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# Industrial Subsidies along Domestic Value Chains and Their Impacts on China's Exports[*]

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**Abstract**

China is now the world's largest exporter, with average export prices ranging from only 40% to 60% of those in other countries. This paper examines whether industrial subsidies can explain China's export performance and global competitiveness. Using firm-level subsidy data and inter-provincial input-output tables with firm ownership information, we measure both direct subsidies and indirect subsidies from upstream industries. Our analysis yields several key findings: (1) Direct subsidies significantly increase both Chinese firms' probability of exporting (extensive margin) and their export volume (intensive margin), with a larger effect on the intensive margin. (2) Notably, indirect subsidies (especially those from first-tier upstream industries) also play an important role in boosting exports. (3) Both domestic and foreign-invested firms benefit from direct subsidies, though the effects of upstream subsidies vary by firm ownership. (4) Contrary to expectations, subsidies do not lead to lower export prices. Instead, both direct and indirect subsidies are positively associated with product quality, thereby reducing quality-adjusted prices. The mechanism analysis suggests that export growth and quality upgrading are driven by (i) direct subsidies through increased R&D and imported inputs, and (ii) indirect subsidies through domestic intermediate inputs. Overall, the findings indicate that government support may promote quality upgrading and strengthen the global competitiveness of Chinese exporters.

Keywords: Industrial subsidies, export, value chains, quality upgrading

JEL classification: F10; F14



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"*China continues to provide massive subsidies to its domestic industries, which have caused injury to U.S. industries and the industries of other WTO Members. Some of these subsidies also appear to be prohibited under WTO rules.*"
— United States Trade Representative 2023 Report to Congress on China's WTO Compliance, February 2024.[1]

"*China's subsidy policies are strictly under WTO rules and have not caused market distortion or unfair competition.*"
—Vice-Minister of Finance Zou Jiayi, September 25, 2018.[2]

## 1. Introduction

In recent years, industrial subsidies have expanded significantly in China as well as in other major economies, including the United States, the European Union, and Japan. According to the Global Trade Alert (GTA) database, the number of subsidy measures implemented globally each year has more than tripled over the past decade.[3] The increasing use of subsidies by governments worldwide raises concerns about their effects on international trade. In particular, China's emergence as the world's largest exporting country has fueled intense debate over the nature and impact of its industrial and trade policies.

Can industrial subsidies explain China's export performance? To answer this question from a value chain perspective, we examine the impact of industrial subsidies on China's exports at both the firm level and the firm-product-destination level. Using a unique dataset on firm-level subsidies and a new type of China's inter-provincial input-output (IO) tables—which incorporate firm ownership information—we measure both direct subsidies to firms and indirect subsidies from their upstream sectors. While the literature has largely focused on direct subsidies, there is limited empirical evidence on the indirect effects of upstream government support on downstream firms. To the best of our knowledge, this is the first study to quantitatively assess the impact of both direct and indirect subsidies—through IO linkages—on exporting activity, using comprehensive firm-level trade data.

Industrial subsidies in China have increased dramatically, as shown in Figure 1. These subsidies refer to direct payments from central and local governments to the manufacturing, mining, and

[1] https://ustr.gov/about-us/policy-offices/press-office/press-releases/2024/february/ustr-releases-annual-report-chinas-wto-compliance
[2] https://english.www.gov.cn/news/video/2018/09/25/content_281476317804792.htm
[3] https://www.globaltradealert.org/

electricity/water/gas industries.[4] According to the Annual Survey of Industrial Firms (ASIF) conducted by the National Bureau of Statistics (NBS), total subsidies to industrial sectors rose from 28 billion RMB in 1998 to 145 billion in 2013.[5] Notably, there was a sharp acceleration in subsidy levels following the launch of the “Made in China 2025” program in 2015 and the onset of the US–China trade war in 2018. It is estimated that total industrial subsidies reached 562 billion RMB by 2022.

Panel (b) of the figure shows that China accounted for only 3.5 percent of the world’s total exports in 1998, but its share rose to 14.6 percent by 2022.[6] On average, China's export prices were significantly lower—only 40% to 60% of those in the rest of the world during 2000–2019. In the Appendix Table A1, using year–exporter–importer–product-level export data, we estimate China’s relative export unit value controlling for importer-year, product-year fixed effects and we find similar results.[7] Interestingly, the sharp decline in China’s relative export prices coincided with a rapid increase in its export share prior to 2007. However, between 2007 and 2015, China’s relative export prices rose significantly (before declining again after 2015), while its export share continued to expand. This suggests that low export prices alone cannot fully explain the competitiveness of Chinese exporters.

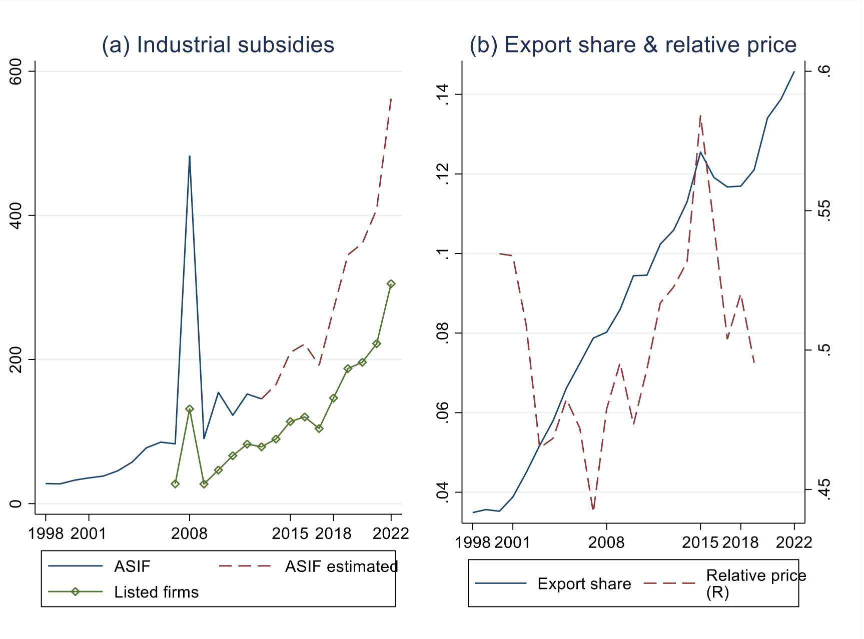
[4] To measure subsidies, we use two firm-level datasets: (i) the Annual Survey of Industrial Firms (ASIF, 1998-2013) collected by the National Bureau of Statistics (NBS) which will be described in details in Section 3.1 and (ii) the Chinese listed firms database (2007-2022) from WIND. As the information on subsidies is not available in the ASIF after 2013, we first aggregate these two datasets and calculate the subsidy share of listed firms in all industrial firms (listed firms and non-listed firms) during 2007-2013, then estimate the total amount of subsidies to the industrial sectors from 2014 to 2022. Listed firms accounted for approximately 30% to 50% of subsidies all industrial firms (listed firms plus non-listed firms).

[5] Subsidies surged in the 2008 global financial crisis (GFC). To minimize the impact of the GFC on the Chinese economy, the Chinese government implemented an economic stimulus program investing 4 trillion RMB in infrastructure and social welfare.

[6] According to the World Integrated Trade Solution (WITS) database, in 2022, China (14.6%), the U.S. (8.3%), Germany (6.3%), Japan (3.5%), and Korea Republic (3.2%) are the top five exporters.

[7] Using international comparable data from the Trade Unit Values (TUV) database, we calculate the simple average of China’s export prices relative to the rest of the world (ROW). The Trade Unit Values (TUV) database provides trade unit values (in USD/ton) at the year– reporter – partner–product level. Products categories correspond to the 6-digit Harmonized System nomenclature, which allows for international comparisons. Unit values are available either as reported by the exporter (FOB, without transport costs) or as reported by the importer (CIF). https://www.cepii.fr/CEPII/en/bdd_modele/bdd_modele_item.asp?id=2

**Figure 1. The Rise of China's Industrial Subsidies and Export**




*Note:* Subsidies are in billion RMB. Subsidies are direct government payments to manufacturing, mining, and electricity/water/gas industries. Export share is China's share in the world exports. China's relative price is China's export unit values divided by the rest of the world (ROW)'s export unit values. The unit values are in USD/ton by construction.
*Source:* Authors' compilation based on the ASIF, National Bureau of Statistics (NBS), WIND Chinese listed firms database, World Integrated Trade Solution (WITS) database, and Trade Unit values (TUV) database, CEPII.

Our empirical analysis utilizes an unbalanced panel dataset comprising over 3 million firm-year observations from 1998 to 2013, which includes rare information on industrial subsidies received by Chinese firms from either local or central governments. It is important to note that we do not consider export-specific subsidies, but rather general production-related subsidies—a distinction also emphasized by Girma et al. (2008). Importantly, we also employ a comprehensive import/export transaction dataset that provides detailed information on trade values and quantities. We find strong evidence that industrial subsidies significantly influence the export performance of Chinese firms. First, direct subsidies promote export activity at both the extensive and intensive margins, although the effect on the extensive margin is relatively smaller. Second, indirect subsidies—especially those originating from first-tier upstream industries—exert a large impact on trade margins. Third, while both domestic firms and foreign-invested enterprises benefit from direct subsidies, the effects of upstream subsidies vary by ownership type, suggesting a nuanced relationship between subsidies and export performance. Finally, both direct and indirect subsidies are associated with higher product quality, resulting in lower quality-adjusted prices. These gains in export growth and quality upgrading are driven by (i) direct subsidies through firm-level R&D and imported inputs, and (ii) indirect subsidies through intermediate inputs sourced from upstream industries.

In summary, subsidized firms are able to export larger volumes and command higher prices, primarily due to improvements in product quality. This dual impact—on both quantity and quality—underscores the potency of industrial subsidies as a tool for enhancing China's export competitiveness. By systematically examining the effects of subsidies along the value chain, our study provides robust, evidence-based insights for policymakers, industry stakeholders, and academic researchers. A deeper understanding of how subsidies shape international competitiveness is essential for informed policymaking and the pursuit of sustainable economic growth.

This study contributes to multiple strands of literature at the intersection of industrial policy, subsidies, international trade, and production networks. Our paper is closely related to the growing body of work examining the relationship between industrial subsidies and export outcomes. Rodrik (2006) highlights the prominent role of industrial policy in shaping China's export-oriented growth. Using firm-level data, Girma et al. (2008) find that production subsidies increase export volumes, though the effects vary by firm characteristics; their analysis, however, focuses solely on domestic firms. In contrast, Bernard and Jensen (2004) find no significant impact of U.S. state-level export promotion programs on plant-level export behavior. More recently, Rotunno and Ruta (2024) leverage a cross-country dataset to show that domestic subsidies generally raise both exports and imports, though these patterns are partly driven by selection bias, as governments tend to support export-oriented and import-competing products. While these studies offer important insights into the direct effects of subsidies, they largely overlook indirect effects through upstream production linkages. Our paper addresses this gap by systematically analyzing how subsidies propagate along domestic value chains and affect downstream firms' export behavior.

In doing so, our paper contributes to the literature on production networks and input–output linkages. Subsidies in upstream sectors can alleviate distortions—such as input price frictions, financial constraints, and resource misallocation—thereby generating positive spillovers. For example, Liu (2019) quantifies that such subsidies in upstream industries improve Chinese economy-wide efficiency by 4.8%. Blonigen (2016) explores how various industrial policies—including subsidies and state ownership—affect downstream exporters in the steel sector. Navarra

(2023), using U.S. federal subsidy data, shows that subsidies have positive spillover effects on indirectly connected downstream industries via input–output relationships. Our contribution lies in the construction of firm-level measures of upstream subsidies by combining rich microdata on subsidy receipts with detailed ownership-differentiated inter-provincial input–output tables (Chen et al., 2023). This allows us to isolate first-tier (direct upstream) and second-tier (indirect upstream) effects and to evaluate their impact on a broad set of export performance metrics, including extensive and intensive margins, export prices, and product quality, both at the firm level and the firm–product–destination level.

Our study also connects to a literature on industrial policy and firm competitiveness. Aghion et al. (2015) show that industrial policies targeting competitive sectors can enhance firm productivity. In the context of shipbuilding, Kalouptsidi (2018) and Barwick et al. (2025) find that China's subsidies in the 2000s reduced production costs and boosted investment and entry, helping China capture global market share from Japan and South Korea. On the other hand, Branstetter et al. (2023) suggest that China's rising wave of government subsidies may have had limited effects in enhancing the productivity of publicly listed firms, casting doubt on the overall efficiency of industrial policy. Similarly, Blonigen (2016) finds that U.S. steel subsidies reduce the export competitiveness of downstream manufacturing sectors. Building on this, we examine how subsidies affect quality upgrading, a key component of long-term competitiveness. By incorporating quality-adjusted prices into our analysis, we uncover welfare-enhancing effects for foreign consumers and importing firms—a novel dimension largely missing in earlier studies.

Finally, our study contributes to the broader literature on the design and consequences of industrial policy (see Juhász et al., 2023 for a review). Prior work has examined a range of instruments, including R&D subsidies (Hall and Van Reenen, 2000; Bloom et al., 2002), location-based subsidies (Neumark and Simpson, 2015; Criscuolo et al., 2019), and export promotion tools (Bernard and Jensen, 2004). To our knowledge, this is the first paper to comprehensively assess the effects of industrial subsidies along domestic value chains on trade performance, using firm-level and matched firm-product-destination data. Our use of detailed microdata and multi-tiered upstream subsidy measures provides an empirically grounded framework for evaluating the ripple effects of subsidies across interconnected sectors.

The remainder of this paper is organized as follows. Section 2 describes the data and variables. Section 3 reports the empirical results. Finally, section 4 concludes the study.

## 2. Data

### 2.1 Industrial Firms

Our primary dataset comes from the Annual Survey of Industrial Firms (ASIF), conducted by China's National Bureau of Statistics (NBS) from 1998 to 2013. The survey covers all state-owned enterprises (SOEs) and non-SOEs with annual sales exceeding RMB 5 million.[8] The term "industry" here includes the mining, manufacturing, and electricity/heat/water sectors. While our analysis focuses on manufacturing firms to assess export performance, we also use data on mining and electricity/heat/water firms to construct indirect upstream subsidies. This study requires precise information on both the industry classification and geographic location of the sample firms. Each firm is classified into a sector based on the 4-digit Chinese Industry Classification, and the dataset provides detailed address and regional code information for each firm.[9]

This dataset contains firm-level information on sales, export value, subsidies, the book value and net value of fixed assets, the number of employees, and wage bills—all of which are essential for this study. We deflate firm-level sales, exports, subsidies, and wage bills using two-digit industry-level output deflators from the *China Statistical Yearbook* compiled by the National Bureau of Statistics (NBS). One drawback of this dataset is that it does not directly provide capital investment information. Following Liu and Lu (2015), we infer investment from the book value of fixed assets, assuming a constant depreciation rate of 5 percent. During this process, we use the provincial fixed investment price index from the *China Statistical Yearbook* to realize investment and capital stock. In line with Brandt et al. (2012), we drop firms with missing, zero, or negative values for sales, fixed assets, or wage bills, since logarithmic transformations of these variables are undefined. We further exclude firms with fewer than eight employees, as they fall under a different legal regime. The dataset includes ownership information, allowing us to classify firms into three categories: SOEs, private domestic firms, and foreign-invested enterprises (FIEs), based on their registered firm type.[10]

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8 The threshold of sales increased to 20 million RMB after 2011.

9 However, in 2003, a new classification system for industry codes (GB/T 4754-2002) was adopted to replace the old classification system (GB/T 4754-1994). To make the industry codes comparable across the entire period, following Brandt et al. (2012), we use a harmonized classification that grouped some industries before and after the revision. During the sample period, however, the administrative boundaries and city codes experienced some changes. Using the 1999 National Standard (GB/T2260-1999) as the benchmark codes, we convert the city codes of all the firms into these benchmark codes to achieve consistency for the city codes in the whole sample period.

10 According to the Criteria for Classifications of the Registration of Enterprise Ownership Types issued by the NBS, only enterprises whose foreign capital accounts for no less than 25% of the total registered capital were eligible to be registered as foreign-invested enterprises.

ASIF contains unique information on subsidies, which is crucial for this study. According to NBS, subsidy refers to the government's regular payment of a fixed subsidy amount based on production volume, sales, etc., or the amount returned from collected value-added taxes. Subsidies can come from both local and central governments.[11] There is no information on direct export subsidies. These payments are considered production-related subsidies (Girma et al. 2008). However, it is unclear what exact purpose the payments were provided for or how firms used these subsidies. There are several reasons for governments to subsidize firms: industrial development, export promotion, supporting firms to innovate, and securing a national advantage in leading industries (WTO, 2006). It is worth mentioning that the subsidy information is not available in 2009, 2010, and 2012. In our analysis, we interpolate them by averaging subsidy amounts in 2007, 2011, and 2013.[12]

Table 1 presents the number of manufacturing firms, subsidized firms, exporters, and subsidized exporters in China from 1998 to 2013, based on ASIF data. The total number of firms increased substantially over the sample period, rising from approximately 140,849 in 1998 to over 285,000 by 2013. The number of subsidized firms and exporters also expanded over time, with the number of subsidized exporters growing from 3,490 in 1998 to 12,352 in 2013. While the share of subsidized firms remained relatively stable at around 10–16% in most years, there was a sharp spike in 2008, coinciding with the global financial crisis (GFC), when nearly 46% of firms received subsidies. Interestingly, although the exporter share remained steady at around 25% throughout the period, the proportion of exporters receiving subsidies nearly doubled—from 10% in 1998 to 24% in 2013—implying a growing reliance on public support among exporting firms. These trends underscore the increasing scale and strategic use of industrial subsidies in China's export-oriented growth model.

Appendix Table A2 presents the summary statistics of the ASIF dataset used in our analysis. The average subsidy amount is 322,000 RMB, with substantial variation across firms. Exporters and foreign-invested enterprises (FIEs) account for 25.4% and 20.2% of the total observations, respectively.

[11] Other than these direct payments from government, export rebate is a fiscal device for encouraging export. Since 2000, the government pays more than 100 billion RMB each year for export tax rebate. However, export rebate is not included in the definition of subsidy in Chinese government expenditure (Girma et al. 2008).

[12] We do not use 2008 data for interpolation as subsidies surged during the 2008 global financial crisis shown in Figure 1.

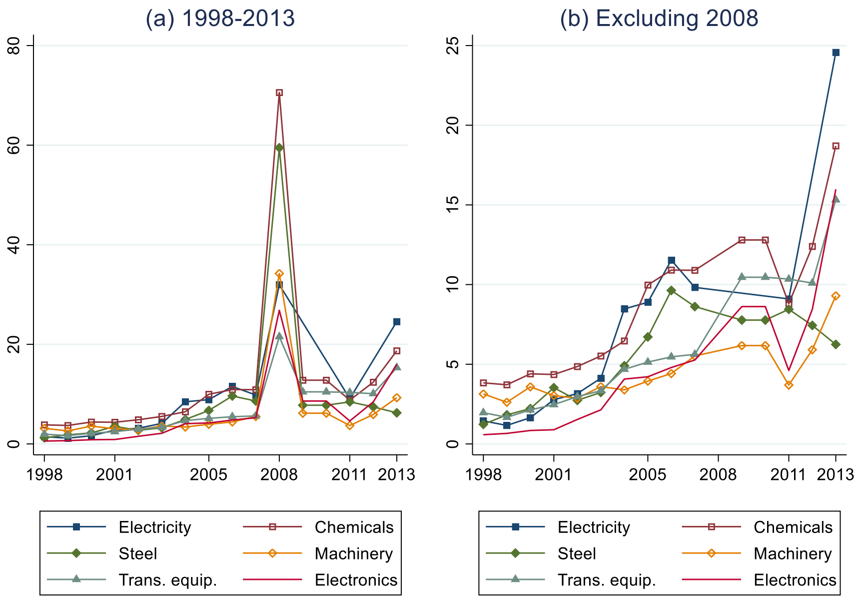
**Table 1. Presence of Subsidized Firms and Exporters**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| year | # of firms | # of subsidized firms | =(2)/(1) | # of exporters | =(4)/(1) | # of subsidized exporters | =(6)/(4) |
| 1998 | 140,849 | 13,542 | 0.10 | 34,797 | 0.25 | 3,490 | 0.10 |
| 1999 | 137,566 | 14,272 | 0.10 | 34,062 | 0.25 | 4,099 | 0.12 |
| 2000 | 139,074 | 15,144 | 0.11 | 36,556 | 0.26 | 4,911 | 0.13 |
| 2001 | 148,725 | 16,624 | 0.11 | 40,124 | 0.27 | 6,106 | 0.15 |
| 2002 | 159,544 | 19,832 | 0.12 | 44,641 | 0.28 | 7,748 | 0.17 |
| 2003 | 176,131 | 23,603 | 0.13 | 50,267 | 0.29 | 9,794 | 0.19 |
| 2004 | 247,411 | 36,404 | 0.15 | 75,198 | 0.30 | 15,852 | 0.21 |
| 2005 | 244,462 | 32,878 | 0.13 | 73,581 | 0.30 | 12,976 | 0.18 |
| 2006 | 274,339 | 35,741 | 0.13 | 77,779 | 0.28 | 13,965 | 0.18 |
| 2007 | 308,811 | 38,206 | 0.12 | 78,413 | 0.25 | 14,200 | 0.18 |
| 2008 | 380,718 | 175,363 | 0.46 | 87,562 | 0.23 | 56,070 | 0.64 |
| 2009 | 397,863 | 62,945 | 0.16 | 82,714 | 0.21 | 24,535 | 0.30 |
| 2010 | 315,508 | 62,726 | 0.20 | 92,017 | 0.29 | 24,391 | 0.27 |
| 2011 | 256,555 | 22,362 | 0.09 | 59,644 | 0.23 | 9,759 | 0.16 |
| 2012 | 275,857 | 36,234 | 0.13 | 62,689 | 0.23 | 16,064 | 0.26 |
| 2013 | 285,767 | 30,022 | 0.11 | 58,516 | 0.20 | 12,352 | 0.21 |
| Total | 3,889,180 | 635,898 | 0.16 | 988,560 | 0.25 | 236,312 | 0.24 |

*Source:* Authors' compilation based on the ASIF.

Figure 2 illustrates the trends in industrial subsidies across major sectors. In absolute terms, subsidies were highest in the electricity (25 billion RMB) and chemical (18 billion RMB) industries in 2013. As upstream industries, these sectors provide essential inputs to downstream manufacturing. The steel industry also received substantial subsidies prior to 2008, but these declined in the subsequent years—possibly reflecting efforts to curb overcapacity. In contrast, subsidies for transportation equipment and electronics industries rose significantly after 2008, reaching 15 billion RMB in 2013. This may indicate a strategic shift toward supporting high-tech industries.

**Figure 2. Industrial Subsidies in Major Industries**




*Note:* Subsidies are in billion RMB. Industry classification is based on 2002 China Input-Output Tables. *Source:* Authors' compilation based on the ASIF, NBS.

To better understand which types of firms are more likely to receive subsidies, Table [X] presents the results of an exploratory regression analysis where the dependent variable is a binary indicator for whether a firm received industrial subsidies. The analysis covers three periods: the full sample from 1998–2013 (column 1), a pre-2008 subsample (1998–2007, column 2), and a post-2008 subsample (2008–2013, column 3). Across all specifications, being an exporter is positively and significantly associated with a higher probability of receiving subsidies, with the marginal effect increasing from 5.7% before 2008 to 7.98% after 2008. This suggests that export-oriented firms are more likely to receive government support, especially in the post-financial crisis period. Lagged firm size (proxied by log sales) and firm age also have positive and statistically significant effects, implying that larger and more established firms are more likely to obtain subsidies. Notably, lagged profitability is positively correlated with subsidy receipt before 2008 but negatively associated afterward, possibly reflecting a shift in subsidy targeting toward less profitable firms during the economic slowdown. SOEs consistently exhibit a strong and positive correlation with subsidy receipt, highlighting preferential treatment toward SOEs. Interestingly, FIEs were less likely to receive subsidies before 2008 but more likely to do so after 2008, indicating a possible policy shift favoring foreign firms during the recovery period.

**Table 2. Determinants of Subsidy Receipt**

| | (1) | (2) | (3) |
|---|---|---|---|
| Sample | 1998-2013 | 1998-2007 | 2008-2013 |
| exporter dummy | 0.0691*** | 0.0573*** | 0.0798*** |
| | (0.000935) | (0.00115) | (0.00127) |
| lagged log sales | 0.0448*** | 0.0433*** | 0.0488*** |
| | (0.000347) | (0.000479) | (0.000404) |
| lagged profitability | 0.0312*** | 0.115*** | -0.0605*** |
| | (0.00397) | (0.00531) | (0.00526) |
| log age | 0.0191*** | 0.0123*** | 0.0255*** |
| | (0.000531) | (0.000657) | (0.000722) |
| SOE dummy | 0.0750*** | 0.0759*** | 0.0752*** |
| | (0.00199) | (0.00213) | (0.00429) |
| FIE dummy | -0.000954 | -0.0233*** | 0.0221*** |
| | (0.00103) | (0.00127) | (0.00135) |
| Province FE | Yes | Yes | Yes |
| Industry FE | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes |
| N | 2688082 | 1381620 | 1306462 |
| adj. R-sq | 0.159 | 0.077 | 0.232 |

*Note:* Dependent variable is subsidized firm dummy in all columns. Sales and firm age are in logarithm. Profitability is gross profits divided by sales. Standard errors are clustered at the firm level. Significance levels: * 0.10 ** 0.05 *** 0.01

### 2.2 Customs Data

The second data source is the census of annual export and import transactions of Chinese firms from 2000 to 2012, compiled by China's General Administration of Customs. This database records each firm's trade value, source of imports, destination of exports, and trade mode (i.e., processing or ordinary trade) at the Harmonized System (HS) 8-digit product level. Chinese customs data have been widely used in previous studies on trade activities and performance of Chinese firms. The data report free-on-board (FOB) export values in U.S. dollars and include traded quantities in one of 12 different units of measurement (e.g., kilograms, square meters), allowing researchers to construct unit values. Some firms in the dataset are pure trading companies that do not engage in manufacturing.[13] To ensure consistency over time, we aggregate the data to the HS 6-digit level using the concordance table provided by the UN Comtrade database.

[13] Following standard practice in the literature, we identify such intermediaries and wholesalers using keywords in firms' names and exclude them from our sample.

It is important to clarify the structure of our dataset for the analysis. To capture export participation and track each firm–product–destination combination from 2000 to 2012, we construct a squared panel dataset. For firm–product–destination pairs with no recorded exports in a given year, we assign a zero trade value. To keep the sample size within feasible computational limits, we exclude small trade partners whose total trade value falls within the bottom ten percent of China's total exports. We also exclude occasional exporters to mitigate issues related to export churning. Specifically, we retain only those firm–HS6–destination observations that recorded positive exports in at least three years during the 2000–2012 period.

Our analysis using the Chinese Customs data is conducted at the firm–product–destination–year level. We examine various aspects of exporting behavior and export performance:

(i) Export Entry (Extensive Margin): A binary indicator equal to one if a firm begins exporting a specific product to a specific destination in year $t$ but did not export the same in year $t-1$.

(ii) Export Value (Intensive Margin): The logarithm of export value for incumbent exporters.

(iii) Export Quantity (Intensive Margin): The logarithm of export quantity for incumbent exporters.

(iv) Export Price: The logarithm of unit value, calculated as export value divided by quantity.

(v) Product Quality: Estimated at the firm–product level following the methods of Khandelwal (2010) and Amiti and Khandelwal (2013), as described below.[14]

(vi) Quality-Adjusted Export Price: Defined as the difference between a firm's export price and its estimated product quality.

We estimate the effective quality—as it enters consumer's utility—of product $p$ exported to destination $d$ by firm $i$ in year $t$, using the following demand equation:

$$\ln(Quantity_{ipdt}) + \sigma \ln(Price_{ipdt}) = FE_p + FE_{dt} + \epsilon_{ipdt} \quad (1)$$

Then, the estimated product quality is given by $\ln(\widehat{Quality}_{ipdt}) = \hat{\epsilon}_{ipdt}$. Conditional on price,

[14] Product quality is not directly observable. In earlier studies, unit values—defined as the ratio of trade value to quantity for each product—have been commonly used as a proxy for quality (e.g., Schott, 2004; Hummels and Klenow, 2005). However, despite its simplicity, unit value can reflect factors other than quality. For example, higher prices may not indicate superior quality but rather result from elevated production costs. To address this limitation, Khandelwal (2010) introduced a novel approach to estimate product quality by incorporating both unit values and export quantities. In this framework, quality is defined as the unobserved characteristics of a product variety that lead consumers to purchase relatively large quantities despite higher prices.

a variety with higher demand (i.e., larger quantity sold) is interpreted as having higher quality. This approach captures the notion that consumers are willing to purchase greater quantities of a product even at relatively high prices if the product possesses desirable unobserved attributes. Keith and Ries (2001) show that the elasticity of substitution, $\sigma$, typically lies between 5 and 10. Following the literature (e.g., Manova and Yu, 2017), we set $\sigma = 5$ in our baseline specification, and our results remain robust to alternative values within this range. To further assess the welfare implications of subsidies for foreign consumers, we compute the *quality-adjusted export price*, defined as the difference between a firm's export price and the estimated product quality. This metric captures the price of exports after accounting for quality improvements driven by subsidies.

Finally, following Yu (2015), we match the Customs data with the ASIF data using firm name, telephone number, postal code, and address information. Summary statistics of the matched sample are reported in Table A3 of the Appendix. The average subsidy amount in this matched sample is 2.192 thousand RMB—substantially higher than that in the full ASIF dataset—reflecting the fact that the matched sample consists exclusively of relatively larger exporting firms.

### 2.3 Inter-Provincial Input-Output Table

The input–output (IO) tables employed in this study are developed by Chen et al. (2023). This dataset is particularly valuable because it incorporates ownership-specific information into China's inter-provincial IO framework, covering 42 sectors and 31 provinces for five benchmark years (1997, 2002, 2007, 2012, and 2017). The ownership classifications include firms owned by mainland China, Hong Kong-Macau-Taiwan, and other foreign entities. Leveraging this rich ownership-disaggregated IO data, we are able to analyze the effects of upstream subsidies on the export performance of downstream industries, while accounting for heterogeneity in ownership structures across sectors and regions.

Using inter-provincial IO tables and firm-level subsidy data, we construct subsidies (intensities) in 1st-tier and 2nd-tier upstream industries as follows:

$$Subsidy\_Up^1_{jor,t} = \sum_{ips} \frac{M^1_{jor,t}}{X_{jor,t}} \frac{M^1_{ips,jor,t}}{\sum_{ips} M^1_{ips,jor,t}} \cdot S_{ips,t} = \sum_{ips} \frac{M^1_{ips,jor,t}}{X_{jor,t}} \cdot S_{ips,t} \quad (2)$$

$$Subsidy\_Up^2_{jor,t} = Up_{jor,t} - Up^1_{jor,t} = \sum_{ips} \left( \frac{M_{ips,jor,t}}{X_{jor,t}} - \frac{M^1_{ips,jor,t}}{X_{jor,t}} \right) \cdot S_{ips,t} \quad (3)$$

We index sectors by $i$ and $j$, ownership types by $o$ and $p$, and provinces by $r$ and $s$. Specifically, the combination $(j,o,r)$ denotes the sector–ownership–province of the downstream (target) industry, while $(i,p,s)$ refers to the corresponding upstream sector. Time is indexed by $t$. We denote nominal value added and output by $V$and $X$, respectively. The inflow of intermediate goods from other provinces is represented by $M$. Additionally, $S$ indicates the amount of subsidies received, and $S/V$ captures subsidy intensity, measured as the ratio of subsidies to value added.

Sector $i$can serve as a 1st-tier upstream sector to sector $j$by supplying intermediate goods directly. Additionally, sector $i$can contribute 2nd-tier by supplying intermediate goods to other sectors that, in turn, supply sector $j$. These direct and indirect upstream relationships are comprehensively captured by the Leontief inverse matrix of the input-output (IO) table. To measure the direct upstream subsidy effect, we use the direct input coefficient, defined as: $\frac{M_{ips,jor,t}}{X_{jor,t}}$, where $M_{ips,jor,t}$ is the flow of intermediates from upstream sector $(i,p,s)$ to downstream sector $(j,o,r)$, and $X_{jor,t}$ is the total output of the downstream sector. This coefficient serves as the weight for computing the 1st-tier upstream subsidy exposure, denoted as $Up^1_{jor,t}$. The 2nd-tier upstream subsidy exposure, $Up^2_{jor,t}$, captures the additional, indirect effects from upstream sectors that do not supply directly to $j$ but are embedded in the production network. It is quantified as the gap between the Leontief input coefficient and the direct input coefficient. This formulation enables us to separate and quantify the distinct contributions of 1st-tier and all 2nd-tier upstream subsidies to downstream sector performance.

The mean subsidy intensity in 1st-tier and 2nd-tier upstream industries is 1.22 percent and 3.35 percent, respectively. These values are reasonable, as the 2nd-tier upstream category encompasses all upstream sectors excluding the immediate (direct) suppliers of the focal industry, thereby capturing a broader set of indirect subsidy channels.

### 2.4 Specification

We estimate the following equation to assess the direct and indirect effects of industrial subsidies on firm-level export outcomes:

$$y_{fjor,t} = \alpha + \beta_1 Subsidy_{fjor,t} + \beta_2 Subsidy\_Up^1_{jor,t} + \beta_3 Subsidy\_Up^2_{jor,t} + \gamma LP_{fjor,t} + FE_f + FE_t + \varepsilon_{fjor,t} \tag{4}$$

where the dependent variable $y_{fjor,t}$ represents either (i) an export participation dummy (extensive margin) or (ii) the logarithm of export value (intensive margin) for firm $f$ operating in sector $j$, with ownership type $o$, in province $r$, in year $t$. $Subsidy_{fjor,t}$ denotes the logarithm of direct subsidy received by the firm, capturing firm-level policy support. $Subsidy\_Up^1_{jor,t}$ measures subsidy intensity in 1st-tier upstream industries, quantifying the influence of direct input suppliers. $Subsidy\_Up^2_{jor,t}$ reflects subsidy intensity in all 2nd-tier upstream industries, capturing indirect effects via broader production networks. Since more productive firms are more likely to engage in export activities (Roberts and Tybout, 1997; Bernard and Jensen, 2004), we include labor productivity as a key control variable in our regressions.[15] We include firm fixed effects ($FE_f$) to control for time-invariant firm heterogeneity and year fixed effects ($FE_t$) to absorb macroeconomic shocks and policy changes common to all firms in a given year. α is a constant term and $\varepsilon_{fjor,t}$ is the error term.

Similarly, we estimate the impact of subsidies along the value chain on export outcomes at the firm–product–destination level using the matched ASIF–Customs data. Specifically, we estimate the following equation:

$$y_{fjor,pdt} = \alpha + \beta_1 Subsidy_{fjor,t} + \beta_2 Subsidy\_Up^1_{jor,t} + \beta_3 Subsidy\_Up^2_{jor,t} + \gamma LP_{fjor,t} + FE_f + FE_{pdt} + \varepsilon_{fjor,pdt} \quad (5)$$

In this specification, the dependent variable $y_{fjor,pdt}$denotes export performance—measured by entry, export value, quantity, price, or product quality—for firm $f$ (in sector $j$, with ownership $o$, located in province $r$) exporting product $p$ to destination $d$in year $t$. We include firm fixed effects ($FE_f$) to account for unobserved firm-specific heterogeneity, and three-way fixed effects ($FE_{pdt}$) to control for product–destination–year–level shocks, such as changes in tariffs, foreign demand conditions, or multilateral trade resistance (as emphasized by Head and Mayer, 2014).

As in the firm-level analysis, we expect positive and statistically significant coefficients on direct subsidies ($\beta_1$) and indirect subsidies from first- and second-tier upstream industries ($\beta_2$, $\beta_3$), reflecting their role in promoting export activity and performance through production networks.

## 3. Results

### 3.1 Subsidy and Trade Margins: Firm level

Table 3 presents the estimation results from equation (4). Columns (1)–(3) indicate that direct subsidies have a positive and statistically significant effect on firms' export participation.

[15] Instead of total factor productivity (TFP), we use labor productivity because the information on value-added and intermediate inputs is missing in the ASIF data after 2008. The results are quantitively similar using TFP for the period during 1998-2007.

However, the magnitude of this effect is relatively modest: A one standard deviation increase in direct subsidy raises the probability of exporting by 1.935×0.47%=0.91%, which is around 0.04% of the average export participation (25.4%). While the impact on the extensive margin is small, the results suggest that subsidies serve as a catalyst, nudging Chinese firms toward entry into international markets. Turning to the intensive margin, columns (4)–(6) show that direct subsidies are positively and significantly correlated with export volumes. A one standard deviation increase in direct subsidy raises the export value by 1.935×5.4%=10.4%, indicating that firms receiving government support substantially expand their export sales. These findings imply that industrial subsidies primarily promote firm-level exports through the intensive margin. Overall, our results are consistent with Girma et al. (2008), who also find that production-related subsidies enhance export performance, albeit using a different model specification and sample period.

**Table 3. Effects of Subsidies on Trade Margins: Firm Level**

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Dep. var. | exporter | exporter | exporter | exports | exports | exports |
| subsidy | 0.00476*** | 0.00473*** | 0.00471*** | 0.0542*** | 0.0540*** | 0.0538*** |
| | (0.000172) | (0.000172) | (0.000172) | (0.00162) | (0.00162) | (0.00162) |
| subsidy_up1 | | 0.307*** | 0.170*** | | 2.052*** | 1.305*** |
| | | (0.0232) | (0.0338) | | (0.192) | (0.289) |
| subsidy_up2 | | | 0.0877*** | | | 0.478*** |
| | | | (0.0154) | | | (0.136) |
| productivity | 0.0114*** | 0.0114*** | 0.0114*** | 0.215*** | 0.215*** | 0.215*** |
| | (0.000443) | (0.000443) | (0.000443) | (0.00410) | (0.00410) | (0.00410) |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 1853724 | 1853724 | 1853724 | 1853724 | 1853724 | 1853724 |
| adj. R-sq | 0.734 | 0.734 | 0.734 | 0.774 | 0.774 | 0.774 |

*Note:* Dependent variables are exporter dummy in columns (1)-(3) and log export value in columns (4)-(6), respectively. Sample is the ASIF during 1998–2007. Standard errors are clustered at the firm level. Significance levels: * 0.10 ** 0.05 *** 0.01

These findings can be interpreted through the lens of Arkolakis (2010), who develops a model in which firms incur market penetration costs—such as advertising expenses—when exporting. Importantly, these costs are not fixed; they increase with the number of foreign consumers a firm aims to reach. In this framework, even low-productivity firms may enter export markets but tend to sell only limited quantities due to their inability to bear high penetration costs. In contrast, highly productive firms can afford greater market access efforts and thus export larger volumes. Within this context, production-related subsidies are expected to have a relatively modest effect on the extensive margin (i.e., the decision to export) but a stronger effect on the intensive margin (i.e., the scale of exports). By alleviating cost constraints, subsidies enable existing exporters to shoulder greater market penetration expenses, thereby expanding their sales in foreign markets.

Interestingly, we also find positive and statistically significant effects of *indirect* subsidies, especially those in 1st-tier upstream industries, on both extensive margin (columns 1–3) and intensive margin (columns 4–6). Again, indirect subsidies promote firm-level exports through intensive margin but not extensive margin. A one standard deviation increase in 1st-tier upstream indirect subsidies increases the probability of downstream firms exporting by 0.25% (0.015× 17%) and raises their export value by approximately 1.95% (0.015×130%). Compared to 1st-tier upstream industries, the estimated coefficients for 2nd-tier upstream subsidies are smaller, though still positive and statistically significant. This pattern is intuitive, as the transmission of subsidy benefits along the value chain tends to attenuate with distance from the focal industry. Overall, these novel findings underscore the importance of subsidy spillover effects via production networks. Subsidies targeted at upstream sectors not only benefit immediate recipients but also amplify export performance downstream, contributing to broader export growth at the firm level. These effects highlight the role of input-output linkages in propagating policy impacts throughout the economy.

Given that subsidy data are interpolated for the years 2009, 2010, and 2012, our main analysis focuses on the 1998–2007 period. As a robustness check, we also estimate the model using the full ASIF 1998–2013 sample, reported in Appendix Table A4. The results remain consistent: both direct subsidies and 1st-tier upstream subsidies exert significant positive effects on export margins.

### 3.2 Subsidy and Trade Margins: Ownership

Foreign-invested enterprises (FIEs) accounted for approximately half of China's total exports during the 2000s. To explore potential heterogeneity in subsidy effects by ownership type, we divide our sample into domestic and foreign-owned firms and re-estimate the model separately. As shown in Table 4, direct subsidies significantly promote both the extensive and intensive margins of exports for both groups. The magnitudes of the effects are broadly comparable, suggesting that direct production-related subsidies benefit all firms regardless of ownership.

However, the indirect effects of upstream subsidies display meaningful variation across ownership types. For domestic firms, both 1st-tier and 2nd-tier upstream subsidies exert significant positive impacts on export performance. In contrast, for foreign firms, only the 2nd-tier indirect subsidies are statistically significant, while 1st-tier effects are negligible. This asymmetric pattern may reflect competitive dynamics in domestic input markets. Domestic firms may benefit more directly from local industrial policies and upstream linkages, while foreign firms—possibly reliant on imported inputs or operating more independently from domestic supplier networks—may be less integrated into the immediate upstream supply chains.

**Table 4. Effects of Subsidies on Trade Margins: Ownership**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Dep. var. | exporter | exporter | exports | exports |
| Sample | Demestic | Foreign | Domestic | Foreign |
| subsidy | 0.00430*** | 0.00492*** | 0.0475*** | 0.0622*** |
| | (0.000191) | (0.000377) | (0.00177) | (0.00368) |
| subsidy_up1 | 0.280*** | -0.601*** | 2.151*** | -5.762*** |
| | (0.0356) | (0.0975) | (0.300) | (0.892) |
| subsidy_up2 | 0.0755*** | 0.173*** | 0.421*** | 1.299*** |
| | (0.0163) | (0.0432) | (0.141) | (0.399) |
| productivity | 0.0102*** | 0.0168*** | 0.157*** | 0.508*** |
| | (0.000453) | (0.00129) | (0.00407) | (0.0124) |
| Firm FE | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes |
| N | 1454751 | 392118 | 1454751 | 392118 |
| adj. R-sq | 0.687 | 0.689 | 0.729 | 0.736 |

*Note:* Dependent variables are exporter dummy in columns (1)-(2) and log export value in columns (3)-(4), respectively. Sample is the ASIF during 1998–2007. Standard errors are clustered at the firm level. Significance levels: * 0.10 ** 0.05 *** 0.01

### 3.3 Subsidy and Trade Margins: Firm-Product-Destination Level

Using the matched ASIF-Customs dataset, we further examine the effects of subsidies on export outcomes at the firm–product–destination level. Table 5 presents the estimation results based on equation (5). In this context, the extensive margin is defined as the initiation of exporting a specific HS 6-digit product to a given destination country. For the intensive margin, we consider both export value and export quantity, enabled by the granularity of the customs data.

Controlling for firm productivity, firm fixed effects, and product–destination–year fixed effects, we find that the coefficients on direct subsidies are statistically significant across all outcome variables. The estimated impact of direct subsidies on the extensive margin (entry into new export markets) is smaller than the effects on the intensive margins (export value and quantity), mirroring the results from the firm-level analysis in Table 3. This reinforces the interpretation that subsidies are more effective in enhancing existing export activities rather than in inducing new product-market entries.

However, the results for indirect subsidies—those channeled through upstream industries—are generally insignificant or not robustly positive. This contrasts with our earlier firm-level findings, which showed clear positive effects of upstream subsidies on export margins. One possible explanation is that while upstream subsidies may help downstream firms by reducing input costs and enhancing production capacity, these benefits do not necessarily translate into expanded exports at the narrowly defined product–destination level. Such indirect benefits may be diffuse across products or markets, weakening their measurable impact in this more granular specification.

To validate the robustness of these findings, we repeat the analysis using an alternative sample covering the 2000–2012 period (Table A6 in the Appendix). The results are consistent: direct subsidies continue to exhibit positive and significant effects on export participation, value, and quantity, while the effects of upstream subsidies remain limited.

**Table 5. Effects of Subsidies on Trade Margins: Firm-Product-Destination Level**

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Dep. var. | entry | entry | value | value | quantity | quantity |
| subsidy | 0.00821*** | 0.00821*** | 0.0148*** | 0.0148*** | 0.0152*** | 0.0152*** |
| | (0.000180) | (0.000180) | (0.00124) | (0.00124) | (0.00127) | (0.00127) |
| subsidy_up1 | | -0.179*** | | 0.271 | | -0.0308 |
| | | (0.0394) | | (0.275) | | (0.278) |
| subsidy_up2 | | -0.0336* | | -0.221* | | -0.263** |
| | | (0.0174) | | (0.123) | | (0.125) |
| productivity | 0.0385*** | 0.0385*** | 0.171*** | 0.171*** | 0.145*** | 0.145*** |
| | (0.000611) | (0.000611) | (0.00422) | (0.00422) | (0.00424) | (0.00424) |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Destination-product-year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 5285013 | 5285013 | 1961268 | 1961268 | 1961268 | 1961268 |
| adj. R-sq | 0.369 | 0.369 | 0.621 | 0.621 | 0.740 | 0.740 |

*Note:* Dependent variables are entry dummy in columns (1)(2), log export value in columns (3)(4), and log export quantity in columns (5)(6), respectively. Sample is the ASIF-Customs matched data during 2000–2007. Standard errors are clustered at the firm level. Significance levels: * 0.10 ** 0.05 *** 0.01

### 3.4 Subsidy, Price, and Quality

Beyond the extensive and intensive margins, the matched ASIF–Customs data allows us to further investigate how industrial subsidies affect export prices and product quality of Chinese exporters. The estimation results are presented in Table 6.

Columns (1) and (2) show that the estimated coefficients on direct subsidies are negative but small and statistically insignificant, suggesting that direct subsidies to Chinese exporters do not significantly reduce export prices (unit values). Interestingly, indirect subsidies—particularly those from 1st-tier upstream industries—are positively and significantly associated with export prices. This finding is unexpected and runs counter to the conventional view that subsidies lower production costs and thereby lead to cheaper exports. These results echo the pattern observed in Figure 2 and imply that low export prices alone cannot explain China's export success.

Columns (3) and (4) indicate that both direct and indirect (1st-tier upstream) subsidies are positively and significantly associated with product quality, supporting the hypothesis that industrial subsidies facilitate quality upgrading. A one standard deviation increase in direct and 1st-tier upstream indirect subsidies increase the product quality of exporting firms by approximately 2.6% (=1.994×1.3%) and 2.1% (=0.014×147%), respectively. The magnitude of the quality effects is larger than that of the price effects, suggesting that subsidies help Chinese firms improve product sophistication and production efficiency, either through in-house investments or by leveraging improvements in their domestic supply chains.

In contrast to their effect on product quality, both direct and 1st-tier indirect subsidies are associated with negative and statistically significant coefficients on quality-adjusted export prices. A one standard deviation increase in direct and 1st-tier upstream indirect subsidies reduce the quality-adjusted export prices by approximately 2.6% (=1.994×-1.3%) and 1.6% (=0.014×-117%), respectively. This implies that, after controlling for product quality, the net price paid by foreign importers and consumers effectively declines. These results suggest that foreign consumers and importing firms benefit from China's industrial subsidies, as they receive higher-quality goods without paying more. For intermediate inputs, this implies that foreign downstream firms can access better-quality Chinese inputs without experiencing increased costs.

As a robustness check, we repeat the analysis using an alternative sample covering 2000–2012 (Table A7 in the Appendix). The results are consistent: direct and upstream subsidies promote quality upgrading and reduce quality-adjusted export prices, reinforcing our interpretation of the positive net welfare effects for foreign buyers.

**Table 6. Effects of Subsidies on Export Prices and Product Quality**

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Dep. var. | price | price | quality | quality | quality_adjused price | quality_adjused price |
| subsidy | -0.000419 | -0.000444 | 0.0131*** | 0.0130*** | -0.0135*** | -0.0135*** |
| | (0.000475) | (0.000475) | (0.00240) | (0.00240) | (0.00201) | (0.00201) |
| subsidy_up1 | | 0.302*** | | 1.477*** | | -1.175*** |
| | | (0.0862) | | (0.466) | | (0.399) |
| subsidy_up2 | | 0.0423 | | -0.0514 | | 0.0937 |
| | | (0.0388) | | (0.208) | | (0.178) |
| productivity | 0.0261*** | 0.0261*** | 0.276*** | 0.275*** | -0.249*** | -0.249*** |
| | (0.00149) | (0.00149) | (0.00784) | (0.00784) | (0.00662) | (0.00662) |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Destination-product-year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 1961268 | 1961268 | 1961268 | 1961268 | 1961268 | 1961268 |
| adj. R-sq | 0.922 | 0.922 | 0.738 | 0.738 | 0.754 | 0.754 |

*Note:* Dependent variables are log unit value in columns (1)(2), log product quality in columns (3)(4), and log quality-adjusted unit value in columns (5)(6), respectively. Sample is the ASIF-Customs matched data during 2000–2007. Standard errors are clustered at the firm level. Significance levels: * 0.10 ** 0.05 *** 0.01

### 3.5 Mechanism: Subsidy, R&D, and Intermediate Inputs

Recent literature has emphasized the critical role of firm-level technological upgrading in driving successful export performance (e.g., Liu and Lu, 2015). Building on our finding that industrial subsidies significantly promote product quality upgrading, we further explore the underlying mechanisms through which firms enhance product sophistication. Specifically, we investigate whether subsidies facilitate adjustments in the following firm-level activities: (i) R&D investment. The ASIF dataset includes information on firm-level R&D expenditure, enabling us to assess whether subsidized firms are more likely to invest in innovation activities that support quality improvement. (ii) Use of imported intermediate goods. We aggregate firm-product-source-level import transactions to construct the total value of imported intermediates at the firm level. Imported intermediate inputs may embody advanced foreign technology and know-how, contributing to product upgrading. (iii) Use of imported capital goods. Similarly, we construct firm-level measures of imported capital goods, which reflect investment in foreign machinery and equipment. These goods are typically associated with higher production efficiency and precision manufacturing.

To ensure data consistency and comparability, we focus on the period 2001–2010, during which all three outcome variables are available in the dataset. The classification of intermediate and capital goods follows the Broad Economic Categories (BEC) framework developed by UN Comtrade, which provides an internationally standardized approach to mapping traded products to their end uses. This classification allows us to reliably distinguish inputs used in current production from those intended to upgrade the production capacity itself. All import values are originally reported in thousands of USD and are converted into RMB to ensure consistency with the currency used in the ASIF dataset.

The estimation results are presented in Table 7. Columns (1) and (2) indicate that direct subsidies have a positive and statistically significant effect on R&D expenditure. A one standard deviation increase in direct subsidy raises the R&D investment by 1.935×4.1%=7.9%, indicating that firms receiving government support substantially expand their R&D activities. In contrast, subsidies to upstream industries are negatively associated with R&D spending by downstream firms. A plausible explanation is that when downstream firms can access high-quality and/or low-cost intermediate inputs from subsidized upstream suppliers, they may have less incentive to invest in their own R&D. Columns (3)–(6) show similar patterns for imports of intermediate and capital goods. Direct subsidies are positively correlated with the import of both types of goods, while upstream subsidies have limited or negative effects. A one standard deviation increase in direct subsidy raises the imported intermediate goods and capital goods by approximately 13.7% (=1.935×7.1%) and 9.1% (=1.935×4.7%), respectively.

These findings suggest a distinct mechanism: direct subsidies enhance export performance by encouraging firms to invest in R&D and acquire high-quality imported inputs. This enables firms to improve product quality and maintain competitiveness in the global market. In contrast, firms benefiting indirectly from subsidies in upstream sectors may rely on domestically sourced intermediate inputs, thereby improving export performance through domestic value chains rather than through their own investment in innovation. In sum, direct subsidies support firm-level upgrading through innovation and international sourcing, whereas indirect subsidies work through supply chain spillovers.

**Table 7. Effects of Subsidies on R&D and Intermediate Inputs**

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Dep. var. | R&D | | Imported intermediate goods | | Imported capital goods | |
| subsidy | 0.0408*** | 0.0408*** | 0.0715*** | 0.0716*** | 0.0473*** | 0.0474*** |
| | (0.00132) | (0.00132) | (0.00291) | (0.00291) | (0.00243) | (0.00243) |
| subsidy_up1 | | -0.639*** | | -1.787*** | | -0.661** |
| | | (0.167) | | (0.442) | | (0.333) |
| subsidy_up2 | | 0.0980 | | -0.0166 | | -0.191** |
| | | (0.0923) | | (0.112) | | (0.0769) |
| productivity | 0.0630*** | 0.0630*** | 0.245*** | 0.245*** | 0.120*** | 0.120*** |
| | (0.00247) | (0.00247) | (0.0102) | (0.0102) | (0.00722) | (0.00722) |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 1450524 | 1450524 | 885401 | 885401 | 885401 | 885401 |
| adj. R-sq | 0.600 | 0.600 | 0.659 | 0.659 | 0.516 | 0.516 |

*Note:* Dependent variables are log R&D expenditure in columns (1)(2), log imported intermediate goods in columns (3)(4), and log imported capital goods in columns (5)(6), respectively. Sample is the ASIF-Customs matched data during 2001–2010. Standard errors are clustered at the firm level. Significance levels: * 0.10 ** 0.05 *** 0.01

## 4. Concluding Remarks

Using a unique firm-level dataset on government subsidies, this paper investigates the impact of industrial subsidies—both direct and along domestic value chains—on the export performance of Chinese firms. The analysis provides robust evidence that direct subsidies significantly promote export participation (extensive margin) and especially export volume (intensive margin), with the latter effect being substantially larger. Strikingly, indirect subsidies to upstream industries also exert sizable effects on exports, though these effects vary by firm ownership. Moreover, both direct and upstream subsidies contribute to product quality upgrading while simultaneously reducing quality-adjusted export prices, indicating welfare gains for foreign buyers and consumers. These outcomes arise through distinct channels: direct subsidies stimulate R&D investment and the use of imported inputs, while indirect subsidies operate through domestic value chains by enhancing access to high-quality intermediate goods. Understanding these multifaceted effects of subsidies is crucial for policymakers, industry stakeholders, and researchers seeking to evaluate the broader implications of industrial policies for export growth. By uncovering the micro-level mechanisms behind China's export competitiveness, this study contributes to the ongoing debate on the role of state support in shaping global trade dynamics.

While our analysis provides robust evidence of the positive effects of industrial subsidies on export performance at both the firm level and the firm-product-destination level, we refrain from making normative claims regarding the overall desirability of such policies. Specifically, we do not assess whether these subsidies are beneficial or detrimental to foreign competitors in the global market. On one hand, foreign firms that rely on high-quality intermediate inputs from China may benefit from improved access to better and potentially cheaper inputs. On the other hand, foreign firms that compete directly with subsidized Chinese exporters may be disadvantaged. Moreover, we do not address the broader cost-benefit or welfare implications for the Chinese economy itself. As highlighted by Wei et al. (2017), subsidy misallocation is a serious issue in China, raising concerns about economic efficiency, rent-seeking behavior, and distortionary resource allocation. These complex questions—relating to international spillovers, global competitiveness, and domestic welfare trade-offs—require further theoretical modeling and empirical analysis.

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**Appendix: Additional Tables and Figures**

**Table A1. China's Relative Export Price**

| | (1) | (2) |
|---|---|---|
| Dep. var. | log Unit Value | log Unit Value |
| China dummy | -1.051*** | -1.048*** |
| | (0.012) | (0.011) |
| Product FE | Yes | No |
| Importer FE | Yes | No |
| Year FE | Yes | No |
| Importer-year FE | No | Yes |
| Product-year FE | No | Yes |
| N | 101602685 | 101602571 |
| R-sq | 0.662 | 0.671 |

*Note:* Dependent variable is log unit value of the export flow (in current USD / metric ton) in all columns. Sample period is 2000-2019. Standard errors are clustered at the importer-product level. Significance levels: * 0.10 ** 0.05 *** 0.01. *Source:* Authors' estimation based on the TUV database, CEPII.

**Table A2. Summary Statistics: ASIF**

| Variable | Obs | Mean | Std. dev. | Min | Max |
|---|---|---|---|---|---|
| exporter dummy | 3,889,180 | 0.254 | 0.435 | 0 | 1 |
| log exports | 3,889,180 | 2.414 | 4.241 | 0 | 19.044 |
| subsidy | 3,889,180 | 273 | 8,592 | 0 | 5,794,491 |
| log subsidy | 3,889,180 | 0.714 | 1.935 | 0 | 15.572 |
| subsidy_up1 | 3,889,180 | 0.012 | 0.015 | 0 | 0.798 |
| subsidy_up2 | 3,889,180 | 0.034 | 0.054 | 0 | 13.108 |
| log labor productivity | 3,811,397 | 5.400 | 1.037 | 2.400 | 8.217 |
| log sales | 3,811,459 | 10.310 | 1.315 | 6.709 | 14.152 |
| profitability | 3,810,007 | 0.036 | 0.085 | -0.534 | 0.397 |
| log firm age | 3,862,165 | 2.008 | 0.766 | 0.000 | 3.584 |
| SOE dummy | 3,889,180 | 0.060 | 0.237 | 0 | 1 |
| FIE dummy | 3,889,180 | 0.202 | 0.401 | 0 | 1 |

*Note:* Sample is the ASIF during 1998-2013. *Source:* Authors' compilation based on the ASIF.

**Table A3. Summary Statistics: ASIF-Customs Matched Data**

| Variable | Obs | Mean | Std. dev. | Min | Max |
|---|---|---|---|---|---|
| entry | 11,521,681 | 0.501 | 0.500 | 0 | 1 |
| log value | 5,768,464 | 3.458 | 2.377 | -3.079 | 8.761 |
| log quantity | 5,768,464 | 8.477 | 3.038 | 0.693 | 15.095 |
| log price | 5,768,464 | -5.031 | 2.021 | -9.536 | 2.473 |
| log quality | 5,768,464 | 1.333 | 5.179 | -13.491 | 17.439 |
| log quality adjusted pric | 5,768,464 | -6.369 | 4.573 | -18.585 | 7.197 |
| subsidy | 11,521,681 | 2,192 | 58,999 | 0 | 5,794,491 |
| log subsidy | 11,521,681 | 1.214 | 1.994 | 0.000 | 13.634 |
| subsidy_up1 | 11,521,681 | 0.012 | 0.014 | 0.000 | 0.798 |
| subsidy_up2 | 11,521,681 | 0.032 | 0.043 | 0.000 | 13.108 |
| log labor productivity | 11,521,681 | 3.532 | 0.988 | 1.485 | 6.442 |

*Note:* Sample is the ASIF-Customs matched data during 2000-2012. *Source:* Authors' compilation based on the ASIF and China Customs.

**Table A4. Effects of Subsidies on Trade Margins: Firm Level, 1998–2013**

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Dep. var. | exporter | exporter | exporter | exports | exports | exports |
| subsidy | 0.00454*** | 0.00452*** | 0.00452*** | 0.0496*** | 0.0495*** | 0.0495*** |
| | (0.000107) | (0.000107) | (0.000107) | (0.00103) | (0.00103) | (0.00103) |
| subsidy_up1 | | 0.159*** | 0.180*** | | 1.497*** | 1.444*** |
| | | (0.0153) | (0.0176) | | (0.128) | (0.146) |
| subsidy_up2 | | | -0.00989*** | | | 0.0253 |
| | | | (0.00335) | | | (0.0289) |
| productivity | 0.00556*** | 0.00556*** | 0.00556*** | 0.152*** | 0.152*** | 0.152*** |
| | (0.000317) | (0.000317) | (0.000317) | (0.00302) | (0.00302) | (0.00302) |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 3534556 | 3534556 | 3534556 | 3534556 | 3534556 | 3534556 |
| adj. R-sq | 0.733 | 0.733 | 0.733 | 0.768 | 0.768 | 0.768 |

*Note:* Dependent variables are exporter dummy in columns (1)-(3) and log export value in columns (4)-(6), respectively. Sample is the ASIF during 1998–2013. Standard errors are clustered at the firm level. Significance levels: * 0.10 ** 0.05 *** 0.01

**Table A5. Effects of Subsidies on Trade Margins: Ownership, 1998–2013**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Dep. var. | exporter | exporter | exports | exports |
| Sample | Demestic | Foreign | Domestic | Foreign |
| subsidy | 0.00413*** | 0.00456*** | 0.0440*** | 0.0584*** |
| | (0.000119) | (0.000237) | (0.00112) | (0.00236) |
| subsidy_up1 | 0.248*** | -0.191*** | 1.999*** | -1.825*** |
| | (0.0190) | (0.0468) | (0.156) | (0.434) |
| subsidy_up2 | -0.0127*** | 0.0192 | -0.0284 | 0.263** |
| | (0.00345) | (0.0129) | (0.0305) | (0.123) |
| productivity | 0.00468*** | 0.00860*** | 0.103*** | 0.390*** |
| | (0.000320) | (0.000945) | (0.00295) | (0.00935) |
| Firm FE | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes |
| N | 2802299 | 722941 | 2802299 | 722941 |
| adj. R-sq | 0.687 | 0.686 | 0.724 | 0.726 |

*Note:* Dependent variables are exporter dummy in columns (1)(2) and log export value in columns (3)(4), respectively. Sample is the ASIF during 1998–2013. Standard errors are clustered at the firm level. Significance levels: * 0.10 ** 0.05 *** 0.01

**Table A6. Effects of Subsidies on Trade Margins:**
**Firm-Product-Destination Level, 2000-2012**

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Dep. var. | entry | entry | value | value | quantity | quantity |
| subsidy | 0.0120*** | 0.0120*** | 0.0124*** | 0.0124*** | 0.0116*** | 0.0116*** |
| | (0.000127) | (0.000127) | (0.000644) | (0.000644) | (0.000659) | (0.000659) |
| subsidy_up1 | | -0.289*** | | 0.117 | | -0.158 |
| | | (0.0208) | | (0.104) | | (0.107) |
| subsidy_up2 | | 0.0221*** | | -0.0229 | | -0.00407 |
| | | (0.00606) | | (0.0269) | | (0.0284) |
| productivity | 0.0327*** | 0.0326*** | 0.103*** | 0.103*** | 0.0796*** | 0.0796*** |
| | (0.000400) | (0.000400) | (0.00212) | (0.00212) | (0.00217) | (0.00217) |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Destination-product-year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 10313270 | 10313270 | 4931475 | 4931475 | 4931475 | 4931475 |
| adj. R-sq | 0.211 | 0.211 | 0.644 | 0.644 | 0.758 | 0.758 |

*Note:* Dependent variables are entry dummy in columns (1)(2), log export value in columns (3)(4), and log export quantity in columns (5)(6), respectively. Sample is the ASIF-Customs matched data during 2000–2012. Standard errors are clustered at the firm level. Significance levels: * 0.10 ** 0.05 *** 0.01

**Table A7. Effects of Subsidies on Export Prices and Product Quality: Firm-Product-Destination Level, 2000-2012**

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Dep. var. | price | price | quality | quality | quality_adjused price | quality_adjused price |
| subsidy | 0.000848*** | 0.000856*** | 0.0158*** | 0.0158*** | -0.0150*** | -0.0150*** |
| | (0.000299) | (0.000300) | (0.00146) | (0.00146) | (0.00120) | (0.00120) |
| subsidy_up1 | | 0.275*** | | 1.219*** | | -0.944*** |
| | | (0.0408) | | (0.204) | | (0.170) |
| subsidy_up2 | | -0.0189* | | -0.0984** | | 0.0796* |
| | | (0.0102) | | (0.0497) | | (0.0415) |
| productivity | 0.0234*** | 0.0235*** | 0.197*** | 0.197*** | -0.173*** | -0.173*** |
| | (0.00100) | (0.00100) | (0.00489) | (0.00489) | (0.00400) | (0.00400) |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Destination-product-year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 4931475 | 4931475 | 4931475 | 4931475 | 4931475 | 4931475 |
| adj. R-sq | 0.906 | 0.906 | 0.703 | 0.703 | 0.730 | 0.730 |

*Note:* Dependent variables are log unit value in columns (1)(2), log product quality in columns (3)(4), and log quality-adjusted unit value in columns (5)(6), respectively. Sample is the ASIF-Customs matched data during 2000–2012. Standard errors are clustered at the firm level. Significance levels: * 0.10 ** 0.05 *** 0.01