a rural country focusing on farming as its primary source of revenue and, with a per capita GDP of \$200, was ranked as one of the poorest countries in Asia (Delisle et al., 2019). China would need to rethink how it does business to break out of these economic standards. The result of restructuring its trade policies was a decision by the highest government. China would open its doors to other countries and allow for trading; additionally, the government shifted its stance on restricting production, labor reserves, capital, technology, etc. (Delisle et al., 2019). The reduction of tariffs and similar policies once put into place to prevent trading caused various countries to search for trading grounds with China. Fast forward to 2021, China has a GDP per capita of \$17,602 ("China GDP"). The drastic increase in wealth is attributed to their successful ability to trade with various countries and to have shifted companies to begin manufacturing in China. The country has seen an average annual rate of 10% increase in GDP

since 1980. The easy access to cheap labor makes China a suitable country for the company's offshoring services to investigate. Furthermore, China's government structure allows them to control companies better, and the government in China can support key industries they feel will yield more revenue.

When reviewing the current stance, the two countries have in technology, economy, and trade it is very clear that both countries are worldwide leaders.

On the trading area, China has positioned itself well when compared to the United States; China economic exports are greater than its imports. The United States is the opposite case, where imports are above than exports leaving the U.S. in a negative trade balance, which is explained when many corporations have relocated (offshored) manufacturing and production to China and because of this, the United States imports more goods than it exports. The United States has had the largest economy in the world for many years. However, the Chinese economy has been growing rapidly due to many different economic reforms. Recent events such as the decisions by China, Russia, and other countries to perform oil transaction using Chinese currency may push China to the top.

### **1.1 Technological competition**

Both countries are focused on advancing different technology platforms. The United States is leading the charge on multiple platforms, but China is close behind. Currently, the race for 5G domination is occurring. 5G is the wireless technology generation above 4G, which simply promises faster speed, lower latency, and more accessibility. Both countries strive to implement their own 5G networks globally to influence other countries. Huawei is leading the sector for China and already establishing 5G networks in a few countries to gain technological control. China established the Digital Silk Road (DSR) in 2015 (Sacks, 2021). The DSR is China's attempt to construct 5G networks along the route for countries. The issue here is that China's government allows it to dictate the decisions all companies in China make. Essentially, companies are an extension of Chinese beliefs and opinions. Because of this, countries worldwide are hesitant to allow Huawei to construct 5G networks. The United States closest allies are more willing to ban outright and tariff this decision, while those further in ties are simply advocating that they will find other partners more aligned with the respective countries' beliefs. The United States is focusing on Intel and Qualcomm to increase research efforts in 5G. However, with only a few cities in the United States running 5G, it is difficult to determine how far behind or ahead the US is compared to China. Furthermore, China can directly pump money into companies it deems valuable, something the United States cannot do. Additionally, COVID-19 caused a supply chain shortage, and the required tools to create 5G transmitters are back-ordered and in short supply; currently, both countries are still striving to take control of the 5G network.

Artificial Intelligence (AI) is another critical sector that has garnered the attention of both countries; China has been stating their intent to bypass all other countries in AI; currently, billions of dollars are being invested in research and creation, with China boasting that it will be the world's AI leader by 2030 (Sachin, 2021). China is teaching AI programs innovative algorithms to increase their productivity. Additionally, engineers and entrepreneurs are being utilized to increase AI's effectiveness. China is putting AI investments to work and has more research created than the United States (Sachin, 2021). Additionally, China's government allows them to gather more data

from its populace and use the data to train the AI. The importance of this data is increased considering the country's large population. Conversely, the United States has been the actual leader in AI because it holds more large IT companies (Ponciano, 2021) within its borders. Apple, Microsoft and Oracle have been at the forefront of innovation in various fields, including AI. Additionally, the United States has invested more than double China's money in AI (Sachin, 2021). The AI front is still being battled, with the United States having the lead.

Quantum computing is a form of computing information with quantum mechanics. Essentially, it is a faster method of analyzing calculations. This area of technology is also being pushed by both countries. The United States recently approved the National Quantum Initiative Act and authorized over a billion dollars in funding (Goodson, 2019). IBM and Google are leading the way for the United States in quantum computing. With its computer generating faster information than a supercomputer, Google has achieved the most considerable feat. Conversely, China has Alibaba and Baidu pushing for their research in the industry. However, China does not have powerful international intellectual property laws that it can lean on for this research and is hindered by the restrictions placed upon it by the United States.

**Table 1. Top 10 Largest Technology Corporations 2021**

Country, and its {number of companies}	Sales, and its (%)	Market Value, and its (%)
	In US billion \$	
US {7}	906.8 (74%)	7281.3 (80%)
China {1}, Taiwan {1} and South Korea {1}	318.8 (26%)	1842.4 (20%)
Total	1225.6	9123.7

Data source: <https://www.forbes.com/sites/jonathanponciano/2021/05/13/worlds-largest-tech-companies-2021/>

Cybersecurity is a crucial area that both countries place high importance on. The internet and digital applications have been a topic of substantial debate within both countries. Privacy acts, abuse of networks, and consumer information are of concern. The United States has had much experience within the field. The country has showcased that it will not be complacent to this and is pushing for international standards for the United Nations and international organizations (Pell et al., 2022). China views cybersecurity as national security and ensures it has the appropriate technology to prevent cyber threats and hackers. Recently, tensions between China and the United States have increased after accusations of China using cyber espionage and theft of intellectual property (Reveron et al., 2020).

## 1.2 Economic competition

Both the United States and China are powerhouses in the global industry. Together they have spurred economic growth in various countries. Interestingly, despite the fierce competition (Wang et al., 2020), both companies have invested in each other's economy. China has invested in research methods and ownership of real estate in the United States. The United States, as mentioned previously, has invested in labor, production, and manufacturing. Therefore, despite competing, both countries have skin in the game. Recently, controversy revolving around the value of both countries' currencies has been mentioned. China has been accused of devaluing its currency while the United States supposedly inflates it. Because China's government has a strong presence in its market, other countries believe that the government can easily influence this value. Despite

this, China has removed restrictions on how it runs companies, and officials mention that the currency's value is based on its market.

The United States has had the leading largest economy in the world for many years. China became the second largest economy in the world in 2010. At this time, the Chinese economy was half the size of the United States' economy. However, in recent years, China has worked to increase its economy. It is now on track to overtake the United States' economy by 2027. When looking at different economic data points, it is very clear that China's economy is growing fast and catching up with the United States. In 2013, China became the world's trading nation. Through a variety of economic reforms that started in 1978, the Chinese has seen an increase in their economic and social development. The Chinese have strategically shifted its economic focus from industrial production to services.

The Gross Domestic Product values of both countries show a similar behavior. The United States for many years has had the largest leading GDP but the Chinese have slowly been looking to close the gap (Figure 1). The gap would be closing faster if it wasn't for rising domestic wages and competition from other Asian companies. Another large impact that has slowed the Chinese's GDP growth was the COVID-19 pandemic, which was originated in China.

While the Chinese continue to plow ahead and push their economy into the number one largest economy position, there will still be some challenges to overcome. The main challenge they face is due to environmental pollutants. The Chinese have been so focused on growing its economy that it has caused a major pollution problem. China will require significant changes in their waste management, investments in clean technology, and new pollution strategies to overcome this challenge.

### **1.3 Trade competition**

The United States and China have extremely tense relationships but also trade heavily with each other. The number one country the United States trades with is China. Once China and the United States normalized relation in 1979, trading between both countries increased significantly and even more so during the past two decades. Both countries have benefited widely from the increase in trading. China's economy has grown 5 times the amount it was when the two countries normalized relations (Salam, 2018). The United States has also seen benefits through increases in sales and access to the Chinese market.

The United States imports 41% more than it exports. China exports more than it imports but it is nearly equal with an only 20% difference. China primarily imports circuits and oils. The United States primarily imports the same two products, circuits and petroleum oils. The United States primarily exports petroleum oils. China primarily exports transmission apparatus and circuits. China primarily exports products to other Asia countries and Japan. The United States primarily exports to China.

Overall, China seems better positioned in the world trade environment. The United States has a very high negative trade balance since they import more than they export (Table 4). China has also benefited more from the trading than the United States since the agreement in 1979.

One reason for trade tension between the countries is the growing trade deficits. The fast and large growth of China has always been deemed a threat by the US government. For instance, in 2004, Walmart purchased \$18 billion in goods from China. The US has made allegations of China purposefully undervaluing its currency to gain unfair leverage in exporting. This could make the prices of the goods low and impossible for other countries to compete with pricing (Sherman, 2020). China was also alleged to steal cyber and intellectual property (Pena-Sanchez, 2013). Over the years, China has demanded the transfer of technology from the US to access China's market. The forced technology transfer makes US companies unhappy. In summary, since China entered the World Trade Organization (WTO) in 2001, its exports and GDP have steadily increased (Dollar, 2022).

## 2. OBJECTIVE

The objective of this essay is to estimate the leadership status that both countries have achieved in technological, economic and trade sectors:

*Technological* via sales and market value of the top 10 ranked corporations, where 7 of such companies are from US; for the *economic* area, the comparison is via their GDPs, and *commercial* through their exports and imports of goods and services.

## 3. RESEARCH HYPOTHESIS

There is a significant discrepancy among the average GDP distributions from 1990 to 2023 between the two countries:

$$H_{1a}: G_{US} \neq G_{China} \quad [1]$$

Thus, the corresponding null hypothesis takes the following notation:

$$H_{0a}: G_{US} = G_{China} \quad [2]$$

In other words,  $H_0$ : The average *GDP distributions* ( $G$ ) are the same for both countries during 1990-2023.

There is a significant discrepancy among the Export-Import average distributions from 1990 to 2023 between both countries:

$$H_{1b}: W_{US} \neq W_{China} \quad [3]$$

So, the corresponding null hypothesis takes the following notation, where the mean *difference distributions* of Exports-Imports ( $W$ ) are the same for the two countries during 1990-2023.

$$H_{0b}: W_{US} = W_{China} \quad [4]$$

## 4. DATA, METHODOLOGY AND RESULTS

In this essay, we conduct an exploratory empirical study to provide evidence on leadership status between US and China about three areas: Technology, economy, and trade. The research is supported by secondary type data collected from financial reports, articles, and commercial information:

<https://data.worldbank.org/data-catalog/world-development-indicators>

<https://data.worldbank.org/indicator/NY.GDP.MKTP.PP.CD?locations=US>

<https://data.worldbank.org/indicator/NY.GDP.MKTP.PP.CD?locations=CN>

<https://data.worldbank.org/indicator/NE.EXP.GNFS.CN?locations=US-CN&skipRedirection=true&view=map>

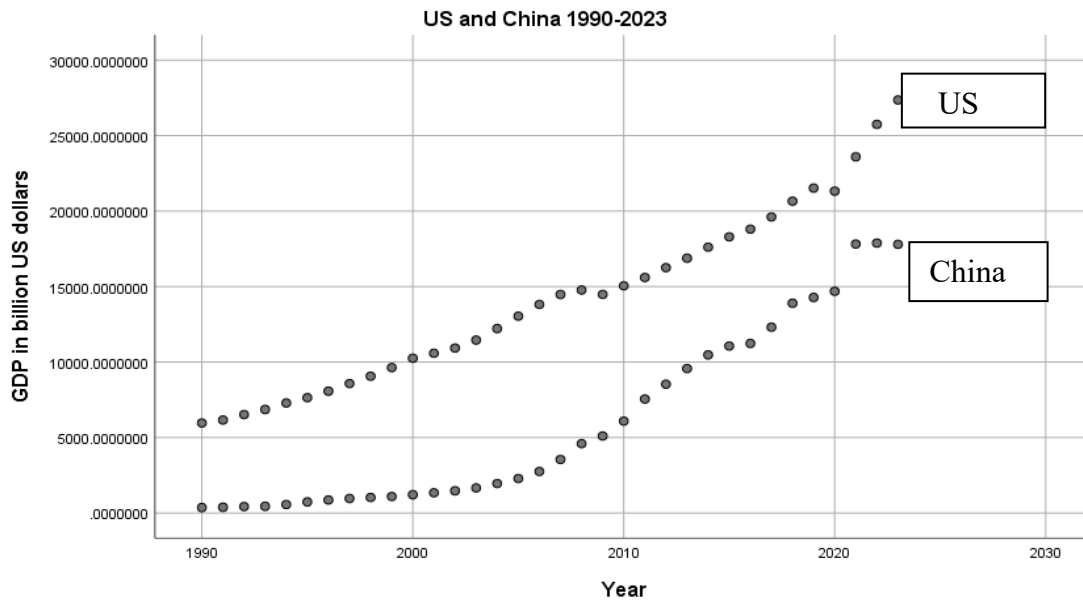
<https://www.forbes.com/sites/jonathanponciano/2021/05/13/worlds-largest-tech-companies-2021/>

Where the world bank provided consecutive annual records from 1990 to 2023; since ever, China's GDP has not exceeded the US's GDP; the evidence is shown in Figure 1.

At the end of 2023, China reached a GDP of \$17,794,781,986,104.5 US dollars, a value that is close to the level \$20,000 billion in Figure 1, meanwhile for the same year US was \$27,360,935,000,000 above the level \$25,000 billion, which represents an estimated average difference of \$9,566.15301389554 billion US dollars in favor of US.

Descriptive statistics and the corresponding analysis of variance (ANOVA) for the data contained in Figure 1 appear in Tables 2 and 3 respectively.

**Figure 1. GDP in US billion \$ for US and China 1990-2023**



Data source: <https://data.worldbank.org/indicator/NY.GDP.MKTP.PP.CD?locations=US>  
<https://data.worldbank.org/indicator/NY.GDP.MKTP.PP.CD?locations=CN>

**Table 2. Descriptive statistics: GDP for US and China**  
 GDP in billion US dollars

Country	Mean	n	Std. Deviation
US	14120.233	34	5874.813
China	6057.838	34	5972.855
Total	10089.034	68	7145.875

**Table 3. ANOVA: GDP for US and China**

Source of Variation	Sum of Squares	degrees of freedom	Mean Square	F	p-value
Between countries	1105036947.2	1	1105036947.2	31.49	<0.001 (Reject H <sub>0a</sub> )
Within countries	2316220001.4	66	35094242.4		
Total	3421256948.6	67			

Dependent variable: GDP in billion US dollars.

The data below supported the trade argument that China is better positioned in the world’s trade environment due to its ability to export such large economic amounts compared to the United States.

**Table 4. Descriptive statistics: Difference (exports-imports) in US \$**

Country	Exports-Imports: Mean	n	Std. Deviation
US	-458984558823.5	34	275429115620.7
China	+161387305431.9	34	153677919383.9
Total	-148798626695.8	68	382946521545.3

Data source: <http://data.worldbank.org/data-catalog/world-development-indicators>

**Figure 2. Difference (exports-imports) in US dollars 1990-2023**



Data source: <https://data.worldbank.org/indicator/NE.EXP.GNFS.CN?locations=US-CN&skipRedirection=true&view=map>

In other words, the commercial activities of US and China 1990-2023 appear in Table 4, where the average difference between exports and imports for each country over time indicates that China has shown positive differences, while the US has generated only negative differences (Figure 2).

**Table 5. ANOVA: Difference (exports-imports) for US and China**

Source of Variation	Sum of Squares	degrees of freedom	Mean Square	F	p-value
Between countries	6542641249316116•10 <sup>9</sup>	1	6542641249316116•10 <sup>9</sup>	131.54	<.001 (Reject H <sub>0b</sub> )
Within countries	3282777321048763.3•10 <sup>9</sup>	66	49739050318920.66•10 <sup>9</sup>		
Total	9825418570364880•10 <sup>9</sup>	67			

Dependent variable: Difference=Exports-Imports (of goods and services in US dollars)

### 5. CONCLUSIONS

Overall, the tension between both countries is felt across the world. China’s rapid rise in technology, trade, and economy has made the United States uneasy. At present time, Figure 1 generates the conclusion that since ever US reached the leadership in economy in terms of the GDP, proving that the US economy has been growing at a rapid rate; so, In technology, Table 1

is evidence of the US leadership in the technology sector in terms of sales (74%) and market value (80%) of the 10 largest technology corporations, where 7 of these companies are from the United States. About the trade competition (Wang et al., 2020), both countries complete a significant amount of trading around the world; but China is better positioned due to its ability to export more than it imports, which is confirmed in Table 4. Therefore, although the United States has been seen in the past as the leading country around the world, when reviewing these three main sectors (technology, economy and trade), it is evident that China is catching up and seeking to overtake the United States, and according to the data analysis of this essay, China is close to achieving it. Thus, with the previous statements presented in this essay, we can conclude that the research objective of this paper has been achieved: The leadership of US remains in two sectors: Technology and economy, meanwhile in the trade sector the headship belongs to China, the evidence is in Figure 2, which is one of the most important contributions of this report; furthermore, with respect to the economic sector, it is important to note that we did an analytical verification of the difference in GDP means between both countries using the ANOVA technique, which was significant at an alpha level of 0.01 (p-value < 0.001 in Table 3, which permits the rejection of the null hypothesis  $H_{0a}$  at alpha=1%). Similarly, the analysis of variance for the data contained in Figure 2 generates a p-value less than 0.001 (Table 5, where  $H_{0b}$  is rejected at alpha=0.01) confirming the leadership status of China in global trade activities measured as the difference between exports and imports of goods and services in US dollars.

We hope this article will provide motivation to research this topic to assess how new worldwide events in technology, economy, commerce, education, health (epidemics and pandemics), illegal drug production abroad (methamphetamine, fentanyl, etc.), proliferation of nuclear weapons, war conflicts, global digital blackouts, uncontrolled population growths, new trade agreements and/or political alliances with other countries, rotation of political leaders who govern in (democratic and/or authoritarian) countries, etc. could influence the leadership status of the two titans of world geopolitics: The United States and China in the short, medium and long term.

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