THE ELUSIVE COST OF TRADE DISRUPTION

CARLO ALTOMONTE, FILIPPO BUCCHI,
GIORGIO PRESIDENTE

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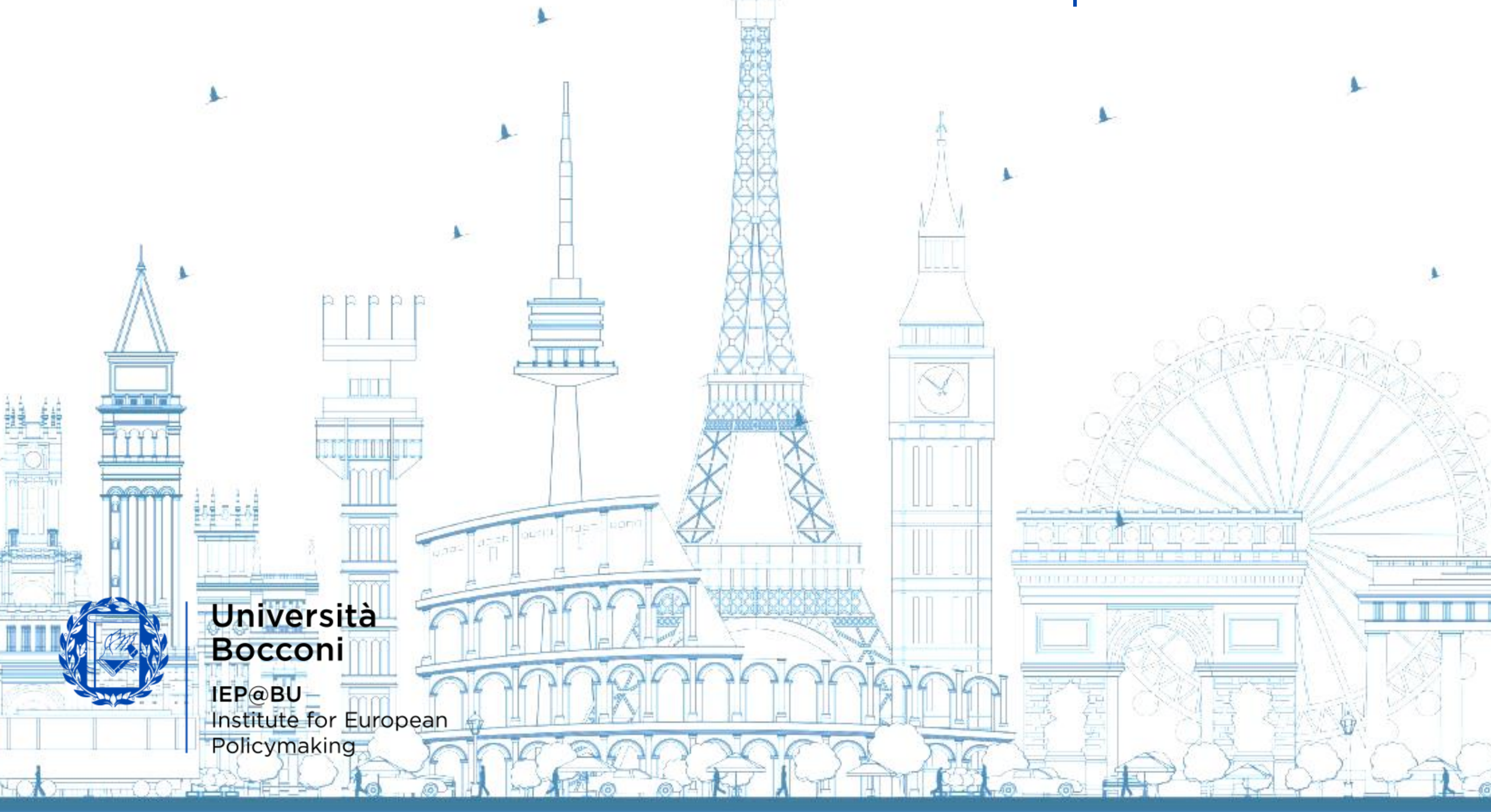

Università Bocconi
IEP@BU
Institute for European Policymaking

Executive Summary

Growing concerns that geopolitical tensions might result in trade disruption and compromise domestic production have spurred energetic reactions by the European Commission, which has launched a series of initiatives aimed at fostering EU's "strategic autonomy".

However, while the list of proposed policy actions is significant, the evidence on which these actions should be based is scant, as very few attempts have been made to quantify the cost of disruptions empirically. This policy brief thus presents a case study quantifying the cost of trade disruption. To that extent, it exploits high-frequency satellite data and daily records of imports and exports in maritime commerce for a sample of Chinese ports exposed to severe natural calamities.

The results suggest that trade activities are on average remarkably resilient to shocks. Robust port infrastructure—combined with the presence of global value chains and the opportunity to diversify sourcing and production—allow trade to fully recover in less than a month after a natural disaster hits.

Based on the evidence of such short-lived costs of trade disruption, inward-looking policies that risk to undo decades of market integration and productivity-enhancing trade agreements seem hardly justifiable. On the contrary, by reducing the ability to differentiate production chains, these policies might increase the costs associated to episodes of trade disruptions in the future.

Introduction

In the last 30 years, global production and international trade have become much more interconnected and interdependent. The recent events in the Red Sea for instance, have highlighted the hazards posed by extended interruptions at critical locations.[1] International institutions concur with growing apprehensions over the escalation of geopolitical threats that could culminate in prolonged conflicts and political fragmentation. The lack of dependable trade agreements, the unpredictable operation of commercial hubs, and the obligatory redirection of routes can have a greater impact as the degree of economic integration increases. Similar concerns have been expressed in other domains. One is Europe's dependency on imported critical raw materials for the production of batteries, while another is the reliance on a handful of foreign countries that dominate the production of semiconductors.

The Cost of Inward-Looking Policies

These concerns have spurred energetic reactions by the European Commission, which has launched a series of initiatives aimed at fostering EU's "strategic autonomy". Examples include the "Chips act" and the "Critical Raw Materials Act", both aimed at making the EU more self-reliant in key strategic areas.[2] More broadly, the policy action of the Commission is increasingly driven by the narrative according to which the EU must be less dependent on foreign countries.

The problem with this narrative is that it has been developed almost in an empirical vacuum.[3] Quantifying the potential cost of trade disruption is thus crucial, as it allows to put in perspective the risks associated to implementing dangerous inward-looking policies, which might undo decades of market integration and productivity-enhancing trade agreements.

This policy brief presents a case study based on daily records of imports and exports in maritime commerce in a sample of Chinese ports exposed to severe natural calamities. Our approach leverages recent advances in satellite data collection technology, thus constituting an example of how big data can help formulating evidence-based policy.

A Glimpse at the Evolution of Global Value Chains

The term "Global Value Chain" refers to a production process where the process of converting inputs into output is carried out across different countries through international trade. Figure 1 shows that

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[1] Wright, R. (2024). Red Sea reroutings to further disrupt car supply chains, warn shipping executives, Financial Times, 23 January. Beattie, A. (2024). How global trade is shrugging off the Houthi attacks, Financial Times, 14 March.

[2] Regulation (EU) 2023/1781 of the European Parliament and of the Council of 13 September 2023 establishing a framework of measures for strengthening Europe's semiconductor ecosystem and amending Regulation (EU) 2021/694 (Chips Act) and
Regulation (EU) 2024/1252 of the European Parliament and of the Council of 11 April 2024 establishing a framework for ensuring a secure and sustainable supply of critical raw materials and amending Regulations (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1724 and (EU) 2019/1020Text with EEA relevance.

[3] Very few attempts have been made to quantify the cost of disruption empirically, with some noteworthy exceptions, such as al. 2023, Baqaee et al. 2024 and Jones et al. 2023. For a theoretical approach, see Grossman, Helpman, and Lhuillier 2023.

GVC participation—the involvement of firms or countries in various stages of the production process across international borders, from raw materials to final goods and services—is highly correlated to gross trade, which both fall during economic downturns and increase during expansions.

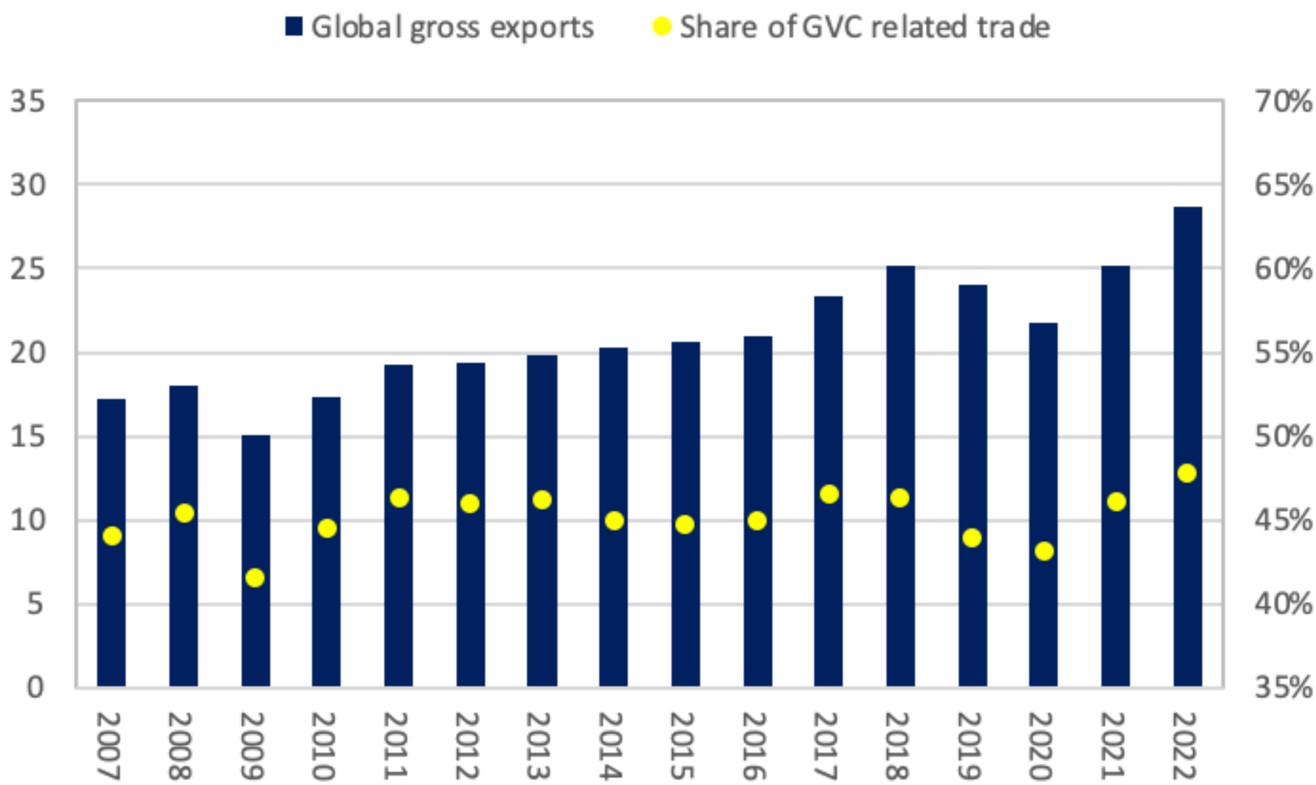

Figure 1
Global trade and GVC involvement (trillion USD).

Source: Asian Development Bank.

The five largest countries involved in commercial trade contribute to 40% of total imports and 38% of total exports (according to most recent observations). But in particular China, the United States and Germany have a primary role. China alone covers 12% and 16% of total import and total export respectively, the United States account for 14% of imports and 8% of exports, while Germany, as European leader, is responsible for 7% of imports and 8% of exports (Figure 2).

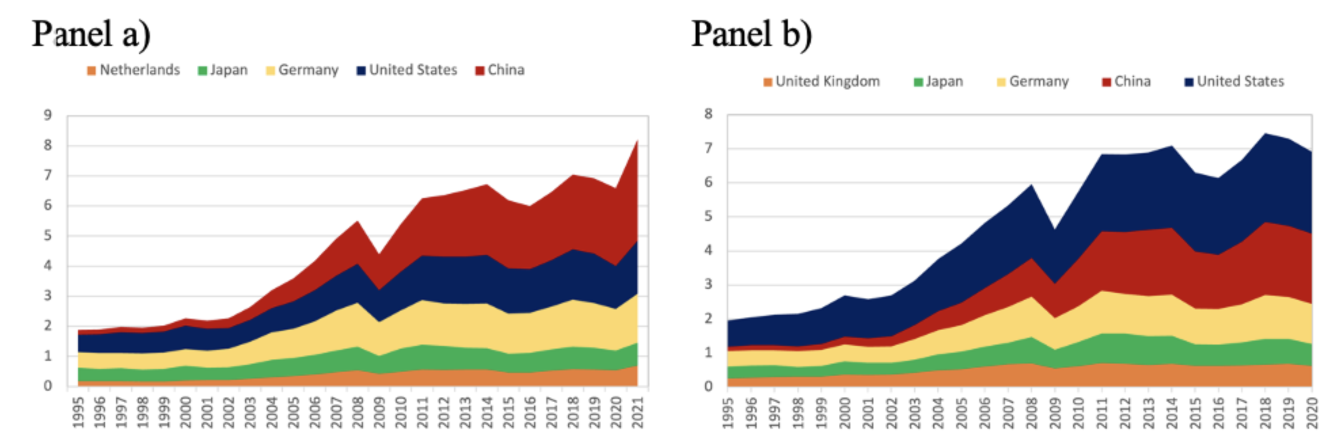

Figure 2
Export of top-5 countries (trillion USD)

Notes: Panel a) Total export; Panel b) Total import.
Source: World Integrated Trade Solution.

Maritime Trade: The Key Role of China

More than 80% of the total volume of international trade is carried by sea (UNCTAD, 2021[4]). China is the country with the largest contribution to maritime trade. Between 2019 and 2023, Chinese ports accounted for 13% of world exports and 27% of global imports, followed by Australia and the United States (Figure 3).
According to PortWatch and Trade Data Monitor, 9 of the 25 most connected ports in the world are Chinese. The first and the second most connected ports are Shanghai and Ningbo, which account for 56% of all Chinese imports and 67% of all Chinese exports.
Thus, a domestic shock to China can heavily back-propagate along the global value chain. This and the large incidence of natural disasters in the area relative to other regions in the world, such as Europe and the United States, make it an ideal laboratory to study the cost of trade disruption.

Measuring the Cost of Trade Disruption

To quantify trade disruption, we use a data from PortWatch, tracking daily seaborne trade flows across 1378 ports worldwide and the occurrence of natural disasters between 2019 and 2023[5].
We focus on 65 Chinese ports out of the 1378 in the sample. Over the sample period, 29 of them are directly affected by seven catastrophic events (Appendix Figure 5).[6]

[4] UNCTAD (2021). Review of maritime transports 2021. Technical report.
[5] Natural disasters include earthquakes, tsunamis, tropical cyclones, floods, volcano, and droughts
[6] Shanghai and Ningbo are the two largest ports in terms of volumes handled.

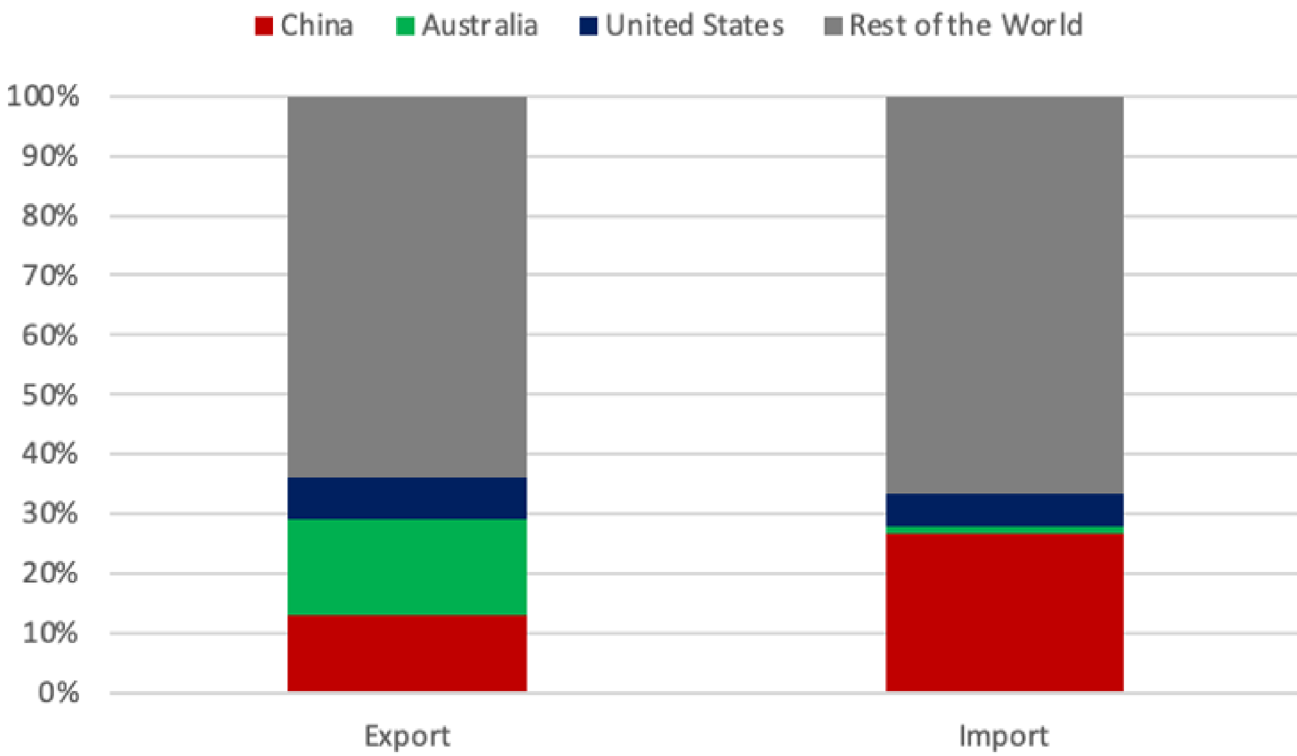

Figure 3
Maritime trade 2019-2023 (country shares)

Source: PortWatch.

The outcome of interest is "aggregate activity", i.e. the sum of imports and exports shipped from or to a port during a week.[7] Our strategy is comparing port-level aggregate activity before and after a natural disaster occurs, against changes in activity in unaffected Chinese ports. Thus, our treatment groups consists in ports affected by a disaster, while the control group consists in ports that are never subject to such disruption. We use the a Two-Way Fixed effect estimator with port and week fixed effects, adapted to allow for staggered heterogeneous treatment effects using the approach of De Chaisemartin and d'Haultfoeuille 2024.

Results: The Short-Lived Impact of an Adverse Shock

Figure 4 presents the results.[8] In our sample, a natural disaster has a large impact on port-level activity, which falls by more than 50% two weeks after the occurrence. Thus, for instance, if the value of weakly inward and outward shipments is one million euros during normal times, when a natural

[7] We aggregate daily observations at the week-level to minimize noise.
[8] The regression results in tabular form can be found in Appendix Figure 6.

disaster hits the port, the value of shipments shrinks to fifty thousand euros.
However, these coefficients are only marginally significant (coeff. = -0.74; s.e. = 0.39) and—most importantly—the impact of the shock is extremely short-lived, overshooting above the baseline level of activity from the third week. Therefore, port activity is not only estimated to fully recover in less than a month, but even to increase as to "catch up" with its pre-shock level.
These results are robust to a number of alternative specifications, including different measures of port activity accounting for the share of re-exported imports or the share of import and export from and to foreign countries, as well as including European ports in the control group, as to mitigate the concern that spillovers from ports hit by a disaster to other Chinese ports might bias the results.

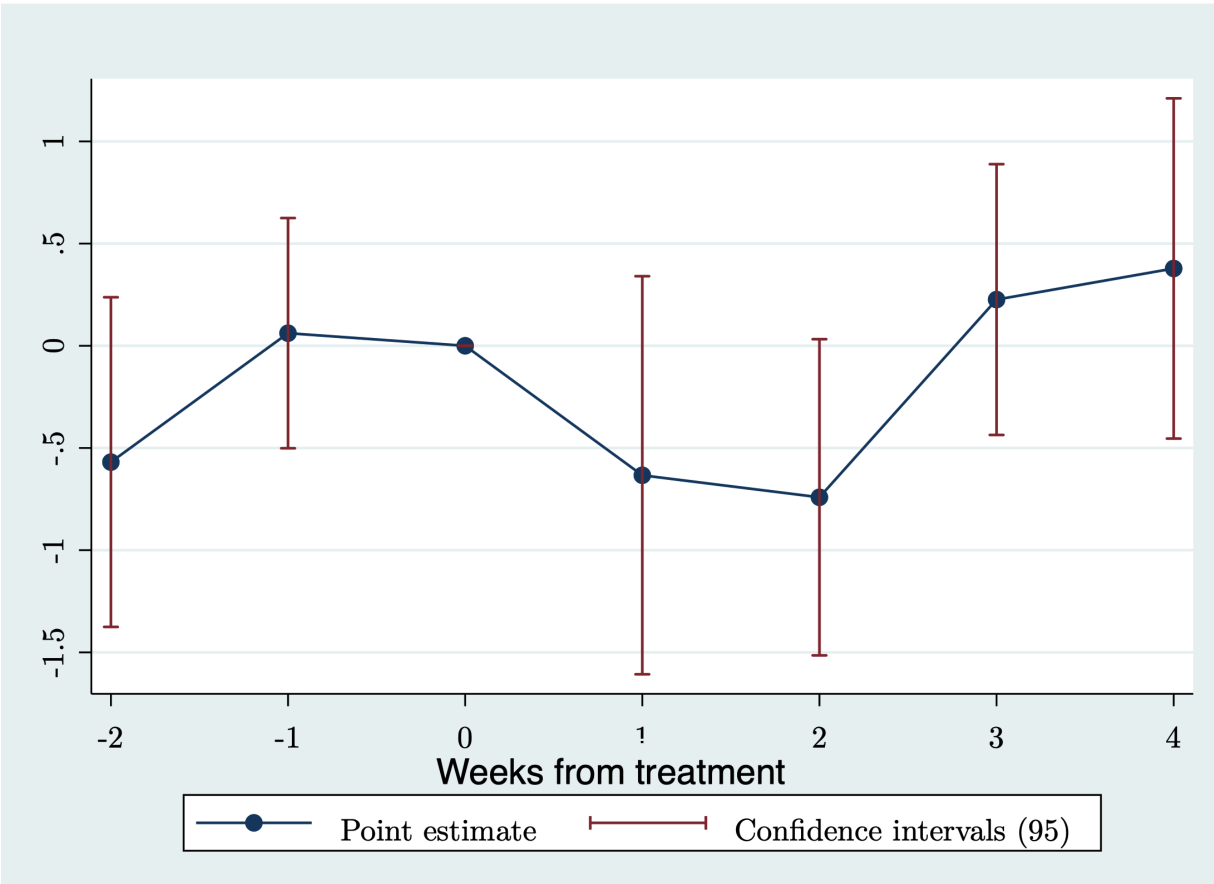

Figure 4
Impact of a natural disaster on port-level activity.

Notes: this figure presents point estimates and 95% confidence intervals from an event study design based on De Chaisemartin and d'Haultfoeuille 2024. The estimation is conducted using the STATA package "did_multiplegt_dyn", which can be found at `https://asjadnaqvi.github.io/DiD/docs/code/06_16_did_multiplegt_dyn/`
The dependent variable is the log-sum of exported and imported goods in a Chinese port. The treatment is a natural disaster hitting the port in a given week. The sample includes 200 observations.

Conclusions

Port facilities are critical nodes in global trade and logistics, serving as gateways for the movement of goods and raw materials. For this reason, shocks to port-level activity might propagate along the value chain and have detrimental effects on the rest of the economy. Yet, the results of our case study reveal a high level of resilience of port activity to shocks.

This is achieved, on one hand, by implementing innovative engineering solutions. The integration of smart technologies, like IoT sensors and AI-driven analytics is an example of how to implement real-time monitoring and predictive maintenance. On the other hand, well-functioning global value chains offer the possibility to diversify sourcing and production, thus contributing to swiftly resume economic activity after disruptions, minimizing delays and financial losses.

This suggests that government efforts are better targeted at improving critical infrastructure and fostering market integration, rather than implementing protectionist measures.

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APPENDIX

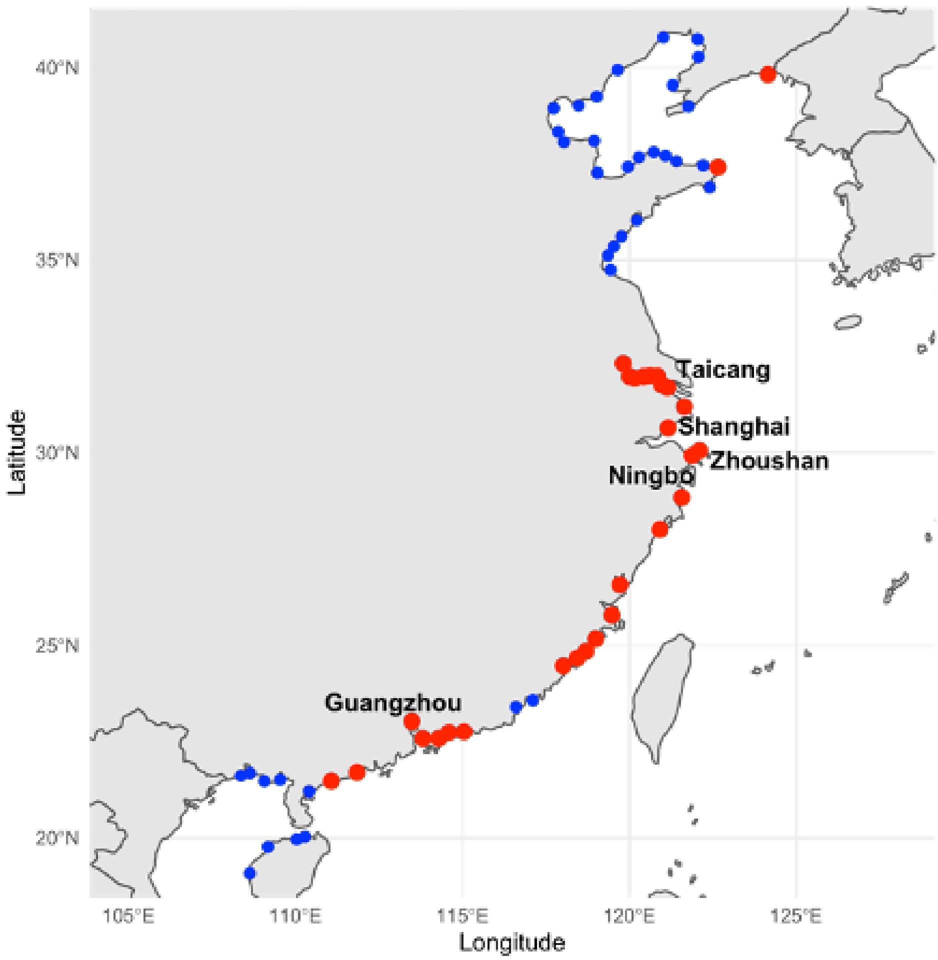

Figure 5
Chinese ports, treatment (red) and control group (blue).

Notes: The largest five treated ports are labelled. Source: PortWatch.

		Estimate	*Standard error*	*Lower limit*	*Upper limit*	*P-value*
Agg. activity	*Effect 1*	-0.63	0.50	-1.61	0.34	0.20
	Effect 2	-0.74	0.39	-1.51	0.03	0.06
	Effect 3	0.23	0.34	-0.44	0.89	0.50
	Effect 4	0.38	0.42	-0.45	1.21	0.37
	Placebo 1	0.06	0.29	-0.50	0.62	0.37
	Placebo 2	-0.57	0.41	-1.38	0.24	0.37

Figure 6
Regression results.

Notes: this figure presents the results from the Two-Way fixed effect estimator of De Chaisemartin and d'Haultfoeuille 2024. The estimation is conducted using the STATA package "did_multiplegt_dyn", which can be found at
`https://asjadnaqvi.github.io/DiD/docs/code/06_16_did_multiplegt_dyn/`