Adapting Under Decoupling: U.S. Sanctions, Supply Chain Localization and the Rise of Domestic Suppliers in China*

Yifan Chen[†]
Zhejiang University

Shuzhong Ma[‡]
Zhejiang University

Heiwai Tang[§]
University of Hong Kong

Hongsheng Zhang[¶]
Zhejiang University

April 22, 2026

Abstract

We analyze how U.S. sanctions and export bans that restrict targeted Chinese firms' access to advanced foreign inputs prompted restructuring of China's supply chains. These measures accelerated China's supply chains' localization at both the intensive and extensive margins: affected domestic suppliers saw significant gains in sales and profitability, and sanctioned firms were more likely to form ties with new domestic suppliers. This reconfiguration was driven by complementary mechanisms: domestic suppliers boosted capabilities via expanded R&D and external patent acquisitions, supported in part by government industrial policies such as subsidies and state-guided fund investments. Industry-level evidence shows higher R&D intensity and greater domestic input self-sufficiency. Overall, our findings demonstrate that foreign pressure has accelerated the upgrading and localization of Chinese supply chains.

Keywords: Sanction, Supply Chains, Localization, Innovation

JEL Codes: F42, F51, L14, G32

*All authors contributed equally to the paper. Neither author has any conflict of interest to declare. We are grateful to Holger Görg, Jingting Fan, Feng Guo, Ruixue Jia, Wojciech Kopczuk, Wan-Hsin Liu, Lei Li, Junxiu Sun, Yong Tan, Haiwen Yan, Lex Zhao, as well as participants at 2nd Kiel-Göttingen-CEPR China Conference for their very constructive comments.

[†]Zhejiang University, School of Economics. yf.chen@zju.edu.cn
[‡]Zhejiang University, School of Economics. mashuzhong@zju.edu.cn
[§]University of Hong Kong, Business School. tangecon@hku.hk
[¶]Zhejiang University, School of Economics. hongshengzhang@zju.edu.cn

1 Introduction

Since the 2017 National Security Strategy designated China as a "strategic competitor," U.S.-China competition has expanded beyond trade to encompass high-tech industries.[1] While a large literature documents the effects of the U.S.-China tariffs on prices, trade volumes, and trade reorientation(Amiti et al., 2019; Fajgelbaum et al., 2020; Alfaro and Chor, 2023; Jiang et al., 2023; Fajgelbaum et al., 2024), those tariffs were designed primarily to increase the cost of Chinese firms' exports, aiming at reducing the U.S.-China bilateral trade imbalance. By contrast, the U.S. government's sanctions and export bans directly restrict targeted Chinese firms from accessing critical foreign inputs, which should have significant effects on the firms' performance, technological progress, and supply-chain reconfiguration. Despite the significance, evidence on the impact of technological decoupling and the channels through which it matters has been limited.

This paper studies this question by exploiting the staggered expansion of the *Entity List*, an end-user-based export control measure administered by the U.S.'s Bureau of Industry and Security (BIS) that imposes restrictions on select Chinese technology firms. The *Entity List* has been increasingly deployed as a geoeconomic tool aimed at limiting China's technological advancement to preserve the U.S. technological leadership (Whang, 2019; Crosignani et al., 2026).[2][3] These sanctions are difficult to circumvent because they prohibit suppliers worldwide from providing items containing substantial U.S. technology to sanctioned entities. Nevertheless, China's technology industries appear to show considerable resilience. Sanctioned firms such as Huawei and DJI have released products powered by domestically produced chips and critical components, and sectors such as semiconductors and artificial intelligence continue to advance. We examine the sources of this resilience, focusing on how sanctions have unintentionally accelerated the upgrading and localization of China's technology sup-

[1] See https://trumpwhitehouse.archives.gov/wp-content/uploads/2017/12/NSS-Final-12-18-2017-0905.pdf.

[2] Figure 1 in Section 2.2 shows that since 2018, the scope of the *Entity List* has expanded rapidly, with the share of Chinese entities on the *Entity List* growing from 19% to 33% by 2024.

[3] For instance, in January 2025, the Bureau of Industry and Security (BIS) added 25 Chinese entities to the *Entity List*, including the chip manufacturer Sophgo and the lithography systems company RSLaser. Particularly noteworthy is the inclusion of the large language model (LLM) company Zhipu and several of its subsidiaries, marking the first instance of a Chinese LLM enterprise being sanctioned. The BIS justified this action by stating that these entities were advancing China's military modernization through the development and integration of advanced artificial intelligence research, a claim that the affected parties have denied.

ply chains.

Our empirical analysis centers on the domestic suppliers of sanctioned firms, which form a core part of China's high-tech ecosystem. We construct a novel dataset combining the *Entity List* designations with global supply chain relationships from FactSet Revere and quarterly firm-level financials from Bureau van Dijk (BvD) Orbis, covering the period 2017q1 through 2023q2. We further use firm-product-level data to identify Chinese peer firms operating in the same sectors as sanctioned firms and compare the performance of their respective suppliers. Because the BIS does not provide advance notice of designations, the timing of sanctions is unexpected for suppliers. Pre-trend tests confirm no significant pre-treatment differences in operating performance between treated and control suppliers, supporting the validity of our difference-in-differences design.

Our first set of results establishes that sanctions trigger supply chain localization. Existing suppliers to sanctioned firms experience a 10.7% increase in sales revenue and a 13.6% increase in gross profits relative to control suppliers. Crucially, these gains accrue exclusively to domestic suppliers. We find no significant performance improvements among suppliers from the U.S., other tech-advanced countries, China-allied countries, or U.S.-allied countries. This pattern rules out explanations based on trade diversion through third countries or "friend-shoring" toward geopolitically proximate partners. Instead, the evidence points to a distinctly inward adjustment: sanctioned firms expand procurement from existing Chinese suppliers along the intensive margin.

At the extensive margin, we show that domestic suppliers are significantly more likely to form new supply chain relations with sanctioned firms, while no comparable increase occurs for foreign suppliers. Together, these results document a structural reconfiguration of supply chains toward domestic sourcing.

A natural question arises: what enables domestic suppliers to substitute for restricted foreign inputs, particularly in technologically demanding sectors? We investigate two complementary mechanisms. The first is the upgrading of domestic supplier capabilities. Following the imposition of sanctions, affected domestic suppliers significantly increase their R&D intensity and expand their purchases of patents from the U.S. and other tech-advanced countries, even as their reliance on domestic patent acquisitions declines. These patterns suggest that suppliers pursue a comprehensive catch-up strategy, combining intensified internal research with the strategic acquisition of frontier foreign technologies to build the capacity required for sustain-

able import substitution. We also find that affected domestic suppliers shift their own upstream procurement toward other Chinese firms, consistent with a broader localization of the supply chain rather than the circumvention of export controls.

The second mechanism is supportive industrial policy. The Chinese government channels resources toward affected domestic suppliers through two instruments: direct subsidies and equity investments via Government Guidance Funds (GGFs), which are public-private investment vehicles targeting strategic high-technology sectors (Wei et al., 2023). We document significant increases in both channels following sanctions. The results also indicate that increased subsidies significantly boost domestic suppliers' R&D intensity and patent purchases. A potential concern is that state resources may be disproportionately directed toward politically connected firms rather than those with the greatest technological potential (Faccio et al., 2006). We find no evidence of preferential treatment toward state-owned enterprises or firms with politically connected executives, suggesting that the allocation of government support is guided by a broader strategic objective of bolstering the domestic supply chain.

Finally, we complement the firm-level analysis with industry-level evidence. Using multi-regional input-output data, we construct for each industry measures of upstream and downstream sanction exposure and examine the effects of sanctions at the industry level. Industries with greater exposure exhibit significantly higher domestic value added (an exhibition of input self-sufficiency) and increased R&D intensity, while their value added does not decline. This pattern suggests that resource reallocation toward import substitution does not generate observable efficiency losses, in contrast to the Russian experience documented by Nigmatulina (2023), where government support to sanctioned firms leads to substantial resource misallocation and weaker aggregate economic performance.

This paper contributes to several strands of the literature. First, we contribute to the growing body of work on the economic effects of sanctions. Much of this literature examines the macroeconomic consequences of broad-based sanctions, particularly in the context of Russia and Iran (Peksen and Peterson, 2016; Crozet and Hinz, 2020; De Souza et al., 2024; Felbermayr et al., 2025). A more recent wave of studies analyzes firm-level effects on targeted entities and their trading partners (Ahn and Ludema, 2020; Besedeš et al., 2021; Crozet et al., 2021; Görg et al., 2024; Li et al., 2024; Crosignani et al., 2026). We shift the unit of analysis from the sanctioned firm to its upstream suppliers, documenting how supply chains reorganize in response to targeted export controls. Unlike the Russian context, where the primary adjustment

margin is trade diversion through third countries (Crozet et al., 2021; Duong et al., 2024; Li et al., 2024; Tyazhelnikov and Romalis, 2024), we show that the Chinese response operates predominantly through domestic substitution, enabled by firm-level capability upgrading and industrial policy.

Second, we contribute to the literature on supply chain resilience and adjustment. A large body of work has studied how firms restructure their supplier networks in response to natural disasters (Barrot and Sauvagnat, 2016; Boehm et al., 2019; Carvalho et al., 2021), trade policy shocks (Huang et al., 2023; Freund et al., 2024), and geopolitical risks (Alfaro and Chor, 2023; Gopinath et al., 2025). We add to this literature by documenting the response to targeted technology sanctions, which differ from trade-war tariffs or broad embargoes in that they restrict access to specific inputs at the firm level. We show that localization operates along both the intensive and extensive margins, driven by endogenous supplier upgrading. This evidence links our findings to the literature on endogenous supply chain formation (Acemoglu and Azar, 2020; Antràs and De Gortari, 2020) and the literature on input quality upgrading in developing economies (Amiti and Konings, 2007; Goldberg et al., 2010).

Third, our paper speaks to the debate on industrial policy and its role in fostering technological self-sufficiency. A growing literature evaluates the effectiveness of government interventions in promoting industrial development, with particular attention to the Chinese context (Aghion et al., 2015; Kalouptsidi, 2018; Liu, 2019; Juhász et al., 2024). We provide micro-level evidence on a specific channel through which industrial policy operates: the targeted support of domestic suppliers in sanctioned supply chains. Our findings suggest that government resources are allocated without apparent political favoritism and effectively stimulate R&D. This provides a more nuanced perspective on the conditions under which state intervention can support technological catch-up without generating the distortionary misallocation observed in other contexts (Faccio et al., 2006; Nigmatulina, 2023).

The remainder of the paper is organized as follows. Section 2 describes the institutional background of the *Entity List* and documents the resilience of sanctioned firms. Section 3 details the data sources and sample construction. Section 4 presents the empirical results, including the baseline effects on supplier performance, the heterogeneity across supplier countries, the analysis of supply chain formation, and the mechanisms driving localization. Section 5 concludes.

2 Institutional Background

2.1 Export Control and *Entity List*

The U.S. export control regime originated with the *Trading with the Enemy Act of 1917*, which restricted trade between the U.S. and designated adversary nations (Berman and Garson, 1967). After World War II, the government retained and expanded this framework through subsequent legislation, including the *Arms Export Control Act of 1976* and the *Export Administration Act of 1979*, both of which targeted commodities and technologies with potential military applications. For much of its history, therefore, the U.S. export control regime functioned as an instrument for addressing national security concerns related to military capabilities (Whang, 2019). This changed with the *Export Control Reform Act of 2018 (ECRA)*, enacted under the Trump administration, which redefined national security to encompass the preservation of U.S. global leadership and thereby explicitly incorporated economic interests into the export control framework. The *ECRA* introduced "requirements to identify and control the export of emerging and foundational technologies,"[4] granting the U.S. government authority to impose export controls in pursuit of broader economic policy objectives under the justification of national security.

The *Entity List*, administered by the Bureau of Industry and Security (BIS), is one of the most prominent firm-level export control instruments.[5] First published in 1997, it was originally designed to prevent entities potentially involved in the proliferation of weapons of mass destruction from accessing specific U.S. technologies. Over time, the criteria for inclusion have broadened to cover activities deemed detrimental to U.S. national security, foreign policy, or economic interests. The *Entity List* targets firms, organizations, and individuals, and it mandates that designated entities obtain licenses before exporting, reexporting, or transferring any items subject to the *Export Administration Regulations (EAR)*. Violations of these licensing requirements can result in severe civil or criminal penalties for all parties involved in the transaction.

A distinguishing feature of the *Entity List* is its extraterritorial reach, which extends regulatory oversight beyond products of strictly U.S. origin to include foreign-produced items incorporating controlled U.S. content or technology. Under the *de minimis* rule, a foreign-manufactured commodity, software, or technology becomes

[4] According to *50 U.S.C. § 4817*.

[5] The effects of other firm-level sanction lists are controlled as a control variable in our baseline specification.

subject to the *EAR* if the value of its controlled U.S.-origin content exceeds 25% of the total value.[6] For example, a high-precision German-made device valued at 100 that incorporates 25 or more in U.S.-origin components may not be exported to a designated entity in China. This scope is further intensified for strategic sectors, such as semiconductors and advanced-node integrated circuits, through the *Foreign Direct Product Rule (FDPR)*. Under this rule, foreign-produced items are restricted even if they contain no physical U.S. content, provided they are the direct product of certain U.S. technology or software, or are manufactured by a facility that is itself a direct product of such technology. As a result, once a firm is placed on the *Entity List*, both U.S. and third-country suppliers face heightened compliance risks and may reassess their supply chain relations with the designated firm. Motivated by this institutional feature, our analysis extends beyond Chinese and U.S. suppliers to examine responses by suppliers from other countries, with particular attention to major exporters of high-technology products and countries geopolitically aligned with either China or the U.S.

2.2 Restrictions on Chinese Tech Firms under *Entity List*

In 2018, the Trump administration issued a notice of proposed rulemaking to classify a range of "emerging technologies," including artificial intelligence, biotechnology, and microprocessor technology, as critical to U.S. national security, thereby complementing the *ECRA*.[7] This initiative served as a strategic counter to the *Made in China 2025* plan, which outlined China's industrial ambitions in high-technology sectors and signaled a period of intensified technological competition. The initial proposal covered broad civilian and commercial domains and drew significant opposition from U.S. industry and academia. The BIS ultimately narrowed its formal controls in 2020 to six categories linked primarily to military applications, advanced semiconductor manufacturing, and digital surveillance.

Despite these formal constraints, the U.S. government has effectively pursued its objectives by leveraging the *Entity List* as a more agile and targeted mechanism for restricting exports of emerging technologies. Representative sanctioned firms span key high-technology fields, including semiconductors (e.g., Huawei, SMIC), artificial intelligence (e.g., SenseTime), and the Internet of Things (e.g., Hikvision). Against

[6] According to *15 C.F.R. § 734.4*.

[7] "Review of Controls for Certain Emerging Technologies", Commerce Department, 83 Fed. Reg. 58,201 (November 19, 2018). See https://www.federalregister.gov/documents/2018/11/19/2018-25221/review-ofcontrols-for-certain-emerging-technologies.

the backdrop of U.S.-China technological decoupling, the frequency and scale of Chinese designations have continued to rise. Figure 1 illustrates the temporal evolution and relative share of Chinese entities on the list. Since 2018, the scope of the *Entity List* has expanded rapidly, with the proportion of Chinese entities increasing from 19% to 33% by 2024. This trend is especially pronounced in recent years: since 2019, more than half of all new additions have been Chinese entities. By 2024, the cumulative number of Chinese firms added reached 266, accounting for 52% of total new entries in that year.[8]

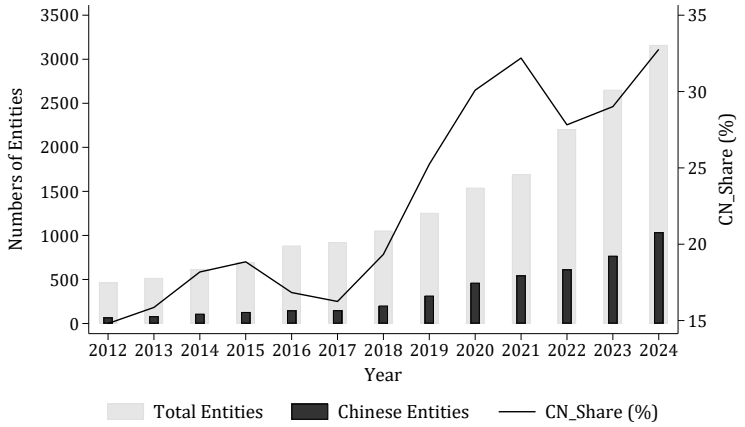


Figure 1. Evolution of Chinese Entities on the *Entity List*

Notes: This figure plots the temporal evolution of entities designated on the *Entity List*, highlighting the frequency of Chinese entities' inclusion and their relative share of the total. The bars represent the absolute number of entities added, and the solid line depicts the share of Chinese entities. For entities appearing multiple times on the *Entity List*, only the date of their initial inclusion is considered.

The *Entity List* prohibits suppliers from exporting products or technologies containing controlled U.S. items to sanctioned firms, thereby inducing severe disruptions to their upstream supply chains. Following its addition to the *Entity List*, for example, Huawei was unable to procure advanced semiconductors from U.S. companies, a restriction that significantly weakened its competitiveness in high-end electronic products such as 5G base stations and high-performance smartphones.[9] Similarly,

[8]Many firms appear multiple times on the *Entity List*. We consider only the date of their first inclusion. The specific *Entity List* is detailed at https://www.ecfr.gov/current/title-15/subtitle-B/chapter-VII/subchapter-C/part-744/appendix-Supplement%20No.%204%20to%20Part%20744.

[9]See https://www.cnbc.com/2020/05/18/huawei-faces-big-blow-from-new-us-rules-to-cut-off-chips.html.

SMIC, China's largest semiconductor foundry, warned that "difficulties in securing key equipment" resulting from U.S. export controls could delay mass production at its new $7.6 billion facility by one to two quarters.[10] While these firms are often alleged to support China's military advancements or human rights violations, the primary objective of the U.S. government is to restrict their access to controlled U.S. items in order to limit their technological progress. Although controlled items traditionally encompassed military technologies (e.g., aerospace, nuclear, and defense technologies), recent years have seen an expansion to include advanced civilian and commercial technologies such as artificial intelligence, quantum technology, and semiconductors (Han et al., 2024).

2.3 The Resilience of Sanctioned Firms

Although inclusion on the *Entity List* is designed to restrict access to controlled U.S. technologies and disrupt upstream supply chains, affected firms demonstrate notable resilience in their operating performance. Figure 2 presents event-study estimates based on sanctioned publicly listed firms.[11] The results indicate no statistically significant decline in sales revenue or gross profits for sanctioned firms relative to their non-sanctioned Chinese peers operating within the same industries. This finding raises a central question: how do sanctioned firms sustain their performance despite stringent restrictions on upstream technological inputs?

A growing body of descriptive evidence suggests that supply chains are undergoing a strategic reconfiguration toward domestic substitutes. Teardown analyses of Huawei's flagship devices, for example, reveal a consistent increase in the proportion of components sourced from Chinese suppliers.[12] Similarly, DJI's thermal imaging drones have reportedly discontinued the use of sensors previously supplied by the U.S.-based FLIR.[13] Consistent with this narrative, Figure 3 shows a pronounced localization trend within the supplier networks of sanctioned firms following designation: the share of U.S. suppliers declines sharply while the share of Chinese suppliers rises.

[10] See https://www.scmp.com/tech/tech-war/article/3209797/tech-war-chinas-top-chip-maker-smic-admits-delays-new-plant-us-tightens-export-semiconductor.

[11] Due to data availability, this analysis focuses on sanctioned listed firms. Subsequent analyses of suppliers' responses relax this restriction.

[12] See https://www.reuters.com/technology/huaweis-new-phone-uses-more-china-made-parts-memory-chip-2024-05-09/.

[13] See https://droneanalyst.com/2020/12/21/dji-added-to-the-us-entity-list-whats-the-impact.

These patterns indicate that sanctioned firms exhibit resilience and that their supplier networks shift toward domestic sourcing. However, analyzing the issue solely from the perspective of the sanctioned firms does not capture the strategic responses of upstream suppliers. Adopting the supplier perspective offers two advantages. First, it allows us to assess whether the observed localization reflects a short-term adjustment or a more durable reconfiguration of supply chains. Second, it enables us to include major sanctioned but non-listed Chinese technology firms, such as Huawei and DJI, along with their suppliers, in our sample. The subsequent analysis therefore focuses on the supplier side, examining the dynamics of suppliers' performance, procurement strategies, and innovation activities.

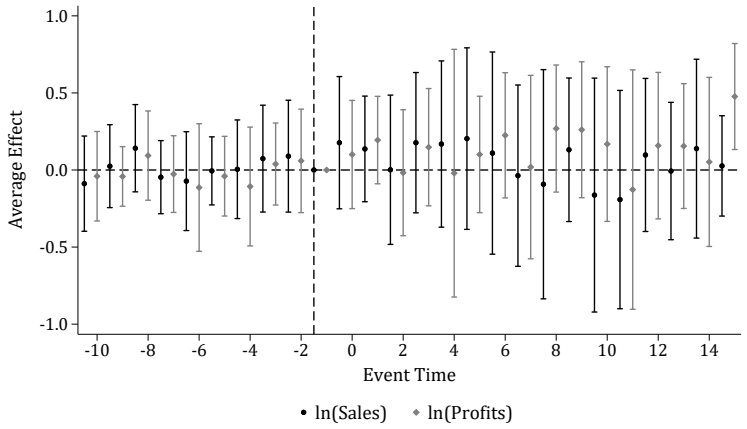


Figure 2. Effects of Sanctions on the Performance of Targeted Firms

Notes: This figure reports event-study estimates of the impact of sanctions on the operating performance of targeted firms. The estimated specification is:

$$y_{jgt} = \alpha + \sum_{p=-10}^{15} \beta_1 Sanction^{target}_{j(t+p)} + \beta_2 \mathbf{X}'_{jt} + \delta_j + \omega_{gt} + \varepsilon_{jgt}$$

where j denotes a firm, g denotes the NACE 2-digit industry, and t denotes a year-quarter. The dependent variables y_{jgt} represent firm performance variables: sales revenue ($ln(Sales)_{jgt}$) and gross profits ($ln(Profits)_{jgt}$), both in logarithmic form. The terms $Sanction^{target}_{j,t+p}$ are leads and lags of the sanction indicator, where $Sanction^{target}_{jt}$ equals one starting from the quarter a firm is added to the *Entity List*. Control variables $\mathbf{X}'_{jt}$ include $Other_sanc_{jt}$ (an indicator for other sanctions) and interactions between pre-treatment firm characteristics ($ln(Assets)$, ROA, L/A, and $Intang$) and time fixed effects. The model includes firm fixed effects (δ_j) and industry-time fixed effects (ω_{gt}). Black dots and gray dots represent point estimates for $ln(Sales)_{jgt}$ and $ln(Profits)_{jgt}$, respectively. Vertical bars indicate 95% confidence intervals based on standard errors clustered by firm.

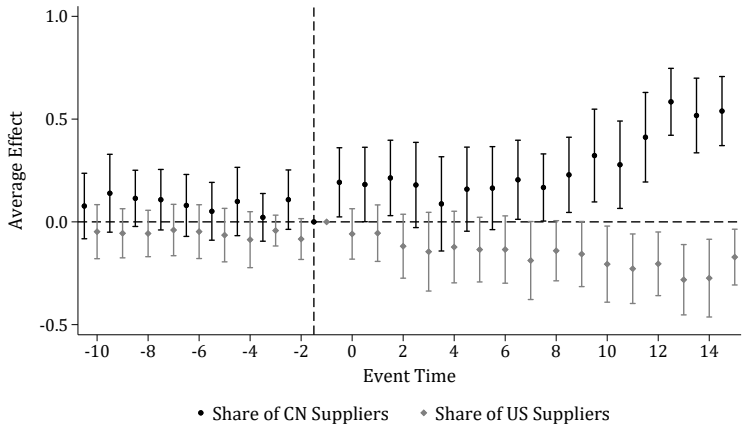


Figure 3. Effects of Sanctions on the Composition of Suppliers to Targeted Firms

Notes: This figure presents event-study estimates showing the evolution of the share of Chinese and U.S. suppliers to sanctioned firms around the time of designation. The dependent variables are the share of Chinese suppliers and the share of U.S. suppliers within a firm's total suppliers. The empirical specification and control variables are consistent with those described in Figure 2. Black dots represent the share of Chinese suppliers, while gray dots represent the share of U.S. suppliers. Vertical bars indicate 95% confidence intervals.

3 Data and Sample Characteristics

3.1 Data Sources

Our analysis combines three main data sources: the *Entity List* published by the BIS, firm-level supply chain data from FactSet Revere, and quarterly financial data from Bureau van Dijk (BvD) Orbis. The sample period spans from the first quarter of 2017 to the second quarter of 2023.

We begin by compiling the complete list of Chinese entities designated on the *Entity List*. This list covers firms, research institutions, universities, individuals, and specific addresses. By the end of 2024, it included 1,036 Chinese entities, representing 32.76% of all entries. We restrict our focus to firms for which detailed supply chain information is available, excluding universities, research institutes, and individuals, as these entities generally do not engage in industrial production or maintain reportable supply chain relationships.

We then manually match the Chinese firms on the *Entity List* to the FactSet Revere database using entity names and addresses, verifying each match through

publicly available information.[14] Using firm-level supply chain data from FactSet Revere, we identify both domestic and overseas suppliers of the sanctioned firms. FactSet Revere is the most comprehensive dataset of firm-level supply chain relationships currently available (Gofman et al., 2020), aggregating relationship information from primary public sources such as regulatory filings, investor presentations, and press releases. As of the second quarter of 2023, the dataset covers over 400,000 firms worldwide (including nearly 20,000 from China) and more than 2 million recorded relationships. On average, each Chinese firm in the dataset has 42 suppliers, 30 of which are domestic.

We also obtain sectoral information for each firm from FactSet Revere. The dataset identifies each firm's core business sector (defined as the sector contributing more than 50% of total revenue) as well as other specialized sectors in which the firm has released products. The product portfolios of sanctioned firms span 795 distinct sectors, including semiconductors, artificial intelligence, cybersecurity, and quantum technology. To implement our difference-in-differences specification, we select non-sanctioned Chinese firms operating in the same sectors as the sanctioned firms to serve as peers.[15] The control group for the suppliers of sanctioned firms is then constructed from the suppliers of these peer firms.

Finally, we obtain detailed quarterly financial data for all sample firms from the BvD Orbis dataset, which covers over 120,000 listed and major unlisted companies worldwide, including 20,550 Chinese firms. The use of quarterly data allows for a precise assessment of the immediate effects of sanctions on supply chain dynamics. To isolate the effects of the *Entity List* designations under study, we exclude Russian and Ukrainian firms, non-Chinese sanctioned firms, and their respective suppliers and customers. This eliminates potential confounding effects from the Russia-Ukraine war and other geopolitical interventions. Applying these criteria, we identify 62 sanctioned Chinese firms (32 of which are publicly listed) with clearly documented supply chain

[14] We exclude trading companies, which primarily engage in trade and resale without direct involvement in production and often operate as shell companies designed to obscure the origins and destinations of trade flows. We also exclude firms that were subsequently removed from the *Entity List* to avoid estimation bias.

[15] A firm's core business sector is not necessarily its most technologically advanced sector, nor the one most likely to trigger sanctions. For example, in the case of Hikvision, the majority of revenue is derived from the "Closed Circuit Television Systems" sector, yet its most technology-intensive operations lie in cybersecurity. When constructing the control group, we therefore consider both the core and specialized business sectors of the sanctioned firms to provide a more comprehensive representation of their technological landscape. In robustness checks, we restrict attention to core business segments only.

relations, along with their 739 suppliers.[16] Correspondingly, we identify 2,427 peer firms and their 4,251 suppliers, which constitute the control group.

3.2 Sample Characteristics

Table A2 presents summary statistics for the treated and control suppliers during the first quarter of our sample period, reporting the mean, standard deviation, median, and a test of differences between the two groups. Crucially for the validity of our identification strategy, we observe no statistically significant differences in sales revenue or gross profit between treated and control suppliers prior to the sanction shock. This initial balance indicates that the two groups exhibited comparable operating performance before treatment. Relative to control suppliers, treated suppliers are smaller in total assets and less leveraged, while holding a higher share of intangible assets. The two groups do not differ significantly in return on assets. We control for these pre-existing differences in all subsequent specifications.

Appendix Table A3 provides comprehensive summary statistics for the full sample period, covering sanctioned firms as well as their upstream suppliers and downstream customers. Our sample comprises 62 sanctioned firms, of which 32 are publicly listed. Panel A reports their firm-level characteristics, while Panels B and C summarize the characteristics of 739 suppliers and 398 customers, respectively. Sanctioned firms are larger and exhibit stronger operating performance than their trading partners, with higher sales and gross profits. This pattern underscores their central role within supply chains and highlights the potential for technology shocks to propagate through production networks.

4 Empirical Results

4.1 Supply Chain Localization

4.1.1 Effects on Suppliers' Performance

Our baseline specification examines whether the performance of suppliers to sanctioned firms changes significantly relative to that of suppliers to non-sanctioned Chinese peers, following designation on the *Entity List*. The dataset is organized at the supplier-quarter level. The specification is as follows:

[16] See Table A1 in the Appendix for a detailed list of the sanctioned firms.

$$y_{i(ck)t} = \alpha + \beta_1 Sanction_{it} + \beta_2 \mathbf{X}'_{it} + \theta_i + \gamma_{ckt} + \varepsilon_{ickt} \quad (1)$$

where i denotes a supplier, c its country of origin, k its NACE 2-digit industry, and t the year-quarter. The dependent variable $y_{i(ck)t}$ measures operating performance, specifically the logarithm of sales revenue ($lnSales_{i(ck)t}$) and gross profits ($lnProfits_{i(ck)t}$). The treatment variable $Sanction_{it}$ equals one starting from the first time in which a downstream firm of supplier i is added to the *Entity List*, and zero otherwise. The treatment group consists of suppliers to sanctioned firms, while the control group comprises suppliers to non-sanctioned Chinese peer firms.

The vector $\mathbf{X}'_{it}$ controls for other determinants of supplier performance. To address potential confounding from dual roles in the production network, we include an indicator $\mathbf{1}\{$ also customer at $t-1\}$, which identifies whether supplier i also served as a customer of the sanctioned firm in the preceding quarter, along with its interaction with $Sanction_{it}$. We also include $Other_sanc_{it}$ to control for exposure to alternative restrictive lists.[17] To mitigate endogeneity concerns arising from the possibility that larger or more profitable firms are more likely to be targeted, we control for pre-treatment firm characteristics, including the logarithm of total assets ($ln(Assets)_i$), return on assets (ROA_i), the leverage ratio (L/A_i), and the ratio of intangible to fixed assets ($Intang_i$). These time-invariant characteristics are interacted with time fixed effects to allow their influence to vary over time. We include supplier fixed effects θ_i to absorb unobservable time-invariant firm heterogeneity, and supplier country-industry-time fixed effects γ_{ckt} to absorb time-varying shocks at the industry or macroeconomic level, such as trade war tariffs, the Russia-Ukraine conflict, or the Covid-19 pandemic. Standard errors are clustered at the supplier level.

The institutional design of the *Entity List* supports the validity of our difference-in-differences design. To preserve deterrence, the BIS provides no advance notice prior to designation, which prevents firms from stockpiling inputs or reallocating assets in anticipation. As a result, neither the targeted firms nor their suppliers are likely to

[17] These sanction lists include the *Unverified List*, the *SDN List*, the *Chinese Military Companies List*, and the *Military End User List*. The *Unverified List* targets entities with unverifiable end-use concerns and imposes additional scrutiny on exporters. The remaining three target entities linked to terrorism, drug trafficking, weapons proliferation, or human rights violations, but do not primarily target U.S. economic interests or technological leadership. Some of these lists impose limited or no substantive restrictions (e.g., the *Unverified List* and the *Military End User List*), while others focus on asset freezes or investment bans (e.g., the *SDN List* and the *Chinese Military Companies List*), aiming to exclude targeted entities from the global financial system. By contrast, the *Entity List* primarily regulates the flow of controlled goods and technologies, seeking to cut off sanctioned entities' access to specific U.S. technologies.

anticipate the timing of the sanctions, reducing the risk of systematic pre-treatment behavioral adjustments.

Table 1 reports the estimated effects of sanctions on supplier performance. Columns (1) and (2) show that β_1 is positive and statistically significant at the 1% level, and this result remains robust to the inclusion of high-dimensional fixed effects in columns (3) and (4). The preferred estimates indicate that suppliers experience a 10.7% increase in sales revenue and a 13.6% increase in gross profits following the sanctioning of their downstream firms.[18] To explore whether the intensity of exposure matters, we replace the binary treatment indicator with the number of sanctioned downstream firms ($Sanc_num$) and their proportion ($Sanc_share$). As shown in columns (5) through (8), the results are robust to these alternative intensity measures.

[18]We also examine whether these shocks propagate further downstream. As shown in Appendix Table A4, the performance of the sanctioned firms' customers does not diverge significantly from that of the control group, suggesting that the impact is primarily concentrated upstream.

Table 1. Effects of Sanctions on Supplier Performance

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	ln(Sales)	ln(Profits)	ln(Sales)	ln(Profits)	ln(Sales)	ln(Profits)	ln(Sales)	ln(Profits)
Sanction	0.1070***	0.1326***	0.1014***	0.1279***				
	(0.0273)	(0.0288)	(0.0310)	(0.0323)				
Sanc_num					0.0764***	0.0792***		
					(0.0206)	(0.0208)		
Sanc_share							0.4154**	0.5434***
							(0.1830)	(0.1837)
Controls	✓	✓	✓	✓	✓	✓	✓	✓
Supplier FE	✓	✓	✓	✓	✓	✓	✓	✓
Supplier Country-Industry-Time FE			✓	✓	✓	✓	✓	✓
R-squared	0.9353	0.9107	0.9422	0.9194	0.9425	0.9196	0.9424	0.9196
No. of obs.	67735	65904	61248	59762	60739	59256	60739	59256

Notes: This table reports the effects of sanctions on supplier performance. The unit of observation is the supplier-quarter, covering the period from 2017q1 to 2023q2. The dependent variables are the logarithm of sales revenue in columns (1), (3), (5), and (7), and the logarithm of gross profits in columns (2), (4), (6), and (8). *Sanction* equals one starting from the first time in which a downstream firm of the supplier is added to the *Entity List*, and zero otherwise. *Sanc_num* denotes the number of sanctioned downstream firms, and *Sanc_share* denotes the proportion of sanctioned downstream firms. Control variables include $\mathbf{1}\{$ also customer at $t-1\}$ and its interaction with *Sanction*; *Other_sanc*, an indicator for exposure to other sanction lists; and interactions between pre-treatment firm characteristics ($ln(Assets)$, ROA, L/A, $Intang$) and time fixed effects. All specifications include supplier fixed effects (θ_i). Columns (3) through (8) additionally include supplier country-industry-time fixed effects (γ_{ckt}). All reported R-squared values are adjusted R-squared. Standard errors, clustered at the supplier level, are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

We conduct several robustness checks to validate these results. Firstly, we restrict the control group to suppliers of Chinese firms operating in the same core business sectors (those contributing over 50% of revenue) as the sanctioned firms. As shown in columns (1) and (2) of Appendix Table A5, our main findings remain robust. We then address potential confounding from concurrent geopolitical events. In the baseline specification, we mitigate such concerns by controlling for time-varying shocks at the country-industry level using fixed effects. Moreover, we also conduct the following three robustness checks: First, the U.S.-China trade war marked the beginning of deteriorating trade relations between the two countries. Anticipating more severe frictions, suppliers may have responded by stockpiling or adjusting supply chains in advance, which could bias our estimates. In columns (3) and (4), we restrict the sample to the post-2018 period, ensuring that all suppliers had already been exposed to the heightened trade tensions of the U.S.-China trade war and had formed

expectations about future trade risks. Second, in columns (5) and (6), we include a trade war shock variable $Tradewar$ using 2018 as a pseudo-policy onset. Third, following the Russia-Ukraine conflict, the U.S. imposed sanctions on a large number of Russian defense companies and state-owned enterprises. Although we have excluded all firms and their supply chain partners directly involved in the conflict, it is possible that the broader geopolitical fallout indirectly affected Chinese supply chains (Li et al., 2024). To address this concern, we re-estimate the models using the pre-2022 sample in columns (7) and (8). Across all specifications, the results remain consistent with the baseline findings.

4.1.2 Event Study

To verify the absence of pre-trends and examine whether there are any anticipatory or phased-in responses to the sanctions, we implement an event study specification:

$$y_{i(ck)t} = \alpha + \sum_{p=-10}^{10} \beta_1 Sanction_{i(t+p)} + \beta_2 \mathbf{X}'_{it} + \theta_i + \gamma_{ckt} + \varepsilon_{ickt} \tag{2}$$

where i denotes a supplier, c denotes the country of i, k denotes the NACE 2-digit industry of i, and t denotes a year-quarter. The dependent variable $y_{i(ck)t}$ represents firm performance measures. $Sanction_{i(t+p)}$ is a set of indicator variables derived from $Sanction_{it}$, each shifted forward or backward by p periods relative to the sanction event.

Figure 4 shows that the coefficients in the pre-sanction periods exhibit no statistically significant deviations from zero, indicating that treated and control suppliers display comparable performance trajectories prior to treatment. Following the imposition of sanctions, the treatment effect rises progressively, with the performance gap between treated and control suppliers widening over time. Because the staggered difference-in-differences estimator is a weighted average of treatment effects across different adoption cohorts, including comparisons between late-treated and early-treated units, it may produce biased estimates when treatment effects are heterogeneous (De Chaisemartin and d'Haultfoeuille, 2020; Baker et al., 2022). Specifically, sanctions imposed at different times may generate varying effects across treatment cohorts, leading to heterogeneity in treatment effects. To address this concern, we also implement the weighted group-time estimator and the stacked estimator, both of which are robust to treatment effect heterogeneity (Cengiz et al., 2019; Sun and Abraham, 2021). Figure A1 demonstrates that the estimated pattern remains unchanged

when using these alternative estimators.

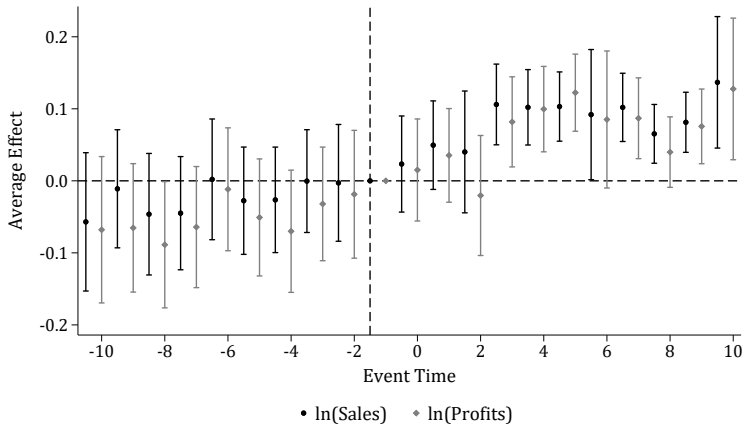


Figure 4. Event Study on the Effects of Sanctions on Supplier Performance

Notes: This figure presents event study estimates of the effects of sanctions on supplier performance. Black and gray dots represent point estimates for $ln(Sales)$ and $ln(Profits)$, respectively. The vertical bars indicate 95% confidence intervals.

4.1.3 Heterogeneity of Supplier Countries

We next investigate which groups of suppliers account for the observed performance gains. In addition to Chinese and U.S. suppliers, we examine suppliers from other technologically advanced economies (hereafter, tech-advanced countries). It is plausible that sanctioned firms respond to input restrictions by redirecting procurement toward these alternative high-tech sources. To test this hypothesis, we identify the top seven non-U.S. and non-Chinese countries ranked by their total exports of high-tech products in 2016. We also account for the potential role of geopolitical alignment. In response to sanctions, firms may prioritize supply chain stability by sourcing from countries with closer geopolitical ties (Li et al., 2024; Gopinath et al., 2025). Following Gopinath et al. (2025), we classify countries into pro-China and pro-U.S. blocs (hereafter, China-allied countries and U.S.-allied countries) based on United Nations voting patterns. We categorize suppliers into five groups according to their country of origin and construct corresponding indicator variables: $\mathbf{1}\{\text{China}\}$, $\mathbf{1}\{\text{U.S.}\}$, $\mathbf{1}\{\text{tech-advanced}\}$, $\mathbf{1}\{\text{China-allied}\}$, and $\mathbf{1}\{\text{U.S.-allied}\}$. We interact these indicators with the treatment variable *Sanction* and incorporate them into the baseline specification in Equation 1. This approach allows us to distinguish whether the observed performance improvement is driven by domestic import substitution, a strategic shift

toward other tech-advanced countries, or friend-shoring of the supply chain.

Table 2 presents the heterogeneity results. Columns (1) and (2) compare Chinese and U.S. suppliers, revealing that post-sanction performance gains accrue primarily to Chinese suppliers. The interaction term between $Sanction_{it}$ and $\mathbf{1}\{\text{China}\}$ is positive and statistically significant, whereas the corresponding coefficient for U.S. suppliers is economically small and statistically insignificant. Columns (3) and (4) extend the analysis to suppliers from other tech-advanced economies. The results remain unchanged, with no significant performance gains observed outside China. Finally, columns (5) and (6) assess whether geopolitical alignment influences supplier responses by distinguishing between China-allied and U.S.-allied countries. We find no evidence that performance effects differ systematically across these blocs, indicating that the estimated improvement is not driven by substitution toward geopolitically aligned foreign suppliers. Overall, the evidence points to a distinctly domestic adjustment pattern: sanctions stimulate demand for domestic substitutes, and the associated performance gains are concentrated among Chinese suppliers.

Table 2. Heterogeneous Effects by Supplier Country Group

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	ln(Sales)	ln(Profits)	ln(Sales)	ln(Profits)	ln(Sales)	ln(Profits)
Sanction	-0.0369	-0.0107	-0.0640	-0.0147	-0.0222	0.0026
	(0.0441)	(0.0504)	(0.0629)	(0.0698)	(0.0570)	(0.0681)
Sanction $\times$**1**{China}	0.1822***	0.1831***	0.2092***	0.1871**	0.1675**	0.1699**
	(0.0601)	(0.0654)	(0.0752)	(0.0814)	(0.0702)	(0.0799)
Sanction $\times$**1**{U.S.}	0.0900	0.0698	0.1170	0.0738	0.0753	0.0565
	(0.0791)	(0.0824)	(0.0907)	(0.0956)	(0.0865)	(0.0941)
Sanction $\times$**1**{tech-advanced}			0.0541	0.0077		
			(0.0884)	(0.1010)		
Sanction $\times$**1**{China-allied}					0.0150	0.0483
					(0.1956)	(0.1551)
Sanction $\times$**1**{U.S.-allied}					-0.0340	-0.0353
					(0.0920)	(0.1062)
Controls	✓	✓	✓	✓	✓	✓
Supplier FE	✓	✓	✓	✓	✓	✓
Supplier Country-Industry-Time FE	✓	✓	✓	✓	✓	✓
R-squared	0.9422	0.9194	0.9422	0.9194	0.9422	0.9194
No. of obs.	61248	59762	61248	59762	61248	59762

Notes: This table reports heterogeneous effects of sanctions on supplier performance across different country groups. The dependent variables are the logarithm of sales revenue in columns (1), (3), and (5), and the logarithm of gross profits in columns (2), (4), and (6). **1**{China}, **1**{U.S.}, **1**{tech-advanced}, **1**{China-allied}, and **1**{U.S.-allied} are indicator variables for whether the supplier is located in China, the U.S., a tech-advanced country, a China-allied country, or a U.S.-allied country, respectively. TTech-advanced countries are defined as the top seven non-U.S. and non-Chinese countries ranked by total exports of high-tech products in 2016, including Germany, South Korea, Singapore, France, Japan, the United Kingdom, and the Netherlands. Data are sourced from the World Development Indicators (WDI) database. China-allied and U.S.-allied countries are classified based on United Nations voting patterns following Gopinath et al. (2025). China-allied countries includes Antigua and Barbuda, Chile, Nigeria, Philippines, Saudi Arabia, Singapore, South Africa, Thailand, and Zambia. U.S.-allied countries includes Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, South Korea, Latvia, Luxembourg, Marshall Islands, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Slovenia, Spain, Sweden, Switzerland, and United Kingdom. All other settings follow those in Equation 1. Adjusted R-squared values are reported. Standard errors are clustered at the supplier level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4.1.4 The Formation of Supply Chain Relations

The preceding results document improvements in the performance of existing domestic suppliers, reflecting an expansion in procurement volume within pre-existing relationships along the intensive margin. We now examine whether supply chain localization also operates along the extensive margin, defined as the formation of new supply chain relations between sanctioned firms and domestic suppliers. To this end,

we employ a linear probability model that compares the likelihood of suppliers from different country groups forming new relations with sanctioned firms relative to their non-sanctioned Chinese peers. The specification is as follows:

$$\begin{aligned} New_connect_{i(ck)j(g)t} = \alpha + \beta_1 Sanction_{jt} + \beta_2 Sanction_{jt} \times \mathbf{1}\{\text{origin of supplier}\} \\ + \beta_3 \mathbf{X}'_{ijt} + \theta_i + \delta_j + \gamma_{ckt} + \omega_{gt} + \varepsilon_{ickjgt} \end{aligned} \tag{3}$$

where i denotes a supplier, c denotes its country of origin, k denotes its NACE 2-digit industry, j denotes the downstream firm, g denotes the NACE 2-digit industry of firm j, and t denotes the year-quarter. $New_connect_{i(ck)j(g)t}$ is an indicator variable equal to one if a supply chain relation between firm j and supplier i is established at time t. We define a relation as being formed at time t if it did not exist previously. $Sanction_{jt}$ equals one starting from the period firm j is added to the *Entity List*, and zero otherwise. To identify which countries' suppliers are more likely to form new relations with sanctioned firms, we interact $Sanction_{jt}$ with the set of country-group indicators $\mathbf{1}\{\text{origin of supplier}\}$ defined previously.

The vector $\mathbf{X}'_{ijt}$ contains relation-level controls. Following Equation 1, we include $\mathbf{1}\{$ also customer at $t-1\}$ and its interaction with $Sanction_{jt}$ to account for potential confounding effects arising from a supplier's dual role. $Other_sanc_{ijt}$ controls for exposure to other sanction lists, equaling one if supplier i or firm j is affected by other sanctions at time t. The specification includes supplier fixed effects (θ_i), firm fixed effects (δ_j), supplier country-industry-time fixed effects (γ_{ckt}), and firm industry-time fixed effects (ω_{gt}). Standard errors are clustered at the relation level.

The coefficient of interest, β_2, captures whether suppliers from a given country group are differentially likely to form new supply chain relations with sanctioned firms relative to non-sanctioned peers. The estimates in Table 3 show that only Chinese suppliers exhibit a statistically significant increase in the probability of forming new relations with sanctioned firms. No comparable increase is found for suppliers from the U.S., other tech-advanced countries, or geopolitically allied countries. These results provide evidence that supply chain localization extends to the extensive margin: new domestic suppliers actively enter to fill the gap created by restricted foreign inputs.

Table 3. Effects of Sanctions on the Formation of Supply Chain Relations

	(1)	(2)	(3)
Dependent variable		New_connect	
Sanction	-0.0144*	-0.0107	-0.0185**
	(0.0083)	(0.0081)	(0.0089)
Sanction ×**1**{China}	0.0164***	0.0127**	0.0204***
	(0.0054)	(0.0050)	(0.0056)
Sanction ×**1**{U.S.}	-0.0035	-0.0071	0.0005
	(0.0121)	(0.0130)	(0.0123)
Sanction ×**1**{tech-advanced}		-0.0105	
		(0.0074)	
Sanction ×**1**{China-allied}			0.0262
			(0.0196)
Sanction ×**1**{U.S.-allied}			0.0081
			(0.0072)
Controls	✓	✓	✓
Supplier FE	✓	✓	✓
Firm FE	✓	✓	✓
Supplier Country-Industry-Time FE	✓	✓	✓
Firm Industry-Time FE	✓	✓	✓
R-squared	0.0415	0.0415	0.0415
No. of obs.	292217	292217	292217

Notes: This table reports the effects of sanctions on the formation of new supply chain relations. The dataset is organized at the relation-year quarter level, covering the period from 2017q1 to 2023q2. The dependent variable *New_connect* equals one if a supply chain relation between a downstream firm and a supplier is newly established at time t. *Sanction* equals one starting from the quarter in which the downstream firm is added to the *Entity List*, and zero otherwise. **1**{origin of supplier} is a set of indicators for the supplier's country group: **1**{China}, **1**{U.S.}, **1**{tech-advanced}, **1**{China-allied}, and **1**{U.S.-allied}. Control variables include **1**{ also customer at $t-1$} and its interaction with *Sanction*, and *Other_sanc*, which equals one if the supplier or its downstream firm is affected by other sanction lists. All specifications include supplier FE (θ_i), firm FE (δ_j), supplier country-industry-time FE (γ_{ckt}), and firm industry-time FE (ω_{gt}). All reported R-squared values are adjusted R-squared. Standard errors, clustered at the relation level, are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4.2 Drivers of Localization

In the Russian context, trade diversion has been a primary channel through which sanctioned entities have mitigated the impact of restrictions. Li et al. (2024) show that firms in neutral countries increased exports of sanctioned products to Russia, weakening the effectiveness of the sanctions regime. Crozet et al. (2021) provide suggestive evidence that indirect exports through neighboring countries served as a circumvention channel, and Tyazhelnikov and Romalis (2024) further document the role of smuggling.

By contrast, we find no evidence of significant trade diversion in the Chinese context. As discussed in Section 4.1, sanctioned Chinese firms do not increase their supply chain relations with third-country suppliers. Instead, they strengthen their ties with domestic suppliers. This observation prompts a central question: why does China's adjustment take the form of supply chain localization rather than rerouting trade through alternative foreign suppliers? The answer lies in China's ability to leverage its industrial capacity and government industrial policies to facilitate domestic substitution, which serve as the two key drivers of supply chain localization. In the following sections, we explore these two complementary mechanisms from the perspective of domestic suppliers.

4.2.1 The Upgrading of Domestic Supplier Capabilities

We first examine whether domestic suppliers upgraded their capabilities to produce substitutes for restricted foreign inputs. Over the past two decades, China has built a comprehensive industrial system encompassing 41 sectors, 207 subsectors, and 666 categories under the UN Industrial Classification, making it increasingly its own largest customer.[19] This industrial breadth enables China to produce the vast majority of industrial goods, though domestic firms still lack certain critical materials and technologies. Following U.S. sanctions, targeted firms can no longer import these inputs directly. However, their domestic suppliers may still be able to access such resources and manufacture the upstream products required by sanctioned firms, which may explain the observed inward shift. Although relying on local partners may entail higher costs than rerouting through third countries, concerns over supply chain security and stability make domestic suppliers a more attractive option. We test this hypothesis by examining whether domestic suppliers altered their sourcing and innovation strategies following the imposition of sanctions.

Suppliers' Sourcing Strategies. We examine whether, relative to the control group, domestic suppliers altered their sourcing distribution following the sanctions. Specifically, we analyze the impact of sanctions on the supply chain structure of affected domestic suppliers. We sequentially replace the dependent variable in Equation 1 with the share of suppliers from China, the U.S., tech-advanced countries, China-allied countries, and U.S.-allied countries. The results are presented in Figure 5. Our

[19] See https://cepr.org/voxeu/columns/china-worlds-sole-manufacturing-superpower-line-sketch-rise and https://unctad.org/system/files/official-document/BRI-Project_RP11_en.pdf.

empirical results indicate that following sanctions, the proportion of Chinese suppliers within the upstream networks of affected domestic suppliers increased significantly. This trend suggests a shift toward domestic sourcing rather than the circumvention of trade barriers. We find no robust evidence to suggest that sanctioned Chinese firms utilize their non-sanctioned suppliers to import restricted products. Instead, the evidence points toward a broader localization of the supply chain. This phenomenon is likely driven by the "chilling effect" induced by heightened geopolitical tensions. Faced with substantial external uncertainty, affected domesitc suppliers proactively pivot toward domestic procurement. By reducing reliance on foreign inputs, these suppliers aim to mitigate the risk of secondary sanctions and fortify the resilience and stability of their supply chains.

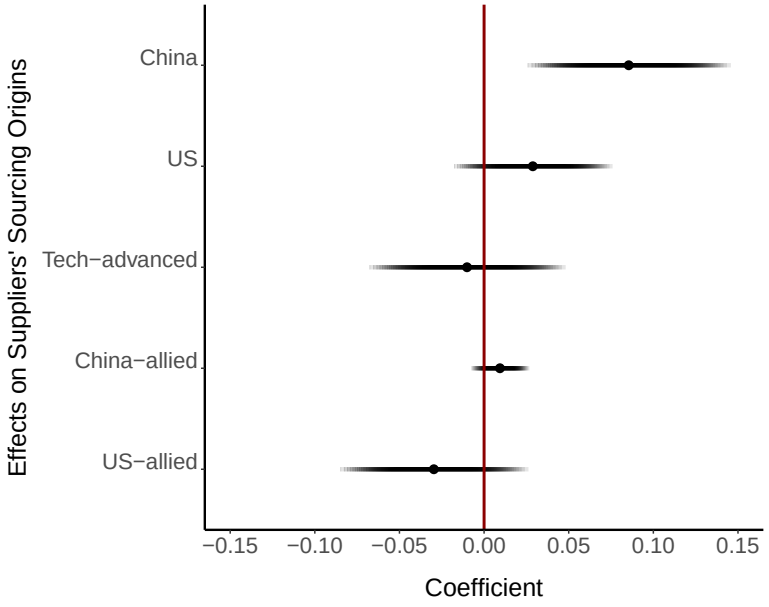


Figure 5. Upstream Procurement of Domestic Suppliers by Country Group

Notes: This figure reports changes in the sourcing shares of domestic suppliers across country groups following sanctions. The panels present coefficients of the interaction term $Sanction \times \mathbf{1}\{\text{China}\}$ estimated from Equation 1. The dependent variables are the number of suppliers from China, the U.S., tech-advanced countries, China-allied countries, and U.S.-allied countries, respectively. All other specifications follow Equation 1. Vertical bars indicate 95% confidence intervals. Full regression results are reported in Appendix Table A6.

Suppliers' Innovation Strategies. We next examine how domestic suppliers acquire the technological capabilities needed to produce substitutes for controlled inputs. We begin with internal R&D activities. Faced with restricted access to foreign technology, domestic suppliers may intensify autonomous development efforts to

achieve technological catch-up and facilitate import substitution. We measure these efforts using two variables: R&D intensity (*R&D_intensity*), defined as the ratio of R&D expenditure to total assets, and research collaboration (*No. of research collaborators*), measured by the number of research collaborators. These measures are constructed from BvD Orbis and FactSet Revere data, respectively. Import substitution typically requires substantial R&D investment and may also involve collaborative projects with technologically advanced partners that facilitate learning and adaptation. Columns (1) and (2) of Table 4 show that affected domestic suppliers significantly increase R&D spending following the imposition of sanctions, whereas the number of research collaborators does not change significantly.

We then turn to external technology acquisition, focusing on two direct channels: patent purchases (*No. of patents purchased*) and patent licensing (*No. of patent licenses*). These represent the most direct mechanisms for incorporating external intellectual property into a firm's production process. Using firm-level transaction data from the Orbis Intellectual Property database, we track the number of patents purchased and licenses obtained by each supplier. The results, reported in columns (3) and (4) of Table 4, reveal a statistically significant increase in patent purchases following sanctions. To identify the geographic origin of these acquired technologies, we decompose patent transactions by the seller's country. As shown in Figure 6, a striking divergence emerges: affected domestic suppliers significantly increase their patent acquisitions from the U.S. and tech-advanced countries, while their reliance on domestic patent purchases declines.

Together, these findings suggest that domestic suppliers do not merely rely on external technology as a short-term stopgap. By simultaneously intensifying internal R&D and strategically acquiring frontier foreign patents, they pursue a comprehensive catch-up strategy designed to build the long-term capacity required for sustainable import substitution.

Table 4. Effects of Sanctions on Domestic Suppliers' Innovation Strategies

Dependent variable	(1) R&D_intensity	(2) No. of research collaborators	(3) No. of patents purchased	(4) No. of patent licenses
Sanction	-0.0013	0.2898	-0.2890*	0.4383**
	(0.0009)	(0.2043)	(0.1584)	(0.2061)
Sanction ×**1**{China}	0.0023**	-0.2443	0.3720*	-1.2344
	(0.0010)	(0.2702)	(0.1940)	(0.8990)
Controls	✓	✓	✓	✓
Supplier FE	✓	✓	✓	✓
Supplier Country-Industry-Time FE	✓	✓	✓	✓
R-squared	0.8260	0.6381	0.6440	0.4806
No. of obs.	57568	46154	70192	3940

Notes: This table reports the effects of sanctions on the innovation activities of domestic suppliers. The dependent variable in column (1) is *R&D_intensity*, defined as the ratio of R&D expenditure to total assets. In column (2), the dependent variable is *No. of research collaborators*. In column (3), the dependent variable is *No. of patents purchased*. In column (4), the dependent variable is *No. of patent licenses*. Columns (2) through (4) are estimated using PPML, and the reported R-squared values are pseudo R-squared. The R-squared in column (1) is adjusted R-squared. **1**{China} is an indicator for whether the supplier is a Chinese firm. All other specifications follow Equation 1. Standard errors, clustered at the supplier level, are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

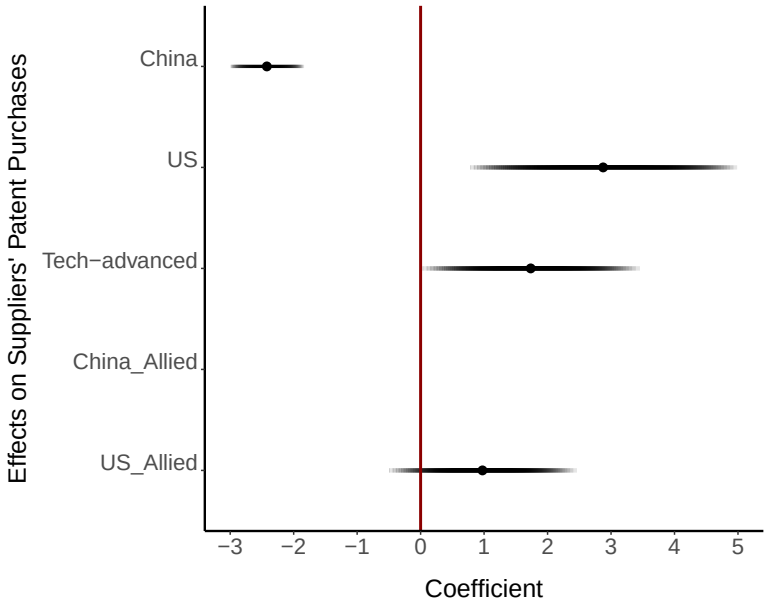


Figure 6. Patent Purchases by Domestic Suppliers across Different Countries

Notes: This figure reports the geographic decomposition of patent purchases by affected domestic suppliers following sanctions. Each coefficient corresponds to the interaction term $Sanction \times \mathbf{1}\{\text{China}\}$ estimated via PPML method based on Equation 1. The dependent variables are the number of patents purchased from China, the U.S., tech-advanced countries, China-allied countries, and U.S.-allied countries, respectively. The result for China-allied countries is omitted due to insufficient observations. Vertical bars indicate 95% confidence intervals. Full regression results are reported in Appendix Table A7.

4.2.2 Supportive Industrial Policies

We next assess the role of industrial policy in facilitating the adjustment of domestic suppliers. The Chinese government has long employed extensive policy instruments to channel subsidies toward high-technology sectors (Goldberg et al., 2024). In the wake of foreign technology sanctions, these interventions have increasingly been directed toward enhancing supply chain resilience and national security rather than merely shielding politically connected firms (Li, 2024). Under this framework, the state may intensify support for domestic suppliers to provide indirect relief to sanctioned downstream firms while strengthening the overall robustness of domestic supply chains. We test this hypothesis by examining whether the government extended greater support to affected domestic suppliers through two channels: direct subsidies and equity investments via Government Guidance Funds (GGFs). Because we focus on domestic policy responses and lack data on state support for foreign firms, the sample in this section is restricted to domestic suppliers.

We first investigate whether affected domestic suppliers received higher subsidies relative to unaffected suppliers following the imposition of sanctions, using the logarithm of subsidies ($ln(Subsidy)$) as the dependent variable. Data are obtained from the CSMAR database.[20] The results in column (1) of Table 5 indicate that sanctions lead to a significant increase in subsidies directed toward affected domestic suppliers.

We then consider the role of GGFs. GGFs are initiated with public fiscal capital and operated by market-oriented professional managers, with the objective of channeling private capital toward strategically prioritized sectors (Wei et al., 2023). A representative example is the National Integrated Circuit Industry Investment Fund, which combines government sponsorship with market-based operation and professional investment management. In practice, the fund allocates capital to semiconductor firms through equity investments, thereby supporting the development of the industry. We identify a subset of national-level GGFs led by core administrative bodies that target critical technologies.[21] The dependent variable Gov_fund is an indicator equal to one if a supplier's equity is held by any of these GGFs, based on firm-level ownership information from CSMAR. The estimates in column (2) show that affected domestic suppliers are significantly more likely to receive GGF equity financing following sanctions.

A potential concern in the literature on industrial policy is that state resources may be disproportionately directed toward firms with stronger political affiliations rather than those with the greatest technological potential (Faccio et al., 2006). To test for this possibility, we interact the sanction treatment indicator with three measures of political linkage: an indicator for state ownership in 2017 ($\mathbf{1}\{\text{SOE}\}$), an indicator for whether the supplier had executives with prior government experience as of 2017 ($\mathbf{1}\{\text{political-connected execs}\}$), and the number of government procurement contracts obtained before 2017 ($Gov_procure$). The results, reported in Appendix Table A8, reveal no statistically significant evidence that state-owned enterprises or suppliers with closer government ties received preferential treatment in the form of higher subsidies or increased GGF investment. This suggests that the allocation of

[20] Since CSMAR provides subsidy data at the annual level, all variables in this section are aggregated to an annual frequency.

[21] The GGFs referenced in this paper include several major national funds differentiated by their supervising authorities. The National Emerging Industry Venture Capital Guiding Fund is overseen by the National Development and Reform Commission, while the China Internet Investment Fund operates under the guidance of the Cyberspace Administration of China. Funds supervised by the Ministry of Finance include the National Integrated Circuit Industry Investment Fund, the National Military-Civil Fusion Industry Fund, and the National Manufacturing Transformation and Upgrading Fund.

state resources is guided by a broader strategic objective of strengthening the upstream supply chain, rather than by a firm's political connections. The absence of preferential treatment toward SOEs or politically connected firms distinguishes the Chinese policy response from more distortionary patterns observed in other sanctioned economies.

Finally, we examine whether government support translates into greater innovation effort. We focus on the two outcome variables that are statistically significant in Section 4.2.1, namely *R&D_intensity* and *No. of patents purchased*, both aggregated to the annual level. Columns (3) and (4) of Table 5 show that subsidies significantly increase both R&D intensity and patent purchases among affected domestic suppliers. By contrast, columns (5) and (6) provide no statistically significant evidence that GGF investment affects R&D or patent acquisition activities. These findings suggest that direct subsidies, rather than equity investments, serve as the effective channel through which government support stimulates innovation. One plausible explanation is that government subsidies in China are often tied to specific policy objectives, which helps channel resources toward targeted technological upgrading (Guo et al., 2016).

Table 5. Government Support to Domesitc Suppliers

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	ln(Subsidy)	Gov_fund	R&D_intensity	No. of patents purchased	R&D_intensity	No. of patents purchased
Sanction	0.1590***	0.0114**				
	(0.0514)	(0.0046)				
ln(Subsidy)			0.0008***	0.0894**		
			(0.0002)	(0.0392)		
Gov_fund					-0.0025	0.0720
					(0.0053)	(0.4115)
Controls	✓	✓	✓	✓	✓	✓
Supplier FE	✓	✓	✓	✓	✓	✓
Supplier Industry-Year FE	✓	✓	✓	✓	✓	✓
R-squared	0.7419	0.5902	0.8106	0.6502	0.7905	0.7092
No. of obs.	13141	15788	12861	11238	14730	13172

Notes: This table reports results on government support to domestic suppliers and its effects on innovation. The sample consists of domestic suppliers only. In column (1), the dependent variable is $ln(Subsidy)$, the logarithm of government subsidies. In column (2), the dependent variable is Gov_fund, an indicator equal to one if a supplier's equity is held by a Government Guidance Fund. In columns (3) and (5), the dependent variable is $R\&D_intensity$, defined as the ratio of R&D expenditure to total assets. In columns (4) and (6), the dependent variable is *No. of patents purchased*. All specifications include supplier fixed effects and supplier industry-year fixed effects, and follow Equation 1 adapted to the annual level. Columns (4) and (6) are estimated using PPML, with pseudo R-squared reported; all other columns use OLS with adjusted R-squared reported. Standard errors, clustered at the supplier level, are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4.3 Industry-Level Evidence

The preceding analysis documents that affected domestic suppliers receive increased government subsidies and GGF investments following sanctions, which in turn facilitate expanded R&D expenditure and technology acquisition. These firm-level responses suggest a growing capacity to produce domestic substitutes for controlled inputs. However, the aggregate welfare implications of such state-led resource reallocation remain ambiguous. In the Russian case, Nigmatulina (2023) find that government support leads to an excessive concentration of resources within sanctioned firms, resulting in significant misallocation that hinders aggregate economic performance. Whether a similar pattern emerges in the Chinese context is an open question. To address this, we evaluate post-sanction shifts in industry-level performance.

We begin by examining the effect of direct sanction exposure on industry-level out-

comes, focusing on GDP and self-sufficiency. We aggregate firm-level sanction data to the industry level to construct a measure of direct exposure, denoted $Sanc_number$. Using industry-level data from the Asian Development Bank (ADB) Multi-Regional Input-Output (MRIO) database, we construct two outcome variables. The first is $ln(GDP)$, the logarithm of industry value added. The second captures the degree of self-sufficiency, measured as the domestic value-added ratio in exports relative to GDP, following the methodology of Wang et al. (2017). The results in columns (1) and (2) of Table 6 show that increased sanction exposure does not significantly affect industry-level GDP, but leads to a significant rise in self-sufficiency.

We then turn to indirect exposure through input-output linkages. Han et al. (2024) show that the effects of sanctions propagate through innovation networks, and we expect similar transmission within production networks. Following their approach, we use MRIO data to quantify upstream and downstream exposure based on pre-determined input shares:

$$Sanc_exposure_up_{ny} = \sum_{m \neq n} Input_{m,n,y=2017} \times Sanc_number_{my} \tag{4}$$

$$Sanc_exposure_down_{ny} = \sum_{n \neq m} Input_{n,m,y=2017} \times Sanc_number_{my} \tag{5}$$

where n and m denote 2-digit MRIO industries and y denotes year. The variable $Input_{m,n,y=2017}$ represents the proportion of inputs from industry m to industry n in 2017, and $Sanc_number_{my}$ represents the number of sanctioned firms in industry m in year y. Accordingly, $Sanc_exposure_up_{ny}$ measures the extent to which industry n is exposed to sanctions through its upstream sectors, whereas $Sanc_exposure_down_{ny}$ captures exposure through downstream linkages.

Using these exposure indices, we evaluate the effects of indirect sanction exposure on industry-level innovation. We measure technological capability by the logarithm of patent applications lagged by one year ($ln(Patent_apply)$) and the ratio of R&D expenditure to gross output ($R\&D_intensity$). Patent data are sourced from the Orbis Intellectual Property database, and R&D expenditures are obtained from the OECD ANBERD database. Columns (3) through (6) of Table 6 show that indirect exposure to sanctions significantly increases industry-level R&D intensity, while having no statistically significant effect on patent applications.

Taken together, increased exposure to sanctions leads to significant enhanced in self-sufficiency and R&D intensity at the industry level, while GDP does not exhibit

a statistically significant decline. These findings suggest that, unlike the Russian case, China reallocates resources toward innovation and import substitution under technology restrictions without incurring the efficiency losses typically associated with severe resource misallocation.

Table 6. Effects of Sanctions on the Performance of China's Industries

Dependent variable	(1) ln(GDP)	(2) Domestic value-added ratio	(3) ln(Patent_apply)	(4) R&D_intensity	(5) ln(Patent_apply)	(6) R&D_intensity
Sanc_number	0.0025	0.0010**				
	(0.0054)	(0.0004)				
Sanc_exposure_up			-0.0317	0.0015***		
			(0.0203)	(0.0002)		
Sanc_exposure_down					0.0017	0.0016***
					(0.0301)	(0.0002)
Controls	✓	✓	✓	✓	✓	✓
Industry FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
R-squared	0.9912	0.9851	0.9817	0.9642	0.9817	0.9669
No. of obs.	231	231	196	90	196	90

Notes: This table presents the effects of sanctions on the performance of China's industries. In column (1), the dependent variable is $ln(GDP)$, the logarithm of industry value added. In column (2), the dependent variable is *Domestic_value_added_ratio*, defined as the ratio of domestic value added in exports to GDP. In columns (3) and (5), the dependent variable is $ln(Patent_apply)$, the logarithm of patent applications lagged by one year. In columns (4) and (6), the dependent variable is *R&D_intensity*, defined as the ratio of R&D expenditure to gross output. The independent variable in columns (1) and (2) is *Sanc_number*, the number of sanctioned firms in the industry. In columns (3) through (6), the independent variables are weighted exposure indices capturing the extent to which an industry's upstream or downstream sectors are affected by sanctions, as defined in Equations 4 and 5. Controls include the logarithm of total output, the GVC participation index, and the revealed comparative advantage index. All specifications include industry and year fixed effects. Adjusted R-squared values are reported. Standard errors, clustered at the industry level, are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

5 Conclusion

The technological rivalry between the U.S. and China represents one of the defining geopolitical challenges of the current era. A primary instrument in this competition is the *Entity List*, which imposes targeted export controls on leading Chinese technology firms, restricting their access to frontier U.S. inputs. While these measures significantly disrupt the upstream supply chains of sanctioned firms, the targeted

entities exhibit notable operational resilience. This paper provides an explanation for this resilience. Using data on supply chain relationships and quarterly firm-level financial performance, we evaluate the effects of the *Entity List* on the domestic and global supply chains of sanctioned Chinese firms.

Our results show that suppliers exposed to downstream sanctions experience significant performance gains, with sales revenue increasing by 10.7% and gross profits by 13.6%. These gains are concentrated exclusively among domestic suppliers, reflecting an expansion of procurement within pre-existing relationships along the intensive margin. Along the extensive margin, new domestic suppliers are significantly more likely to form supply chain relationships with sanctioned firms. Together, these findings document a systematic trend toward supply chain localization.

We identify two complementary drivers of this localization. First, affected domestic suppliers significantly increase their R&D intensity and expand patent acquisitions from the U.S. and other tech-advanced countries, building the capability to produce substitutes for restricted inputs. Second, the Chinese government channels resources toward affected domestic suppliers through direct subsidies and equity investments via Government Guidance Funds. This state support does not appear to be driven by political favoritism toward SOEs or politically connected firms, but instead reflects a broad-based strategic effort to strengthen the domestic supply chain. Subsidies, in particular, translate into measurably higher R&D spending and patent purchases. At the industry level, greater sanction exposure leads to higher domestic input self-sufficiency and increased R&D intensity, with no discernible decline in GDP. In contrast to the resource misallocation documented in the Russian context, these findings suggest that China's policy response has not generated observable efficiency losses.

Our analysis carries broader implications. The results suggest that, rather than containing Chinese technological advancement, U.S. export controls may inadvertently accelerate the self-sufficiency of Chinese supply chains. The findings also illustrate how targeted industrial policies can support supply chain adjustment under technology restrictions, offering a perspective on the conditions under which state intervention can facilitate technological catch-up without generating severe distortions.

References

Acemoglu, D. and P. D. Azar (2020). Endogenous production networks. *Econometrica 88*(1), 33–82.

Aghion, P., J. Cai, M. Dewatripont, L. Du, A. Harrison, and P. Legros (2015). Industrial policy and competition. *American economic journal: macroeconomics 7*(4), 1–32.

Ahn, D. P. and R. D. Ludema (2020). The sword and the shield: The economics of targeted sanctions. *European Economic Review 130*, 103587.

Alfaro, L. and D. Chor (2023). Global supply chains: The looming "great reallocation". Technical report, National Bureau of Economic Research.

Amiti, M. and J. Konings (2007). Trade liberalization, intermediate inputs, and productivity: Evidence from indonesia. *American economic review 97*(5), 1611–1638.

Amiti, M., S. J. Redding, and D. E. Weinstein (2019). The impact of the 2018 tariffs on prices and welfare. *Journal of Economic Perspectives 33*(4), 187–210.

Antràs, P. and A. De Gortari (2020). On the geography of global value chains. *Econometrica 88*(4), 1553–1598.

Baker, A. C., D. F. Larcker, and C. C. Wang (2022). How much should we trust staggered difference-in-differences estimates? *Journal of Financial Economics 144*(2), 370–395.

Barrot, J.-N. and J. Sauvagnat (2016). Input specificity and the propagation of idiosyncratic shocks in production networks. *The Quarterly Journal of Economics 131*(3), 1543–1592.

Berman, H. J. and J. R. Garson (1967). United states export controls–past, present, and future. *Columbia Law Review 67*(5), 791–890.

Besedeš, T., S. Goldbach, and V. Nitsch (2021). Cheap talk? financial sanctions and non-financial firms. *European Economic Review 134*, 103688.

Boehm, C. E., A. Flaaen, and N. Pandalai-Nayar (2019). Input linkages and the transmission of shocks: Firm-level evidence from the 2011 tōhoku earthquake. *Review of Economics and Statistics 101*(1), 60–75.

Carvalho, V. M., M. Nirei, Y. U. Saito, and A. Tahbaz-Salehi (2021). Supply chain disruptions: Evidence from the great east japan earthquake. *The Quarterly Journal of Economics 136*(2), 1255–1321.

Cengiz, D., A. Dube, A. Lindner, and B. Zipperer (2019). The effect of minimum wages on low-wage jobs. *The Quarterly Journal of Economics 134*(3), 1405–1454.

Crosignani, M., L. Han, M. Macchiavelli, and A. F. Silva (2026). Securing technological leadership? the cost of export controls on firms. *Journal of Financial Economics 175*, 104192.

Crozet, M. and J. Hinz (2020). Friendly fire: The trade impact of the russia sanctions and counter-sanctions. *Economic policy 35*(101), 97–146.

Crozet, M., J. Hinz, A. Stammann, and J. Wanner (2021). Worth the pain? firms' exporting behaviour to countries under sanctions. *European Economic Review 134*, 103683.

De Chaisemartin, C. and X. d'Haultfoeuille (2020). Two-way fixed effects estimators with heterogeneous treatment effects. *American economic review 110*(9), 2964–2996.

De Souza, G., N. Hu, H. Li, and Y. Mei (2024). (trade) war and peace: How to impose international trade sanctions. *Journal of Monetary Economics 146*, 103572.

Duong, K. T., L. D. T. Huynh, A. D. B. Phan, and N. T. Vu (2024). From russia with love: International risk-sharing, sanctions, and firm investments. *Economics Letters 244*, 112005.

Faccio, M., R. W. Masulis, and J. J. McConnell (2006). Political connections and corporate bailouts. *The journal of Finance 61*(6), 2597–2635.

Fajgelbaum, P., P. Goldberg, P. Kennedy, A. Khandelwal, and D. Taglioni (2024). The us-china trade war and global reallocations. *American Economic Review: Insights 6*(2), 295–312.

Fajgelbaum, P. D., P. K. Goldberg, P. J. Kennedy, and A. K. Khandelwal (2020). The return to protectionism. *The Quarterly Journal of Economics 135*(1), 1–55.

Felbermayr, G., C. Syropoulos, E. Yalcin, and Y. V. Yotov (2025). On the heterogeneous effects of sanctions on trade. *Canadian Journal of Economics/Revue canadienne d'économique 58*(1), 247–280.

Freund, C., A. Mattoo, A. Mulabdic, and M. Ruta (2024). Is us trade policy reshaping global supply chains? *Journal of International Economics 152*, 104011.

Gofman, M., G. Segal, and Y. Wu (2020). Production networks and stock returns: The role of vertical creative destruction. *The Review of Financial Studies 33*(12), 5856–5905.

Goldberg, P. K., R. Juhász, N. J. Lane, G. L. Forte, and J. Thurk (2024). Industrial policy in the global semiconductor sector. Technical report, National Bureau of Economic Research.

Goldberg, P. K., A. K. Khandelwal, N. Pavcnik, and P. Topalova (2010). Imported intermediate inputs and domestic product growth: Evidence from india. *The Quarterly journal of economics 125*(4), 1727–1767.

Gopinath, G., P.-O. Gourinchas, A. F. Presbitero, and P. Topalova (2025). Changing global linkages: A new cold war? *Journal of International Economics 153*, 104042.

Görg, H., A. Jacobs, and S. Meuchelböck (2024). Who is to suffer? quantifying the impact of sanctions on german firms. *Journal of Economic Behavior & Organization 228*, 106767.

Guo, D., Y. Guo, and K. Jiang (2016). Government-subsidized r&d and firm innovation: Evidence from china. *Research policy 45*(6), 1129–1144.

Han, P., W. Jiang, and D. Mei (2024). Mapping us–china technology decoupling: Policies, innovation, and firm performance. *Management Science 70*(12), 8386–8413.

Huang, Y., C. Lin, S. Liu, and H. Tang (2023). Trade networks and firm value: Evidence from the us-china trade war. *Journal of International Economics 145*, 103811.

Jiang, L., Y. Lu, H. Song, and G. Zhang (2023). Responses of exporters to trade protectionism: Inferences from the us-china trade war. *Journal of International Economics 140*, 103687.

Juhász, R., N. Lane, and D. Rodrik (2024). The new economics of industrial policy. *Annual Review of Economics 16*(1), 213–242.

Kalouptsidi, M. (2018). Detection and impact of industrial subsidies: The case of chinese shipbuilding. *The Review of Economic Studies 85*(2), 1111–1158.

Li, H., Z. Li, Z. Park, Y. Wang, and J. Wu (2024). To comply or not to comply: Understanding neutral country supply chain responses to russian sanctions. *Available at SSRN 5031650*.

Li, J. (2024). Sanction busting via industry boosting: How china strategically counteracts us sanctions on chinese firms.

Liu, E. (2019). Industrial policies in production networks. *The Quarterly journal of economics 134*(4), 1883–1948.

Nigmatulina, D. (2023). Sanctions and misallocation. how sanctioned firms won and russia lost.

Peksen, D. and T. M. Peterson (2016). Sanctions and alternate markets: How trade and alliances affect the onset of economic coercion. *Political Research Quarterly 69*(1), 4–16.

Sun, L. and S. Abraham (2021). Estimating dynamic treatment effects in event studies with heterogeneous treatment effects. *Journal of econometrics 225*(2), 175–199.

Tyazhelnikov, V. and J. Romalis (2024). Russian counter-sanctions and smuggling: Forensics with structural gravity estimation. *Journal of International Economics 152*, 104014.

Wang, Z., S.-J. Wei, X. Yu, and K. Zhu (2017). Measures of participation in global value chains and global business cycles. Technical report, National Bureau of Economic Research.

Wei, Y., Y. Y. Ang, and N. Jia (2023). The promise and pitfalls of government guidance funds in china. *The China Quarterly 256*, 939–959.

Whang, C. (2019). Undermining the consensus-building and list-based standards in export controls: what the us export controls act means to the global export control regime. *Journal of International Economic Law 22*(4), 579–599.

6 Appendix

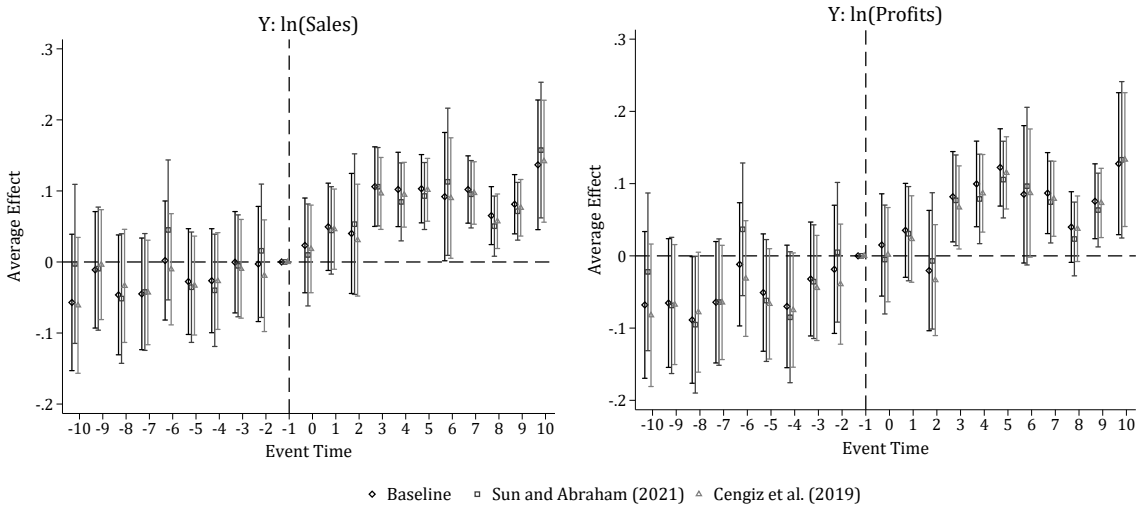


Figure A1. Event-Study Estimates Using Robust Estimators

Notes: This figure presents event-study estimates based on robust estimators. The left panel displays results with $ln(Sales)$ as the dependent variable, and the right panel displays results with $ln(Profits)$ as the dependent variable. We apply the weighted group-time estimator and the stacked estimator (Cengiz et al., 2019; Sun and Abraham, 2021). Vertical bars indicate 95% confidence intervals.

Table A1. Chinese Technology Firms on the *Entity List*

Firm name	Firm name
Firm name	Firm name
Anhui Quanta Communication Technology Co.,Ltd.	Inspur Group Co.,Ltd.
Beijing Kuangshi Technology Co., Ltd.	Kuang-Chi Technologies Co.,Ltd.
Beijing Liuhe BGI Co.,Ltd.	Kyland Technology Co., Ltd.
Beijing Sensetime Technology Development Co.,Ltd.	Leadway Technology Limited
Beijing UniStrong Science	Technology Co.,Ltd.
Loongson Technology Co.,Ltd.	
Cambricon Technologies Co.,Ltd.	Nanjing Guosheng Electronics Co.,Ltd.
Cethik Group Co.,Ltd.	Nanjing LES Information Technology Co.,Ltd.
Changsha Jingjia Microelectronics Co.,Ltd.	Qihoo 360 Technology Co.,Ltd.
China Electronics Technology Group Corporation 7th Research Institute	ROFS Microsystem (Tianjin) Co.,Ltd.

Continued from previous page

Firm name	Firm name
China Electronics Technology Group Corporation 14th Research Institute	Semiconductor Manufacturing International Corporation
China Electronics Technology Group Corporation 28nd Research Institute	Shaanxi Changling Electronic Technology Co.,Ltd.
China Electronics Technology Group Corporation 30th Research Institute	Shanghai Integrated Circuit Research Development Center Co.,Ltd.
China Electronics Technology Group Corporation 52nd Research Institute	Shanghai Microelectronics Equipment Co., Ltd.
China Electronics Technology Group Corporation 54th Research Institute	SJ Semiconductor Corporation
China New Era Group Limited	Suzhou Centec Communications Co.,Ltd.
CloudWalk Technology Co.,Ltd.	Suzhou Keda Technology Co., Ltd.
Dawning Information Industry Co.,Ltd.	Tanyuan Technology Co.,Ltd.
DJI Technology Co.,Ltd.	The 4th Paradigm Technology Co., Ltd.
FiberHome Technologies Group	Tiandy Technologies Co.,Ltd.
Fujian Jinhua Integrated Circuit Co.,Ltd.	Tianjin 764 Communication Navigation Technology Co.,Ltd.
Hangzhou Hikvision Digital Technology Co.,Ltd.	Tianjin Phytium Information Technology Co.,Ltd.
Hangzhou Hualan Microelectronics Corp	Tongfang NucTech Technology Co.,Ltd.
Hansen Technologies Limited	Tonghui Electronics Co.,Ltd.
Hebei Puxing Electronic Technology Co.,Ltd.	Wuhan Raycus Fiber Laser Technologies Co.,Ltd.
Hefei Bitland Optoelectronic Technology Co.,Ltd.	Xinhua San Semiconductor Technology Co.,Ltd.
Hengtong Optic-electric Co.,Ltd.	Xinjiang GCL New Energy Material Technology Co.,Ltd.
Hisilicon Optoelectronics Co.,Ltd.	Xinjiang Sailing Information Technology Co.,Ltd.
Huahai Zhihui Technology Co.,Ltd.	Yangtze Memory Technologies Co.,Ltd.
Huawei Technologies Co.,Ltd.	Zhejiang Hesheng Silicon Co.,Ltd.
Hunan Goke Microelectronics Co.,Ltd.	Zhejiang Dahua Technology Co.,Ltd.
Iflytek Co.,Ltd.	Zhongtian Technology Submarine Cable Co.,Ltd.

Notes: This table lists the sanctioned firms included in our sample. CETC-affiliated research institutes are included because many have undergone partial corporatization and have developed independent production capacities and supply chain linkages that distinguish them from purely academic institutions.

Table A2. Summary Statistics: Pre-Treatment Sample (2017q1)

Variable	Stat.	Treated	Control	Difference
ln(Sales)	Mean	11.0615	11.1498	-0.0883
	STD	1.5938	1.7674	(0.0914)
	Median	10.9484	11.0248	
	No. of obs.	362	2320	
ln(Profits)	Mean	9.7392	9.8139	-0.0746
	STD	1.5409	1.6781	(0.0891)
	Median	9.6044	9.6793	
	No. of obs.	355	2237	
ln(Assets)	Mean	13.0380	13.2502	-0.2122**
	STD	1.4474	1.5774	(0.0828)
	Median	13.0057	13.1037	
	No. of obs.	361	2328	
ROA	Mean	1.0015	0.8354	0.1662
	STD	2.4298	3.2057	(0.1440)
	Median	0.9200	0.9000	
	No. of obs.	361	2324	
L/A	Mean	0.3864	0.4488	-0.0624***
	STD	0.1947	0.2302	(0.0113)
	Median	0.3826	0.4431	
	No. of obs.	361	2328	
Intang	Mean	0.2881	0.2138	0.0743***
	STD	0.2734	0.2278	(0.0153)
	Median	0.1796	0.1301	
	No. of obs.	354	2202	

Notes: This table reports summary statistics for treated and control suppliers in 2017q1, including the mean, standard deviation, and median, alongside a test of differences between the two groups. $ln(Sales)$ is the logarithm of sales revenue; $ln(Profits)$ is the logarithm of gross profits; $ln(Assets)$ is the logarithm of total assets; ROA is the return on assets; L/A is the ratio of total liabilities to total assets; $Intang$ is the ratio of intangible assets to fixed assets. Robust standard errors are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A3. Summary Statistics: Sanctioned Firms and Supply Chain Partners

Variable	No. of firms	No. of obs.	Mean	SD	Median
Panel A: Sanctioned firms (listed)					
ln(Sales)	62 (32)	461	12.2305	2.0158	12.3103
ln(Profits)	62 (32)	458	11.3478	1.8274	11.4157
ln(Assets)	62 (32)	443	13.8340	1.3849	14.0615
ROA	62 (32)	461	1.3773	5.2669	1.0900
L/A	62 (32)	461	0.4020	0.2134	0.4195
Intang	62 (32)	455	0.2189	0.1734	0.1685
Panel B: Suppliers					
ln(Sales)	739	10829	11.7170	1.7137	11.6930
ln(Profits)	739	10545	10.5682	1.6534	10.4839
ln(Assets)	739	10853	13.2196	1.5545	13.1226
ROA	739	10837	1.8758	4.7555	1.6600
L/A	739	10842	0.4220	0.2122	0.4126
Intang	739	10402	0.2611	0.2614	0.1493
Panel C: Customers					
ln(Sales)	398	5704	12.1169	1.9840	12.1183
ln(Profits)	398	5388	10.8229	1.9983	10.7647
ln(Assets)	398	5726	13.3910	1.8390	13.2695
ROA	398	5720	1.6493	5.3096	1.5900
L/A	398	5706	0.5071	0.2359	0.5103
Intang	398	5410	0.3017	0.2817	0.1974

Notes: This table reports summary statistics for sanctioned firms and their supply chain partners over the full sample period (2017q1 to 2023q2). Panel A covers sanctioned firms, Panel B covers their suppliers, and Panel C covers their customers. The number of publicly listed sanctioned firms is reported in parentheses.

Table A4. Effects of Sanctions on Customer Performance

Dependent variable	(1) ln(Sales)^b	(2) ln(Profits)^b	(3) ln(Sales)^b	(4) ln(Profits)^b
Sanction^b	0.0226	0.0442	0.0702	0.0254
	(0.0405)	(0.0434)	(0.0657)	(0.0648)
Controls	✓	✓	✓	✓
Customer FE	✓	✓	✓	✓
Customer Country-Industry-Time FE			✓	✓
R-squared	0.9382	0.9192	0.9424	0.9227
No. of obs.	45587	44255	39538	38619

Notes: This table reports the effects of sanctions on customer performance. The dataset is organized at the customer-year quarter level, covering the period from 2017q1 to 2023q2. The treated group consists of customers of sanctioned firms, while the control group comprises customers of non-sanctioned Chinese peer firms. The dependent variables are the logarithm of sales revenue ($ln(Sales)^b$) in columns (1) and (3), and the logarithm of gross profits ($ln(Profits)^b$) in columns (2) and (4). $Sanction^b$ equals one starting from the first quarter in which an upstream firm of the customer is added to the *Entity List*, and zero otherwise. Controls follow Equation 1, constructed from the customer perspective. All reported R-squared values are adjusted R-squared. Standard errors, clustered at the customer level, are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A5. Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Peers in Focused Sectors as the Control Group		Post-2018 Sample		Inclusion of the Trade War Shock Variable		Pre-2022 Sample	
Dependent variable	ln(Sales)	ln(Profits)	ln(Sales)	ln(Profits)	ln(Sales)	ln(Profits)	ln(Sales)	ln(Profits)
Sanction	0.0954***	0.1235***	0.1204***	0.1418***	0.1035***	0.1273***	0.0975***	0.1164***
	(0.0322)	(0.0341)	(0.0320)	(0.0329)	(0.0286)	(0.0304)	(0.0264)	(0.0285)
Tradewar					-0.0062	0.0019		
					(0.0238)	(0.0264)		
Controls	✓	✓	✓	✓	✓	✓	✓	✓
Supplier FE	✓	✓	✓	✓	✓	✓	✓	✓
Supplier Country-Industry-Time FE	✓	✓	✓	✓	✓	✓	✓	✓
R-squared	0.9404	0.9156	0.9557	0.9346	0.9422	0.9194	0.9525	0.9316
No. of obs.	57714	56368	44326	43183	61248	59762	45146	44095

Notes: This table reports robustness checks for the baseline results. Columns (1) and (2) use suppliers of peer firms operating in the same core business sectors (contributing over 50% of revenue) as an alternative control group. Columns (3) and (4) restrict the sample to the post-2018 period. Columns (5) and (6) include a trade war shock indicator ($Tradewar$) using 2018 as a pseudo-policy onset. Columns (7) and (8) restrict the sample to the pre-2022 period. All other specifications follow Equation 1. All reported R-squared values are adjusted R-squared. Standard errors, clustered at the supplier level, are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A6. The Effects of Sanctions on the Sourcing Strategies of Domestic Suppliers

	(1)	(2)	(3)	(4)	(5)
Dependent variable	Share of suppliers from different countries				
Origin of supplier	China	U.S.	Tech-advanced	China-allied	U.S.-allied
Sanction	-0.0076	-0.0266	-0.0004	-0.0099	0.0177
	(0.0159)	(0.0221)	(0.0256)	(0.0078)	(0.0243)
Sanction $\times$**1**{China}	0.0855***	0.0288	-0.0101	0.0094	-0.0297
	(0.0305)	(0.0237)	(0.0294)	(0.0086)	(0.0282)
Controls	✓	✓	✓	✓	✓
Supplier FE	✓	✓	✓	✓	✓
Supplier Country-Industry-Time FE	✓	✓	✓	✓	✓
R-squared	0.4679	0.6477	0.6475	0.6288	0.6305
No. of obs.	58665	58665	58665	58665	58665

Notes: This table reports the effects of sanctions on the upstream sourcing strategies of affected domestic suppliers. The dependent variable in each column is the share of suppliers from China, the U.S., tech-advanced countries, China-allied countries, and U.S.-allied countries, respectively. **1**{China} is an indicator for whether the supplier is a Chinese firm. All other specifications follow Equation 1. All reported R-squared values are adjusted R-squared. Standard errors, clustered at the supplier level, are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A7. The Effects of Sanctions on Domestic Suppliers' Patent Purchases

	(1)	(2)	(3)	(4)
Dependent variable	No. of patents purchased from different countries			
Origin of seller	China	U.S.	Tech-advanced	U.S.-allied
Sanction	1.8863**	-0.9154**	0.1332	0.0283
	(0.7684)	(0.4630)	(0.3355)	(0.2741)
Sanction ×**1**{China}	-2.4224***	2.8755**	1.7345**	0.9744
	(0.7943)	(1.2664)	(0.8707)	(0.7515)
Controls	✓	✓	✓	✓
Supplier FE	✓	✓	✓	✓
Supplier Country-Industry-Time FE	✓	✓	✓	✓
R-squared	0.7147	0.8237	0.8792	0.8293
No. of obs.	42464	10937	13449	14154

Notes: This table reports the effects of sanctions on patent purchases by affected domestic suppliers, decomposed by the seller's country of origin. The dependent variable in each column is the number of patents purchased from China, the U.S., tech-advanced countries, and U.S.-allied countries, respectively. All estimates are based on the PPML method, and reported R-squared values are pseudo R-squared. **1**{China} is an indicator for whether the supplier is a Chinese firm. The result for China-allied countries is omitted due to insufficient observations. All other specifications follow Equation 1. Standard errors, clustered at the supplier level, are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A8. Heterogeneous Effects of Government Support by Political Ties

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	ln(Subsidy)	Gov_fund	ln(Subsidy)	Gov_fund	ln(Subsidy)	Gov_fund
Sanction	0.1445**	0.0086**	0.1561**	0.0093**	0.1483***	0.0087**
	(0.0591)	(0.0037)	(0.0607)	(0.0037)	(0.0543)	(0.0036)
Sanction ×**1**{SOE}	0.0548	-0.0071				
	(0.0905)	(0.0088)				
Sanction ×**1**{political-connected execs}			0.0106	-0.0115		
			(0.0828)	(0.0077)		
Sanction ×Gov_procure					0.0730	-0.0097
					(0.1142)	(0.0077)
Controls	✓	✓	✓	✓	✓	✓
Supplier FE	✓	✓	✓	✓	✓	✓
Supplier Country-Industry-Year FE	✓	✓	✓	✓	✓	✓
R-squared	0.7419	0.5571	0.7418	0.5572	0.7419	0.5571
No. of obs.	13141	25394	13141	25394	13141	25394

Notes: This table examines whether government support to domestic suppliers varies with political ties. $ln(Subsidy)$ is the logarithm of government subsidies. Gov_fund is an indicator equal to one if a supplier's equity is held by a Government Guidance Fund. **1**{SOE} is an indicator for state ownership as of 2017. **1**{political-connected execs} is an indicator for whether the supplier had executives with prior government experience as of 2017. *Gov_procure* is the number of government procurement contracts obtained before 2017. All other specifications follow Equation 1, with the time dimension adjusted to the annual level. All reported R-squared values are adjusted R-squared. Standard errors, clustered at the supplier level, are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$