Trade Wars: Impact of Interdependence and Asymmetry in Economic Relations on their Outcomes

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Abstract
The paper is concerned with the asymmetry in the economic relationship between the United States of America (USA) and the People's Republic of China (PRC), focusing on the implications of their trade war. The objective is to predict which nation could withstand greater economic pressure and potentially win a severe trade confrontation. Employing a multifaceted approach, the study utilizes the Sectoral Hirschmann index, Regional Hirschmann index, Marginal Propensity to Import (MPM), and Import Penetration index to analyze trade dynamics. The results have shown the increase of China's export diversification, as evidenced by its Sectoral Hirschmann index with a downward trend, as well as its significantly lower Regional Hirschmann index, indicating that China is actively seeking to penetrate various international markets, reducing reliance on the USA. Conversely, the USA exhibits a stable, diversified export structure, but its trend of index shows a growing concentration in certain sectors. China's high import penetration index reflects its dependency on imports, typical of its role in the global supply chain, while the USA's lower index suggests strong domestic production. The findings suggest that the USA is more independent in absolute terms, but in terms of trends, China's proactive economic strategies post-trade war have been more effective, and, if the trends persist, the USA risks losing the trade war in the future. The author concludes by emphasizing the importance of trade diversification for nations to enhance resilience against geopolitical and economic uncertainties.
Keywords: Trade War, Asymmetry, Economic Pressure, Trade Diversification, USA, PRC

Торговые войны: влияние взаимозависимости и асимметрии в экономических отношениях на их результаты

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Аннотация
Статья сосредоточена на асимметрии экономических отношений между Соединенными Штатами Америки (США) и Китайской Народной Республикой (КНР), в контексте продолжающейся между ними торговой войны. Цель — предсказать, какая нация способна, согласно последним доступным на момент написания статьи данным, выдержать большее экономическое давление и потенциально выиграть при серьезной торговой конфронтации. Применяя многофакторный подход, статья задействует секторальный и региональный индексы Хиршмана, Маржинальную склонность к импорту и проникновение импорта для анализа торговой динамики. Результаты выступают индикатором идущей диверсификации экспорта со стороны Китая, в пользу чего свидетельствуют негативный тренд секторального индекса Хиршмана и значительно меньший региональный индекс Хиршмана, демонстрирующий активное проникновения Китая на различные международные рынки, снижая опору на США. Напротив, США показывают стабильную и диверсифицированную структуру экспорта, но тренд индексных показателей отображает растущую концентрацию в определенных секторах. Высокое проникновение импорта в китайской экономике отражает ее зависимость от импорта, типичную для такой роли в мировой производственной цепи, в то время как меньшие показатели этого параметра у США отражают развитое местное производство. Результаты исследования указывают, что США — более независимая в абсолютных значениях сторона, однако, с точки зрения обнаруженных тенденций, проактивные экономические стратегии торговой войны КНР оказались эффективнее, и, если тренд сохранится, США рискуют проиграть в торговой войне в будущем. Сопутствующий вывод: диверсификация в торговле имеет большое значение для любой

нации, повышая ее устойчивость в условиях геополитической и экономической неопределенностей.

Ключевые слова: торговая война, асимметрия, экономическое давление, торговая диверсификация, США, КНР.

I. INTRODUCTION

In this survey we present the analysis of asymmetry in economics of trade partners that can lead to fatal disability of one side to support a stable inner economy without its trade partner. Asymmetry between countries engaging in trade wars makes it easier for one side to win for harder for the other side not to lose, and while the more collisions will come, the more severe trade wars can be expected. In this situation it's rational to try to predict which side is about to win if the most severe trade war that can possible be starts just now, and to choose the strategy. The most severe trade confrontation can be predicted between two modern leader countries, such as United States of America (USA) and People's Republic of China (PRC), which already started to engage in trade war and which have a high level of interdependence, harming every side of conflict during the happening escalations. The Sino-American trade conflict was started in March 2018 by American government of president Trump and led to a series of bilateral hostile economic actions. The conflict hurt both countries. Only in first two years Gross Domestic Product of USA and PRC decreased by −1.35 % and −1.41 %, respectively [10]. Even after such consequences conflict hasn't stopped, and next American President, Joe Biden, continued the trade policy of former president. At the time of writing this article there was no signs of cancelling such a trade policy by president Trump, who returned to his president's seat. This economic conflict can't be overlooked by scientists and needs to be analyzed, and this article is an invitation for discussion about asymmetry side of USA and PRC trade wars that may be even the most important factor in future stages of mentioned economic confrontation. We will try to find out if any side of this trade conflict may endure higher level of economic pressure, being able to win the possible hardened trade war, or not, and if this country is USA or PRC. For the sake of accuracy, the article contains analysis of data provided by complex of methods, which can show the real situation from different sides and provide in sum a more relevant picture of abilities and disabilities of USA and PRC in possible hardened competition.

II. THEORETICAL FRAMEWORK

Since the beginning of Sino-US trade war there was a lot of works, measuring the effects of ongoing confrontation and abilities of opponents. Computable General Equilibrium (CGE) models were most popular method. For example, some valuable numbers were provided in 2022 [10]. They showed the fall of world GDP due to confrontation and recommended import substitution, which should be the most effective for PRC. A lot of other scientists used different CGE models too. There are both results showing potential bigger PRC resilience [4; 3] and that US will suffer less [1]. One such article was devoted to international agreements and their impact, saying that Asia should benefit a lot, withstanding the trade war [13]. Some other collectives of authors used the standard trade model, and their results are contradictory too: both high negative consequences after even announcements of measures [6] and denial of important consequences [7]. Between other chosen methods there are

scenarios [14; 11], Trade Policy Uncertanity (TPU) [2] and geographic relational perspective [9]. One group of authors predicted big changes in world trade and bipolar world [11], while scenarios suggested in 2018 told about decoupling with USA and lasting global recession [14]. Article about TPU described negative impact of TPU on both counties, suggesting ways to fight this side of trade war [1]. Collective who chose to use geographical methods found possible parameters that can describe regions resilience: percentage of foreign firms in regions exports and if such a region is specialized on high-value-adding exports [9]. Articles, which were written in Russian, touched upon the trade war issues differently with their own conclusions. For example, one specialist defined the American sanctions injurious for PRC, but came to conclusion, that USA and PRC will come to agreement eventually [5]. Another article in the same year stated that possible agreement won't resolve the problems that started the war, predicting that conflict will last longer [4]. Some specialist looked from Russian perspective: professor Gordienko analyzed the Sino-American interdependence and history of trade war and suggested to cooperate with whether USA or PRC due to opening perspectives [8]. We will try to provide new review of trade war by analysis of four different criteria, that wasn't used in any of these articles.

III. METHODS

1. Sectoral Hirschmann index

The Sectoral Hirschmann index is used to reflect the degree of concentration within a country's or a region's exports across different industries. The mathematical formula is as follows[5]:

$$SH = \sqrt{\sum_i \left[\frac{\sum_d x_{isd}}{\sum_d X_{sd}}\right]^2}$$

The value interval is between 0 and 1, with 1 indicating that only one product is exported, which refers to a high degree of concentration. Vice versa, values closer to 0 suggest a more equal distribution of market shares among export industries.

2. Regional Hirschmann index

The Regional Hirschmann index serves as an indicator of the geographical distribution of exports. It assesses the extent to which a region or nation's exports are spread across various destinations. The mathematical formula is as follows[6]:

$$SH = \sqrt{\sum_d \left[\frac{\sum_s x_{sd}}{\sum_{sw} X_{sw}}\right]^2}$$

Similar to SH index, RH index also ranges from 0 to 1, with higher values signifying a concentration of exports in a limited number of markets.

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[5] Where, **s** represents the country of interest, **d** denotes the set of all countries globally, **i** signifies the specific sector of interest, **x** indicates the export flow of the commodity, and **X** represents the overall export flow. Each term within the brackets reflects the proportion of good **i** within the exports of countrys.

[6] Where, **s** represents the set of source countries being examined, **d** denotes the set of destination countries, **w** signifies the comprehensive set of countries globally, and **X** indicate the bilateral export flow from the source to the destination. Our objective is to aggregate the data across all destinations, thus ensuring that the sets **d** and **w** encompass identical elements.

3. Marginal Propensity to Import

Marginal Propensity to Import (MPM) quantifies the responsiveness of imports to income changes, calculated as the ratio of the change in total imports to the change in GDP over a specified period, usually one year. It can be expressed as follows[7]:

$$\frac{\Delta \sum_s M_{sd}}{\Delta GDP_d}$$

Meanwhile, the MPM can also function as an essential indicator for evaluating a nation's dependency on imports. A higher MPM indicates greater dependency on foreign goods for economic activities.

4. Import Penetration

The import penetration index shows how much domestic demand (which is found by subtracting net exports from GDP) is filled by imports. It's defined as the ratio of total imports to domestic demand, which can be expressed as follows[8]:

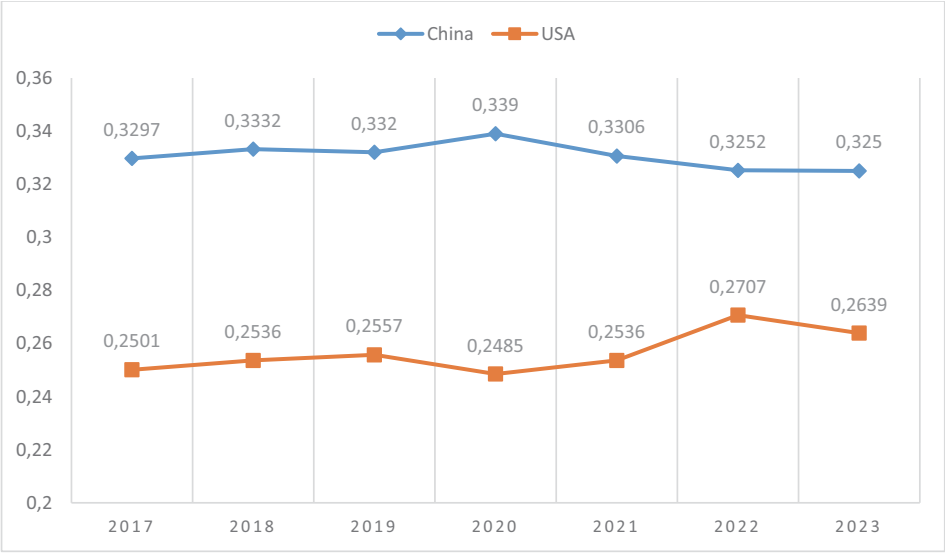
$$\frac{\sum_s M_{sd}}{GDP_d - \sum_s X_{ds} + M_{sd}} \times 100$$

Additionally, import penetration is a direct reflection of a country's dependency in the area of trade. Increased import penetration signifies greater dependency on imports for the specific product or industry.

IV. RESULTS

1. Sectoral Hirschmann index

***Chart 1*: Sectoral Hirschmann index of China & America (2017–2023)[9] (compiled by the authors)**



[7] Where **d** is the country under study, **s** is the set of all other countries and **Δ** is the change operator, while **M** is total bilateral imports and GDP is gross domestic product (of country **d**). The values range from 0, indicating no additional GDP is directed to imports, to 1, where the entire GDP increase is spent on imports.

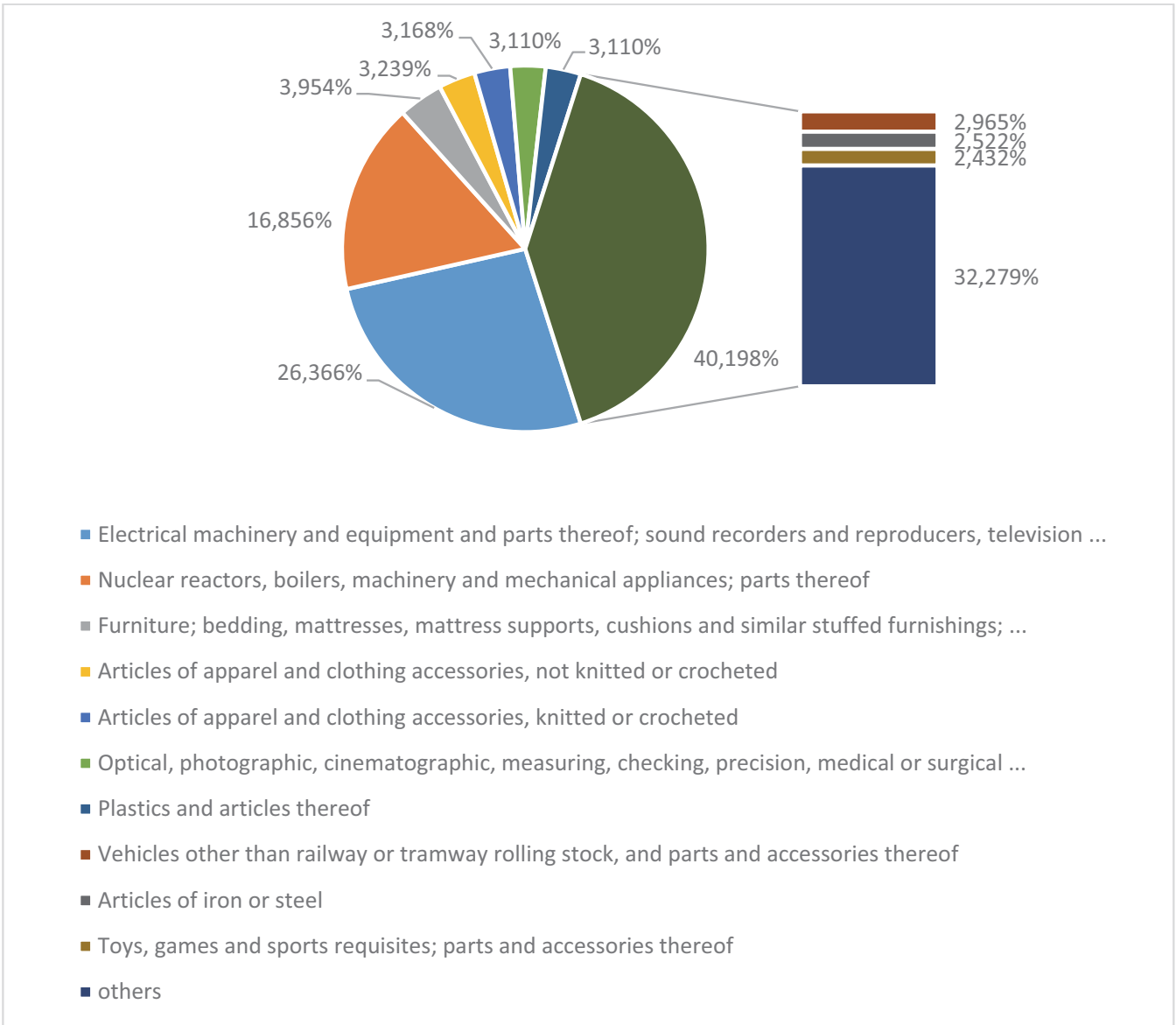
[8] Where d is the country under study, s is the set of all other countries and X is total bilateral exports, while M is total bilateral imports and GDP is gross domestic product (of country d). Its values range from 0%, indicating complete domestic production with no imports, to 100 %, where all domestic demand is met exclusively through imports, with no domestic production or exports.

[9] Source: TRADE MAP URL: https://www.trademap.org/ (Visit date: 20.11.2024)

China's SH index shows a slight increase from 2017 to 2020, indicating a slight increase of concentration in certain sectors during that period. However, from 2020 onwards, the index decreases. In general, China's SH index dropped by 0.0047 from 2017 to 2023. This minor decrease suggests a gradual diversification of China's export over this period. The trend in the SH index indicates that China is progressively overcoming the impacts of the trade war.

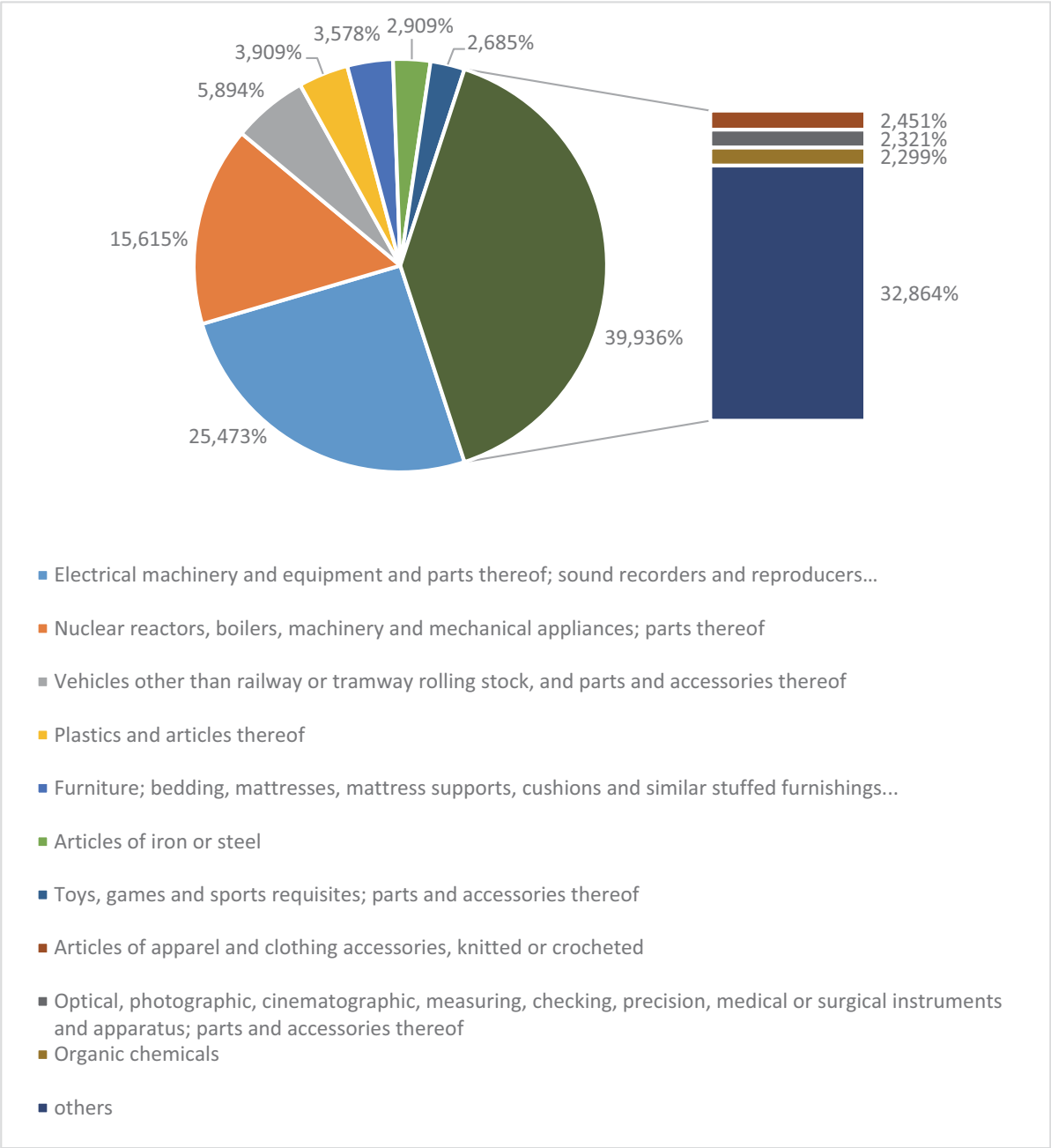
The same conclusion can be drawn from the major export product share. China's first and second largest export products remain unchanged in 2017 and 2023, but their total proportion falls from 43.2 % to 41.6 %. The gap between the top five exported products narrows, reflecting a more diversified export product structure. In addition, the share of vehicle exports rises significantly, from 2.96 % in 2017 to 5.89 % in 2023, ranking third in China's export, while less technological products like furniture have seen a decline, indicating a shift towards a more technology-oriented export structure.

***Chart 2*: Major Product Share of China's Exports (2017)[10]**
(compiled by the authors)



[10] Source: TRADE MAP URL: https://www.trademap.org/ (Visit date: 20.11.2024)

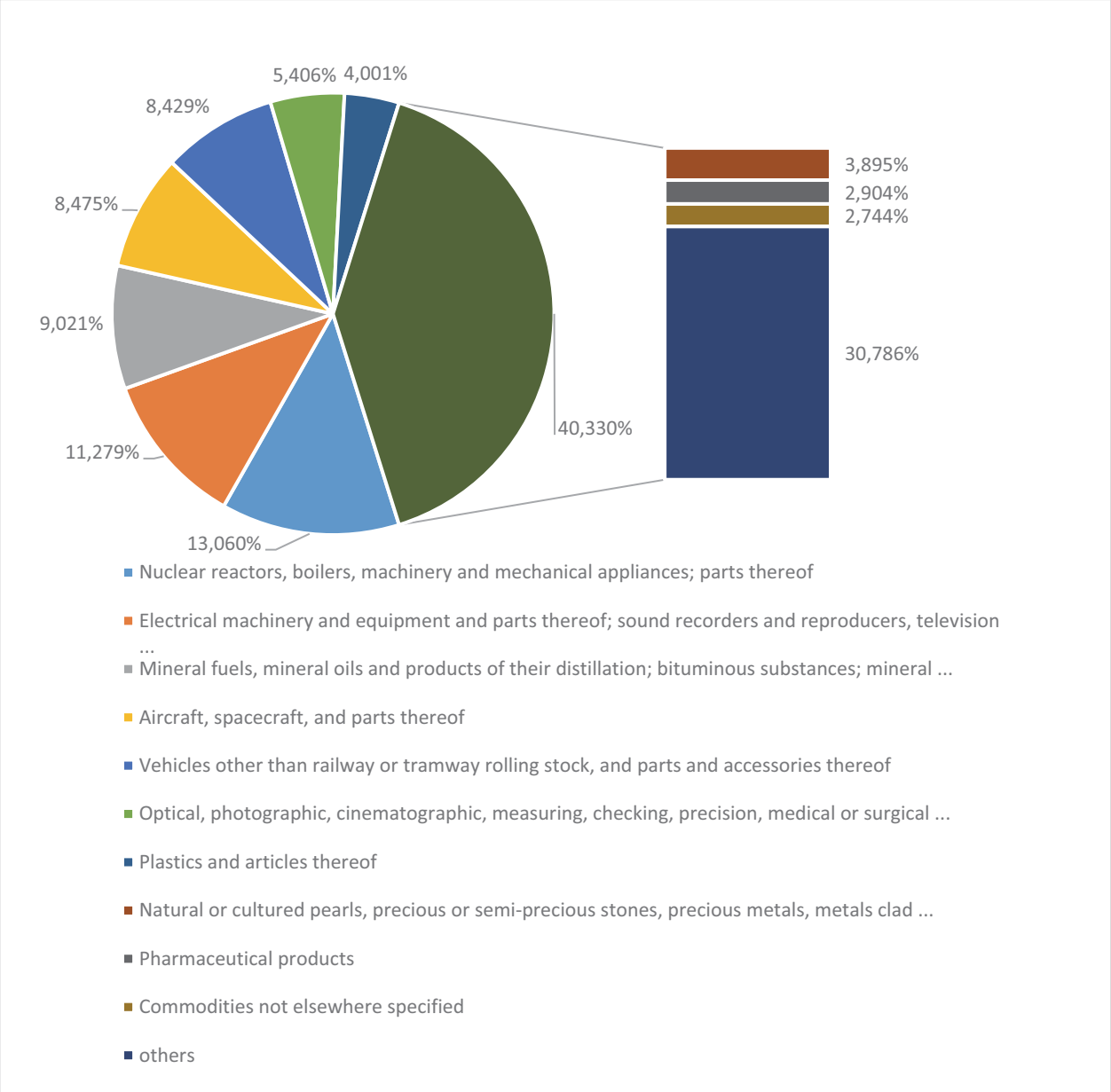
***Chart 3*: Major Product Share of China's Exports (2023)[11] (compiled by the authors)**



For the USA, the SH index demonstrates a relatively stable pattern around 0.25 from 2017 to 2021. Over the span of 2017 to 2023, there is an increase of 0.0138. The sustained low level of the USA SH index signifies a broad and varied export portfolio, which typically confers resilience against market volatility. However, the pronounced fluctuations observed between 2021 and 2023, coupled with an overall upward trajectory in the index, suggest a growing concentration in certain export sectors. For example, from 2017 to 2023, the share of the top two exported products increases from 24.339 % to 27.545 %. Notably, in 2023, crude oil is poised to become the largest export commodity for USA for the first time in history. Against a backdrop of increased global economic uncertainty, this means that price volatility in the international oil market is likely to have a greater impact on the USA economy.

[11] Source: TRADE MAP URL: https://www.trademap.org/ (Visit date: 20.11.2024)

***Chart 4*: Major Product Share of America's Exports (2017)[12] (compiled by the authors)**



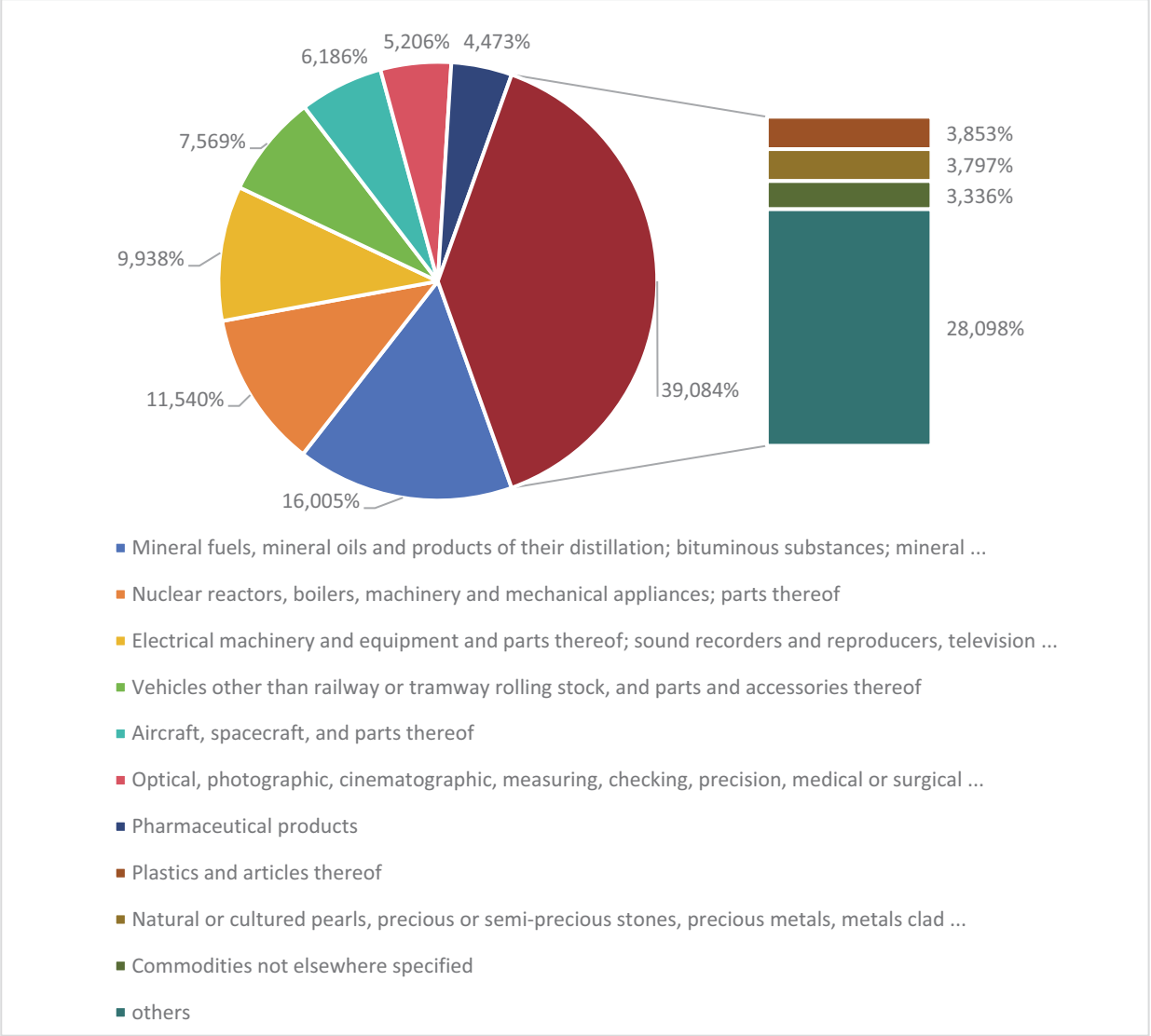
When examining the absolute size of the SH Index, it's evident that China's export concentration is generally higher than that of the USA. This is particularly noticeable when considering the top two product categories in China's exports, which contribute to a significantly larger share of the total exports compared to their counterparts in the USA. This disparity in concentration suggests that China's export landscape is more reliant on a smaller number of sectors. If the USA impose sanctions to these sectors, China's export would be influenced.

From the perspective of trend, China's SH index has generally exhibited a downward trajectory, whereas the USA SH index has shown an upward trend. The greater fluctuation of the USA SH index also suggests that the structure of the USA export economy is less stable. Throughout this period, the trade war has imposed significant challenges on the economies of both countries, compounded by the effects of pandemics, the subsequent global supply chain crisis, and rising geopolitical tensions. The decline in China's SH index amidst these adverse

[12] Source: TRADE MAP URL: https://www.trademap.org/ (Visit date: 20.11.2024)

conditions suggests that the country is proactively pursuing changes and transformations in its export structure, and is beginning to see positive outcomes.

***Chart 5*: Major Product Share of America's Exports (2023)[13] (compiled by the authors)**



2. Regional Hirschmann index

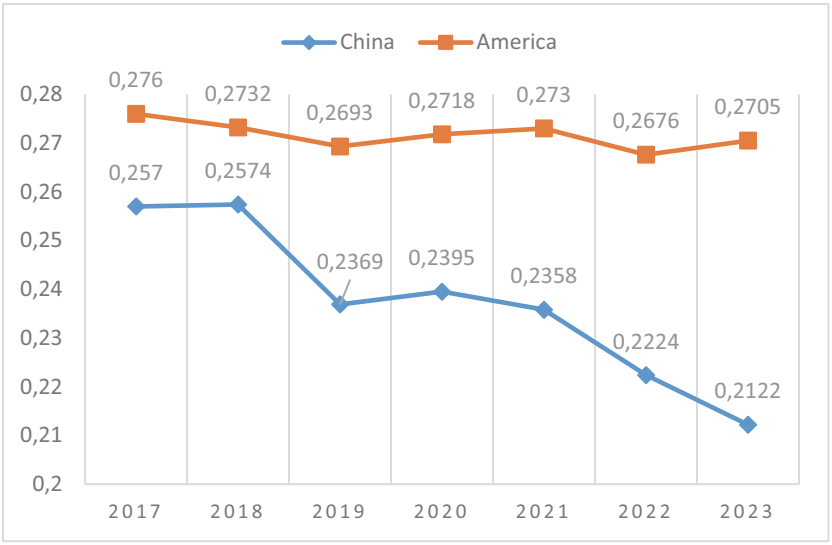
Numerically, China's RH index is lower than that of the US in every year, with a median level of 0.2369, while the median level of the index in the United States is 0.2718. This suggests that China has a more balanced and diverse export market.

In terms of the trend of change, China's RH index delineates a pronounced downward slope, with a notable plunge occurring from 2018 to 2019, indicating that China has been proactively venturing into alternative international markets beyond the USA. Despite the pandemic's influence, which kept China's RH index relatively stable at around 0.237 from 2019 to 2021, a consistent decline is observed from 2022, down to 0.2123 in 2023. For example, in 2023, China's exports to ASEAN account for 15.53 % of the total, overtaking the United States as China's largest export partner. Conversely, the USA, whose RH index has little change in general, fluctuates around 0.27 in 2017–2019, shows a slight downward

[13] Source: TRADE MAP URL: https://www.trademap.org/ (Visit date: 20.11.2024)

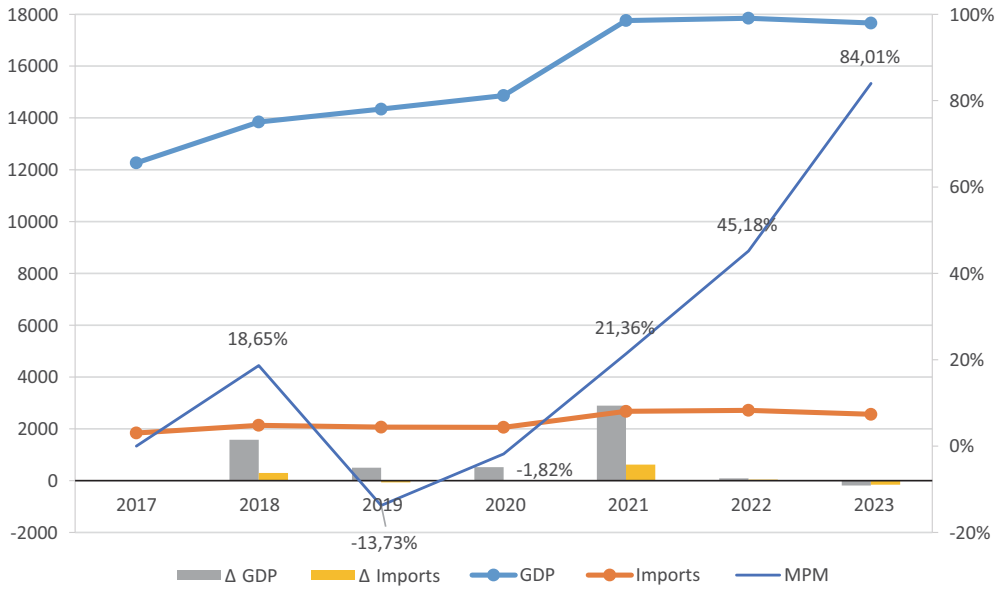
trend then an upward trend due to the impact of the epidemic and peaks at 0.273 in 2021, the highest level since the outset of the trade war. In the post epidemic era, the U.S. RH index floats with erratic changes. In 2017, the disparity in the RH index of the two countries is 0.019, and widens to 0.0583 in 2023. This indicates that China has implemented more effective measures to navigate the trade war, and relies on the U.S. market to a lesser extent.

***Chart 6*: Regional Hirschmann index of China & America (2017–2023)[14] (compiled by the authors)**



3. Marginal Propensity to Import index

***Chart 7*: Trade and Production Data for China (2017– 2023) (billions of US dollars)[15] (compiled by the authors)**

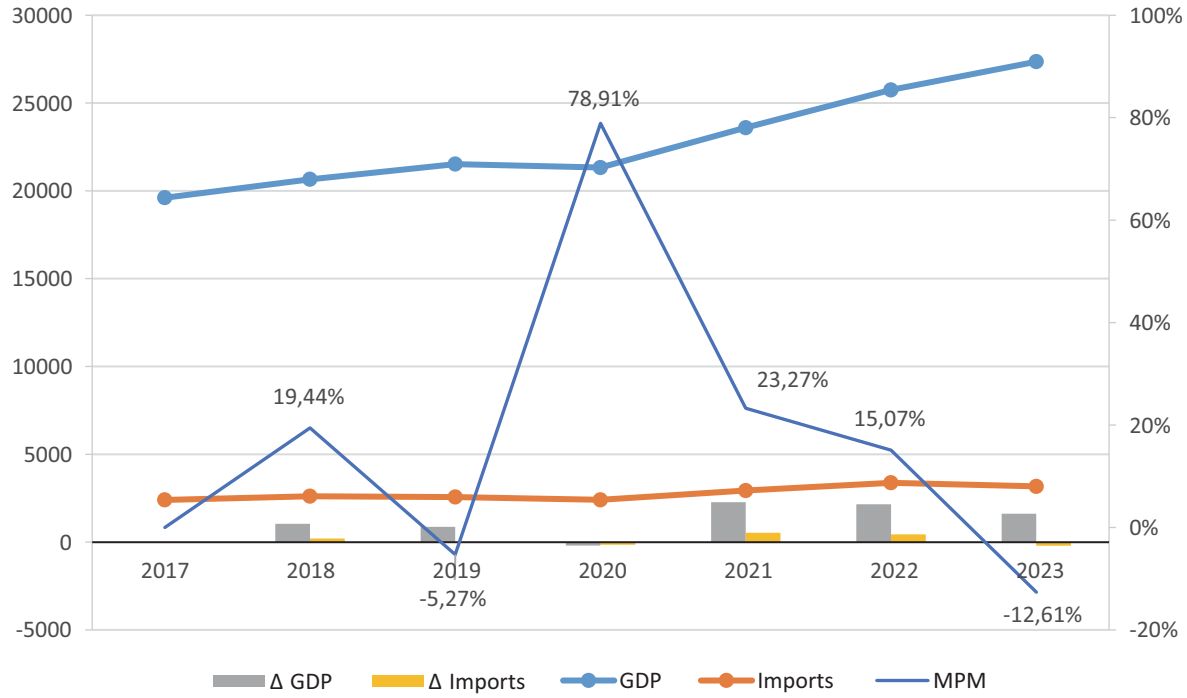


[14] Source: TRADE MAP URL: https://www.trademap.org/ (Visit date: 20.11.2024)

[15] The GDP data is from the World Development Indicators (WDI), while the trade data is from COMTRADE. The same goes for the data sources for the tables in the following content.

Chart 7 indicate that China reached its minimum in 2019, marking the first negative figures. Imports fell despite modest GDP growth, likely because trade tensions prompted firms to adopt import substitution strategies and reduce dependency on US imports. Additionally, domestic industrial restructuring enabled localization of certain products, further decreasing import demand. In 2020, the decline in imports continued slightly, affected by the pandemic's disruption of global supply chains. Then, the MPM remained stable until 2021, showing a gradual increase with minor fluctuations in 2022. Notably, the MPM in 2023 is 0.8401, indicating a significant level. Despite a slight GDP contraction, the drop in imports is more pronounced, suggesting a reduced reliance on imports during economic downturns.

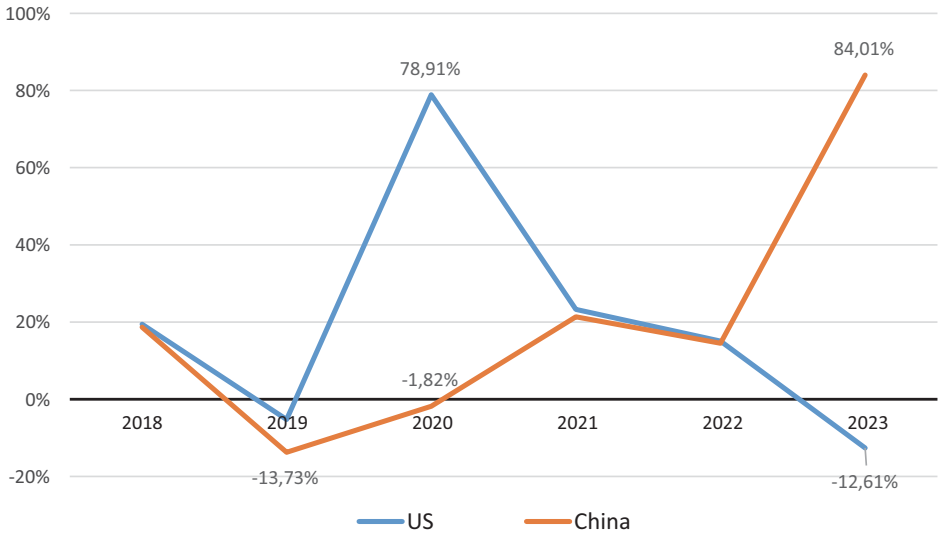
***Chart 8*: Trade and Production Data for the USA (2017-2023) (billions of US dollars) (compiled by the authors)**



Since 2017, the US has seen peak import prices, with the MPM declining annually into negative territory by 2019, signaling lower import prices. This trend aligns with global supply chain dynamics and monetary policy. In 2020, the MPM rebounded due to the pandemic, indicating increased import prices, while a slight decline occurred in 2021, though it remained positive. Moving into 2022–2023, GDP growth slowed down, accompanied by a deceleration in import growth. By 2023, briefly affected by the global trade environment and dollar fluctuations, the MPM returned to negative territory, revealing an atypical relationship where imports did not align with GDP changes. Internal structural shifts within the US economy may have impacted import dynamics, such as the rise of domestic industries substituting imported goods or shifts in consumer and business demand.

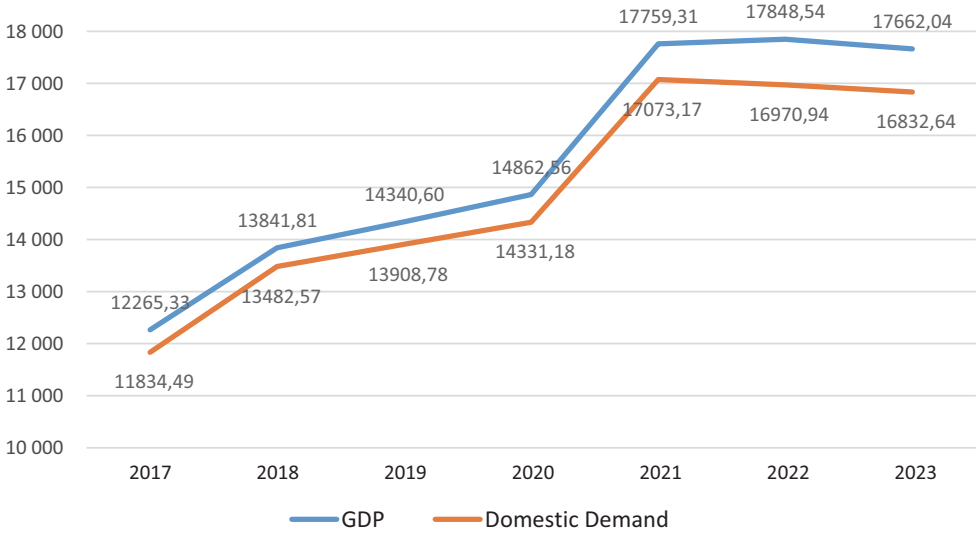
In the early years, particularly in 2018, the MPM for both were relatively aligned, suggesting a degree of similarity in their import behaviors. However, significant divergences emerged over time. In 2019–2020, China's MPM expressively declined, while the US experienced a modest decrease followed by a remarkable rebound in 2020. After that, both nations reported positive import values, though with differing magnitudes. By 2023, the US index reverted to negative, while China's remained positive and reached a peak.

***Chart 9*: Comparison of Marginal Propensity to Import Index (2017-2023) (compiled by the authors)**



4. Import Penetration index

***Chart 10*: GDP & Domestic Demand Data for China (2017-2023) (billions of US dollars) (compiled by the authors)**



This period reveals a complex trajectory of alterations in China. In the short term, China's import penetration increased during 2017–2018 due to domestic economic growth driving consumption upgrades and prompting to import technology and equipment to enhance production efficiency and quality. In 2021–2022, as China's economy rebounded, enterprises resumed operations and increased imports to satisfy demand, aided by restored trade channels. During the 2019–2020 downturn, rising trade tensions increased import costs, driving firms to pursue domestic alternatives, while the pandemic disrupted global supply chains, prompting a shift to local resources. In 2022–2023, high inflation with other challenges weakened market demand and pressured China's exports, causing to scale

back production and imports, while domestic industrial restructuring fostered import substitution. Despite short-term fluctuations, long-term trends will likely stabilize and converge.

***Chart 11*: Exports and Imports Data for China (2017-2023) (billions of US dollars) (compiled by the authors)**

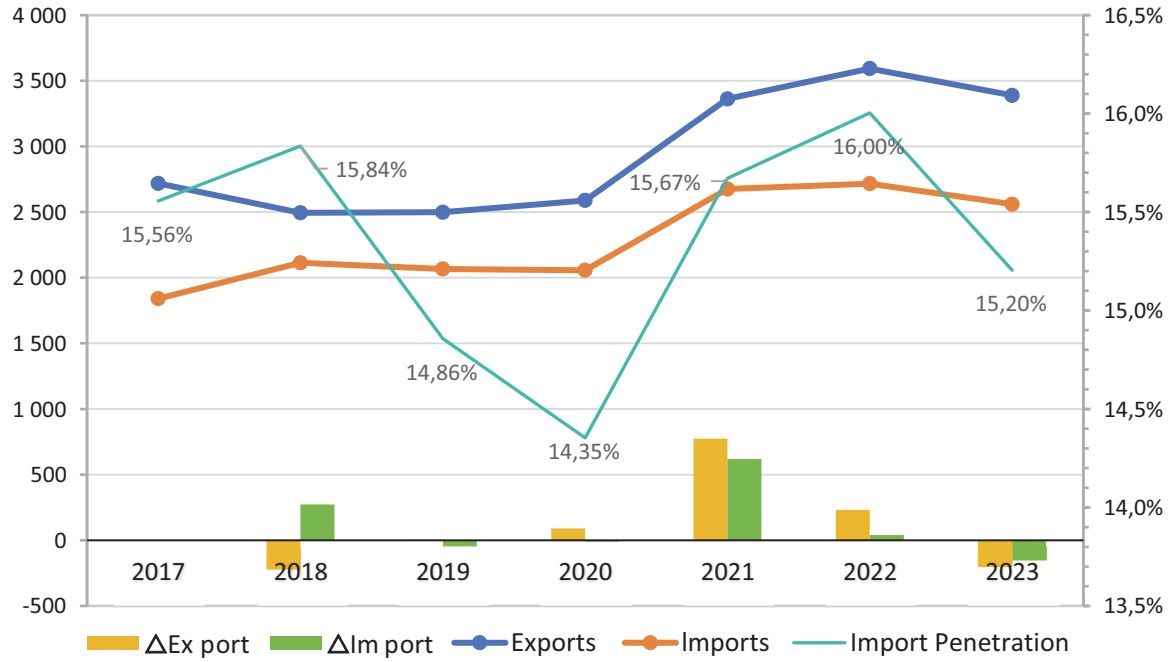


***Chart 12*: GDP & Domestic Demand Data for the USA (2017–2023) (billions of US dollars) (compiled by the authors)**

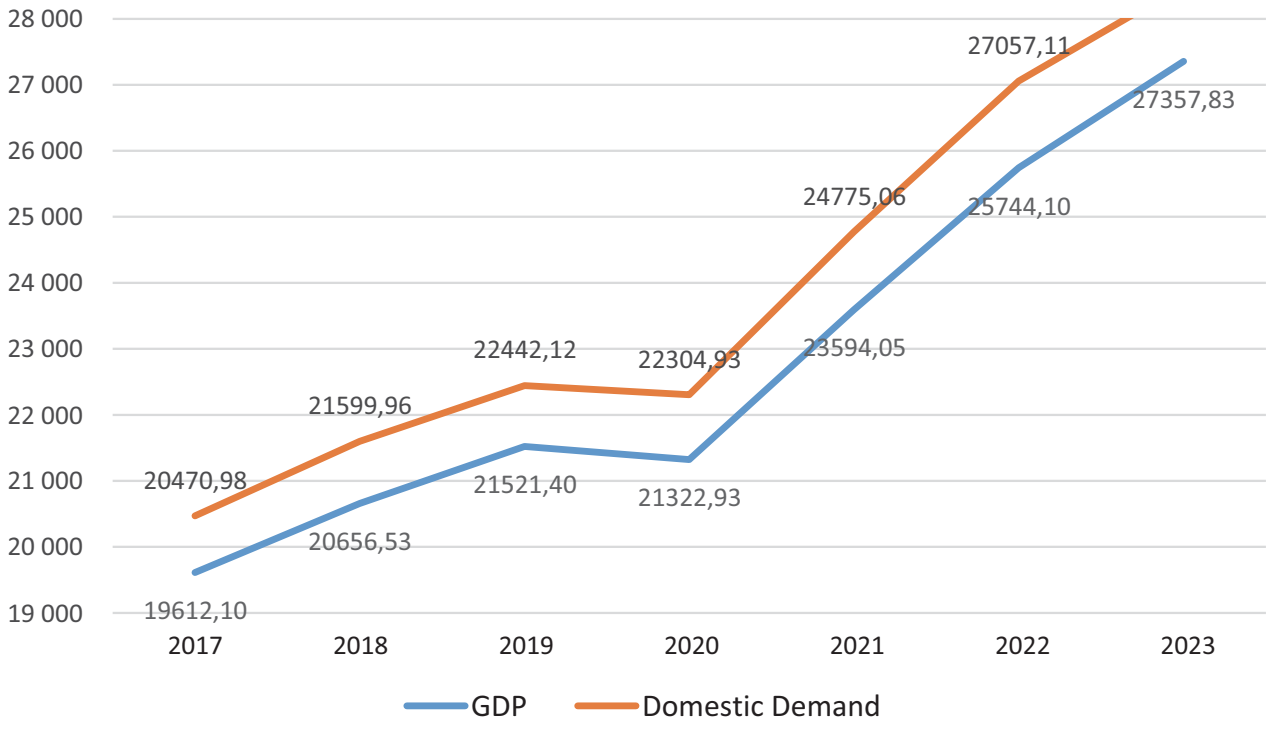
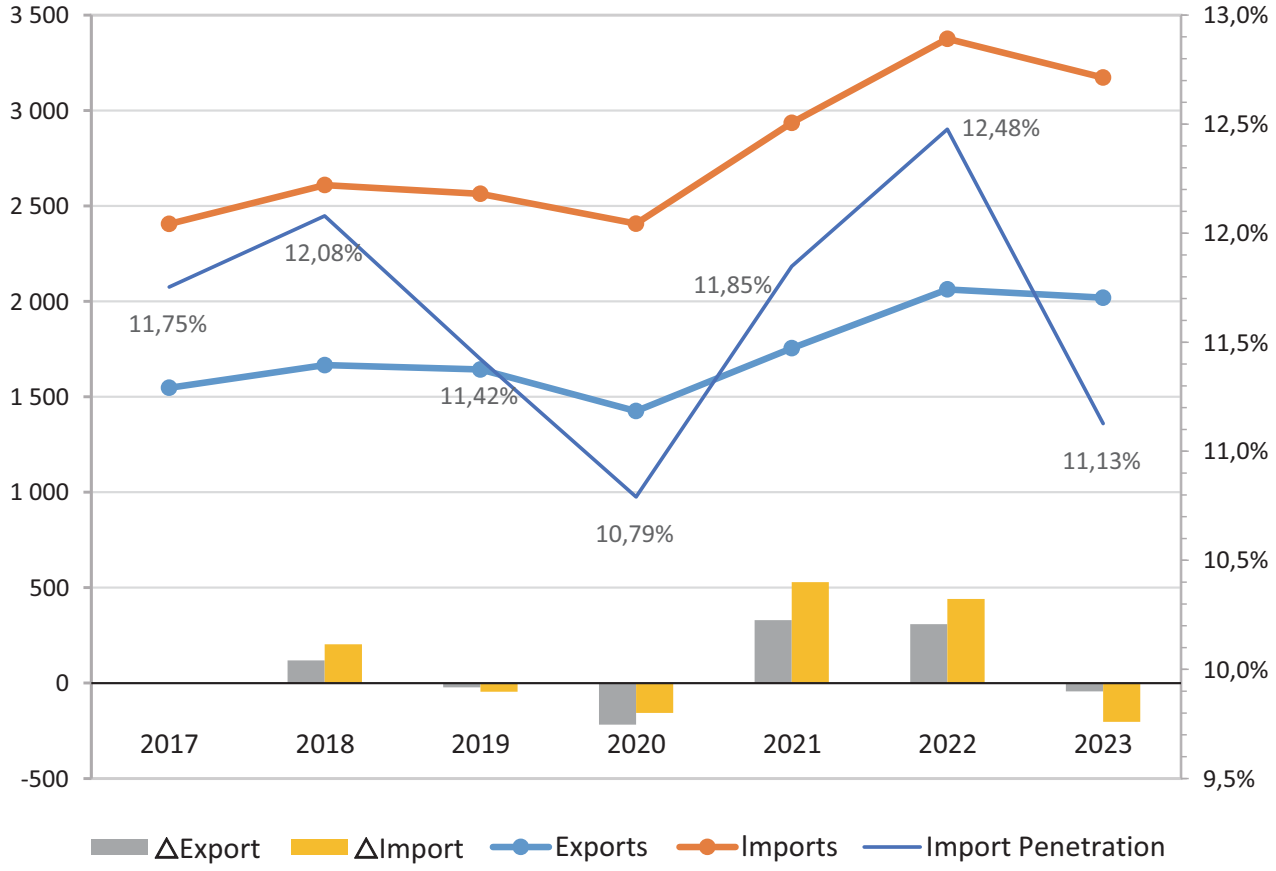


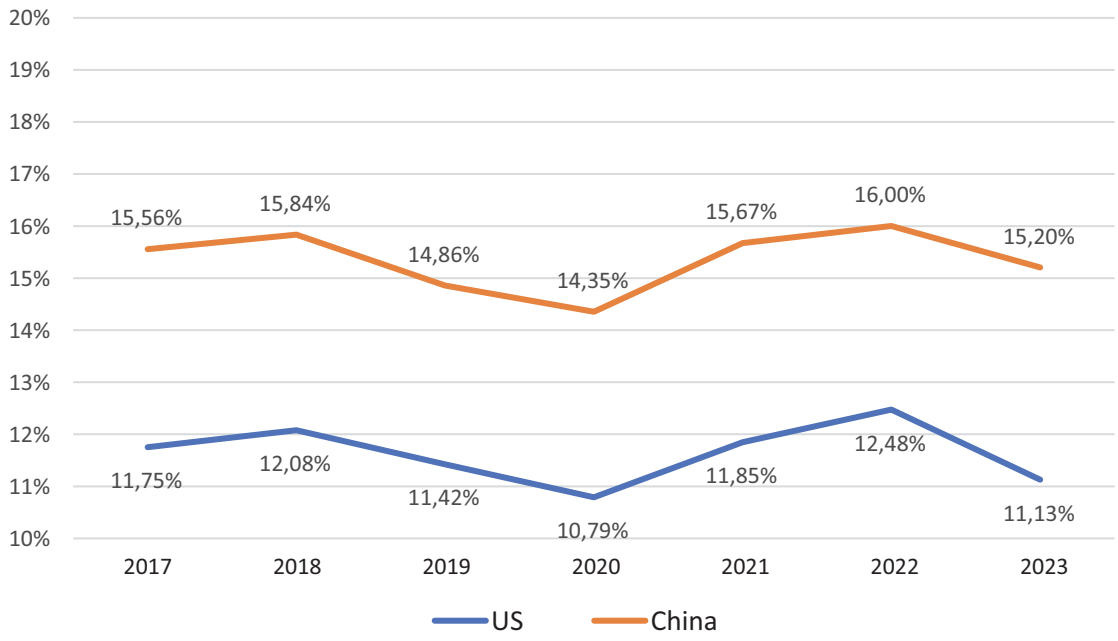
***Chart 13*: Exports and Imports Data for the USA (2017–2023) (billions of US dollars) (compiled by the authors)**



Starting at 11.754 % in 2017, it witnessed a gradual increase, indicating a growing dependency on imports to satisfy domestic consumption. However, a slight contraction occurred in 2019, suggesting a minor reduction in import reliance. The year 2020 experienced a significant drop, largely due to the pandemic-related disruptions and reduced import. Then, a recovery was evident with the index rebounding and it further surged in 2022 as the economy recovered and consumer demand heightened. In 2023, a slight decline was observed, potentially affected by changes in trade policy, increases in domestic production or shifts in consumer behavior. This data highlights the ongoing dependency of the US on imports with the index consistently remaining above 11 %, while illustrating the effects of economic fluctuations and global occurrences on import penetration.

From 2017 to 2023, China's import penetration index consistently surpassed that of the US, indicating a higher openness to imports and a greater degree of dependency on foreign goods in certain aspects. However, this dependency is not necessarily negative, which reveals China's active role in international trade and global economic integration. For example, as a major manufacturing country, its substantial demand for raw materials and intermediate goods results in significant import penetration. Conversely, the US's lower index suggests reduced import dependency, probably due to a more diversified domestic capacity that meets substantial demand, and US trade policies, particularly protectionism, curtail import inflows, further reducing the index. Meanwhile, trade asymmetry is apparent in China's high import penetration. This asymmetry stems from divergent trade policies and global economic conditions with China's liberalization promoting imports while US protectionism constrains them.

***Chart 14*: Comparison of the Import Penetration Index (2017-2023) (compiled by the authors)**



IV. CONCLUSION

The analysis of economic indicators reveals trade dynamics between China and the United States. China's high but declining Sectoral Hirschmann index indicates export diversification. The decreasing index shows efforts to penetrate various international markets, reducing reliance on specific regions, particularly the US. Conversely, the US maintains a stable but low Sectoral Hirschmann index with a diversified export structure that mitigates sector-specific shocks. Nonetheless, the recent increase in this index points to a growing reliance on certain export sectors. The US's lower import penetration index reflects strong domestic production to satisfy internal demand, yet it remains vulnerable to global trade volatility, as evidenced by pandemic-related disruptions. To conclude, in terms of absolute value, the United States is relatively more independent but in terms of prevailing trends, the economic strategies implemented by China post-trade war have demonstrated effectiveness, whereas the United States' development appears to be lagging. Hence, if this trend continues, the US risks losing its dominant position and will also be likely to lose the trade war in the future, given China's strong growth potential.

As mentioned before, the enduring dominance of the United States is under unprecedented challenges. The dynamic asymmetry between the United States and China is in a state of flux. China's increasing diversification in export sectors and markets suggests it is taking a proactive approach to reducing dependency on any single market, including the US. This strategy could lead to a more balanced trade relationship, where China is less susceptible to US trade policies and can negotiate from a position of strength. As a manifestation of anti-globalization, trade wars will only bring obstacles to the global flow of capital, commodities and human resources, which will not be beneficial to the long-term development of any country. We hope the strategic shifts in dependency levels will drive negotiations and shape the dynamics of trade policies in the future, restoring the principles of free trade to the international community. However, whether the trade war stops or not, it is imperative

for a nation to actively pursue a strategy of trade diversification, thereby diminishing its dependence on any single market and enhancing its resilience against geopolitical and economic uncertainties.

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