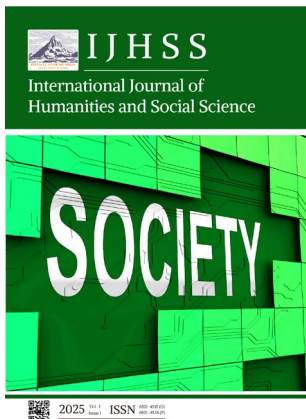*Article* **Open Access**

The COVID-19 Shock and Its Impact on China's Trade Flows: A Sectoral Data Approach

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Abstract: This study explores the significant impact of the COVID-19 pandemic on international trade flows, with a specific focus on sectoral differences in performance. By analyzing comprehensive trade data from 2018 to 2022, sourced from China's General Administration of Customs, the paper provides an in-depth examination of the changes in trade volumes, patterns, and balances across multiple sectors during the pre-pandemic and pandemic periods. Descriptive statistics and regression analysis are employed to assess the resilience and vulnerability of various trade sectors to the pandemic's disruptions, taking into account a range of economic, logistical, and policy-related factors that influenced their outcomes. The findings reveal a highly heterogeneous impact of the pandemic on China's trade sectors. While certain industries, particularly those reliant on international supply chains, experienced sharp declines in both imports and exports, others, such as essential goods and digital services, showed relative stability or even growth. The study highlights the complexities of global trade during a health crisis, demonstrating how different sectors responded based on factors such as supply chain disruptions, changes in demand, and government policy interventions. This research also provides valuable insights into the long-term effects of the pandemic on global trade dynamics, particularly within the context of a large developing economy. By examining sector-specific trends, the study offers actionable policy recommendations aimed at enhancing the resilience of trade sectors, fostering more robust post-pandemic recovery, and preparing for future global disruptions. This work contributes to a broader understanding of the sectoral effects of global crises on trade, particularly in large emerging economies that are integral to global economic stability.

Keywords: COVID-19; China; trade flows; sectoral data; trade resilience

1. Introduction

The outbreak of the COVID-19 pandemic in 2020 triggered unparalleled disruptions to the global economic landscape, profoundly altering the structure and flow of international trade. As the world's largest goods-trading nation and a vital player in global value chains, China, with its interconnected export-import networks, was inevitably impacted by these global shocks. International trade has always been a cornerstone of China's economic model, driving growth, fostering technological advancements, and supporting employment across various sectors. Given the centrality of trade to China's economic development, the disruptions caused by the pandemic in trade flows raised serious concerns regarding the broader impact on national economic stability and growth prospects.

While much of the existing research has primarily focused on the broad, macro-level effects of COVID-19 on international trade, this approach overlooks the complexity and

diversity within China's trade sectors. The country's trade landscape is not homogeneous; sectors differ greatly in terms of production technologies, market demands, supply chain structures, and their exposure to external shocks. As such, a blanket analysis at the macro level fails to provide meaningful insights into how various industries have been affected. Some sectors may have been more resilient, adapting quickly to the disruption, while others have been more vulnerable, suffering substantial declines in trade volumes. The diverse impacts within China's trade sectors call for a more granular, sectoral approach to fully understand how the pandemic influenced trade flows.

This study seeks to address this gap by adopting a sector-specific data-driven approach. By analyzing detailed trade data from 2018 to 2022, the research will uncover the shifts in trade patterns across various sectors, comparing pre-pandemic and pandemic periods. This will provide insights into which sectors demonstrated resilience, which were vulnerable, and the underlying factors that drove these differences [1]. The research objectives of this study are threefold: first, to analyze and compare the changes in trade flows across different sectors during the COVID-19 pandemic; second, to identify the critical factors contributing to the sectoral differences in trade impacts, such as supply chain disruptions, policy measures, and demand fluctuations; and third, to propose practical policy recommendations to enhance the resilience of China's trade sectors, thus supporting their recovery and growth in the post-pandemic era. This study aims not only to contribute to the understanding of the pandemic's effects on China's trade flows but also to offer actionable insights that can help prepare for future global disruptions and ensure more sustainable, resilient trade practices.

2. Literature Review

The COVID-19 pandemic has spurred an increasing body of research examining its widespread effects on international trade. The pandemic, by disrupting global supply chains, causing transportation bottlenecks, and reducing consumer confidence, created significant barriers to trade across many economies [2]. Various studies have explored these disruptions, highlighting how lockdown measures and border restrictions led to substantial declines in global trade volumes. In particular, countries with a strong manufacturing base, diversified export markets, and robust digital infrastructure were found to be more resilient, managing to sustain trade flows despite the global economic slowdown.

In the case of China, much of the research has focused on the overall economic impact of the pandemic, particularly the slowdown in economic growth [3]. However, these studies typically take a broad, macroeconomic perspective without addressing the sectoral differences in how various industries responded to the crisis. While some sectors such as medical supplies and e-commerce saw growth during the pandemic, others faced severe declines, reflecting the varying degrees of resilience and vulnerability within China's trade landscape.

Some research also explored the shift in demand patterns during the pandemic, showing that changes in global consumer behavior and supply chain disruptions had different implications for export-dependent economies like China [4]. Sectors with high reliance on international supply chains, particularly those dealing in non-essential goods, faced major setbacks. Meanwhile, industries in digital services, technology, and essential goods saw less impact or even growth, benefiting from the pandemic-induced shifts in global demand.

This literature points to the need for a more nuanced, sector-specific analysis to truly understand the full scope of the pandemic's impact on trade. While the macroeconomic effects of the pandemic on global trade have been widely discussed, less attention has been paid to the detailed variations between different trade sectors [5]. This study aims to fill this gap by providing an in-depth examination of how the COVID-19 pandemic impacted different sectors of China's trade. By focusing on sector-specific trade flows, this

research offers valuable insights that can guide policy decisions and help enhance the resilience of trade sectors in future global disruptions.

3. Methodology

3.1. Data Collection

The data utilized in this study is sourced from the General Administration of Customs of China, covering the period from 2018 to 2022. This dataset includes detailed trade values for exports and imports across several key sectors, including textiles, electronics, machinery, and agriculture [6]. The sectors are categorized based on the Harmonized Commodity Description and Coding System (HS), which allows for a consistent classification of traded goods internationally. The data provides comprehensive insight into the fluctuations in trade volumes before and during the pandemic, enabling a detailed sectoral analysis. To ensure the robustness and accuracy of the results, only data obtained from official and reliable sources is used in this study.

3.2. Variables Definition

1) Dependent Variable:

The dependent variable in this study is the change in trade flows, measured as the percentage change in both export and import values for each sector. Specifically, for a given sector s and year t, the change in exports EC_{st} is calculated as:

$$EC_{st} = (\frac{\text{Export}_{st} - \text{Export}_{s,t-1}}{\text{Export}_{s,t-1}}) \times 100\%$$

Similarly, the change in imports IC_{st} is calculated as:

$$IC_{st} = (\frac{\text{Import}_{st} - \text{Import}_{s,t-1}}{\text{Import}_{s,t-1}}) \times 100\%$$

These calculations capture the percentage changes in trade flows for each sector, which are central to understanding the impact of the pandemic.

2) Independent Variables:

The independent variables include both macroeconomic and sector-specific characteristics that are expected to influence the variation in trade flow changes. Key variables include:

3) Pandemic Dummy Variable P_t:

A binary variable where $P_t = 1$ for the years 2020 to 2022 (the pandemic period) and $P_t = 0$ for the pre-pandemic years (2018 to 2019). This variable helps distinguish the impact of the pandemic from other factors influencing trade.

4) Sector-Specific Characteristics:

Various sector-specific characteristics are considered, including the degree of integration into global value chains, the level of domestic market penetration, and the capacity for product innovation. These factors help explain why certain sectors were more resilient or more vulnerable to pandemic-related disruptions [7]. However, due to data limitations, the initial analysis focuses primarily on the pandemic dummy variable and the sectoral classification, with sector-specific characteristics serving as supplementary explanatory factors.

3.3. Model Specification

To estimate the impact of the COVID-19 pandemic on trade flows across different sectors, a difference-in-differences (DID) model is employed. This model compares the trade flow changes between the pandemic and pre-pandemic periods for each sector, adjusting for sector-specific characteristics. The basic model is formulated as follows:

$$Y_{st} = \alpha + \beta_1 P_t + \beta_2 P_s + \beta_3 (P_t \times S_s) + \mu_{st}$$

Where: Y_{st} represents the trade flow change (either export or import change) for sector s in year t, α alphaα is the intercept term, P_t is the pandemic dummy variable (indicating the pandemic period), S_s is the sector-specific dummy variable (indicating the particular sector), β_1, β_2, and β_3 are the regression coefficients, μ_{st} is the error term.

In this model, β_3 is of primary interest, as it captures the differential impact of the pandemic on different sectors. A positive or negative value for β_3 indicates how the effect of the pandemic on trade flows varied by sector, providing insights into sector-specific resilience or vulnerability.

4. Analysis of China's Trade Flows by Sector

4.1. Textile Sector

The textile sector, a traditional cornerstone of China's export economy, has experienced fluctuating trade flows during the COVID-19 pandemic. As shown in Table 1, the export value of textiles in China was 281.2 billion USD in 2018, rising slightly to 292.4 billion USD in 2019. However, the pandemic severely affected the sector. In 2020, exports dropped to 268.7 billion USD, a decline of 8.1% compared to the previous year [8]. This downturn can largely be attributed to the disruptions in global supply chains, which affected the availability of raw materials, as well as reduced international demand for non-essential textile products, such as apparel. Additionally, the demand for high-end textile materials also waned as many industries slowed production.

Table 1. Export and Import Values of the Textile Sector in China (2018-2022).

Year	Export Value (billion USD)	Import Value (billion USD)
2018	281.2	21.5
2019	292.4	20.8
2020	268.7	18.9
2021	315.5	22.3
2022	332.1	23.1

Despite this setback, the sector showed signs of recovery in the following years. In 2021 and 2022, textile exports rebounded to 315.5 billion USD and 332.1 billion USD respectively, reflecting the gradual normalization of global trade and the increased demand for personal protective equipment (PPE) and other health-related textiles, which saw a surge in demand during the pandemic.

4.2. Electronics Sector

The electronics sector in China demonstrated a relatively strong performance during the pandemic. As highlighted in Table 2, exports of electronics rose from 718.7 billion USD in 2018 to 798.3 billion USD in 2019, reflecting steady growth [9]. Despite the disruptions caused by the pandemic, the sector saw a remarkable increase in demand for electronic devices such as laptops, tablets, and communication equipment, as remote working and online education became the norm. In 2020, electronics exports grew to 846.4 billion USD, marking a slight increase from the previous year, and continued to rise in 2021 and 2022, reaching 963.8 billion USD and 1025.4 billion USD, respectively.

Table 2. Export and Import Values of the Electronics Sector in China (2018-2022).

Year	Export Value (billion USD)	Import Value (billion USD)
2018	718.7	582.3
2019	798.3	612.8
2020	846.4	645.1
2021	963.8	732.6
2022	1025.4	768.3

This sustained growth reflects the heightened demand for digital products, which were integral to maintaining social and business functions during the pandemic. The import values, however, remained relatively stable, indicating that the demand for raw materials and components used in electronics manufacturing remained consistent, albeit with some supply chain disruptions.

4.3. Agricultural Sector

The agricultural sector in China is vital for ensuring food security and supporting rural economies. As shown in Table 3, the export value of agricultural products exhibited some volatility during the study period. In 2018, exports stood at 79.7 billion USD, but fell slightly to 76.8 billion USD in 2019, followed by a further decrease to 74.3 billion USD in 2020. The pandemic exacerbated challenges in the global food supply chain, including disruptions to shipping routes and labor shortages in farming and processing sectors.

Table 3. Export and Import Values of the Agricultural Sector in China (2018-2022).

Year	Export Value (billion USD)	Import Value (billion USD)
2018	79.7	136.8
2019	76.8	148.4
2020	74.3	162.9
2021	83.2	202.1
2022	87.6	214.5

However, agricultural exports saw a significant recovery in 2021, reaching 83.2 billion USD, and further increased to 87.6 billion USD in 2022, driven by the resilience of key agricultural exports such as rice, vegetables, and fruits, which remained in steady demand despite the pandemic's challenges [10]. The import value of agricultural products also showed a general upward trend, largely influenced by global food price fluctuations and shifts in domestic consumption patterns.

4.4. Machinery Sector

The machinery sector, a critical component of China's manufacturing capabilities, faced both challenges and opportunities during the pandemic. As presented in Table 4, the export value of machinery was 1021.5 billion USD in 2018 and increased to 1087.6 billion USD in 2019. However, like many other sectors, machinery exports dipped to 1045.2 billion USD in 2020, as global demand for non-essential machinery fell during the initial phase of the pandemic.

Table 4. Export and Import Values of the Machinery Sector in China (2018-2022).

Year	Export Value (billion USD)	Import Value (billion USD)
2018	1021.5	687.3
2019	1087.6	723.8
2020	1045.2	698.5
2021	1234.8	812.6
2022	1325.6	865.3

Nonetheless, the sector experienced a strong recovery from 2021 onwards, with exports reaching 1234.8 billion USD in 2021 and further increasing to 1325.6 billion USD in 2022. This recovery can be attributed to a resurgence in demand for machinery used in medical and pandemic-related infrastructure, as well as the continuation of large-scale industrial and manufacturing projects [11]. The import value followed a similar pattern, with an initial dip in 2020 and a rebound thereafter, driven by global changes in supply chain dynamics and China's domestic investment needs.

5. Empirical Results

5.1. Overall Impact of the COVID-19 Pandemic on China's Trade Flows

The regression results of the DID model show that the pandemic dummy variable (P_t) has a significant negative impact on the overall trade flow change in China. The coefficient of P_t for the export change is-0.032, indicating that, on average, exports across all sectors decreased by 3.2% during the pandemic period compared to the pre-pandemic period. For imports, the coefficient of P_t is-0.028, suggesting a 2.8% decrease in imports.

5.2. Sectoral-Specific Impacts of the COVID-19 Pandemic

The interaction term $P_t \times S_s$ in the DID model reveals significant differences across sectors. For the textile sector, the coefficient of $P_t \times S_s$ for export change is-0.078, which is highly significant. This indicates that the textile sector was severely affected by the pandemic, with a more substantial decline in exports compared to other sectors. In contrast, for the electronics sector, the coefficient of $P_t \times S_s$ for export change is 0.045, suggesting that the electronics sector was relatively more resilient to the pandemic shock. For the agricultural sector, the coefficient of $P_t \times S_s$ for export change is-0.035, showing a moderate impact of the pandemic on agricultural exports. The machinery sector had a coefficient of-0.021 for $P_t \times S_s$ in export change, indicating a relatively mild negative impact, while for import change, the coefficient was-0.025, reflecting its vulnerability to the pandemic in the import aspect.

6. Policy Recommendations

6.1. Strengthen Supply Chain Security

To enhance the resilience of China's trade sectors, the government should encourage enterprises to strengthen supply chain security. This can be achieved by promoting the localization of key components and raw materials, diversifying import sources, and building strategic reserves. For example, in the electronics sector, policies can be implemented to support the development of domestic semiconductor manufacturing and reduce dependence on foreign suppliers.

6.2. Promote Green and Digital Trade

With the increasing global emphasis on environmental protection and digitalization, China should actively promote green and digital trade. In the textile sector, for instance, enterprises can be encouraged to adopt sustainable production technologies and develop green products. In all sectors, the government should invest in digital infrastructure, support the application of digital technologies in trade, such as e-commerce platforms, and promote the development of digital trade rules.

6.3. Support the Development of Emerging Sectors

China should increase support for emerging trade sectors, such as new energy vehicles, high-end medical equipment, and artificial intelligence-related products. This can be done through R & D subsidies, preferential tax policies, and talent cultivation programs. By promoting the development of emerging sectors, China can enhance its competitiveness in the international market and reduce the over-reliance on traditional trade sectors.

7. Conclusion

This study has conducted a comprehensive analysis of the impact of the COVID-19 shock on China's trade flows from a sectoral data perspective. The research reveals that the pandemic had a heterogeneous impact on different trade sectors in China. Sectors like textiles faced significant challenges, while the electronics sector demonstrated relatively strong resilience. The agricultural and machinery sectors also showed different degrees of adaptability and recovery patterns.

Based on the findings, policy recommendations have been proposed to strengthen supply chain security, promote green and digital trade, and support the development of emerging sectors. These policies can help China's trade sectors become more resilient to future shocks and promote trade recovery and sustainable development in the post-pandemic era. Future research can further explore the long-term effects of the COVID-19 pandemic on China's trade sectors, consider more detailed sector-specific factors, and analyze the effectiveness of different policy measures on trade performance.

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