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Pains or gains: Trade war, trade deficit, and tariff evasion[☆]

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ABSTRACT

This paper reveals that the reduction in the US-China trade deficit during the trade war obscured reporting discrepancies in US imports of Chinese products due to tariff evasion. We empirically examine the effect of the US-China trade war on tariff evasion in US imports of Chinese goods and provide direct evidence that market demand of entry states contributes significantly to tariff evasion. Using the input-output table, we find that a one standard deviation increase in local demand causes a 1.312-fold rise in tariff evasion for affected products post–trade war. This effect mainly works through intermediate goods, and its impact grows as importers' tariff liabilities increase. Further analysis considering local social environments shows that voters' attitudes toward trade protection and the development of labor unions play crucial roles in mediating the influence of market demand on tariff evasion.

1. Introduction

In 2018, former US president Donald Trump started a trade war with China in the name of reducing the US trade deficit with China. Indeed, looking at the trade deficit between the United States and China, shown in Fig. 1 (yellow diamond node line), it increased continuously from 2011 to 2018, before plunging 24.9 % percent from 2018 to 2020. Trump's Cabinet claimed that this was an

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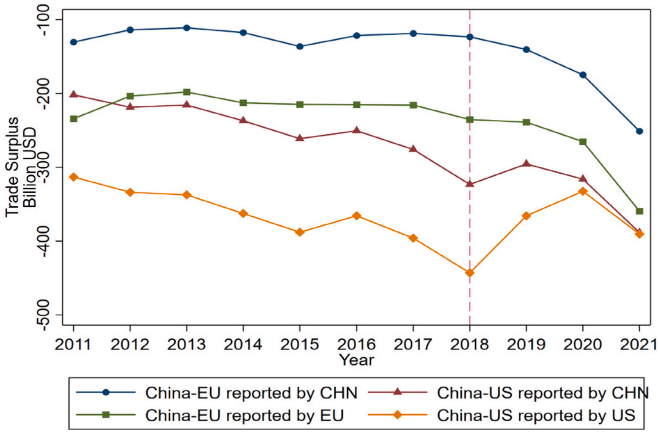

Fig. 1. Bilateral analysis of trade deficits: China–European Union and China–United States.
Note: This figure presents the changes in trade surpluses between China and the United States, as well as between China and the European Union. The red triangular node line represents the change in trade surplus between the United States and China, calculated based on Chinese customs data (import from $us_{\text{reported by chn}}$ − export to $us_{\text{reported by chn}}$). The yellow diamond node line represents the change in trade surplus between the United States and China, calculated based on US customs data (export to $chn_{\text{reported by us}}$ − import from $chn_{\text{reported by us}}$). The blue circular node line represents the change in trade surplus between the European Union and China, calculated based on Chinese customs data (import from $eu_{\text{reported by chn}}$ − export to $eu_{\text{reported by chn}}$). The green square node line represents the change in trade surplus between the European Union and China, calculated based on EU customs data (export to $chn_{\text{reported by eu}}$ − import from $chn_{\text{reported by eu}}$). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

important achievement of the 2018 trade war (Wall Street Journal).[1] In contrast, using the trade deficit reported by China shows a smooth trend over this period, as indicated by the red triangular node line in Fig. 1. The difference between the trade deficit reported by the United States and the trade deficit reported by China is huge.[2] The discrepancy between the two trade deficit versions is mostly due to the bilateral discrepancy in US processing of Chinese imports, which is often considered to involve import-side tariff evasion (Fisman and Wei, 2004; Ferrantino et al., 2012).[3] Therefore, from Trump's standpoint, was the US-China trade war successful? Did the trade war reduce the trade deficit, or did the change in the deficit reflect increased tariff evasion?

Current research on tariff evasion mainly focuses on developing countries, where tariff evasion behavior is attributed to poor governance and corrupt customs authorities (Laajaj et al., 2023; Javorcik and Narciso, 2017; Chalendard et al., 2023). The research assumes that countries with strong governance, such as the United States, do not experience tariff evasion (Javorcik and Narciso, 2017). However, according to CBP Trade Statistics,[4] the number of tariff evasion cases investigated under the Enforce and Protect Act (EAPA) increased from 7 to 64, with the amounts involved rising from \$15 million to \$215 million between 2018 and 2020. Meanwhile, there are various real-world cases showing that tariff evasion through underreporting unit values, underreporting quantities and misclassifying products in US customs is not impossible (Ferrantino et al., 2012).[5] The existing literature focuses more on trade diversion (Alfaro and Chor, 2023; Grossman et al., 2024) in the US response to the negative impacts of the trade war on downstream industries. Perhaps more importantly, the economic relationship between China and the United States is complex, and many of the products that are traded are indispensable for US consumers and firms.[6] For import products that cannot be easily replaced, have US importers responded to increasing costs because of the imposition of tariffs during the trade war through tariff evasion?

After years of effort in promoting trade liberalization, in 2018 there was unprecedented momentum for anti-globalization. In the trade war initiated by the United States, especially toward China, the targeted products experienced several waves of tariff increases

[1] "Donald Trump: My Tariff Policies Were a Success": The trade deficit with China was down year-over-year for five straight quarters before Covid hit in 2020…….Only a fool or a fanatic would dismiss these facts as irrelevant (https://www.wsj.com/articles/donald-trump-my-tariff-policies-were-a-success-foreign-markets-2ec33248).

[2] According to China's trade data reported by Chinese customs, although the trade war changed the trend of the continuous expansion of the US-China trade deficit, there was no significant reduction in the trade deficit. The trade deficit remained basically unchanged from 2018 to 2020, only decreasing by US\$7.1097 billion (as shown by the red triangular node line in Figure 1), which was far lower than the US\$110.540 billion reduction in the trade deficit as reported by the United States.

[3] The difference in the trade deficit between China and the United States from 2018 to 2021 changed by US\$11.774 billion. After excluding the influence from the export-side, the remaining import gap change is US\$84.98 billion, which accounts for 72.18 % of the bilateral trade deficit change.

[4] https://www.cbp.gov/newsroom/stats/trade.

[5] Fein (2024) and Tycko (2024) stated that misreporting imported goods to the Customs and Border Protection (CBP) has become a key strategy for importers to evade tariffs. Some representative cases are in Appendix E.

[6] According to US trade data from UN Comtrade, the trade volume between China and the United States in 2020 was 81.17 % of that in 2018. Until 2022, China was the largest trading partner of imports for the United States.

Table 1
US tariff imposition on chinese products during the trade war.

(1) Round	(2) Value ($ billion)	(3) Variety(HS6)	(4) Announcement Date	(5) Tariff Added in Announcement	(6) Effective Date	(7) Effective Tariff Added
First Round	34	530	2018.04	25 %	2018.07	25 %
	16	199	2018.04	25 %	2018.08	25 %
Second Round	200	3044	2018.07	10 %	2018.09	10 %
					2019.05	25 %
Third Round	125	1438	2019.05	25 %	2019.09	15 %
					2020.01	7.5 %
	175	Repeal of Enforcement				

Note:This table presents the procedure of the United States Trade Representative's Office (USTR) for the imposition of tariffs on imports from China. Column 1 represents the rounds of the trade war initiated by the United States; column 2 shows the total value of the imports involved; column 3 shows the number of HS 6-digit categories involved in each round of tariff imposition; column 4 displays the anoucement date for the tariff increases; column 5 presents the proposed tariff rates; column 6 shows the effective data of the tariffs for each round; and column 7 shows the effective tariff imposed in each round. Data source: USTR.

(details are shown in Table 1), covering almost all the products imported from China (Jiang et al., 2023).[7] The imposition of tariffs increases trade costs (Amiti et al., 2019; Handley et al., 2025), with the majority of import tariffs being borne by US importers (see Fig. A1), which significantly increases production costs in downstream industries.

In this paper, we provide perhaps the first study extensively investigating the effects of tariff increases during the trade war on tariff evasion in the United States. We use the discrepancy between import values reported by the United States and China to measure tariff evasion in the United States, following Fisman and Wei (2004). We divide imports into products that were and were not affected by the trade war, and use the difference-in-differences (DID) method to identify the pertinent causal effects, using the European Union as a benchmark. Our baseline results show that the trade war had a positive and significant effect on tariff evasion during the importation process of Chinese products in the United States. According to the results of our event study, by 2021, the gap value caused by tariff evasion explained 69.70 % of the gap between the values of the trade deficit reported by the United States and China. Our result remains robust after controlling for shipment conditions, local customs development, and subsample analysis for each round of tariff increases. In exploring the potential mechanisms, following the method of Fisman and Wei (2004), we find that underreporting unit values, underreporting quantities, and misreporting categories are three possible channels.

In the existing literature on tariff evasion, researchers tend to assume that all products enter the market from their intended destinations with high demand intensity. However, this overlooks the nonuniform distribution of ports, where certain products are compelled to access the US market through ports in areas that do not consume those products locally. Disparities in local industrial structures due to input-output linkages across port areas lead to variations in the degree of demand faced by imported products. In port areas with negative downstream industry shocks due to the trade war, our regression results indicate that the effect of tariff imposition on tariff evasion is exacerbated. In particular, on average, a one standard deviation increase in demand intensity in the port area results in an increase of 1.312 times in tariff evasion. This effect is particularly pronounced for intermediate goods and products for which US importers, rather than exporters, pay the tariffs. This implies that our heterogeneous results on demand intensity in entry states arises to reduce the cost of the supply of intermediate goods, to alleviate tariff pressure on US importers, providing additional support for the rationale for analyzing local demand in the port areas.

We conduct a series of robustness tests of our baseline results. We systematically discuss and eliminate influences from the export end, the transportation process, external shocks, and import customs. Moreover, to mitigate the noise that stems from the identification strategy and variable construction, we use a winsorized dependent variable, alternative explanatory variables, and a streamlined sample, all of which generate results that are consistent with our conclusion.

In the heterogeneity analysis, we look at how local conditions influenced the relationship between the trade war and tariff evasion. First, to garner more votes, local governments may consider the negative shock on downstream industries due to tariff increases and, therefore, have different attitudes toward products with diverse local demand intensity.[8] Local voters' attitudes could influence the local government's port management and impact the level of scrutiny of customs officials. We thus examine the role of voter support for trade protectionism in downstream industries in the occurrence of tariff evasion. Our results indicate that support for trade protectionism in the entry markets decreases the heterogeneous effects of local demand intensity. Second, the development of unions could also increase the heterogeneity of local demand intensity. In destination markets where there are no unions, it may be more difficult to evade tariffs due to customs officials' familiarity with the products in demand. However, as local unions develop, governments are compelled to consider the negative impacts of increased tariffs on local downstream industries, which leads to improved efficiency in transmitting demand information. Thus, unions can influence tariff evasion by affecting the efficiency of port operations. Our

[7] Compared to other targeted trade protection measures (e.g., antidumping duties), the trade war tariffs featured broader coverage and a relatively uniform increase within a short timeframe, reducing policy variation across products and thereby amplifying the effects of demand intensity and social factors.

[8] In the process of policy implementation, politicians often selectively enforce policies to maximize their support from specific constituencies (Holland, 2016).

empirical results indicate that the development of unions was an important channel in the process of tariff evasion in port areas during the trade war.

Overall, our paper contributes to several strands of literature. First, it contributes to the debate on the effectiveness of the US-China trade war by pointing out the differences between the US-China trade deficit reported by Chinese and US ports. Our findings show that the reduction of the US trade deficit during the trade war was mainly due to US tariff evasion rather than changes in imports and exports. Without considering this point, trade policy makers may misinterpret the effectiveness of the US-China trade war. In an earlier Fed note, Clark and Wong (2021) show that the statistical discrepancy between US and China changes after the trade war, which motivates our study, though they do not conduct extensive econometric analysis and links trade war and tariff evasion with local demand intensity, mechanisms and social environments. Moreover, our paper contributes to the trade war literature by looking at its effect on the trade deficit, beyond welfare (Fajgelbaum et al., 2020; Cavallo et al., 2021), price adjustments (Amiti et al., 2019; Flaaen et al., 2020), and trades (Jiang et al., 2023; Alessandria et al., 2025).

Second, at the micro level, previous studies have focused on how US importers responded to the US-China trade war through the lens of trade diversion and global value chains (Grossman et al., 2024; Handley et al., 2025). For example, using recent data, Alfaro and Chor (2023) show that US direct sourcing from China decreased, while low-wage countries and friendshoring alternatives gained corresponding imports. However, a significant portion of US-China trade cannot be shifted. Our paper focuses on the remaining trade between the United States and China after the trade war. This is comprised of US imports from China in which the United States has a comparative disadvantage and cannot easily find alternatives from other countries. In this case, we find that US importers may have considered tariff evasion as a viable instrument for responding to the trade war.

Third, existing studies on the causes of tariff evasion mainly focus on customs, attributing tariff evasion to the inherent difficulty of product inspection (Javorcik and Narciso, 2008), as well as the efficiency of and corruption within customs administrations (Laajaj et al., 2023; Javorcik and Narciso, 2017; Chalendard et al., 2023; Mishra et al., 2008). Using local demand in port areas, our paper provides a new interpretation of tariff evasion from the perspective of country's domestic demand, thereby extending the extant framework for analyzing tariff evasion and providing more direct evidence of tariff evasion behaviors occurring at the import end.[9] More specifically, this explanation may not be adequate in the case of the United States, where trade policies are partially formed by constituents. We point out that while tariffs are federally regulated, tariff collection relies on local ports (Betz, 2019), which are managed by local authorities and responsible for the livelihoods of local citizens and the performance of local firms. This creates the possibility for the transmission of local demand to customs. In other words, while tariff evasion is perceived as a coping mechanism for enterprises facing tariff increases, how local demand influences tariff evasion has not been verified. Therefore, we provide evidence of the facilitating role of input demand intensity at import destinations in the tariff evasion process.

Fourth, our paper contributes to the literature on the downstream effects of trade barriers. In exploring the impacts of changes in tariffs, an increasing number of studies are not confined to the direct effects, but also look at the spillover effects of tariffs through input-output linkages in downstream industries (Lovely and Yang, 2018; Handley et al., 2025; Acemoglu et al., 2016). They show that tariff changes lead to increased production costs in downstream industries, inhibit business investment, and have adverse effects on labor markets (Jabbour et al., 2019; Bown et al., 2024; Barattieri and Cacciatore, 2023). Moreover, changes in tariffs can also increase social costs in regions with downstream industries that are heavily affected through the labor market (Autor et al., 2019; Pierce and Schott, 2020; Che et al., 2018). However, existing studies assume homogeneity in the impacts of trade policies across industries in different regions and overlook the differences in demand intensity at the import destination. In contrast, our findings reveal regional differences in attitudes toward product tariff evasion, leading to varying “effective tariff rates” across port areas.[10] Neglecting this issue would lead to an underestimation of the impact of trade protection policies on downstream industries or regions.

The paper proceeds as follows. Section 2 describes the background of the trade war and the distribution of entry ports. Section 3 provides a description of the data and variables used in the paper. Section 4 presents the empirical strategy. Section 5 provides our baseline results, results on the role of demand intensity, and robustness checks. Section 6 investigates the roles of voters' attitudes toward trade protection and the development of unions in port areas. Section 7 concludes.

[9] The existing literature typically indirectly demonstrates that the increase in trade discrepancy resulting from higher tariffs reflects import-related tariff evasion, by examining the positive correlation between tariff hikes and the disparity in bilateral trade reports (Mishra et al., 2008; Demir and Javorcik, 2020; Kee and Nicita, 2022; Fisman and Wei,2004), while excluding other factors that could lead to trade discrepancy beyond tariff evasion on the import end. However, by using demand intensity in product import destinations, we show that the increase in tariff evasion resulting from tariff imposition is directly influenced by local input demand. Furthermore, by linking this with socioeconomic factors in the importing countries, the paper not only provides direct evidence of import-related tariff evasion, but also offers a deeper analysis of the underlying causes of such tariff evasion. In this sense, we offer new insights for identifying customs tariff evasion.

[10] Currently, the effects of trade policy through downstream industries are an important issue and US firms cannot entirely exclude Chinese suppliers for self-production. Downstream enterprises resort to tariff evasion to alleviate the rising input costs, which, in turn, suppresses the effectiveness of US protective trade policies. The existing literature confirms that while trade wars may offer certain protective measures (Fajgelbaum et al., 2020), the tariffs imposed are often fully or partially passed on through pricing adjustments (Amiti et al., 2019; Flaaen et al., 2020; Fajgelbaum et al., 2020), which are borne by domestic importers and consumers (Cavallo et al., 2021). Moreover, given that intermediate goods constitute a significant portion of the targets of the trade war (Bown and Zhang, 2019), the imposition of tariffs affects the production costs of downstream US businesses through supply chain disruptions (Lovely and Liang, 2018). These businesses represent 84 % of total US exports and 65 % of manufacturing employment (Handley et al., 2025), leading to negative impacts on production and employment in downstream industries, which in turn force downstream industries to resort to measures such as supply chain relocation (Alfaro and Chor, 2023).

2. Background

2.1. Trade war, changes in the trade deficit, and import gap

One of the main targets of the trade war (Jiang et al., 2023) was to narrow the US trade deficit with China, and the Trump administration claimed that this was an important achievement (Wall Street Journal).[11] The US port data after the trade war show a rapid reduction in the trade deficit between China and the United States. By 2020, the trade deficit had decreased by US$110.54 billion (the yellow diamond node line in Fig. 1); however, this phenomenon is not substantiated by the statistics from China's port data. From 2018 to 2020, China's data show that the trade deficit decreased by only US$7.11 billion (the red triangular node line in Fig. 1); that is, it remained basically unchanged, far lower than the reduction in the trade deficit that was recorded by the US data. There is a significant difference in the change in the bilateral trade deficit (the red triangular node line in Fig. 2), and the difference reached US $117.74 billion between 2018 and 2021, resulting in findings of opposite trends in the trade deficit recorded by China compared to the US data.[12]

Prior to the trade war, the gap in the bilateral trade deficit between China and the United States remained stable for a long time. To eliminate the influence of other factors, we use China-EU trade as a control in Figs. 1 and 2. The results show that the bilateral trade deficits recorded by China and the European Union remained relatively stable throughout the whole sample period. In sum, it was the US-China trade war that led to a significant change in the difference in the trade deficit between China and the United States. However, the change in the US trade deficit might not have been caused by changes in actual China-US trade; instead, it might have been an "illusion" manifested by the change in the statistical difference in the bilateral trade deficit.

By definition, the trade deficit is determined by the difference between imports and exports. The calculation of the US trade deficit includes two parts of trade, namely, the part of the United States importing products from China, and the part of the United States exporting products to China, both of which are corresponding values that can be reported by the United States or China. Thus, the difference in the bilateral trade deficit is decomposed according to the import and export parts, shown in Fig. 3[13] The figure shows that the gap between the values of US exports to China reported by the United States and those reported by China after the trade war remains relatively stable. However, the gap between the values of US imports from China reported by the United States and China (import gap) changed significantly from 2018 to 2021, reaching a difference of US$110.56 billion, accounting for 93.90 % of the change in the trade deficit gap (110.56/117.74).

During the trade war, in response to the pressure on the exports of related Chinese products due to the increase in US tariffs, China raised the export rebate rate for related products, which may have led to changes in customs declaration behavior for products at the export end. Yet, this policy was not only targeted at products exported to the United States, but also other countries that import Chinese products. To distinguish whether the trade gap mainly stemmed from the import gap reported by United States and China, we use the European Union as a control group to eliminate the potential influence of China's tax rebate policy. We find that during 2018–21, the difference between the change in the gap in US imports (US$110.56 billion) and the change in the gap in EU imports (US$25.58 billion) still leaves US$84.98 billion, or 72.18 % of the change in the trade deficit gap (84.98/117.74).[14] To be cautious, Considering the recent increase in de minimis imports in U.S.-China trade and their potential impact on trade statistics (Fajgelbaum and Khandelwal, 2024), we provide the detailed background and estimate the pertinent effects in Appendix D.[15] Figs. D2 and D3 show that our core conclusion is unaffected, after excluding all changes in de minimis imports from China. In addition, we decompose the trade discrepancies in US imports of Chinese products, shown in Fig. F1, which indicates that the gap mainly comes from the tariff-imposed products.[16]

Then, the question we are asking in this paper is that in terms of shrinking the trade deficit between China and the US, was the US-China trade war successful from the perspective of the United States? The change in the trade deficit reported by the United States reflects either a reduction in the deficit or incorrect information due to large-scale import tariff evasion (pains or gains?). We attempt to examine this through a product-level analysis in subsequent sections.

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[11] https://www.wsj.com/articles/donald-trump-my-tariff-policies-were-a-success-foreign-markets-2ec33248.

[12] The US statistics show that from 2018 to 2021, the trade deficit with China decreased by US$52.589 billion, but according to China's trade data, the US trade deficit with China increased by US$65.157 billion.

[13] The difference in the trade surplus between the United States and China can be decomposed into the sum of the gap between China's imports of US products and US imports of Chinese products. This also applies to the European Union. The calculation is as follows:

$$\underbrace{\left(\text{import from us}_{\text{reported by chn}} - \text{export to us}_{\text{reported by chn}}\right) - \left(\text{export to chn}_{\text{reported by us}} - \text{import from chn}_{\text{reported by us}}\right)}_{\textit{difference on trade deficit reported by US and China}} =$$

$$\underbrace{\left(\text{import from chn}_{\text{reported by us}} - \text{export to us}_{\text{reported by chn}}\right)}_{\textit{import gap for US imports from China}} + \left(\underbrace{\text{import from us}_{\text{reported by chn}} - \text{export to chn}_{\text{reported by us}}}_{\textit{export gap for US exports to China}}\right).$$

[14] When we replace "trade deficit" of Figure 1 with "gross trade" or "gross import" and adjust the y-axis of Figures 2 and 3 to reflect the proportion of discrepancies in gross trade, the conclusions presented in each figure remain largely unchanged, though the trends become smoother. These results are available upon request.

[15] Since January 2010, the U.S. Census Bureau has classified de minimis import with product information under their original HS codes. For imports lacking product information, the Bureau estimates total values using customs, shipment, and Foreign Trade Zones data and record them as "low-valued imports" under code 9999.95.0000. These figures are all included in total trade statistics.

[16] Please refer to Appendix F for details.

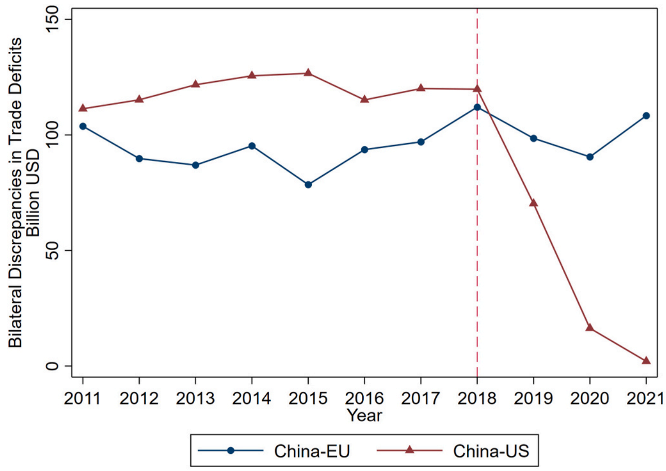

Fig. 2. Bilateral statistical discrepancies in trade deficits: China–European Union and China–United States.
Note: This figure illustrates the changes in statistical discrepancies regarding trade deficits between China and the U.S., as well as between China and the EU. The red triangular node line represents the variation in the discrepancies in the reported US trade surplus between China and the United States: $(\text{import from us}_{\text{reported by chn}} - \text{export to us}_{\text{reported by chn}}) - (\text{export to chn}_{\text{reported by us}} - \text{import from chn}_{\text{reported by us}})$. The blue circular node line represents the variation in the discrepancies in the reported EU trade surplus between China and the European Union: $(\text{import from eu}_{\text{reported by chn}} - \text{export to eu}_{\text{reported by chn}}) - (\text{export to chn}_{\text{reported by eu}} - \text{import from chn}_{\text{reported by eu}})$. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

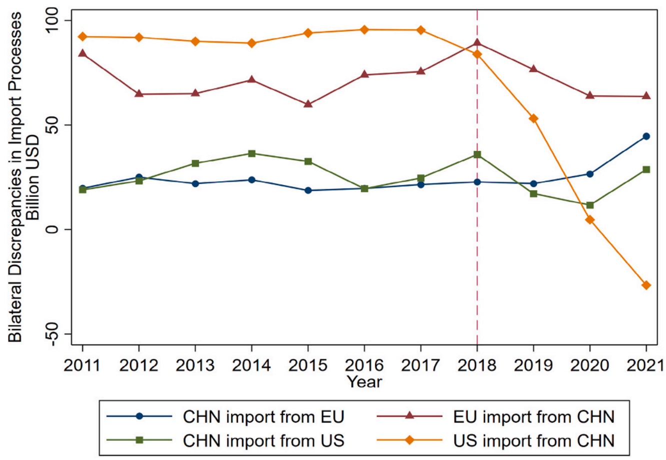

Fig. 3. Bilateral statistical discrepancies in different import processes.
Note: This figure decomposes the discrepancies in trade deficits presented in Fig. 2, offering statistics on the discrepancies in trade values reported by each side for the same trade processes, encompassing US imports of Chinese goods (yellow diamond node line, $\text{import from chn}_{\text{reported by us}} - \text{export to us}_{\text{reported by chn}}$), Chinese imports of US goods (green square node line, $\text{import from us}_{\text{reported by chn}} - \text{export to chn}_{\text{reported by us}}$), EU imports of Chinese goods (red triangular node line, $\text{import from chn}_{\text{reported by eu}} - \text{export to eu}_{\text{reported by chn}}$), and Chinese imports of EU goods (blue circular node line, $\text{import from eu}_{\text{reported by chn}} - \text{export to chn}_{\text{reported by eu}}$). For a detailed decomposition, see footnote 13. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

2.2. US customs tariff revenue collection

2.2.1. Collection of customs tariffs and attitudes toward tariffs across ports

In the United States, customs tariffs are uniformly imposed nationwide, and the collected revenues go to the federal government rather than state governments. However, implementation of the tariffs relies on inspections by customs officials at various border ports, which are spread across the country (Betz, 2019; Mangini, 2023). More importantly, the imposition of tariffs on certain products may have adverse effects on regional downstream industries (Amiti et al., 2019; Flaaen et al., 2020; Fajgelbaum et al., 2020), in which case, different regions may have exhibited different attitudes toward tariff increases due to the trade war.

Since the passage of the Customs Modernization Act of 1993 in United States, importers are responsible for reporting the types and values of products entering the United States. Meanwhile, custom officials rely on their knowledge to assess the reported product categories, quantities, and prices and determine the applicable tariffs. Misreporting of products may face financial penalties, but fines are relatively uncommon (Mangini, 2023).[17] As the strictness of the inspection increases, the time required for customs clearance also increases. In practice, considering the issues of container congestion and port operation efficiency,[18] to avoid delays in customs clearance and delivery, customs officials cannot thoroughly inspect each container. They must make trade-offs of quality and quantity in the process of inspections (Betz, 2019). Therefore, tariff evasion becomes possible. Customs officials' attitudes toward auditing and the operational efficiency of the ports jointly influence the efficiency of tariff collection (Laajaj et al., 2023).

Ports and the relevant customs officials are likely influenced by local economic conditions. On the one hand, customs officials often reside near ports (Chalendard et al., 2023), making them more influenced by local attitudes toward trade protection. On the other hand, while ports are managed by state and municipal governments, the collected tariff revenues go to the federal government. Instead, these tariffs, borne by local importers and consumers through price transfers (Amiti et al., 2019; Flaaen et al., 2020; Fajgelbaum et al., 2020), negatively impacted local economies, particularly downstream industries and labor markets (Cavallo et al., 2021; Lovely and Yang, 2018). Consequently, regions with differing industrial structures likely exhibited varying attitudes toward the trade war. Moreover, to garner the support of more voters, politicians often selectively enforce laws and regulations (Holland, 2016), and may be influenced by the attitudes of voters and the development of unions (Bown et al., 2024). Thus, market demand in port regions could have influenced tariff collection processes.

In addition, port operations are influenced by unions (Paul and Macdonald, 2017). Major US ports are primarily dominated by the International Longshore and Warehouse Union (ILWU) and the International Longshoremen's Association (ILA), which hold significant power in the employment of port workers and can influence customs operations through actions such as strikes. For instance, in 2002, West Coast port managers proposed automating data entry to improve efficiency, offering higher wages and pensions to affected workers. However, the ILWU opposed the plan, citing concerns over job losses and increased skill demands. When automation proceeded, workers went on strike, shutting down US ports for 10 days. Similar disputes have arisen during recent port automation efforts. Clearly, unions can influence port efficiency. The factors listed above indicate that local market demand has a certain influence on tariff collection by customs officials.

2.2.2. Uneven distribution of ports and different structures of demand for products across ports

Differences in the industrial structure in various regions mean that there are disparities in the demand intensity for different products within the same locality. In other words, even for identical products, their significance varies across different regions. Meanwhile, the uneven distribution of US ports is notable, with major ports concentrated along coastal areas and some states lacking large ports and customs facilities. Consequently, certain products enter the US market through ports with lower demand intensity, resulting in substantial variations in the significance of products in the port of entry. Such heterogeneity in demand for products in the port areas provides favorable conditions for investigating the role of local demand in the process of product tariff evasion.

Utilizing interindustry input-output relationships, we calculate the proportion of labor in downstream industries across different regions to measure the negative impact of increases in product tariffs on the local labor markets in the port areas (see Eqs. (2) and (3) for details). This approach provides direct evidence that validates that tariff evasion is used as a means of mitigating the adverse effects of trade protection.

3. Data and variables

3.1. Trade war and tariff imposition

We examine the tariff evasion behavior of US importers in response to the US imposition of tariffs on Chinese products during the US-China trade war. To identify the timing and Chinese products involved in each round of tariffs that the United States imposed on Chinese products, we carefully checked the list of products with increased tariffs on the official website of the Office of the United States Trade Representative. This list provides accurate information on the targeted products (HS 8-digit) during the trade war, the timing of tariff imposition, and the tariff rates on related products in each round. As tariff evasion aims to circumvent the costs imposed by tariffs, we focus on the specific execution times of the tariffs rather than the times of the announcements.

3.2. Tariff evasion

The trade data set we use comes from the UN Comtrade database for 2011–21. This data set provides information on trade among countries, including importers and exporters, HS 6-digit product categories, the timing of transactions, quantities, values, and other related details. Perhaps more importantly, we have information reported by exporters and importers separately, making the identification of tariff evasion possible. Given the fact that the transit time for goods is generally more than two weeks for maritime

[17] See "What every member of the trade community should know about: Customs administrative enforcement process: fines, penalties, forfeitures and liquidated damages. An Informed Compliance Publication" (US Customs and Border Protection, 2004). Relative to income tax evasion, the low punishment of customs tariff audits somewhat increases the possibility of tariff evasion in the process of imports.

[18] For example, a standard shipping container can hold 1170 cubic feet, and major US ports handle millions of containers annually. The Port of Los Angeles, which is the largest port in the United States, handles nearly 9 million containers annually, averaging more than 20,000 containers per day.

shipments between China and the United States,[19] we use annual data to mitigate the noise caused by the delay due to shipping time in our measurement of tariff evasion. Following Fisman and Wei (2004), the specific methodology for measuring the extent of tariff evasion at the product level is as follows[20]:

$$Gap\ Value_{c,i,t} = ln\left(report\ export\ value_{c,i,t\ china}\right) - ln\left(report\ import\ value_{c,i,t\ china}\right) \tag{1}$$

where $report\ import\ value_{c,i,t\ china}$ represents the value of product i imported from China in year t, reported by customs in country c; and $report\ export\ value_{c,i,t\ china}$ denotes the value of product i exported from China to country c in year t, reported by customs in China. $Gap\ Value_{c,i,t}$ is calculated as the difference between these two terms, which measures the extent of tariff evasion in country c in the process of importing product i from China in year t.[21]

To see the possible impact of the trade war on the gap value, Fig. A3 shows the trend of the average of gap values for products imported by the European Union and the United States, straddling the period of the US-China trade war. This preliminary result indicates that prior to 2018, the gap values in the United States and the European Union were relatively stable, with pertinent values being largely parallel. However, after the outbreak of the trade war in 2018, the gap value in the US market experienced a rapid increase, while the gap value in the EU market remained relatively stable. The difference continues and we see a clear divergence between these two gap values after 2018. Overall, Fig. A3 suggests that the outbreak of the trade war led to an increase in the gap value of Chinese imports in the US market, and presumably the increase was caused by tariff evasion. We formally test this result in our regression analysis.

Additionally, in Table A1, we categorize products according to their HS-code Product Category. The statistical results indicate that, compared to the period before the trade war, the gap value for all product categories in U.S.-China trade has increased after the trade war.[22] Moreover, we observe large variation in the gap values across product categories. Interestingly, numbers shown in the last two rows indicate that the change in gap value for intermediate goods is higher than non-intermediate goods, i.e., 0.209 vs. 0.126, which motivates our latter focus on the intermediate-input channel.

3.3. Product demand intensity

Descriptive background information shows that the importance of the products that arrive in different ports varies significantly due to differences in the industrial structures in the port areas. To proxy this importance, we calculate the proportion of the labor force in downstream industries in the regions, utilizing an input-output table. Here, we use three data sets. The first is the interindustry input-output table. We obtained input coefficients $input_{n,m}$, where n represents the producing industry and m denotes the input industry, using the 2012 input-output table from the US Bureau of Economic Analysis. In other words, $input_{n,m}$ indicates the quantity of input m required to produce one unit of output in industry n. We use the concordance table between HS 6-digit codes and the North American Industry Classification System to obtain each sector's demand for the corresponding products (Pierce and Schott, 2012). The second data set is the County Business Pattern database. This database records the labor force in various industries across states each year, which allows us to identify the importance of imported products for downstream industries in the entry regions (Acemoglu et al., 2016; Pierce and Schott, 2020; Bown et al., 2024). The third database is from the United States International Trade Commission website, which provides statistics on US product imports and their distribution at entry ports. We combine these data with information on the industrial structure in the port areas to assess the importance of each product in its entry area.

The specific equation is the following:

$$key\ demand_{s,i} = 100 * \sum_{n} \frac{emp_{s,n,2017} \times 1\left(input_{n,i} = \max_{m} input_{n,m}\right)}{emp_{s,2017}}$$

$$key\ input\ channel_i = \sum_{s} \frac{import_{i,s,2017} \times key\ demand_{s,i}}{import_{i,2017}} \tag{2}$$

where $key\ demand_{s,i}$ reflects the proportion of labor in state s working in downstream industries for which product i is a key input, which represents the degree of demand for different products in different states. Here, we consider entry area at the state level due to data limitations and thus lack of more detailed information. Following Bown et al. (2024), if product i is the largest input for downstream industry n, $1\left(input_{n,i} = \max_{m} input_{n,m}\right)$ takes the value of 1, representing the key inputs; and $emp_{s,n,2017}$ denotes

[19] https://www.autochina-logistics.com/a/16890.html.

[20] The other method of identifying import tariff evasion assesses the value discrepancies reported during the import declaration process. This method utilizes comprehensive micro-level data from customs clearance to analyze performance variations among different customs inspectors during the examination of various import declarations. While this approach directly targets tariff evasion in the product importation process, it requires a series of micro-level data, including customs declaration, clearance, assignment of declaration forms, and customs personnel inspection outcomes. Consequently, it imposes high data requirements and its applicability is limited.

[21] In the robustness testing process, this study systematically eliminates other disturbances in the trade process.

[22] This trend persists in the majority of products (18/21) even after removing the comparison with China-EU trade.

employment in downstream industry n in state s in 2017. Here, we chose the year before the US-China trade war started, hopefully to eliminate the potential impacts of the trade war on product imports (Caldara et al., 2020) and labor structure (Bown et al., 2024).[23] The variable $key\ input\ channel_i$ denotes the average demand for product i by taking the weighted average of the share of imports in the entry states as weights.

Table 2 shows the descriptive correlation between tariff evasion and demand intensity for goods in port areas. We divide the products into two groups based on the mean demand intensity. The table presents the median gap value of the products within each group for Europe and the United States for each year (2014–21). These values indicate that there was significant variation in tariff evasion behavior before and after the trade war, and exhibit differences across port areas with different demand intensities. Products with higher demand intensity exhibited stronger tariff evasion behavior post–trade war. Interestingly, this effect is not attributed to inherent product characteristics. More specifically, before 2018, the differences between Europe and the United States in the low demand group were relatively small (column 3), whereas tariff evasion behavior in the United States for the high-demand group was significantly lower than that in the European Union (column 2). The differences between Europe and the United States in the high-demand group remained lower than those for the low-demand products (column 4). This might have been due to the fact that customs officials are more familiar with products in regions with high demand intensity, leading to a better understanding of their classification and value, thereby making it difficult to evade tariffs through underreporting unit values or misreporting the categories, and thus resulting in lower tariff evasion rates. This conjecture excludes the possibility that high-demand products are inherently more prone to tariff evasion because of endogeneity. However, after the trade war in 2018, both the high- and low-demand groups in the United States exhibited higher gap values compared to those in the European Union, and the difference increased continuously, indicating the presence of tariff evasion behavior. Moreover, tariff evasion increased more for products with high demand intensity, leading to the gap between Europe and the United States narrowing rapidly and surpassing the gap in the low-demand group in 2019 and 2020.[24] Overall, this preliminary evidence suggests that in response to the increased costs resulting from the trade war, there was more tariff evasion behavior for products with high demand intensity in the port areas.

Because some industries' key inputs are internal to their own industries, our results may be contaminated by industries' own protective behavior during the trade war. As a robustness check, we adjust our construction of the pertinent variables by removing the diagonal of the input-output table and selecting the largest input industry outside the industry itself as the key input (Eq. (3))[25]:

$$key\ demand(non-self)_{s,i} = 100*\sum_n \frac{emp_{s,n,2017} \times 1\left(input_{n,i} = \max_{m \neq n} input_{n,m}\right)}{emp_{s,2017}}$$

$$key\ input\ channel(non-self)_i = \sum_s \frac{import_{i,s,2017} \times key\ demand(non-self)_{s,i}}{import_{i,2017}} \tag{3}$$

3.4. Other variables

To explore the channels leading to tariff evasion behavior, we introduce additional indicators, including intermediate inputs, tariff burden, support for Trump in the relevant state, and the development of unions. Intermediate goods are measured based on the Broad Economic Categories product codes. Tariff burden is defined as the proportion of imports that were Delivered Duty Paid (DDP)[26] as a percentage of total imports for each product.

Trump consistently advocated "America First" during his campaign and criticized trade liberalization measures such as the North American Free Trade Agreement and "permanent normal trade relations" with China. Therefore, it is possible that the support for Trump in each state during the 2016 election reflected the attitudes of the state's voters toward trade protection measures. We use $\text{trump share}_i = \sum_s \frac{import_{i,s,2017} \times trump2016_s}{import_{i,2017}}$ to measure support for Trump at the product level, where $trump2016_s$ denotes the support for Trump in state s during the 2016 election, indicating the level of support for Trump in products' entry states. We use $\text{union}_i = \sum_s \frac{import_{i,s,2017} \times \text{union}_s}{import_{i,2017}}$ to measure the union conditions for product i, where union_s represents the proportion of union workers in each state in 2016 (Hirsch and Macpherson, 2003). Both trump share_i and union_i are weighted averages using the share of imports in the entry states as weights.

Descriptive statistics for each variable are shown in Table 3, and they are all within a reasonable range for our analysis.

[23] Our rationale here is that due to differences in inputs among various products in different industries, typically dominated by a few industries, the importance of key inputs compared to other product inputs in downstream industries varies considerably, as shown in Figure A2.

[24] Affected by the widespread labor strikes brought about by the COVID-19 pandemic in the United States in 2021, manufacturing production stagnated, resulting in the reduced importance of inputs across various regions. In 2021, this manifested in a decrease in the gap between Europe and the United States for the high-demand group compared to the low-demand group. This further validates the rationale for the analysis.

[25] In this alternative measure of demand intensity, we expand the definition of key industries by including industries ranked in the top two input coefficients. Actually, the alternative construction of the local demand variable does not affect our general results, which are available upon request.

[26] DDP is the only trade term where import duties are borne by the exporter.

Table 2
Heterogeneity in demand intensity.

(1) Year	(2) High Demand Intensity: Median (Gap Value in US)-Median (Gap Value in EU)	(3) Low Demand Intensity: Median (Gap Value in US)-Median (Gap Value in EU)	(4) Difference between the Two Groups
2014	−0.0478	0.0205	−0.0683
2015	−0.0866	−0.0062	−0.0804
2016	−0.1004	−0.0015	−0.0989
2017	−0.0145	0.0368	−0.0513
2018	0.0393	0.0550	−0.0157
2019	0.1411	0.0803	0.0608
2020	0.2031	0.1683	0.0348
2021	0.1351	0.1859	−0.0508

Note: This table presents a comparison of the gap value in Chinese imports between the United States and the European Union before and after the trade war across different levels of demand intensity in the entry destinations. HS 6-digit products are divided into high-demand and low-demand groups based on their average importance to the entry states (key input channel$_i$). The medians of the gap value for both EU and US imports are calculated annually. The differences between the two are show in columns 2 and 3 for products with high and low demand intesnity, respectively. Column 4 shows the difference between the values in columns 2 and 3. Please refer to Eq. (2) for the construction of demand intensity key input channel$_i$.

Table 3
Descriptive statistics for the main variables.

Variable	Obs	Mean	Std.Dev.
Gap Value	92,032	−0.429	1.523
Gap Quantity	83,770	−0.405	1.660
Gap Unit Value	83,770	−0.004	0.750
Tariff	105,468	0.0316	0.0780
Key Input Channel	94,718	0.151	0.713
Trump Share	95,863	0.367	0.277
Vote Share	95,863	0.412	0.0590
Union Member	95,863	13.02	3.973
Union Represent	95,863	14.35	4.096
Intermediate	103,758	0.620	0.485
DDP	88,383	0.0415	0.162

Note: This table presents descriptive statistics for the main variables used. The Gap Value represents the bilateral trade discrepancy, denoting product tariff evasion, constructed according to Eq. (1). Gap Quantity and Gap Unit Value capture differences in bilateral trade quantities and unit values of products, respectively. Tariff indicates the tariff rates imposed on products during the trade war. Key Input Channel denotes the average demand intensity of products over entry destinations. For a specific product, Trump Share denotes the proportion of entry states won by Trump in the 2016 presidential election. For a specific product, Vote Share represents the average Trump support rate in the entry districts in the 2016 election. Union Member indicates the average proportion of union workers in entry states. Union Represent indicates the average proportion of workers covered by union contracts in entry states (Hirsch and Macpherson, 2003). Intermediate is a dummy variable for intermediate goods, categorized based on Broad Economic Categories codes. DDP represents the proportion of US imports through Delivered Duty Paid (DDP) terms responsibility for import tariffs.

4. Empirical strategy

4.1. Impact of the trade war on tariff evasion in the United States

During the trade war, the United States imposed tariffs on Chinese imports with broad coverage and relatively consistent tariff rates, which resulted in minimal policy variations across products. To mitigate such influence, we use EU imports of Chinese products as a control group for the DID setup. Basically, we are comparing the difference in the tariff evasion behavior for imported products affected by the trade war between the United States and the European Union before and after the trade war. The estimating equation is as follows:

$$Gap\ Value_{c,i,t} = \beta_1 treated_{c,i} \times post_{i,t} + \delta_t + \delta_{c,i} + \varepsilon_{c,i,t} \tag{4}$$

where $Gap\ Value_{c,i,t}$ represents the trade discrepancy between country c (the United States or the European Union) and China's reported exports in year t for imported product i, which could reflect the extent of product tariff evasion. The variable $treated_{c,i}$ is a dummy that takes the value of 1 if product i from country c was subject to imposed tariffs during the trade war and 0 otherwise. The variable $post_{i,t}$ is a period indicator that takes the value of 1 after the imposition of the tariff in the corresponding round and 0 otherwise. There might be some concern that measures using dummies could miss certain information on changes in tariffs. Therefore, as a robustness check, we use the specific tariff imposition rates for each product at different times ($tariff_{c,i,t}$) as an alternative. Country-product fixed effects are denoted by $\delta_{c,i}$, controlling all the time-invariant characteristics that vary at the country-product level. The time-invariant country and product characteristics are all absorbed by $\delta_{c,i}$ in the model. Year fixed effects, denoted by δ_t, control any policy or other macro shocks in the European Union and the United States. The random disturbance term for the covariates that cannot be observed by the econometrician is denoted by $\varepsilon_{c,i,t}$.

One condition for DID is that the treatment and control groups should exhibit similar trends in the absence of the trade war. Since opinion polls could not predict Donald Trump's victory in the 2016 presidential election, Trump's trade policy should have strong exogeneity to individual firms (Amiti et al., 2019). Perhaps more importantly, Trump's policy aimed to prevent the development of key industries in China (Ju et al., 2024) and to reverse the trade deficit (Jiang et al., 2023), rather than product tariff evasion, thus providing more exogeneous variation. To provide evidence that pre-trends are similar for the treated and the control group formally, we rely on the following estimating equation:

$$Gap\ Value_{c,i,t} = \sum\nolimits_{k=-6}^{-2} \alpha_k treated_{c,i} \times pre_{k,i,t} + \sum\nolimits_{k=0}^{3} \alpha_k treated_{c,i} \times post_{k,i,t} + \delta_t + \delta_{c,i} + \varepsilon_{c,i,t} \tag{5}$$

Specifically, we employ the year prior to the policy shock as the control group, with $pre_{k,i,t}$ representing the year dummy variable before policy implementation. For product i, if year t is the kth year before the imposition of trade war tariffs, then $pre_{k,i,t}$ is set to 1 and 0 otherwise. Similarly, $post_{k,i,t}$ serves as the year dummy variable after policy implementation. For product i, if year t is the kth year after the imposition of trade war tariffs, then $post_{k,i,t}$ is set to 1 and 0 otherwise. Meanwhile, to ensure DID identification, we control for year fixed effects and country-product fixed effects simultaneously.

4.2. Impact of demand intensity on tariff evasion

To examine how demand intensity affected the effect of the trade war on tariff evasion, we use the following model specification:

$$\begin{aligned} Gap\ value_{c,i,t} &= \beta_1 treated_{c,i} \times post_{i,t} + \delta_t + \delta_{c,i} \\ &+ \beta_2 key\ input\ channel_i \times \left(\beta_1 treated_{c,i} \times post_{i,t} + \delta_t\right) + \varepsilon_{c,i,t} \end{aligned} \tag{6}$$

where $key\ input\ channel_i$ represents the average demand intensity of product i at its entry port. By including $key\ input\ channel_i \times \delta_t$, the model aims to mitigate the interference of temporal trends arising from differences in demand structures when identifying the heterogeneous effects of the triple interaction term $key\ input\ channel_i \times treated_{c,i} \times post_{i,t}$ on tariff evasion.

Furthermore, to explore the reasons for the relationship among the trade war, demand intensity, and tariff evasion behavior, we extend Eq. (6) by introducing additional interaction variables, denoted as $heterogeneous_i$. The specific model is depicted as follows:

$$\begin{aligned} Gap\ value_{c,i,t} &= \beta_1 treated_{c,i} \times post_{i,t} + \delta_t + \delta_{c,i} \\ &+ \beta_2 key\ input\ channel_i \times \left(\beta_1 treated_{c,i} \times post_{i,t} + \delta_t\right) \\ &+ \gamma_1 heterogeneous_i \times \begin{pmatrix} \beta_1 treated_{c,i} \times post_{i,t} + \delta_t \\ +\beta_2 key\ input\ channel_i \times \left(\beta_1 treated_{c,i} \times post_{i,t} + \delta_t\right) \end{pmatrix} + \varepsilon_{c,i,t} \end{aligned} \tag{7}$$

where $heterogeneous_i$ denotes different heterogeneous variables, such as product characteristics, intermediate inputs, or tariff burden. The variable $heterogeneous_i$ represents local voter support for Trump and union development status in the port area. Again, in the model, we include $heterogeneous_i \times \delta_t$ and $heterogeneous_i \times key\ input\ channel_i \times \delta_t$ to eliminate the influence of temporal trends.

5. Main results

5.1. Trade war and tariff evasion

This section presents our main results on the effects of the trade war on promoting tariff evasion behavior during the importation process of Chinese products into the United States. The results indicate that compared with EU imports, the trade war prompted US importers to evade the tariffs through methods such as underreporting unit values and quantities and misclassifying product categories. By 2021, the gap value caused by these mechanisms explained 69.70 % of the gap between the trade deficits reported by the United States and China.

Table 4 provides the baseline results. In column 1, the dependent variable is the gap value, with fixed effects for the importing country, HS 6-digit product, and year. In column 2, we further control for country-product fixed effects. To mitigate the influence of

Table 4
Effect of the trade war on tariff evasion.

	(1)	(2)	(3)	(4)
	Gap Value	Gap Value	Gap Value (95)	Gap Value (90)
Treated*Post	0.155***	0.134***	0.124***	0.104***
	(0.018)	(0.017)	(0.013)	(0.010)
Product FE	YES	NO	NO	NO
Country FE	YES	NO	NO	NO
Year FE	YES	YES	YES	YES
Country*Product FE	NO	YES	YES	YES
R-squared	0.527	0.655	0.672	0.674
Observations	91,884	91,551	91,551	91,551

Note:The dependent variable in columns 1 and 2 is Gap Value, constructed using Eq. (1). Columns 3 and 4 winsorize the Gap Value at 5 % and 10 %, respectively. Column 1 controls for product fixed effects, year fixed effects, and country fixed effects. Columns 2 to 4 control for year fixed effects and country*product fixed effects. Robust standard errors clustered at the product level are in parentheses. *** Significant at the 1 % level.

outliers, columns 3 and 4 use values winsorized at 5 % and 10 %, respectively. Considering the results in column 2, the regression coefficient for Treated*Post is 0.134, which is significant at the 1 % level, implying a 13.4 % increase in the difference in tariff evasion between the values of the trade deficit reported by the United States and China compared to the difference between the values reported by the European Union and China after the trade war.[27] This conclusion remains under various winsorization choices and fixed effect specifications.

To demonstrate that the increase in tariff evasion behavior was indeed influenced by the trade war, we conduct a flexible estimation using the year prior to each product's exposure to the trade war as the base year, to provide evidence for the parallel trend assumption (as shown in Fig. 4 for Eq. (5)). The results indicate that prior to the trade war, there was no significant difference in tariff evasion behavior between the treatment and control groups. However, for the period after the trade war began, our key coefficient estimates are consistently positive and significant and increase continuously. This pre-trend test gives us more confidence that the rise in tariff evasion behavior was indeed attributable to the trade war rather than other omitted variables. Interestingly, using the estimate from three years after the trade war, we find that the change in the import gap caused by tariff changes accounted for 69.70 % of the trade deficit gap reported by the United States and China ($325.259 \times \left(e^{0.225} - 1\right) / 117.747 \ = 69.70\%$), which is very close to our coarse calculation of 72.18 %.

To corroborate the evidence on parallel trends, we conduct a placebo test by falsely advancing the trade war shock by two years. Intuitively, this wrongly assigned policy shock should not have an effect on tariff evasion behavior; otherwise, the setup of our estimating equation would be problematic. In Table A2, column 1, the results indicate that there is no significant effect of the trade war on tariff evasion behavior, lending additional support to our DID assumption.

To retrieve the information that we lose by using a single dummy variable setup, we make use of variation across the rounds of the trade war as a robustness check. To reduce biases caused by the progressive DID approach (Goodman-Bacon, 2021), we separately analyze the changes in tariff evasion behavior resulting from each round, using unique sets of affected products as the treatment groups. In column 2 in Table A2, the treatment group consists of US HS 6-digit products taxed only during the first round of the trade war, and the control group includes related products imported from Europe and those exempt from tariffs in all three rounds. Columns 3 and 4 present the results corresponding to the second and third rounds of the trade war, respectively. The regression results in columns 2 to 4 are all positive coefficient estimates that are significant at the 1 % level. The strongest effects come from the first round, perhaps because it was the round with the largest tariff imposition. Overall, our main conclusion stands under this robustness check.

Due to the predominant usage of the maritime transportation mode in trade processes, the two- to six-week shipping cycle may introduce disturbances to the estimating equation. To alleviate this concern, we resort to 2016 Chinese customs data, to compile the proportions of different transportation modes for products exported from China to Europe and the United States. Column 5 in Table A2 provides results with only observations of products for which air freight was used for more than 70 % of the exports. The results still exhibit positive and significant coefficient estimates on the trade war. Following Javorcik and Narciso (2008), in column 6 we use a first-difference specification, controlling for the trend in tariff evasion behavior across products induced by factors such as the development of customs. The results continue to show a positive and significant key estimate. These findings confirm that the significant increase in tariff evasion detected in the baseline model was indeed caused by the trade war.

Turning to channels, following Fisman and Wei (2004), we examine underreporting of import unit values and quantities as well as

[27] The pertinent tariff evasion elasticity is 0.635 (column 1, Table A13), which is lower than the elasticity of 1.772 estimated by Ferrantino et al. (2012).

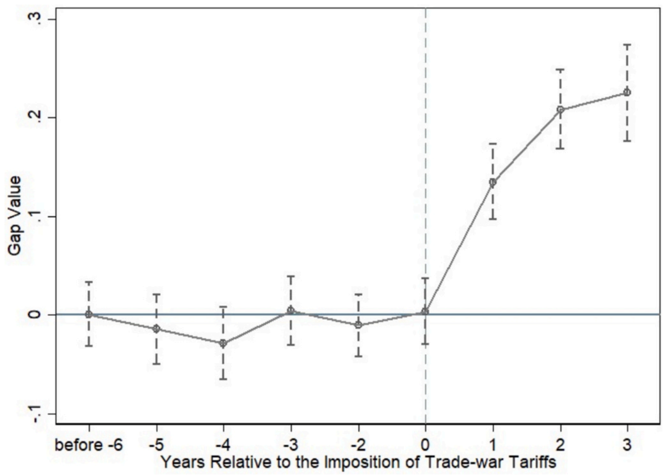

Fig. 4. Parallel trends test.
Note: This figure illustrates the results of the parallel trends test, as specified in Model (5). The dependent variable is the gap value, constructed as described in Eq. (1). The pre1 period is used as the baseline, controlling for year fixed effects and country*HS6 fixed effects. Confidence intervals are at the 10 % level. Standard errors are clustered at the HS 6-digit level.

Table 5
Channels of tariff evasion.

	(1)	(2)	(3)	(4)
	Gap Unit Value	Gap Quantity	Gap Value	Gap Quantity
Treated*Post	0.053***	0.078***	0.229***	0.210***
	(0.010)	(0.020)	(0.054)	(0.069)
Tariff on similar products			−0.101*	−0.144**
			(0.056)	(0.071)
Year FE	YES	YES	YES	YES
Country*Product FE	YES	YES	YES	YES
R-squared	0.500	0.637	0.668	0.637
Observations	83,244	83,244	83,566	83,244

Note: In column 1, the dependent variable is Gap Unit Value. In column 2, the dependent variable is Gap Quantity. Please refer to Eq. (8) (in footnote 28) for the detailed construction. Following Fisman and Wei (2004), the average tariff rate imposed on similar products (the same HS 4-digit) is used as a control: $\text{Tariff on similar products}_i = \sum_{j\epsilon I_i} \frac{\text{value of exports from China to USA}_{j,2017} \times \text{tariff}_{j,t}}{\sum_{j\epsilon I_i} \text{value of exports from China to USA}_{j,2017}}$, where I_i denotes the set of products within the same HS 4-digit; to avoid distortion caused by underreporting, we use weights from export data in 2017. In columns 3 and 4, the dependent variables are Gap Value and Gap Quantity, respectively. Each column controls for year fixed effects and country*product fixed effects. Robust standard errors clustered at the product level are in parentheses. * Significant at the 10 % level; ** Significant at the 5 % level; *** Significant at the 1 % level.

misclassification of product categories, and the pertinent results are reported in Table 5. Our dependent variable, gap value can be decomposed into gap quantity and gap unit value.[28] Columns 1 and 2 present the relevant results for gap unit value and gap quantity, respectively. They show that the coefficient estimates of Treated*Post are both positive and significant at the 1 % level in the two columns. This suggests that relative to the European Union's imports, US imports that were affected by the trade war exhibit increases of 5.3 % and 7.8 % in gap unit value and gap quantity, respectively. These two increases sum to 13.1 %, which aligns closely with the 13.4 % observed in the baseline model. Overall, our results here suggest that US firms engaged in tariff evasion through underreporting both the quantities and unit values of imported products.

As further evidence of misreporting during the importation process, following Javorcik and Narciso (2017), we add the variable “Tariff on similar products” as a regressor, which represents the average level of tariff imposition for HS 6-digit products under the HS

[28] Following Amiti et al. (2019) and Fajgelbaum et al. (2020), the unit value of the product is utilized as a proxy for price. The decomposition can be achieved as follows: $\textit{Gap Value}_{c,i,t} = \ln\left(\textit{report}\ \text{export}\ \textit{quantity}_{c,i,t} * \textit{report}\ \text{export}\ \textit{unit value}_{c,i,t}\right) - \ln\left(\textit{report import quantity}_{c,i,t\ china} * \textit{report import unit value}_{c,i,t}\right) = \ln\left(\textit{report export quantity}_{c,i,t}\right) - \ln\left(\textit{report import quantity}_{c,i,t\ china}\right) + \ln\left(\textit{report export unit value}_{c,i,t}\right) - \ln\left(\textit{report import unit value}_{c,i,t\ china}\right) = \textit{Gap Quantity}_{c,i,t} + \textit{Gap Unit Value}_{c,i,t}$ (8)

4-digit code (the notes in Table 5 describe the specific construction). Columns 3 and 4 in Table 5 provide the corresponding results using Gap Value and Gap Quantity as the dependent variables, respectively. The results show a negative and significant impact of "Tariff on similar products,"[29] suggesting that for a particular HS 6-digit product, if similar products within the same HS 4-digit category were not subject to tariff imposition during the trade war, this would have incentivized the misreporting of product categories for tariff evasion, which in turn confirms the existence of the channel of misreporting across similar product categories.

In summary, during trade war, importing enterprises resorted to tactics such as underreporting import unit values, underreporting import quantities, and misreporting product categories to avoid paying additional tariffs. By 2021, the gap value caused by these mechanisms explained 69.70 % of the change in the gap between the trade deficits reported by the United States and China.

5.2. The role of import destination demand

Bown and Zhang (2019) show that tariff increases during trade wars tend to target intermediate inputs disproportionately. The imposition of tariffs on intermediate inputs imported from China constituted 20 % of total intermediate goods imports, which was significantly higher than the 9 % for final goods. Tariff increases on intermediate inputs can transmit through input-output relationships, ultimately negatively impacting downstream manufacturers (Lovely and Yang, 2018) and thus labor markets (Bown et al., 2024; Handley et al., 2025). Was demand in the downstream US market a driver for the corresponding increases in tariff evasion? In this section, we explore this question by investigating variations in product import destination demand.

The uneven distribution of ports necessitates that products imported by states without ports must enter the US market through other states. Meanwhile, variations in industrial structure across regions allow us to construct the demand intensity of imported goods in product import destinations (port areas). Table 6 provides results for the impact of product import destination demand on tariff evasion behavior during the trade war. Columns 1 and 2, respectively, control for $key\ input\ channel_i{*}post_t$ and $key\ input\ channel_i{*}\delta_t$ to eliminate the time trends from different import destination demand structures. The pertinent coefficient estimates on the interaction terms are significantly positive, providing preliminary evidence on the importance of the demand intensity of import destinations for tariff evasion. To mitigate the influence of trade protection on inputs that are their own crucial upstream sectors, columns 3 and 4 utilize the share of labor in non-self-industries as key inputs in each state for an alternative measure of demand intensity. The corresponding results remain positive and significant, although the impact of demand becomes somewhat smaller, perhaps due to the fact that after excluding self-industries, key inputs used by certain industries are not the highest proportion of product inputs. Using the estimates in column 2 as a benchmark, increasing demand intensity by one standard deviation leads to a 1.312-fold increase in tariff evasion (0.713*0.219/0.119).

Since the identification of key inputs is based on input-output relationships in the production process, this heterogeneity is more applicable to intermediate inputs; therefore, we provide the relevant results for intermediate products in columns 1 and 2 in Table 7. The estimate on Treated*Post*Intermediate suggests that in the absence of local demand, the heterogeneous effects of intermediate products were relatively smaller compared to non-intermediate products. One possible explanation is that there was a higher proportion of homogeneous products in intermediate products, and, relative to differentiated products, it is easy to judge the prices and categories of homogeneous products, which renders tariff evasion more difficult (Javorcik and Narciso, 2008). Importantly, in column 1, we look at the heterogeneous effect of demand intensity by interacting the Treated*Post*Intermediate*Key input channel with dummies for intermediate and non-intermediate products, respectively. We find that the heterogeneous effect of demand intensity can only be seen in intermediate products, with no effect on non-intermediate products. Column 2 replaces the construct of Key input channel with Key input channel (non-self), which has no effect on the results.[30] Furthermore, in Table A3, to strengthen this result, we provide subsample results using observations on intermediate and non-intermediate products, respectively. Again, there is little effect on the conclusion. When we limit the sample to intermediate products, a one standard deviation increase in import destination demand intensity leads to a 2.700-fold expansion in tariff evasion (0.713*0.303/0.080).

To corroborate our baseline results, we investigate the role of tariff responsibility for importers and exporters using Eq. (7). If tariffs are borne by exporters rather than importers, we expect that the positive effect of the trade war on tariff evasion decreases. We use trade data between Vietnam and the United States from 2017 to 2020 to calculate the proportion of imports that were Delivered Duty Paid (DDP) as a percentage of total imports for each product (Fig. A1 provides details), which we consider as a proxy for the extent of import tariffs borne by exporters. Columns 3 and 4 in Table 7 report the results. Column 3 adds as regressors Treated*Post*DDP and Treated*Post*DDP*Key input channel; and column 4 adds as regressors Treated*Post* DDP and Treated*Post*DDP*Key input channel (non-self). We see that the coefficient estimates of Treated*Post * Key input channel and Treated*Post*Key input channel (non-self) are both significantly positive, whereas the estimate of Treated*Post*DDP*Key input channel is negative and significant. These results indicate that compared to exporters, when import tariffs are paid by importers, changes in import destination demand have a stronger effect on promoting product tariff evasion, with this effect decreasing as the proportion borne by exporters increases.[31]

[29] When we restrict the sample to the subset of goods that did not face trade-war tariff increases, the estimate for "tariffs on similar products" remains negative and statistically significant. The results are available upon request.

[30] As shown in columns 1 to 2 in Table B1, when we replace Treated*Post with the specific tariff rate in the pertinent interaction term, the conclusion remains.

[31] When the proportion of tariffs borne by China exceeds 40.49 %, the heterogeneous effects of local demand intensity become negative, although the share of such products in our sample is merely 3.6 %. To mitigate the influence of the tariff level across products, columns 3 and 4 in Table B1 provides results by substituting Treated*Post with the specific tariff imposition, in which case our main conclusion remains.

Table 6
Impact of demand intensity on tariff evasion.

	(1)	(2)	(3)	(4)
	Gap Value	Gap Value	Gap Value	Gap Value
Treated*Post	0.120***	0.119***	0.123***	0.121***
	(0.018)	(0.018)	(0.018)	(0.018)
Treated*Post*Key Input Channel	0.188**	0.219***		
	(0.081)	(0.083)		
Treated*Post*Key Input Channel (Non-Self)			0.135**	0.174**
			(0.067)	(0.071)
Year FE	YES	YES	YES	YES
Country*Product FE	YES	YES	YES	YES
Key Input Channel*Post	YES	NO	YES	NO
Key Input Channel*Year FE	NO	YES	NO	YES
R-squared	0.658	0.658	0.658	0.658
Observations	87,135	87,135	87,135	87,135

Note: The dependent variable in the table is Gap Value, constructed using Eq. (1). The Key Input Channel denotes the average demand intensity using Eq. (2); Key Input Channel $(\text{Non}-\text{Self})_i$ represents the result after removing the diagonal coefficients in the input-output table. Each column controls for year fixed effects and country*product fixed effects. Robust standard errors clustered at the product level are in parentheses. * Significant at the 10 % level; ** Significant at the 5 % level; *** Significant at the 1 % level.

Table 7
Heterogeneous effect of intermediate goods and tariff burden.

	Intermediate Goods		Tariff Burden	
	(1)	(2)	(3)	(4)
	Gap Value	Gap Value	Gap Value	Gap Value
Treated*Post	0.166***	0.167***	0.116***	0.118***
	(0.024)	(0.024)	(0.019)	(0.019)
Treated*Post*Intermediate	−0.086**	−0.085**		
	(0.035)	(0.035)		
Treated*Post*Intermediate*Key Input Channel	0.303***			
	(0.101)			
Treated*Post*(1-Intermediate)*Key Input Channel	0.084			
	(0.133)			
Treated*Post*Intermediate*Key Input Channel (Non-Self)		0.250***		
		(0.087)		
Treated*Post*(1-Intermediate)*Key Input Channel (Non-Self)		0.047		
		(0.111)		
Treated*Post*DDP			−0.014	−0.008
			(0.113)	(0.111)
Treated*Post*Key Input Channel			0.232**	
			(0.091)	
Treated*Post*DDP*Key Input Channel			−0.573*	
			(0.346)	
Treated*Post*Key Input Channel (Non-Self)				0.181**
				(0.078)
Treated*Post*DDP*Key Input Channel (Non-Self)				−0.501*
				(0.301)
Year FE	YES	YES	YES	YES
Country*Product FE	YES	YES	YES	YES
Control	YES	YES	YES	YES
R-squared	0.659	0.659	0.666	0.666
Observations	86,776	86,776	76,515	76,515

Note: The dependent variable in each column is Gap Value. Columns 1 and 2 examine the impact of intermediate goods in the presence of demand intensity. Intermediate is a dummy variable indicating whether the product is an intermediate good, classified according to the Broad Economic Categories codes. Columns 3 and 4 show the heterogeneous effect of tariffs borne by importers. DDP represents the proportion of US imports through Delivered Duty Paid (DDP) terms responsibility for import tariffs. A smaller value of DDP implies more tariffs are borne by the importers. Each column controls for year fixed effects and country*product fixed effects. Robust standard errors clustered at the product level are in parentheses. * Significant at the 10 % level; ** Significant at the 5 % level; *** Significant at the 1 % level.

In sum, the results in this section indicate that products entering the US market through ports with high demand intensity exhibit more tariff evasion. In addition, this effect becomes larger for intermediate goods and when US importers pay the tariffs. These results imply that the gap in trade values between the United States and China after the trade war is not solely attributable to factors within China or factors related to the transportation process. In contrast, US domestic demand intensity plays an indispensable role.

5.3. Robustness checks

As shown in Fig. A4, our empirical results may be influenced by factors such as export-side dynamics, transportation processes, trade environments, and import-side dynamics. To ensure the robustness of our main results, we conduct a battery of robustness checks in this section.

5.3.1. Eliminating interference from export-side behavior

On the export side, we consider two sources that may have contributed to the discrepancy: (1) overreporting of export values, and (2) the existence of re-export trade.

5.3.1.1. Overreporting on the export side caused by China's export tax rebate. On the export side, overreporting of export values may contribute to the trade discrepancy. China has adopted a partial rebate policy: when the rebate rate for exports does not exceed the value-added tax rate, exporters need to pay a "net export tax" for exports, leading to a tendency for exporters to underreport export volumes (Ferrantino et al., 2012). In response to the negative impact of the trade war on Chinese exports, China's government implemented four rounds of increases in export tax rebate rates during 2017–19, which restrained the underreporting behavior of Chinese exporters and thus may have had a positive impact on the trade discrepancy between the United States and China.

Nevertheless, in terms of policy content, the relevant influence on our results is limited because the changes in export tax rebate rates target different products and apply to all of China's trading partners. Our paper employs a DID approach (the European Union versus the United States), which helps to mitigate such noise. In addition, the Chinese government set export tax rebates based on tariff increases after the trade war, rather than basing them on the demand intensity in port areas in the United States; thus, the export tax rebates should have had no influence on the heterogeneous effect of demand intensity on tariff evasion. The results in Table 6 alleviate our concern that the increase in the trade discrepancy was solely caused by overreporting on the export side.

In terms of practical impact, concerns remain that VAT rebates could have a greater impact on Chinese exports to the US, e.g., the trade war did not involve the EU and imports in EU could be mostly composed by the goods for which the VAT rebates haven't changed much. To possibly alleviate this concern, following the literature (Ferrantino et al., 2012), we add a control export value-added tax rebate rates at product-year level in the baseline model, which is obtained from Database of Export Tax Refund Rate released by the State Administration of Taxation; meanwhile, we interact VAT rebates with a US dummy and further add this interaction as a control. The corresponding results are reported in Table A4. We find that indeed Export Tax Rebate has a positive and significant effect on the gap value and the interaction term between Export Tax Rebate and US dummy is not significant. This means that VAT rebate does cause an over-reporting in the export end and there is no differential response for trading partners. More importantly, controlling the influence of VAT, our baseline results are not jeopardized.

5.3.1.2. Re-exports. Hong Kong's re-exports have been an important factor in explaining the discrepancy in trade values between mainland China and the United States (Feenstra et al., 1999). On the one hand, some products exported from Hong Kong to the United States may be recorded as Chinese products by US customs, while they are not recorded in Chinese export statistics. On the other hand, facing tariff increases due to the trade war, Chinese exporters may have resorted to re-exports to evade the tariffs.[32]

To eliminate the influence of Hong Kong's re-exports on our results, following Ferrantino et al. (2012), we treat mainland China and Hong Kong as a single unit of analysis in the regression. In other words, the difference between the reported imports from China and Hong Kong combined to the United States and the reported exports from China and Hong Kong combined is used as the dependent variable in the regression. The related empirical results are presented in Table A5, with column 1 for the baseline model, column 2 adding Treated*Post*Key input channel, and column 3 adding Treated*Post*Key input channel (non-self). The results show that after excluding the disturbance caused by Hong Kong's re-exports, the trade war still exerted a significant and positive effect on tariff evasion. Moreover, in column 2, increasing the demand intensity by one standard deviation, the increase in tariff evasion is 1.255 times higher (0.713 * 0.220 / 0.125).

5.3.2. Eliminating the disturbance from the transportation process

5.3.2.1. Transportation time. The variation in transportation time and costs may have affected the bilateral trade discrepancy, thus contaminating our estimates. Due to the substantial share of maritime transportation in China-US trade, which typically involves a transit time of more than two weeks, there exists an inherent difference in trade statistics between China and the United States within the same time frame. More specifically, imports recorded by the United States at the beginning of the year may be attributed to the previous year in China, while exports at the end of the year in China may be counted by the United States as imports in the following year, thus resulting in differences in the recorded trade volumes between the two countries. In addition, as the trade war effectively dampened exports of relevant Chinese products (Jiang et al., 2023), the trade volume attributed to China in the previous year but counted by the United States will exceed the trade volume attributed to China in the same year, leading to a reduction in the trade discrepancy. Consequently, this could result in underestimating the impact of the trade war. As a robustness check, when the sample is

[32] We also check the potential other countries serving as re-export hubs and utilize UN Comtrade data on re-exports, which cannot materially affect our main results and these results are available upon request.

restricted to products primarily transported by air freight, as shown in Table A2, column 5, the key estimate is still positive and significant, suggesting that our baseline results are robust to this concern.[33]

5.3.2.2. Transportation costs. On transportation costs, due to differences in value accounting between the import and export sides, generally speaking, the value recorded on the export side is mostly FOB, while on the import side, CIF is predominant. The former does not include transportation costs incurred during the transportation process. Therefore, the recent rise in transportation costs directly affects the numerical value of the bilateral trade gap, thereby influencing the reliability of the estimated results.

To mitigate the interference of trade costs between countries, Table A6 further controls for country-year fixed effects, controlling for trade costs at the country-year level, in our baseline model.[34] In columns 1 to 3, the dependent variable is the trade gap between China and the United States (Gap Value), and in columns 4 to 6, the dependent variable is the trade gap when we consider mainland China and Hong Kong as a single entity. The results indicate that even after controlling for country-year fixed effects, the positive effect of the trade war on tariff evasion behavior persists and the effect of import demand structure becomes even larger.

5.3.3. Excluding external environmental interference

5.3.3.1. Exchange rate. The changes in the exchange rates for the euro, RMB, and US dollar can induce different trends in trade discrepancies. However, our results in Table A6 indicate that after controlling for country-year fixed effects, the positive effect of the trade war on tariff evasion remains, thereby ruling out the concern that exchange rates may contaminate our empirical findings.

5.3.3.2. Disruption caused by the COVID-19 pandemic. Given that our sample period ranges from 2011 to 2021, straddling the COVID-19 pandemic, an event that affected international trade, this may mask the true variation in tariff evasion. As a robustness check, we exclude observations from 2020 and 2021, limiting the sample to ranging from 2011 to 2019, a period during which all three rounds of trade war policies were implemented, while the COVID-19 pandemic had not yet emerged. The relevant results, shown in Table A7, indicate that the key estimates in columns 1 to 3 are little changed. Using the estimate in column 2 as a benchmark, the result implies that increasing destination-specific demand intensity by one standard deviation will cause a corresponding increase in tariff evasion by 3.651-fold (0.713*0.169/0.033), which is larger than our baseline estimate. This finding suggests that the outbreak of the pandemic weakened the demand for inputs in the United States due to factors such as strikes, thereby suppressing the heterogeneous effect of destination-specific demand.

5.3.3.3. Exclusion of the influence of other external factors. To eliminate the influence of other factors, we conduct a falsification test by reversing the original import-export relationship in constructing the dependent variable, $\textit{Gap Value}\,(\textit{Vers})_{c,i,t} = \log(\text{value of exports from USA or EU to China})_{c,i,t} - \log(\text{value of imports to China from USA or EU})_{c,i,t}$. That is, we use the gap value during the import process in China for the corresponding products as the dependent variable. Intuitively, we should not observe a significant effect of the trade war using this dependent variable; otherwise, our baseline model would suffer from an endogeneity issue due to other external factors. The pertinent results, reported in Table A8, are not significant, thereby ruling out the possibility that the baseline results are accidental outcomes caused by external factors and influencing factors during the transportation process.[35]

5.3.4. Excluding influences on the import side

On the import side, differences between the FOB and CIF prices, customs advancement, de minimis imports, and disparities in the locations of entry ports can all influence the bilateral trade gap, thereby disturbing our identification of tariff evasion behavior. Among these possible influencing factors, the difference between FOB and CIF prices is primarily caused by transportation costs and insurance, as discussed earlier. This section systematically eliminates the remaining confounders.[36]

5.3.4.1. Customs advancement. Based on the approach outlined by Javorcik and Narciso (2008), we conduct regression analysis using the first difference of the dependent variable to mitigate the influence of customs advancement trends on product tariff evasion. Specifically, we replace the dependent variable with the first-order difference of the gap value, while maintaining the same controls as in the baseline regression. The results, presented in column 6 in Table A2, continue to show a positive and significant effect of the trade war on tariff evasion.

[33] The results controlling for country-year fixed effects in Table A6 and the falsification test reported in Table A8 can also partially alleviate our concern on the bias caused by transportation time.

[34] The falsification test reported in Table A8 further alleviates this concern about transportation costs.

[35] We also look at how Chinese imports from US react to retaliatory tariffs from China. We find that estimates on retaliatory tariffs are quantitatively small and not statistically significant, possible due to the short time span during trade war or China's increasing standard on product inspection on imports. These results are available upon request.

[36] In unreported results, we check how non-tariff barriers have affected value gap and obtain the conclusion that are consistent with Kee and Nicita (2022), while NTBs do not have a stronger impact on the gap value of the products that are affected by US-China trade war. These results are available upon request.

5.3.4.2. De Minimis imports. With the rapid development of cross-border e-commerce, de minimis imports in U.S. increase significantly. Since de minimis imports could enjoy tariff exemption under certain threshold, they do not require complete filing, which may obscure our key estimates, although in some cases, they could serve as a form of tariff evasion. However, most de minimis imports have been recorded under their respective product codes since January 2010, the lower reporting requirements for tariff exemptions have led some de minimis imports to be classified under 9999.95.0000. Despite the fact that the value of 9999.95.0000 in U.S. imports of Chinese products has remained below 1 % during the sample period, there remains a risk of overestimating import values.[37] We construct a dummy for de minimis in accounting for its potential effects on our main results, i.e., the variable is set to 1 if the product code appears on the 'List of Cross-Border *E*-commerce Retail Import Commodities (2019 Edition)' issued by the Chinese Ministry of Finance,[38] and 0 otherwise.[39] To account for trade war effects, we also control for interactions between de minimis and Treated*Post, as well as de minimis*time dummies for the estimation results reported in Table A9.[40] Our main results remain robust when the potential influence of de minimis imports are controlled for. Logically, since de minimis mainly affects trade in final goods while our demand heterogeneity is driven by intermediate goods' input-output relationships, this means controlling for de minimis will increase the impact of demand heterogeneity. Indeed, we find that one standard deviation increase in demand heterogeneity raises tariff evasion by 1.401 times (0.713*0.226/0.115), which is larger than our benchmark estimates, giving us more confidence on our baseline results.

5.3.4.3. Location of entry ports. Most ports are dispersed along border regions. Meanwhile, the costs of trade between different US ports and China are different, with transportation time and costs being relatively lower for ports in the western region. Since exporters select the corresponding ports for entry, in which case the preference is unobserved, this may affect the heterogeneity of entry port demand intensity. To exclude the influence of choice of ports in the analysis of tariff evasion, we control for the distribution of entry port locations broadly. Based on the definition provided by the U.S. Census Bureau, we divide the United States into western and non-western regions.[41] The corresponding dummy variable, $west\ port_s$, takes a value of 1 if the entry port is in the western region and 0 otherwise. Then, we calculate the proportion of imports entering the western region for each product as $\text{west port share}_i = \sum_s \frac{import_{i,s,2017} \times west\ port_s}{import_{i,2017}}$. We add as a control in the baseline model west port share_i multiplied by year indicators controlling for temporal trends resulting from differences in the geographic locations of entry ports. The results are presented in Table A10. The coefficient of Treated*Post*West Port Share is not significant and has little effect on our baseline estimates. In particular, the estimate in column 2 indicates that increasing demand intensity by 1 standard deviation will increase tariff evasion by 2.213-fold (0.713 * 0.239 / 0.077).

5.3.5. Other model specifications

5.3.5.1. Removing the influence of outliers. To reduce the potential influence of outliers on the empirical results, we apply a 5 %–95 % winsorizing procedure to the dependent variable. The regression results are presented in Table A11, which uses our baseline specifications. The results in columns 1 to 3 indicate that the coefficients for both Treated*Post and Treated*Post*Key input channel remain statistically significant and positive, which is consistent with our baseline results.

5.3.5.2. Balanced panel. Since some products subject to tariff increases in the United States do not have corresponding imports in the European Union, this may affect our identification. Meanwhile, although the US government included almost all HS 6-digit products imported from China in the planning documents in the tariff escalation during the trade war (Jiang et al., 2023), the products listed in Round 3 Catalog C were ultimately not subject to tariff escalation due to negotiations between China and the United States in 2019. To eliminate the potential influence of these products on tariff evasion, we exclude products that were not subject to tariff escalation and retain only products imported from China by both the European Union and the United States. The corresponding results, using the baseline specification, are reported in Table A12. The results remain consistent with the baseline results.

*5.3.5.3. Replacing post*treat with tariff.* In the baseline model, we use Treated*Post as the key regressor in the DID analysis. However, different products are subject to varying degrees of tariff imposition, with the first two rounds imposing a 25 % ad valorem tariff, while the third round imposed a 15 % tariff. To mitigate potential noise from variations in tariff imposition across products, in the baseline model, we replace Treated*Post with the changes in tariffs that each country-product experienced. The results are shown in Table A13. We find that a 1 % increase in tariffs during the trade war leads to a 0.669 % increase in Gap Value, which is consistent with Ferrantino et al.'s (2012) estimate; increasing demand intensity by 1 standard deviation, the change in Gap Value resulting from a 1 % increase in

[37] Meanwhile, raising the tariff exemption threshold may lead firms to evade tariffs through methods such as splitting packages or underreporting values. Such evasion is not captured by the import gap, causing an underestimation of tariff losses by U.S. Customs if import gap is used as the dependent variable. Although underreporting below $800 can affect the gap value, it is itself a form of tariff evasion and does not affect the main findings of this study.

[38] https://www.gov.cn/xinwen/2016-04/09/content_5062650.htm

[39] The reason for this construction is that most de minimis products are associated with cross-border e-commerce.

[40] As shown in Table D1, when we replace Treated*Post with the specific tariff rate in the pertinent interaction term, our main conclusion remains.

[41] The western region includes Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oklahoma, Oregon, Texas, Utah, Washington, and Wyoming. The other states are defined as the non-western region.

tariffs increases to 1.339 % [(0.713*1.024 + 0.609)%]. This analysis implies that our results are robust to a more nuanced measure of the trade war.

6. Heterogeneity analysis

The preceding analysis showed a significant increase in evasion of tariffs on Chinese imports following the trade war. Moreover, it highlighted the heterogeneous impacts of local demand intensity on tariff evasion. This suggests that local market conditions in the United States directly influenced tariff evasion behavior induced by the trade war. How did local market conditions influence the tariff evasion process? We conjecture that the political and social environments in various regions may have exerted varying effects on tariff evasion behavior and local demand heterogeneity.

Although the imposition of the tariffs was uniform, enforcement of tariffs relies on local customs officials at various border ports (Laajaj et al., 2023). In this case, in each state's ports, the attitudes of the customs officials toward tariff enforcement significantly affected tariff collection. On the one hand, the attitudes of customs officials toward tariff enforcement are influenced by the local environments in which they work and live, as well as the local population's attitudes toward trade protection; this may affect the rigor of tariff inspections. On the other hand, port operations are under the jurisdiction of state governments, and labor unions and local government attitudes may influence their operational efficiency. Therefore, we investigate the relationship between tariff evasion and local market conditions at entry ports, based on local support for Trump and the development of labor unions.

6.1. Local attitudes toward trade protection

During his tenure, Trump consistently advocated for "America First" and criticized trade liberalization measures such as the North American Free Trade Agreement and "permanent normal trade relations" with China. As the initiator of the trade war, during his campaign, Trump promised to implement protectionist measures. Thus, support for Trump in each state during the 2016 election can serve as a proxy for voters' attitudes toward trade protection. We construct two measures of local support for Trump: the proportion of states won by Trump in import entry states, $\text{Trump share}_i = \sum_s \frac{\text{import}_{i,s,2017} \times \text{Trump2016}_s}{\text{import}_{i,2017}}$, where Trump2016_s represents the support for Trump in state *s* during the 2016 election, which takes the value of 1 if Trump won and 0 otherwise; and the average rate of support for Trump in import entry states, $\text{vote share}_i = \sum_s \frac{\text{import}_{i,s,2017} \times \text{vote2016}_s}{\text{import}_{i,2017}}$, where vote2016_s represents the rate of support for Trump in state *s* during the 2016 election.

By including Trump share_i and vote share_i in estimating Eq. (7), we have the results reported in Table 8. In columns 1 to 2, the proportion of import entry states that Trump won is used for the heterogeneity analysis. The positive and significant estimate on Treated*Post*Key input channel in column 1 suggests that when products entered the US market in regions with relatively low support for trade protection, local demand intensity significantly promoted tariff evasion. In contrast, the estimate on Treated*Post*Key input channel*Trump share is significantly negative, indicating that as support for Trump increased in the destination markets, the impact of demand intensity on tariff evasion diminished. Considering that using dummy variables might overlook the winning margins within each state,[42] columns 3 to 4 repeat the analysis in columns 1 to 2, using the average share of votes supporting Trump, vote share_i. Consistent with the results reported in columns 1 to 2, local support for trade protection decreased the impact of local demand intensity on tariff evasion.[43] Overall, these results indicate that in the entry destinations, voters' attitudes toward trade protectionism played a significant role in import tariff evasion.

6.2. Labor unions

The development of labor unions creates favorable conditions for tariff evasion. On the one hand, the development of port unions affects the automation process and the hiring of workers at ports, which are strongly associated with port operational efficiency (Paul and Macdonald, 2017), making customs tariff inspections more susceptible to local influences. On the other hand, endorsements by unions play a significant role in political elections (Sieg and Wang, 2013; Baldwin and Magee, 2000; Bombardini et al., 2023; Autor et al., 2020; Che et al., 2022), thereby making unions more efficient in conveying local demand information from workers. In this context, as unions advocate for workers' rights and power (Sly and Soderbery, 2014; Carluccio and Bas, 2015), we look at how unions influenced the process of import tariff evasion when there were potential negative impacts of tariff increases on downstream industries in the port areas (Bown et al., 2024; Handley et al., 2025).

We use the proportion of unionized workers in each state and the proportion of workers covered by union contracts in 2016 as proxies for the development of labor unions in different states (Hirsch and Macpherson, 2003). Employing model (7), we investigate the effect of unions on tariff evasion and further look at their role in the influence of local demand intensity. The results are presented in Table 9, where columns 1 to 2 utilize the average number of union members in import destinations to gauge the level of local union

[42] The support rates for Trump within losing and winning states also exhibit significant differences. For instance, although Trump lost in New Hampshire, his support rate reached 46.46 %, which exceeded that of the winning state, Utah, at 45.54 %.

[43] To mitigate the influence of varying tariff imposition rates during the trade war, in the regression, we further replace Treated*Post with the tariffs imposed on each product. The results are shown in Table B2, and our conclusion remains robust.

Table 8
The role of local attitudes toward trade protection.

	Proportion of Trump-winning States		Average Supporting Rate for Trump	
	(1)	(2)	(3)	(4)
	Gap Value	Gap Value	Gap Value	Gap Value
Treated*Post	0.078**	0.081**	0.034	0.043
	(0.037)	(0.037)	(0.183)	(0.182)
Treated*Post*Key Input Channel	0.823***		2.700***	
	(0.179)		(0.756)	
Treated*Post*Key Input Channel (Non-self)		0.697***		2.269***
		(0.154)		(0.645)
Treated*Post*Trump Share	0.099	0.099		
	(0.090)	(0.089)		
Treated*Post*Key Input Channel*Trump Share	−1.204***			
	(0.350)			
Treated*Post*Key Input Channel (Non-self)*Trump Share		−1.046***		
		(0.299)		
Treated*Post*Vote Share			0.196	0.183
			(0.441)	(0.438)
Treated*Post*Key Input Channel*Vote Share			−5.658***	
			(1.725)	
Treated*Post*Key Input Channel (Non-self)*Vote Share				−4.781***
				(1.470)
Year FE	YES	YES	YES	YES
Country*Product FE	YES	YES	YES	YES
Control	YES	YES	YES	YES
R-squared	0.659	0.659	0.658	0.658
Observations	87,135	87,135	87,135	87,135

Note: The dependent variable in each column is Gap Value. We use Trump share$_i$ for columns 1 to 2 and vote share$_i$ for columns 3 to 4 in measuring the attitudes of voters at entry ports toward trade protection, which are constructed as Trump share$_i = \sum_s \frac{\text{import}_{i,s,2017} \times \text{Trump2016}_s}{\text{import}_{i,2017}}$ and vote share$_i = \sum_s \frac{\text{import}_{i,s,2017} \times \text{vote2016}_s}{\text{import}_{i,2017}}$. Each column controls for year fixed effects and country*product fixed effects. Robust standard errors clustered at the product level are in parentheses. * Significant at the 10 % level; ** Significant at the 5 % level; *** Significant at the 1 % level.

development. Results in column 1 indicate, first, the estimate on Treated*Post*Key input channel is negative and significant, indicating that in import destinations where there were no unions, an increase in the importance of products in the import destination led to a decrease in tariff evasion. It seems that demand intensity did not directly promote tariff evasion but required the unions to convey the impact. Second, the positive and significant estimate on Treated*Post*Key Input Channel*Union Member indicates that as unions developed, the impact of demand intensity at entry ports on tariff evasion gradually shifted from negative to positive. When the proportion of union members exceeded 8.554 %,[44] an increase in demand intensity led to an increase in tariff evasion, which underscores the significant role of unions in the effect of demand intensity on tariff evasion. The estimate of Treated*Post*Union member is small and not statistically significant, indicating that the influence of unions on tariff evasion only applied to products that had a larger demand intensity in the entry destination. For products that did not affect the local labor market, unions had no effect on tariff evasion, which implies that unions served as an important channel for the effect of demand intensity.

Our results remain robust when we replace Key Input Channel with Key Input Channel (non-self) as an alternative measure in column 2 in Table 9. In columns 3 to 4, we repeat the same specification as that in columns 1 to 2, using the average number of union representatives among entry destinations as an alternative measure of union development, and this has little effect on our main conclusion. To eliminate the influence of tariff rates during the trade war, we replace Treated*Post with the tariff level on each product as the key regressor. The corresponding results, shown in Table B3, deliver a similar conclusion as that of columns 1 to 2 in Table 9.[45]

7. Conclusion

This paper has shown that the US-China trade war was not as successful in reducing the trade deficit between China and the United States as Trump has described, mainly due to importers evading paying customs tariffs. The paper contributes to the literature by describing a more realistic image of the effects of the trade war on the “trade deficit,” which is of great significance for trade policy formation. Currently, tariff evasion is generally attributed to the reporting value due to importers. However, prior research did not

[44] Of the products in the sample, 87.17 % exceed this threshold.
[45] Note that the heterogeneous analysis in our paper may not be interpreted wholly as causation, though it is important for investigation and further exploration can be done in the future.

Table 9
Heterogeneity analysis of union development.

	Average number of union members among import entry states		Average number of union representatives among import entry states	
	(1)	(2)	(3)	(4)
	Gap Value	Gap Value	Gap Value	Gap Value
Treated*Post	0.158*	0.158*	0.151*	0.151*
	(0.085)	(0.084)	(0.090)	(0.089)
Treated*Post*Key Input Channel	−0.633**		−0.716**	
	(0.291)		(0.315)	
Treated*Post*Key Input Channel (Non-self)		−0.539**		−0.610**
		(0.245)		(0.265)
Treated*Post*Union Member	−0.003	−0.003		
	(0.006)	(0.006)		
Treated*Post*Key Input Channel*Union Member	0.074***			
	(0.024)			
Treated*Post*Key Input Channel (Non-self)*Union Member		0.062***		
		(0.020)		
Treated*Post*Union Represented			−0.002	−0.002
			(0.006)	(0.006)
Treated*Post*Key Input channel*Union Represented			0.073***	
			(0.023)	
Treated*Post*Key Input Channel (Non-self)*Union Represented				0.062***
				(0.020)
Year FE	YES	YES	YES	YES
Country*Product FE	YES	YES	YES	YES
Control	YES	YES	YES	YES
R-squared	0.659	0.659	0.659	0.659
Observations	87,135	87,135	87,135	87,135

Note: This table provides estimation results using Eq. (7). The dependent variable in each column is Gap Value. Following Hirsch and Macpherson (2003), columns 1 to 2 use the proportion of union workers at the entry states, denoted by union $\text{member}_i = \sum_s \frac{\text{import}_{i,s,2017} \times \text{union member}_s}{\text{import}_{i,2017}}$, where union member_s represents the proportion of union members in state s. Columns 3 to 4 use the proportion of workers covered by union contracts, denoted by union $\text{member}_i = \sum_s \frac{\text{import}_{i,s,2017} \times \text{union member}_s}{\text{import}_{i,2017}}$, where union represent_s represents the proportion of workers represented by a union in state s, including both union members and nonmembers whose work is under union protection. Each column controls for year fixed effects and country*product fixed effects. Robust standard errors clustered at the product level are in parentheses. * Significant at the 10 % level; ** Significant at the 5 % level; *** Significant at the 1 % level.

provide direct evidence associated with the import market. Instead, there was limited heterogeneity analysis, for example, focusing on the intrinsic characteristics of products. In particular, although tariff evasion behavior is considered as a means for companies to cope with changes in costs resulting from tariff increases, we lack concrete empirical evidence on the relationship between product tariff evasion and downstream industries.

By combining the varying importance of products across entry ports and the nonuniform distribution of ports in the United States, we examined the impact of entry port demand intensity on tariff evasion during the China-US trade war. Our DID analysis showed that following the trade war, importers in the United States engaged in tariff evasion through underreporting unit values and quantities as well as misreporting categories. Demand intensity at the port of entry significantly influenced product tariff evasion during the trade war. This pattern was even more pronounced for intermediate goods. Yet, when tariffs were borne by exporters, this heterogeneous effect diminished. These results remain robust after accounting for external factors and different model specifications.

Turning to channels, we looked at the roles of voter support for trade protectionism and union development in port areas. Our results indicate that local voters' support for trade protectionism inhibited import tariff evasion and hindered the facilitating effect of demand intensity at ports of entry. Moreover, labor unions played a significant role in the process of tariff evasion during the trade war, and the impact of demand intensity at the port of entry increased as labor unions developed.

Overall, our result shows the importance of input-output linkages in today's world, with substantial development in global value chains. The results also demonstrate that the trade relationship between China and the United States is complicated, and it is difficult to cut off trade between the two countries by using trade protection policies such as trade wars. Therefore, trade policies, including tariff barriers and non-tariff barriers, which are formed to be mutually beneficial to all the trade partners are welcome, while trade protectionism might only do harm to the local economy in the host country through downstream industry shocks.

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Declaration of competing interest

The authors declare that they have no relevant or material financial interests that relate to the research described in this paper.
Yi Che declares that he has no relevant or material financial interests that relate to the research described in this paper.
Donglin Lin declares that he has no relevant or material financial interests that relate to the research described in this paper.
Yan Zhang declares that she has no relevant or material financial interests that relate to the research described in this paper.

Appendix A

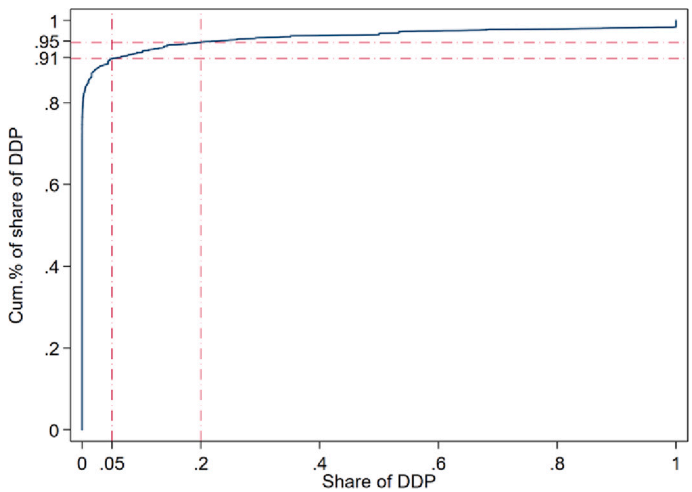


Fig. A1. Cumulative distribution of DDP Share_i.
Note: This figure depicts the cumulative distribution of the proportion of import duties borne by exporters during the importation process in the United States from 2017 to 2021. The horizontal axis represents the proportion of imports conducted on a Delivered Duty Paid (DDP) basis relative to total imports of each product, $\text{DDP share}_i = \frac{\sum_{k \in K_i,t} \text{import from vietnam}_{k,i,t} * \text{DDP}_{k,i,t}}{\sum_{k \in K_i,t} \text{import from vietnam}_{k,i,t}}$, where i denotes the HS 6-digit product, k represents the firm, and t denotes year. DDP is an international trade term denoting the only condition where the exporter bears the responsibility for paying import duties (see specific details in Table C1). A higher value of DDP share_i means a higher proportion of import transactions for which the exporter is responsible for paying import duties. The vertical axis represents the cumulative distribution of product categories. Because relevant data from China is not available, and considering that Vietnam is a developing country with a similar industry structure to China, where various manufacturing firms have moved from China to Vietnam for exports (Alfaro and Chor, 2023), we use data from Vietnam to calculate DDP Share_i.

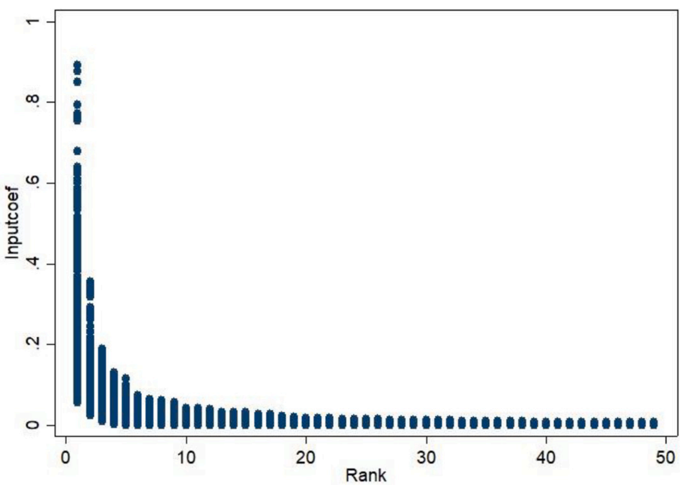


Fig. A2. Scatter plot of input share for the top 50 inputs in each industry.
Note: This figure shows the proportion of the top 50 inputs in various industries. The horizontal axis represents the ranking of inputs used in different industries, while the vertical axis represents the share of inputs used in production. The inputs are mainly concentrated at the top ranking. The data are from the 2012 US Bureau of Economic Analysis US Input-Output Table.

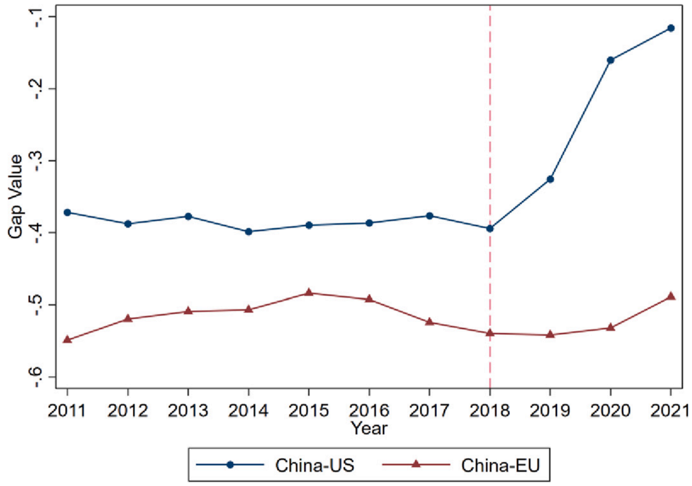


Fig. A3. Annual discrepancy in bilateral trade value between China and the United States or the European Union.
Note: This figure shows the bilateral trade discrepancies in Chinese exports to the United States and the European Union from 2011 to 2021. The horizontal axis represents the year, and the vertical axis indicates the average bilateral trade discrepancies for each group. Following Fisman and Wei (2004), the bilateral trade discrepancy for each product is $\text{Gap Value}_{c,i,t} = \ln\left(\text{report export value}_{c,i,t\ \text{china}}\right) - \ln\left(\text{report import value}_{c,i,t\ \text{china}}\right)$. The red triangular node line represents the value of the difference in Chinese imports to the European Union, and the blue circular node line denotes the difference in Chinese imports to the United States. The data are from UN Comtrade.

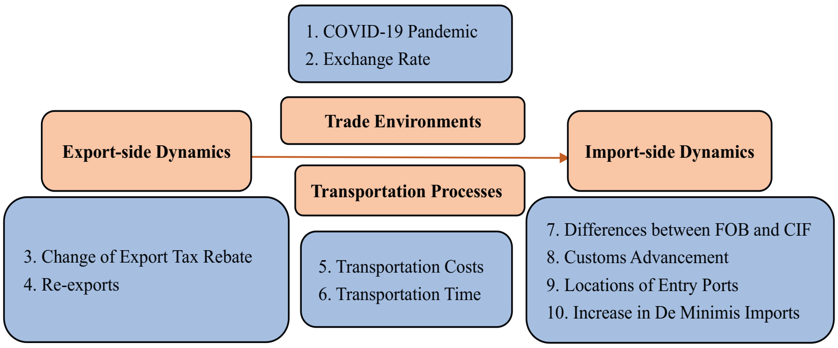


Fig. A4. Factors affecting tariff evasion.

Note: This figure lists possible confounding factors affecting tariff evasion. In the robustness checks, we alleviate concerns about these factors.

Table A1
Changes in the gap value across product categories and uses during the trade war.

Product	Gap Value before the Trade War (2017)	Gap Value after the Trade War (2021)	Change of Gap Value during the Trade War	Relative Change of Gap Value during the Trade War
Panel A Group by Product Category in HS-code				
Live animals; animal products (HS Chapters 1–5)	−0.228	−0.196	0.032	0.065
Vegetable products (HS Chapters 6–14)	0.008	0.187	0.179	0.145
Animal or vegetable fats and oils and their cleavage products; prepared edible fats; animal or vegetable waxes (HS Chapter 15)	0.420	0.553	0.133	0.536
Prepared foodstuffs; beverages, spirits, and vinegar; tobacco and manufactured tobacco substitutes (HS Chapters 16–24)	0.189	0.377	0.189	0.402
Mineral products (HS Chapters 25–27)	0.288	0.346	0.058	0.304

(continued on next page)

Table A1 (*continued*)

Product	Gap Value before the Trade War (2017)	Gap Value after the Trade War (2021)	Change of Gap Value during the Trade War	Relative Change of Gap Value during the Trade War
Products of the chemical or allied industries (HS Chapters 28–38)	−0.121	−0.069	0.052	0.113
Plastics and articles thereof; rubber and articles thereof (HS Chapters 39–40)	−0.135	0.003	0.138	0.063
Raw hides and skins, leather, furskins, and articles thereof; saddlery and harness; travel goods, handbags, and similar containers; articles of animal gut (other than silk-worm gut) (HS Chapters 41–43)	−0.135	0.491	0.626	0.361
Wood and articles of wood; wood charcoal; cork and articles of cork; manufactures of straw, of esparto or of other plaiting materials; basketware and wickerwork (HS Chapters 44–46)	0.063	0.195	0.132	0.008
Pulp of wood or other fibrous cellulosic material; recovered (waste and scrap) paper or paperboard; paper and paperboard and articles thereof (HS Chapters 47–49)	−0.352	−0.037	0.315	0.282
Textiles and textile articles (HS Chapters 50–63)	0.041	0.325	0.284	0.217
Footwear, headgear, umbrellas, sun umbrellas, walking-sticks, seat-sticks, whips, riding-crops, and parts thereof; prepared feathers and articles made therewith; artificial flowers; articles of human hair (HS Chapters 64–67)	−0.160	0.178	0.339	0.267
Articles of stone, plaster, cement, asbestos, mica, or similar materials; ceramic products; glass and glassware (HS Chapters 68–70)	−0.079	0.354	0.434	0.312
Natural or cultured pearls, precious or semi-precious stones, precious metals, metals clad with precious metal, and articles thereof; imitation jewellery; coin (HS Chapter 71)	0.194	0.299	0.105	−0.666
Base metals and articles of base metal (HS Chapters 72–83)	−0.182	0.052	0.234	0.099
Machinery and mechanical appliances; electrical equipment; parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles (HS Chapters 84–85)	−0.277	−0.007	0.270	0.163
Vehicles, aircraft, vessels, and associated transport equipment (HS Chapters 86–89)	0.159	0.324	0.165	0.201
Optical, photographic, cinematographic, measuring, checking, precision, medical, or surgical instruments and apparatus; clocks and watches; musical instruments; parts and accessories thereof (HS Chapters 90–92)	−0.251	−0.058	0.193	0.154
Arms and ammunition; parts and accessories thereof (HS Chapter 93)	−0.621	−0.428	0.193	−0.364
Miscellaneous manufactured articles (HS Chapters 94–96)	−0.237	0.074	0.311	0.111
Works of art, collectors' pieces, and antiques (HS Chapter 97)	−1.972	−0.209	1.764	−1.774
Panel B Group by Product Use				
Intermediate Goods	−0.183	0.116	0.299	0.209
Non-intermediate Goods	−0.208	0.042	0.250	0.126

Note: This table reports the heterogeneous changes in the value gap across product categories and uses. Panel A groups products by their corresponding HS2 product category; Panel B classifies products as intermediate or non-intermediate goods based on their BEC codes. Columns 1 and 2 respectively provide the gap values for different products in U.S.-China trade before (2017) and after (2021) the trade war. Column 3 reflects the change in gap value for each product in U.S.-China trade before and after the trade war, which is the difference between columns 1 and 2, calculated as follows: Change of Gap Value$_{i,USA}$ $= \left(Gap\ Value_{i,USA,2021} - Gap\ Value_{i,USA,2017}\right)$. Column 4 further uses the change in gap value in China-EU trade during the same period as a benchmark to exclude the impact of the export side. The calculation is as follows: Relative Change of Gap Value$_i$ $= \left(Gap\ Value_{i,USA,2021} - Gap\ Value_{i,USA,2017}\right) - \left(Gap\ Value_{i,EU,2021} - Gap\ Value_{i,EU,2017}\right)$.

Table A2
Robustness tests.

	Placebo	Round1	Round2	Round3	Flight	D Gap
	(1)	(2)	(3)	(4)	(5)	(6)
	Gap Value	Gap Value	Gap Value	Gap Value	Gap Value	D.Gap Value
Treated*Post		0.213***	0.151***	0.108***	0.379***	0.046***
		(0.040)	(0.025)	(0.038)	(0.113)	(0.011)
Treated*Alc_pre2	0.020					
	(0.018)					
Year FE	YES	YES	YES	YES	YES	YES
Country*Product FE	YES	YES	YES	YES	YES	YES
R-squared	0.680	0.630	0.649	0.667	0.537	0.060
Observations	77,173	19,482	54,504	28,153	5860	80,403

Note: Column 1 conducts a placebo test by advancing the policy experiment by two years while deleting observations post the trade war. Columns 2 to 4, respectively, investigate the impact of the trade war in different rounds. Column 5 uses a sample of products with a high proportion in air transport; the proportions of air transport in transactions between China and Europe or the United States both exceed 70%. The dependent variable in columns 1 to 5 is Gap Value, constructed using euqation 1. The dependent variable in column 6 is constructed using the first-difference method. Each column controls for year fixed effects and country*product fixed effects. Robust standard errors clustered at the product level are in parentheses. * Significant at the 10 % level; ** Significant at the 5 % level; *** Significant at the 1 % level.

Table A3
Subsample analysis between intermediate and non-intermediate goods.

	Intermediate Goods			Non-immediate Goods		
	(1)	(2)	(3)	(4)	(5)	(6)
	Gap Value	Gap Value	Gap Value	Gap Value	Gap Value	Gap Value
Treated*Post	0.114***	0.080***	0.083***	0.161***	0.166***	0.167***
	(0.024)	(0.026)	(0.026)	(0.025)	(0.024)	(0.024)
Treated*Post*Key Input Channel		0.303***			0.084	
		(0.101)			(0.133)	
Treated*Post*Key Input Channel (Non-self)			0.250***			0.047
			(0.087)			(0.111)
Year FE	YES	YES	YES	YES	YES	YES
Country*Product FE	YES	YES	YES	YES	YES	YES
Baseline Controls	NO	YES	YES	NO	YES	YES
R-squared	0.630	0.633	0.633	0.703	0.710	0.710
Observations	55,711	53,105	53,105	34,759	33,671	33,671

Note: This table shows the heterogeneous impact of demand intensity on tariff evasion in subsamples of intermediate and non-intermediate goods. Based on the products' Broad Economic Categories code, products are divided into two subsamples, intermediate and non-intermediate goods. The dependent variable in each column is Gap Value. Columns 1 and 4 investigate the impact of the trade war on tariff evasion. Columns 2 and 5 investigate the role of demand intensity in entry states during the trade war using Eq. (6). Columns 3 and 6 remove the industry's own products as inputs in constructing demand intesnity. Each column controls for year fixed effects and country*product fixed effects. Robust standard errors clustered at the product level are in parentheses. * Significant at the 10 % level; ** Significant at the 5 % level; *** Significant at the 1 % level.

Table A4
Controlling for export tax rebate during trade war.

	(1)	(2)	(3)
	Gap Value	Gap Value	Gap Value
Treated*Post	0.132***	0.115***	0.117***
	(0.018)	(0.018)	(0.018)
Treated*Post*Key Input Channel		0.220***	
		(0.083)	
Treated*Post*Key Input Channel (non-self)			0.175**
			(0.071)
China's Export Tax Rebate	0.011***	0.010***	0.010***
	(0.004)	(0.004)	(0.004)
China's Export Tax Rebate*USA	−0.007	−0.007	−0.007
	(0.005)	(0.005)	(0.005)
Year FE	YES	YES	YES
Country*Product FE	YES	YES	YES
Baseline Controls	YES	YES	YES
R-squared	0.655	0.658	0.658
Observations	91,529	87,135	87,135

Notes: This table controls for the impact of changes in China's export tax rebate rates on the gap value to eliminate the possible influence of inflated export reports. We collect annual export tax rebate rates for different products from the State Taxation Administration of China, creating the variable $\textit{China's Export Tax Rebate}_{c,i,t}$. This variable is interacted with the US-China trade dummy (USA_c) denoted by $\textit{China's Export Tax Rebate}_{c,i,t} * USA_c$. Column 1 investigates the effect of the trade war on tariff evasion. Columns 2 and 3 investigate the role of demand intensity. Each column controls for year fixed effects and country*-product fixed effects. Robust standard errors clustered at the product level are in parentheses. * Significant at the 10 % level; ** Significant at the 5 % level; *** Significant at the 1 % level.

Table A5
Re-Exports.

	(1)	(2)	(3)
	Gap Value (HK)	Gap Value (HK)	Gap Value (HK)
Treated*Post	0.139***	0.125***	0.128***
	(0.016)	(0.017)	(0.017)
Treated*Post*Key Input Channel		0.220***	

(continued on next page)

Table A5 (*continued*)

	(1)	(2)	(3)
	Gap Value (HK)	Gap Value (HK)	Gap Value (HK)
		(0.076)	
Treated*Post*Key Input Channel (Non-self)			0.174***
			(0.065)
Year FE	YES	YES	YES
Country*Product FE	YES	YES	YES
Baseline Controls	NO	YES	YES
R-squared	0.652	0.658	0.658
Observations	92,750	88,016	88,016

Note: This table excludes the influence of Hong Kong's re-exports. In this analysis, exports from Hong Kong and mainland China are considered as coming from the one entity. The bilateral trade Gap Value (HK) between the United States or the European Union and China or Hong Kong is constructed similarly to Eq. (1): $\text{Gap Value}_{c,i,t} = \ln\left(\text{report export value}_{c,i,t \text{ china or HK}}\right) - \ln\left(\text{report import value}_{c,i,t \text{ china or HK}}\right)$. Column 1 verifies the effect of the trade war on tariff evasion using Eq. (4). Columns 2 and 3 investigate the role of demand intensity using Eq. (6). Each column controls for year fixed effects and country*product fixed effects. Robust standard errors clustered at the product level are in parentheses. * Significant at the 10 % level; ** Significant at the 5 % level; *** Significant at the 1 % level.

Table A6
Controlling for country-year fixed effects.

	Gap Value			Gap Value (HK)		
	(1)	(2)	(3)	(4)	(5)	(6)
Treated*Post	0.036	0.015	0.018	0.049*	0.027	0.029
	(0.032)	(0.032)	(0.032)	(0.029)	(0.029)	(0.029)
Treated*Post*Key Input Channel		0.202**			0.204***	
		(0.083)			(0.076)	
Treated*Post*Key Input Channel (Non-self)			0.158**			0.158**
			(0.071)			(0.065)
Country*Year FE	YES	YES	YES	YES	YES	YES
Country*Product FE	YES	YES	YES	YES	YES	YES
Baseline Controls	NO	YES	YES	NO	YES	YES
R-squared	0.655	0.658	0.658	0.652	0.659	0.659
Observations	91,551	87,135	87,135	92,750	88,016	88,016

Note: This table further controls for country-year fixed effects, eliminating potential influence from transportation process and exchange rates on Gap Value. In columns 1 to 3, the dependent variable is Gap Value, while in columns 4 to 6, the dependent variable is Gap Value (HK) (please refer to the notes in Table A5). Columns 1 and 4 report the effect of the trade war on tariff evasion using Eq. (4). Columns 2, 3, 5, and 6 report results on the role of demand intensity using Eq. (6). Each column controls for year fixed effects, country*year fixed effects, and country*product fixed effects. Robust standard errors clustered at the product level are in parentheses. * Significant at the 10 % level; ** Significant at the 5 % level; *** Significant at the 1 % level.

Table A7
Controlling for COVID-19 disruption.

	(1)	(2)	(3)
	Gap Value	Gap Value	Gap Value
Treated*Post	0.039**	0.033*	0.035*
	(0.019)	(0.019)	(0.019)
Treated*Post*Key Input Channel		0.169*	
		(0.092)	
Treated*Post*Key Input Channel (Non-self)			0.138*
			(0.081)
Year FE	YES	YES	YES
Country*Product FE	YES	YES	YES
Baseline Controls	NO	YES	YES
R-squared	0.689	0.691	0.691
Observations	74,591	70,965	70,965

Note: To eliminate the influence of the COVID-19 pandemic on the baseline results, this table excludes observations from 2020 onward. The dependent variable in each column is Gap Value, constructed using Eq. (1). Column 1 investigates the effect of the trade war on tariff evasion using Eq. (4). Columns 2 and 3 look at the role of demand intensity using Eq. (6). Each column controls for year fixed effects and country*product fixed effects. Robust standard errors clustered at the product level are in parentheses. * Significant at the 10 % level; ** Significant at the 5 % level; *** Significant at the 1 % level.

Table A8
Falsification test by reversing the direction of trade.

	(1)	(2)	(3)
	Gap Value (Verse)	Gap Value (Verse)	Gap Value (Verse)
Treated*Post	0.012	−0.002	−0.002
	(0.024)	(0.025)	(0.025)
Treated*Post*Key Input Channel		0.091	
		(0.079)	
Treated*Post*Key Input Channel (non-self)			0.080
			(0.067)
Year FE	YES	YES	YES
Country*Product FE	YES	YES	YES
Baseline Controls	NO	YES	YES
R-squared	0.594	0.593	0.593
Observations	87,754	82,156	82,156

Note: In this table, we reverse the import and export relationship in calculating Gap Value. The construction of the dependent variable is as follows: Gap Value $\text{vers}_{c,i,t}$ = ln(report exports from USA or EU to China)$_{c,i,t}$ − ln(repoet imports to China from USA or EU)$_{c,i,t}$. In the regression, the dependent variable in each column is replaced with gap value $\text{vers}_{c,i,t}$ using the baseline model. Column 1 investigates the effect of trade war on tariff evasion using Eq. (4). Columns 2 and 3 investigate the role of demand intensity in port areas using Eq. (6). Each column controls for year fixed effects and country*product fixed effects. Robust standard errors clustered at the product level are in parentheses. * Significant at the 10 % level; ** Significant at the 5 % level; *** Significant at the 1 % level.

Table A9
Control for changes in De Minimis imports.

	(1)	(2)	(3)
	Gap Value	Gap Value	Gap Value
Treated*Post	0.130***	0.115***	0.118***
	(0.022)	(0.023)	(0.022)
Treated*Post*Key Input Channel		0.226***	
		(0.084)	
Treated*Post*Key Input Channel (Non-self)			0.179**
			(0.072)
Treated*Post*De minimis	0.020	0.016	0.014
	(0.034)	(0.033)	(0.033)
Year FE	YES	YES	YES
Country*Product FE	YES	YES	YES
Baseline Controls	YES	YES	YES
De minimis*Year FE	YES	YES	YES
R-squared	0.655	0.658	0.658
Observations	91,551	87,135	87,135

Note: This table controls for the impact of de minimis import fluctuations on tariff evasion identification. We construct a de minimis dummy in accounting for its influence. Since most de minimis products are associated with cross-border e-commerce, the variable is set to 1 if the product code appears on the 'List of Cross-Border *E*-commerce Retail Import Commodities (2019 Edition)' issued by the Chinese Ministry of Finance, and 0 otherwise. Additionally, we control for De minimis_i*Treated*Post and De $\text{minimis}_i*\delta_t$. Column 1 investigates the effect of the trade war on tariff evasion using Eq. (4). Columns 2 and 3 investigate the role of demand intensity using Eq. (6). Each column controls for year fixed effects and country*product fixed effects. Robust standard errors clustered at the product level are in parentheses. * Significant at the 10 % level; ** Significant at the 5 % level; *** Significant at the 1 % level.

Table A10
The role of the geographical distribution of entry ports.

	(1)	(2)	(3)
	Gap Value	Gap Value	Gap Value
Treated*Post	0.109***	0.077**	0.080**
	(0.034)	(0.035)	(0.035)
Treated*Post*Key Input Channel		0.239***	
		(0.083)	
Treated*Post*Key Input Channel (Non-self)			0.191***
			(0.072)
Treated*Post*West Port Share	0.088	0.115	0.113
	(0.085)	(0.086)	(0.086)
Year FE	YES	YES	YES
Country*Product FE	YES	YES	YES
Baseline Controls	YES	YES	YES
West share*Year FE	YES	YES	YES

(*continued on next page*)

Table A10 (*continued*)

	(1)	(2)	(3)
	Gap Value	Gap Value	Gap Value
R-squared	0.658	0.658	0.658
Observations	87,135	87,135	87,135

Note: This table tries to exclude the influence of the geographical distribution of the entry ports on the relationship between the trade war and tariff evasion. To control for the influence of the distribution of entry ports, we construct a control variable, west port share$_i$. In constructing this variable, first, we divide the states of the United States into eastern and western parts according to the U.S. Census Bureau, and west port$_s$ is set to 1 if the entry port is located in the western part and 0 otherwise. Second, we construct the product-level variable west port share$_i = \sum_s \frac{\text{import}_{i,s,2017} \times \text{west port}_s}{\text{import}_{i,2017}}$, denoting the proportion of products entering western ports in the United States. Column 1 investigates the effect of the trade war on tariff evasion, using Eq. (4). Columns 2 and 3 investigate the role of demand intensity using Eq. (6). Each column controls for year fixed effects and country*product fixed effects. Robust standard errors clustered at the product level are in parentheses. * Significant at the 10 % level; ** Significant at the 5 % level; *** Significant at the 1 % level.

Table A11
Excluding the influence of outliers.

	(1)	(2)	(3)
	Gap Value (95 %)	Gap Value (95 %)	Gap Value (95 %)
Treated*Post	0.124***	0.114***	0.115***
	(0.013)	(0.014)	(0.014)
Treated*Post*Key Input Channel		0.150**	
		(0.059)	
Treated*Post*Key Input Channel (Non-self)			0.120**
			(0.051)
Year FE	YES	YES	YES
Country*Product FE	YES	YES	YES
Baseline Controls	NO	YES	YES
R-squared	0.672	0.676	0.676
Observations	91,551	87,135	87,135

Note: This table uses a sample with 5 % winsorized on the dependent variable to mitigate the influence of outliers. Column 1 investigates the effect of the trade war on tariff evasion using Eq. (4). Columns 2 and 3 investigate the role of demand intensity using Eq. (6). Each column controls for year fixed effects and country*product fixed effects. Robust standard errors clustered at the product level are in parentheses. * Significant at the 10 % level; ** Significant at the 5 % level; *** Significant at the 1 % level.

Table A12
Robustness analysis of sample uniformity.

	(1)	(2)	(3)
	Gap Value	Gap Value	Gap Value
Treated*Post	0.134***	0.117***	0.120***
	(0.018)	(0.018)	(0.018)
Treated*Post*Key Input Channel		0.219***	
		(0.083)	
Treated*Post*Key Input Channel (Non-self)			0.173**
			(0.071)
Year FE	YES	YES	YES
Country*Product FE	YES	YES	YES
Baseline Controls	NO	YES	YES
R-squared	0.656	0.661	0.661
Observations	83,981	80,880	80,880

Note: To mitigate the influence of sample selection, we retain only the products affected by the tariffs imposed during the trade war and their corresponding imports from Europe, while excluding products that only show up in either the United States or Europe. Column 1 investigates the effect of of the trade war on tariff evasion using Eq. (4). Columns 2 and 3 investigate the role of demand intensity using Eq. (6). Each column controls for year fixed effects and country*product fixed effects. Robust standard errors clustered at the product level are in parentheses. * Significant at the 10 % level; ** Significant at the 5 % level; *** Significant at the 1 % level.

Table A13
Robustness check using the tariff level during the trade war.

	(1)	(2)	(3)
	Gap Value	Gap Value	Gap Value
Tariff	0.669***	0.609***	0.620***
	(0.083)	(0.088)	(0.087)
Tariff*Key Input Channel		1.024**	
		(0.488)	
Tariff *Key Input Channel (Non-self)			0.791*
			(0.417)
Year FE	YES	YES	YES
Country*Product FE	YES	YES	YES
Baseline Controls	NO	YES	YES
R-squared	0.655	0.658	0.658
Observations	91,551	87,135	87,135

Note: This table investigates the effect of differential tariff imposition rates on tariff evasion. In column 1, using Eq. (4), we investigate the effect of the trade war on tariff evasion by replacing $treated_{c,i}*post_t$ with $Tariff_{c,i,t}$. Columns 2 and 3 investigate the role of demand intensity using Eq. (6). Each column controls for year fixed effects and country*product fixed effects. Robust standard errors clustered at the product level are in parentheses. * Significant at the 10 % level; ** Significant at the 5 % level; *** Significant at the 1 % level.

Appendix B

Table B1
Heterogeneous effect of tariff level, intermediate goods and tariff burden.

	Intermediate Goods		Tariff Burden	
	(1)	(2)	(3)	(4)
	Gap Value	Gap Value	Gap Value	Gap Value
Tariff	0.938***	0.946***	0.603***	0.618***
	(0.123)	(0.123)	(0.093)	(0.092)
Tariff*Intermediate	−0.544***	−0.536***		
	(0.172)	(0.171)		
Tariff*Intermediate*Key Input Channel	1.552***			
	(0.582)			
Tariff*(1-Intermediate)*Key Input Channel	0.341			
	(0.832)			
Tariff*Intermediate*Key Input Channel (Non-self)		1.270**		
		(0.505)		
Tariff*(1-Intermediate)*Key Input Channel (Non-self)		0.132		
		(0.680)		
Tariff *DDP			0.002	0.027
			(0.545)	(0.538)
Tariff* Key Input Channel			1.168**	
			(0.537)	
Tariff* DDP *Key Input Channel			−4.201*	
			(2.166)	
Tariff*Key Input Channel (Non-self)				0.888*
				(0.461)
Tariff* DDP*Key Input Channel (Non-self)				−3.592*
				(1.877)
Year FE	YES	YES	YES	YES
Country*Product FE	YES	YES	YES	YES
Control	YES	YES	YES	YES
R-squared	0.659	0.659	0.666	0.666
Observations	86,776	86,776	76,515	76,515

Note: This table uses the same specification as that in Table 7, while replacing $treated_{c,i}*post_t$ with specific tariff rates $Tariff_{c,i,t}$ for each product by each country in each year. Each column controls for year fixed effects and country*product fixed effects. Robust standard errors clustered at the product level are in parentheses. * Significant at the 10 % level; ** Significant at the 5 % level; *** Significant at the 1 % level.

Table B2
Heterogeneous effect of the tariff level, support for trade protection.

	Proportion of Trump-winning States		Average Support Rate for Trump	
	(1)	(2)	(3)	(4)
	Gap Value	Gap Value	Gap Value	Gap Value
Tariff	0.516***	0.529***	0.869	0.924
	(0.188)	(0.187)	(0.884)	(0.877)
Tariff*Key Input Channel	4.150***		14.424***	
	(1.098)		(4.496)	
Tariff*Key Input Channel (Non-self)		3.537***		12.007***
		(0.935)		(3.826)
Tariff*Trump Share	0.189	0.192		
	(0.429)	(0.426)		
Tariff*Key Input Channel*Trump Share	−6.121***			
	(2.083)			
Tariff*Key Input Channel (Non-self)*Trump Share		−5.400***		
		(1.779)		
Tariff*Vote Share			−0.674	−0.769
			(2.103)	(2.087)
Tariff*Key Input Channel*Vote Share			−30.427***	
			(10.204)	
Tariff*Key Input Channel (Non-self)*Vote Share				−25.480***
				(8.687)
Year FE	YES	YES	YES	YES
Country*Product FE	YES	YES	YES	YES
Control	YES	YES	YES	YES
R-squared	0.659	0.659	0.658	0.659
Observations	87,135	87,135	87,135	87,135

Note: This table uses the same specification as that in Table 8 by replacing $\text{treated}_{c,i}*\text{post}_t$ with the specific tariff rates $\text{Tariff}_{c,i,t}$ on each product in each country in each year. Each column controls for year fixed effects and country*product fixed effects. Robust standard errors clustered at the product level are in parentheses. * Significant at the 10 % level; ** Significant at the 5 % level; *** Significant at the 1 % level.

Table B3
Tariff imposition magnitude: heterogeneity analysis of union development.

	Average number of union members among import entry states		Average number of union representatives among import entry states	
	(1)	(2)	(3)	(4)
	Gap Value	Gap Value	Gap Value	Gap Value
Tariff	0.559	0.558	0.513	0.511
	(0.399)	(0.395)	(0.426)	(0.422)
Tariff*Key Input Channel	−3.383**		−3.805**	
	(1.703)		(1.840)	
Tariff*Key Input Channel (Non-self)		−2.922**		−3.281**
		(1.442)		(1.558)
Tariff*Union Member	0.003	0.004		
	(0.031)	(0.030)		
Tariff*Key Input Channel*Union Member	0.387***			
	(0.141)			
Tariff*Key Input Channel (Non-self)*Union Member		0.326***		
		(0.119)		
Tariff*Union Represented			0.006	0.007
			(0.030)	(0.029)
Tariff*Key Input Channel*Union Represented			0.383***	
			(0.137)	
Tariff*Key Input Channel (Non-self)*Union Represented				0.323***
				(0.116)
Year FE	YES	YES	YES	YES
Country*Product FE	YES	YES	YES	YES
Control	YES	YES	YES	YES
R-squared	0.659	0.659	0.659	0.659
Observations	87,135	87,135	87,135	87,135

Note: This table uses the same specification as that in Table 9 by replacing $\text{treated}_{c,i}*\text{post}_t$ with the specific tariff rates $\text{Tariff}_{c,i,t}$ on each product in each country in each year. Each column controls for year fixed effects and country*product fixed effects. Robust standard errors clustered at the product level are in parentheses. * Significant at the 10 % level; ** Significant at the 5 % level; *** Significant at the 1 % level.

Appendix C

Table C1
Introduction to incoterms international trade terms in 2020.

Trade Terms (2020)	EXM	FCA	FAS	FOB	CFR	CIF	CPT	CIP	DAP	DPU	DDP
Packaging	Buyer/Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller
Loading Charges	Buyer	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller
Delivery to Port/Place	Buyer	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller
Export Duty & Taxes	Buyer	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller
Origin Terminal Charges	Buyer	Buyer	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller
Carriage Charges	Buyer	Buyer	Buyer	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller
Loading on Carriage	Buyer	Buyer	Buyer	Buyer	Seller	Seller	Seller	Seller	Seller	Seller	Seller
Insurance						Seller		Seller			
Destination Terminal Charges	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Seller	Seller	Seller	Seller	Seller
Delivery to Destination	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Seller	Seller	Seller
Unload at Destination	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Seller	Buyer
Import Duty & Taxes	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Seller

Note: This table presents the attribution of different costs under various trade conditions. Red indicates responsibility borne by the exporter, while blue indicates responsibility borne by the importer. Import tariffs are shown in the last row. It is evident from the table that DDP is the only trade condition where import tariffs are borne by the exporter.

Appendix D. De Minimis imports

D.1. Background of the increase in De Minimis Value

In 2016, the U.S. raised the de minimis exemption threshold for import duties from $200 to $800. Coupled with the rapid growth of cross-border e-commerce and rising tariffs from trade wars, the number of de minimis imports into the U.S. has increased significantly. This rise can be attributed to four main cases: 1) Higher exemption thresholds result in more imports that would otherwise be tariffed now qualifying as de minimis imports; 2) The growth of cross-border e-commerce has reduced transaction values, increasing the incidence of de minimis imports; 3) To avoid tariffs and benefit from de minimis exemptions, some imports are split into multiple smaller packages; 4) Some imports are declared below $800 to evade tariffs.

D.2. Statistical details of De Minimis import value

To understand the statistical details of de minimis imports and investigate their impact on national-level trade deficits and their decomposition, as well as product-level tariff evasion in the context of this study, we consulted the Census Bureau's 'Guide to the U.S. International Trade Statistical Program' and contacted DataWeb via email.[46]

According to the Census Bureau 'Guide to the U.S. International Trade Statistical Program,' although de minimis imports face fewer reporting requirements due to tariff exemptions, their total transaction values are still estimated. The U.S. Census Bureau has calculated low-valued imports and exports estimates since the inception of the exemption levels. Prior to 2010, the value of goods under $2001 did not need to be reported at customs, and the Census Bureau estimated these values using historical ratios of low-value goods relative to total imports from individual countries. These estimates are recorded as total amounts under a single commodity code, rather than within the original product categories.

Since there is a greater availACElity of low value import data, much of this data is utilized rather than relying solely on estimates. The import data used are those transactions filed electronically through the Automated Commercial Environment (ACE), which constitutes the majority of electronic import filings. In January 2010, the Census Bureau revised its methodology to more closely associate most low-value import estimates with specific HS codes (Chapters 1 to 97), while imports not matching specific product categories are included under 'Low-valued imports,' with the product code 9999.95.0000.[47]

Appendix E. Potential impacts of De Minimis imports

E.1. Impact of De Minimis import value on trade deficit reporting and national-level import gaps

E.1.1. Estimated de minimis import value is recorded within total trade values and does not interfere with national-level trade deficit and import gap statistics

In the overall trade statistics, de minimis imports are included through recording and estimation. In the absence of product underreporting for tariff evasion, the presence of de minimis imports does not cause a decrease in the total trade values reported by the

[46] https://www.census.gov/foreign-trade/guide/sec2.html; https://www.usitc.gov/dataweb_help.htm.

[47] In the estimation process, the Census Bureau uses (1) total low-value import data submitted electronically (i.e., via ACE), (2) estimated values for low-value data submitted on paper, (3) estimated values for low-value express shipments, and (4) total low-value data from Foreign Trade Zones (FTZ) submitted either on paper or electronically. For detailed definitions, see https://www.census.gov/foreign-trade/guide/sec2.html.

Census Bureau. Thus, the rise in de minimis import under cases 1–3 (in Section 1 of Appendix D) does not affect trade deficit statistics (Figs. 1 and 2) or bilateral import discrepancies (Fig. 3). Case 4, which involves deliberate underreporting to evade tariffs, does not conflict with the objectives of this study.

E.1.2. Even when a more stringent approach is used by subtracting the increase in de minimis imports post-2018 from bilateral trade deficit and import discrepancy statistics, the changes remain steep after the trade war

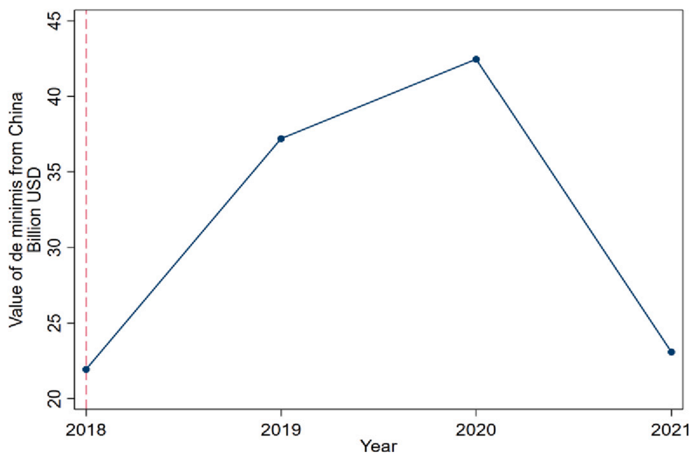
First, we use de minimis data from the CBP[48] to estimate the De Minimis Value of Chinese imports into the U.S., as detailed in the formula (A.1). Changes are illustrated in Fig. D1.

$$\text{total value of de minimis imports from China}$$
$$= \text{total value of all de minimis imports} \times \left(\frac{\text{Volume of de minimis imports from China}}{\text{Volume of all de minimis imports}}\right) \quad \text{(A.1)}$$

Second, we further calculate the changes in de minimis value of U.S. imports from China relative to 2018[49] and exclude these changes to obtain a 'cleaner' measure of the trade deficit discrepancies (Fig. D2, dashed red triangular node line) and import gap variations (Fig. D3, dashed yellow diamond node line) between China and the U.S. to mitigate the impact of de minimis imports. Results in Figs. D2 and D3 show that, even after excluding the increase in de minimis import value, the bilateral trade deficit discrepancies and import gap remain steeply rising post-2018, with a total increase of $116.597 billion from 2018 to 2021, where the import gap accounts for 93.84 % (109.417/116.597). Thus, although de minimis import value has garnered attention in recent years, its presence does not affect the conclusion that the observed changes in U.S. trade deficit statistics post-trade war are primarily an illusion caused by tariff evasion through underreporting.

E.2. Impact of De Minimis imports on the measurement of value gaps related to product-level tariff evasion

Although most de minimis imports have been recorded under their respective product codes since January 2010, the lower reporting requirements for tariff exemptions have led some de minimis imports to be classified under 9999.95.0000. Despite the fact that the value of 9999.95.0000 in U.S. imports of Chinese products has remained below 1 % during the sample period, it is possible to overestimate the imports. This study constructs a de minimis dummy variable to exclude its influence. Since most de minimis products are associated with cross-border e-commerce, the variable is set to 1 if the product code appears on the 'List of Cross-Border *E*-commerce Retail Import Commodities (2019 Edition)' issued by the Chinese Ministry of Finance, and 0 otherwise. To account for trade war effects, we control for interactions between de minimis and Treated*Post, as well as de minimis and time dummies. The results in Table A9 indicate that our conclusion remains robust. Since de minimis mainly affects final goods and demand heterogeneity is driven by intermediate goods' input-output relationships, controlling for de minimis increases the impact of demand heterogeneity. In particular, one standard deviation increase in demand heterogeneity raises tariff evasion by 1.401 times (0.713*0.226/0.115), which is larger than our baseline estimate. In Table D1, we replace Treated*Post with the specific tariff rate in the pertinent interaction term, our main conclusion remains.



[48] SECTION 321 DE MINIMIS SHIPMENTS FISCAL YEAR 2018 to 2021 STATISTICS (https://www.cbp.gov/sites/default/files/assets/documents/2022-Oct/FY2018-2021_De%20Minimis%20Statistics%20update.pdf)

[49] Since the USITC only released statistical reports for 2018–2021, our estimates are limited to the total value of de minimis imports from China during this period. To exclude the interference of increased de minimis imports post-trade war, we use the annual changes in the value of de minimis imports from China relative to 2018 to assess their potential impact on trade deficit and import gap statistics.

Fig. D1. Value of De Minimis Imports from China to the United States.
Note: This figure presents the changes in the value of de minimis imports from China to the United States. We estimate the total value of de minimis imports from China using the formula (A.1). Given that the USITC has only released statistical reports for the years 2018 to 2021, our estimates are confined to the total value of de minimis imports from China within this timeframe.

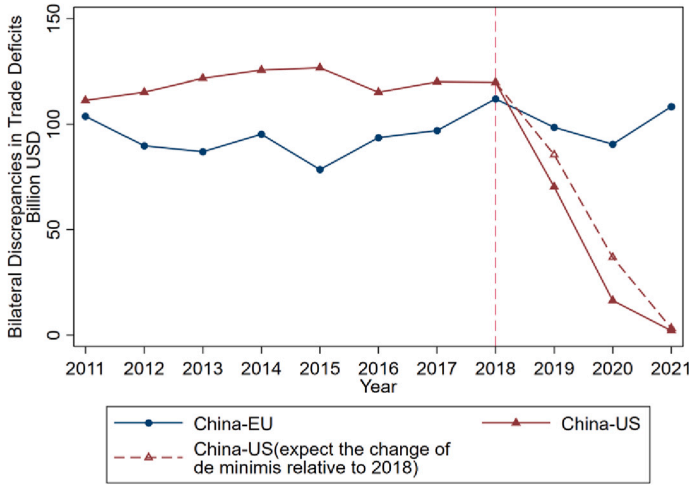


Fig. D2. Bilateral statistical discrepancies in trade deficits: China–EU and China–US (Eliminating Changes in De Minimis Import Values from China to the U.S. Relative to 2018).
Note: This figure presents the bilateral statistical discrepancies in trade deficits between China and the United States after excluding changes in the total value of de minimis imports from China to the U.S. relative to 2018. The solid red triangular node and blue circular node lines represent the variation in discrepancies in the reported U.S. trade surplus between China and the United States, and between China and the European Union, respectively. The definitions are consistent with those in Fig. 2. The dashed red triangular node line is constructed by adding the changes in the total value of de minimis imports from China to the U.S. relative to 2018 in the bilateral statistical discrepancies in trade deficits between China and the United States.

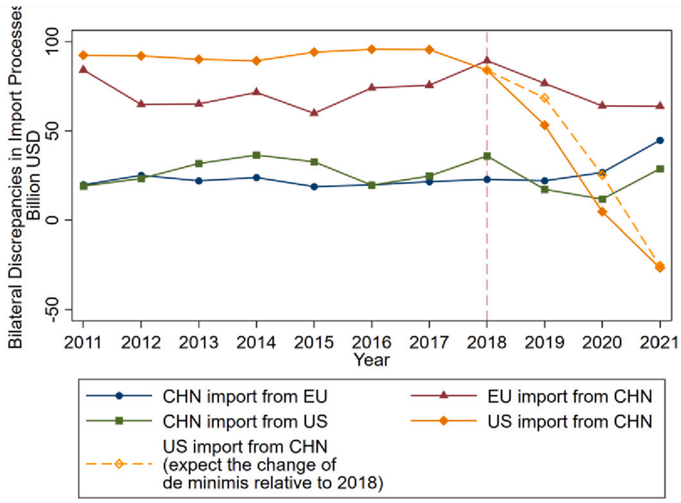


Fig. D3. Bilateral statistical discrepancies in different import processes (Eliminating Changes in De Minimis Imports from China to the U.S. Relative to 2018).
Note: This figure decomposes the discrepancies in trade deficits presented in Fig. D2, providing statistics on the discrepancies in trade values reported by each side for the same trade processes. The solid yellow diamond node, green square node, red triangular node, and blue circular node lines represent the bilateral reporting discrepancies in U.S. imports of Chinese goods, Chinese imports of U.S. goods, EU imports of Chinese goods, and Chinese imports of EU goods, respectively, with definitions consistent with Fig. 3. The dashed yellow diamond node line includes changes in the total value of de minimis imports from China to the U.S. relative to 2018 in the bilateral reporting discrepancies for U.S. imports of Chinese goods, thereby fully accounting for the impact of de minimis changes during the trade war on the bilateral reporting discrepancies.

Table D1
Controlling for changes in De Minimis imports.

	(1)	(2)	(3)
	Gap Value	Gap Value	Gap Value
Tariff	0.597***	0.546***	0.560***
	(0.096)	(0.103)	(0.102)
Tariff*Key Input Channel		1.116**	
		(0.491)	
Tariff*Key Input Channel (Non-self)			0.864**
			(0.419)
Tariff*De minimis	0.399**	0.331*	0.322*
	(0.178)	(0.174)	(0.174)
Year FE	YES	YES	YES
Country*Product FE	YES	YES	YES
Baseline Controls	YES	YES	YES
De minimis*Year FE	YES	YES	YES
R-squared	0.655	0.658	0.658
Observations	91,551	87,135	87,135

Note: This table uses the same specification as that in Table A9 by replacing $\text{treated}_{c,i}$*post_t with the specific tariff rates $\text{Tariff}_{c,i,t}$ on each product in each country in each year. Each column controls for year fixed effects and country*product fixed effects. Robust standard errors clustered at the product level are in parentheses. * Significant at the 10 % level; ** Significant at the 5 % level; *** Significant at the 1 % level.

Appendix F. Real-world cases showing that Tariff Evasion in US customs is not impossible

First, two Wisconsin companies, PCA (selling wire harnesses, battery cables, and other wiring products) and GEP (selling power distribution products), allegedly underreported goods values by up to 70 % on invoices for imports from China between 2016 and November 2021, evading millions in duties, especially after 2018's additional tariffs (https://www.justice.gov/usao-edwi/pr/two-brookfield-wisconsin-based-companies-and-their-owners-pay-over-10-million-resolve).

Second, Ford Motor Company underreported the value of certain Transit Connect vehicles to U.S. Customs and Border Protection (CBP) and misclassified the imports, declaring cargo vans (25 % tariff) as passenger vehicles (2.5 % tariff), resulting in a $365 million penalty (https://www.justice.gov/opa/pr/ford-motor-company-agrees-pay-365m-settle-customs-civil-penalty-claims-relating).

Third, Ghacham and Mohamed Ghacham underreported the value of imported apparel by over $32 million between July 2011 and February 2021, failing to pay approximately $6,390,792 in duties (https://www.irs.gov/compliance/criminal-investigation/clothing-wholesaler-ordered-to-pay-nearly-10-point-4-million-for-violating-us-drug-trafficking-sanctions-and-for-customs-fraud).

Appendix G. Decomposition of trade discrepancies in US or EU imports of Chinese products

To provide preliminary evidence that the underreporting behavior at the import end was caused by the imposition of tariffs during the trade war, we divide the reported values in the process of the United States importing Chinese products based on whether they were affected by the imposition of tariffs, as shown in Fig. F1. The figure shows that before the trade war, for each group of products, the values reported by the United States and China were parallel, although the data on the import end are always higher than those on the export end. This is because the data on the import end include the cost, insurance, and freight (CIF), while the data on the export end are calculated free on board (FOB). After the trade war, the trade value of the three groups, namely, the products subject to the trade war tariffs in the process of the European Union importing from China, the non-tariff-imposed products in the process of the European Union importing from China, and the non-tariff-imposed products in the process of the United States importing from China, still maintained the trend before the trade war, and there was no significant trend change after the trade war compared to before the trade war. However, for the tariff-imposed products in the process of the United States importing from China, the reported value changed significantly. After the trade war, the CIF statistics at the import end were even lower than the FOB statistics at the export end. In all, it is likely that the difference in bilateral reporting of trade deficits arose due to low reporting of imported products due to the imposition of import tariffs during the trade war.

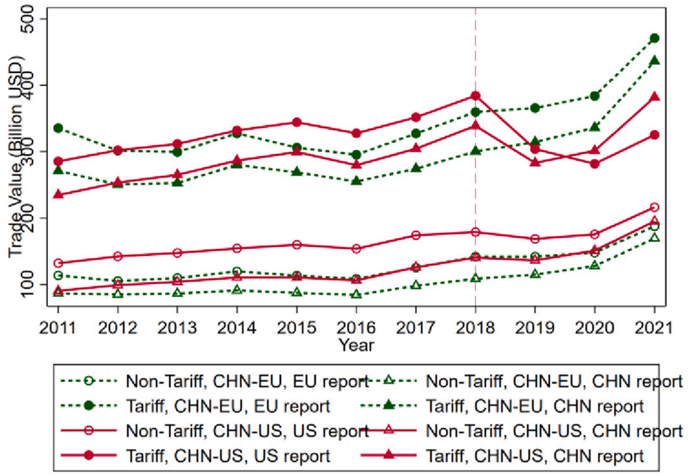


Fig. F1. Decomposition of trade discrepancies in US or EU imports of Chinese products (Tariff and Non-Tariff Components of Bilateral Reported Trade Values).

Note: This figure categorizes and aggregates the bilateral reported values of trade processes involving US or EU imports of Chinese products based on whether the corresponding HS 6-digit products were subject to US tariffs during the trade war. The red solid line represents trade between China and the United States, while the green dashed line represents trade between China and the European Union. Circular nodes denote total import values reported by the United States or the European Union, and triangular nodes denote export values reported by China. Solid nodes indicate HS 6-digit products that were subject to US tariffs during the trade war, while hollow nodes represent products that were not tariffed.

Data availability

Replication for "Pains or Gains: Trade War, Trade Deficit, and Tariff Evasion" (Original data) (Mendeley Data)

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