The Effects of Subsidies Along Supply Chains

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Abstract

The increasing use of industrial policy by governments worldwide raises concerns about their trade implications. In this paper, I study the effects of US politically motivated subsidies on exports, both directly (in subsidised industries) and indirectly (in industries connected through domestic input-output linkages). To this end, I use a unique dataset on federal subsidies introduced by the United States since 2000. I first document a lack of transparency: despite multilateral trading rules, only a minority of these subsidies are notified to the WTO. To identify the causal effects of subsidies on exports, I exploit exogenous political shocks driven by changes in the identity swing states across electoral terms. Politically motivated subsidies foster exports in industries directly and indirectly exposed to them. Contrary to WTO case law, which typically associates indirect subsidies with price suppression, these subsidies increase producers and input prices. Additionally, they spur investment in subsidised industries and lead to productivity gains in vertically connected industries. This analysis contributes to the ongoing debate on reforming multilateral trading rules on subsidies by highlighting the need for greater transparency and a broader understanding of how subsidies spill over along supply chains.

Keywords: Corporate Subsidies, International Trade, Input-Output Linkages.
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1 Introduction

Industrial policy is on the rise, evolving amidst new global challenges, fragmented production, and geopolitical tensions (Juhász et al., 2023). Governments worldwide are increasingly providing financial assistance to businesses, raising concerns about the effects of subsidies on international trade. Most subsidies are not directly trade-related but target specific industries for a mix of economic, administrative, social, or political reasons. Nevertheless, all subsidies can, in principle, affect trade flows and generate trade distortions by selectively benefiting some firms in particular countries over others (World Bank, 2023).[1] Subsidies can also affect the export performance of vertically connected industries. For example, subsidising semiconductor producers may benefit manufacturers of electronic devices (downstream) and silicon suppliers (upstream).

These concerns are not new; they were raised during the Uruguay Round (1986-1993) that paved the way for the World Trade Organisation (WTO) when countries negotiated the Subsidies and Countervailing Measures Agreement (SCMA). The SCMA prohibits direct trade-related measures (export and local-content subsidies) and requires states to notify "specific" subsidies to the WTO (i.e., targeted to a firm, industry, or region). Notifications help countries become aware of these subsidies and eventually impose countervailing duties (CVDs) in case of competitive harm. Yet, various aspects of the SCMA have been criticised, with calls to reform it (e.g., Cosbey & Mavroidis, 2014; IMF, 2022).

In this paper, I empirically study the effects of politically motivated subsidies on exports, both direct (in subsidised industries) and indirect (in industries connected through domestic production linkages). Electoral motivations are strong determinants of subsidies (Evenett et al., 2024). My analysis leverages unique data on US federal subsidies available through the 1966 US Freedom Of Information Act (FOIA) and the 2007 Federal Funding Accountability and Transparency Act (FFATA).

I first document a lack of transparency: only a fraction of US federal subsidies are notified to the WTO. To identify the causal effects of politically motivated subsidies on exports, I exploit exogenous political shocks driven by changes in the identity of swing states across electoral

[1] Countries raised trade concerns about the US IRA, which grants \$369 bln for green investment, and the CHIPS & Science Act, which grants \$52.7 bln for investments in the semiconductor industry (Financial Times, 2023).

terms. The identification assumption is that expectations on swing states trigger subsidies that would not have occurred otherwise. I find that politically motivated subsidies foster exports (and employment) in industries directly and indirectly exposed to them. The positive supply chain effects stem from investment spillovers and productivity gains in vertically connected industries rather than input price suppression. My analysis contributes to the policy debate by advocating enhanced transparency in subsidy reporting to the WTO and a more comprehensive interpretation of how the effects of subsidies spill over supply chains.

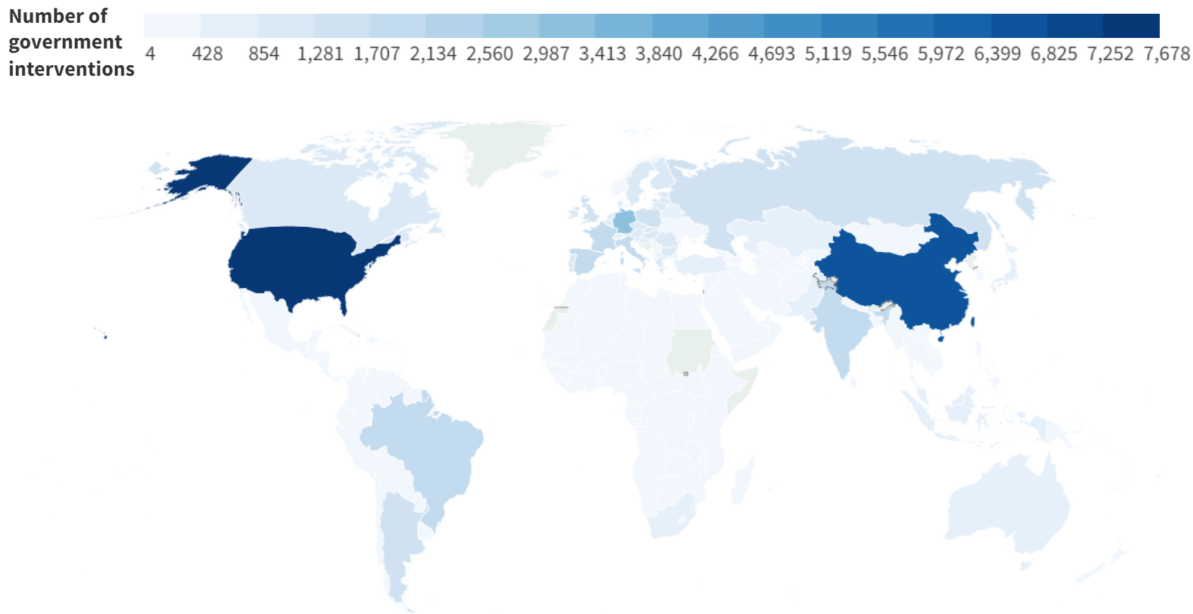
For my analysis, I use detailed data on US subsidies from the Subsidy Tracker, initially collected by Good Jobs First. The United States is the second-largest exporter globally and the second-largest user of subsidies after China (see Figure 1).[2] Between 2000 and 2020, US federal agencies provided 61 billion USD in federal grant subsidies and 18.7 trillion USD in federal insurance, loans and tax-exempt bonds. These contributions collectively accounted for 11% of the GDP during that period. When considering subsidies up to 2024, the total amount rises to approximately 56 trillion USD. One advantage of focusing on the US is the availability of federal data through the FOIA and the FFATA, which provide publicly accessible information. Leveraging these Acts, Good Jobs First has collected firm-level data, offering complete coverage of federal subsidies through the Subsidy Tracker database. I aggregate this data from the firm level to the 6-digit industry level. I focus on subsidies awarded between 2000 and 2020. These subsidies can come from grants, tax credits, and loans. Subsidy programmes have various official objectives (e.g., R&D, job creation, investment promotion, advanced technology programs). Export subsidies, prohibited by the SCMA, are rarely used. Combining these data with subsidy notifications to the WTO reveals that the United States only reports about 30% of its federal subsidies.

The link between subsidies and exports is complex. Hidden economic, political, or electoral motivations may influence subsidy recipients and the design of subsidy programs. Anecdotal evidence suggests that electoral motivations drive US federal policies.[3] Beyond the policy interest, studying politically motivated subsidies offers a methodological advantage: I can causally identify the effects of such subsidies through a shift-share instrument based on "swing-state" politics. The instrumental variable (IV), which builds on **Bown2024<empty citation>**, leverages po-

[2]The United States is also the most frequently accused country of violating WTO subsidy rules. US subsidies and the related CVDs have been contested 43 times (see Figure A.1).

[3]E.g., In 2024, Biden announced grants to retool factories for EVs in major swing states Morning Star (2024).

Figure 1: Number of Government Interventions by Awarding Country in 2008-2019



Note: According to The 28th Global Trade Alert (2021), the United States, China, Germany, India, the United Kingdom, France, and Italy award subsidies most frequently.
Source: Own construction based on The 28th Global Trade Alert (2021).

litical shocks driven by changes in the identity of swing states during election cycles and the industries' salience for voters, as measured by employment shares.

To explore the trade effects of subsidies along supply chains, I define variables for downstream and upstream exposure to subsidies using Input-Output (I-O) tables from the Bureau of Economic Analysis (BEA). I instrument these variables using indexes of downstream and upstream exposure to swing politics.

I find that politically motivated subsidies significantly boost exports in the recipient industries. Controlling for industry and time-fixed effects, a 1% increase in subsidies results in a 0.32% rise in exports. The increase in exports in directly subsidised industries outweighs the increase in output. Employment and imports also rise. These effects also extend along the supply chain as well: a 1% increase in subsidies to suppliers results in a 0.29% rise in exports downstream, while a 1% increase in subsidies to customers leads to a 0.09% increase in exports upstream.

Several mechanisms may explain why the effects of subsidies ripple through domestic supply chains, leading to higher exports upstream and downstream. Subsidies may lower production costs, resulting in cheaper inputs for downstream industries. If investment costs decrease, firms may invest in research and development (R&D) and create new products or enhance the quality of existing ones. Production may expand and generate economies of scale. To investigate the mechanisms behind the indirect positive effects of US federal subsidies on trade, I analyse the response of prices, investment, value-added and productivity to subsidies.

The WTO case law on subsidies and trade requires countries willing to impose a countervailing duty to prove indirect harm from (foreign) subsidies by showing that subsidies are passed through to prices. In other words, countries have to prove that foreign competitors benefit indirectly from upstream subsidies through reduced input prices (Grossman & Mavroidis, 2003; Shadikhodjaev, 2012). Moreover, the SCMA does not explicitly address spillovers to upstream industries. By contrast, I find that the effects of US federal subsidies transmit along supply chains in both directions and are not associated with price suppression. Subsidies stimulate investments without suppressing prices (most US federal subsidies explicitly mention investment promotion objectives) and enhance the recipient industries' value-added and productivity. These effects may explain why vertically connected industries benefit from subsidies from their suppliers and customers.

This paper contributes to the international trade and industrial policy literature by providing novel causal evidence of the effectiveness of subsidies in enhancing exports, both directly and indirectly through supply linkages. It contributes to the ongoing debate about reforming multilateral trading rules on subsidies by spotlighting two primary concerns within the current framework of the WTO. Firstly, it emphasises the importance of strengthening transparency in reporting, as only a small portion of US subsidies have been notified to the WTO. Secondly, it stresses the relevance of both supplier and buyer linkages in the transmission of industrial policies. Although the SCMA foresees indirect harm from input subsidies, it lacks clear guidance on substantiating subsidy pass-through, with the case law traditionally focusing on price suppression alone. This paper demonstrates that subsidy pass-through can manifest in both directions of the supply chain through investment spillovers and productivity gains. It suggests broadening the interpretation of spillover effects of subsidies along supply chains to accommodate mechanisms other than pass-through to price.

2 Literature Review

As subsidies attract attention across multiple domains, this paper contributes to various strands of the literature.

The first is a broad literature on subsidies and industrial policy (see Lane (2020), Bulfone (2023), and Juhász et al. (2023) for recent literature reviews). A considerable literature has investigated the effects of industrial policy along several macro and micro-economic dimensions, including aggregate growth (e.g., Pack, 2000; Manelici & Pantea, 2021), employment (e.g., Bernini & Pellegrini, 2011), R&D (e.g., Myers & Lanahan, 2022), and total factor productivity (TFP) (e.g., Beason & Weinstein, 1996; Lee, 1996; Aghion et al., 2015; Rotemberg, 2019). Harrison and Rodriguez-Clare (2019) provide a theoretical basis for industrial policy focusing on efficiency and welfare implications. Bloom et al. (2019) summarises the pros and cons of different industrial policy instruments for promoting innovation, finding that R&D tax credits and direct public funding are the most productive. Studies that provide causal evidence on the direct effects of subsidies leverage aspects of quasi-natural experiments in the context of specific policies. For example, Becker et al. (2010) and Criscuolo et al. (2019) exploited changes in the eligibility criteria, whereas Wolff and Reinthaler (2008) and Aguiar and Gagnepain (2017) used shocks to funding availability. This strand of the literature provides evidence that subsidies boost economic growth, sales, and employment (e.g., Becker et al., 2010; Criscuolo et al., 2019). Beyond traditional industrial policy, some studies have examined other forms of government spending. Particularly relevant to this paper are studies focused on the US context, which have analysed the effects of public procurement contracts (Hebous & Zimmermann, 2021) and green investments (Hasna, 2022). Most notably, Barattieri et al. (2023) estimates the impact of government spending along the supply chain using detailed US government procurement data. I contribute to this literature by providing novel causal evidence on the trade effects of subsidies.

A second, less developed strand of the literature explores the trade effects of subsidies, with a primary focus on export promotion policies and mainly in developing countries.[4] Munch and Schaur (2018) and Broocks and Van Biesebroeck (2017) document the positive impact of the Danish and Flemish export promotion policies on firms' export performance. Defever et al. (2020) and (Bao et al., 2017) find that Nepal's cash incentive scheme for exports and China's

[4]Few papers study the trade effects of production-related subsidies (e.g., Görg et al., 2008; Girma et al., 2020).

tax rebate on textile exports increased targeted product exports. Bernard and Jensen (2004), instead, find no significant effect of US state export promotion on the probability of exporting. However, in the context of the United States, the second-largest exporter in the world, export subsidies are only a tiny fraction of US subsidy policies. The contribution of this paper is to shed light on the trade effects of all types of US federal subsidies and on their transmission along supply chains.

In evaluating the supply chain effects of subsidies, this paper relates to the literature on I-O linkages. This stream of the literature examines the local market impact of vertically transmitted idiosyncratic shocks, such as natural disasters (**Carvalho**; e.g., Barrot & Sauvagnat, 2016), trade policies (**Bown2024**; e.g., Erbahar & Zi, 2017), and procurement (e.g., Cox et al., 2020; Barattieri et al., 2023). The literature has almost overlooked the relationship between subsidies and exports along value chains. Theoretically, Liu (2019) studies the transmission of industrial policies to vertically-related industries and its equilibrium effects on the aggregate economy. In the empirical literature, Blonigen (2016) analyses industrial policies (including export and production subsidies, government ownership, cartel arrangements, and non-tariff measures) targeting the steel sector. He documents that a one s.d. increase in industrial policy interventions is associated with a 3.6% decline in export competitiveness for downstream manufacturing industries. Moerenhout (2020), instead, studies explicitly fossil fuels subsidies, finding positive downstream trade effects by lowering the cost of production. Atalay et al. (2023) investigates the impact of a set of place-based policies on revenues, employment, and TFP along Turkish domestic production networks. Contributing to this fast-growing body of literature, this paper provides novel causal evidence of the positive trade effects of politically motivated subsidies along domestic supply chains in the United States.

Finally, this paper is also related to the literature on swing-state politics. Expanding upon the observation that electoral motives influence policy outcomes (e.g., Persson et al., 1997; Persson & Tabellini, 2004), this strand of the literature shows that US presidential candidates strategically direct their campaign resources towards swing states to optimise their likelihood of winning elections (e.g., Stromberg, 2008). This mechanism also leads to a bias in US trade policies favouring swing states (e.g., Muûls & Petropoulou, 2013; Conconi et al., 2017; Ma & McLaren, 2018). This paper empirically shows that the Electoral College system affects subsidy policies too.

3 Data and Variables

I process rich data for the United States by combining several sources of data, including detailed firm and industry-level information on subsidies from Subsidy Tracker, I-O tables from the BEA, industry-level exports from the United Nations Comtrade database, employment from the County Business Patterns (CBP) database of the US Census Bureau, industry price indexes from the US Bureau of Labor Statistics (BLS), and value-added, investment and productivity from the National Bureau of Economic Research (NBER). The following subsections provide a detailed description of the main data and variables used.

3.1 Federal Subsidies

Subsidies in the United States are granted by either the federal government and agencies or state and local governments and agencies. In this paper, I focus on federal subsidies awarded between 2000 and 2020. A federal subsidy is any financial contribution by a federal agency awarded to a firm engaged in an economic activity. Eligibility and selection criteria for federal subsidies vary depending on the awarding agency and the specific program. My main data source for subsidies is Subsidy Tracker. I supplement this database in two ways. First, I fill in some missing information on the firms' 6-digit industry codes using several external data sources. Second, I match the subsidy programmes from Subsidy Tracker to the subsidy notifications by the United States to the WTO under the SCMA.

Subsidy Tracker Subsidy Tracker is a search engine developed by the American nonprofit organisation Good Jobs First.[5] Among others, Subsidy Tracker has been used by Slattery and Zidar (2020) and Slattery (2023) for state subsidies. Leveraging the FOIA, Good Jobs First draws the data from government disclosures via reports and websites and direct data requests to government agencies (a large number of federal grant and loan entries come from the USASpending.gov website) and supplements it with corporate press releases, newspaper articles, and academic reports. Subsidy Tracker provides complete coverage of federal loan and grants

[5] Other existing datasets, although available at the cross-country level, have more limited coverage. For example, a dataset on industrial policies is the The 28th Global Trade Alert (2021) (see https://www.globaltradealert.org/). However, the dataset covers policies as of 2008, and it only records the changes (not stocks) in subsidy policies affecting trading partners.

data[6] from 2000 to the present.[7]

For each subsidy (or portion of a multi-year subsidy), the dataset reports extensive information on the recipient company, including the recipient company's and parent company's names, the headquarters (HQ) location, the physical address or the state of the subsidised firm (or plant), the 6-digit North American Industry Classification System (NAICS) code, and the coarser industry and sector classifications. The dataset also reports detailed information on the subsidy, namely the granting agency, the subsidy type, the award and disbursement years, the program's name (and the corresponding code used in the catalogue of federal domestic assistance), and the disbursed value (amounts below $1,000 are reported as zeros). For loans, bond financing, loan guarantees, and federal bailouts or venture capital, the dataset reports the face value, excluding repayment amounts. The allocation of federal resources can take several forms (see Table A.2).[8] After loans, grants are the most frequently-used instrument, but the largest subsidies, aside from loans, are granted in the form of tax credits (see Figure A.4). In this paper, I refer to federal subsidies as federal grants and federal tax credits. I also collect information on federal loans to create an alternative specification of subsidies.

Compustat I combine Subsidy Tracker with Compustat North America and Compustat Global, using a fuzzy matching algorithm based on the companies' names. Compustat is a comprehensive database, managed by S&P Global Market Intelligence, that provides detailed financial and market data on public companies, primarily sourced from SEC filings. The database includes data on income statements, balance sheets, cash flow statements, and firm-specific information such as sector of activity and address. The integrated dataset allows me to retrieve the 6-digit NAICS code of the subsidised firms when Subsidy Tracker does not provide it. Exploiting detailed information from Compustat, Figure A.5 presents some statistics on the subsample of subsidised firms in Compustat. On average, subsidised firms have 13 times higher sales, five times more capital, and employ over four times as many employees as non-subsidised firms (these differences are statistically significant at the 0.01 confidence level, as confirmed by t-tests for mean differences). The most extensive subsidy packages are awarded to major corporations, like

[6] Subsidy Tracker provides full coverage of federal grants, loans, loan guarantees, tax-exempted bonds, and insurance. However, the coverage might not be complete for federal tax credits, since the federal government does not disclose all recipients of tax-based subsidies.

[7] Some information is also collected for subsidies between 1990 and 2000, but not in a comprehensive way.

[8] As subsidies must involve transfers of public resources from a government agency, federal contracts are not included.

Wells Fargo Bank in financial services and Summit Texas Clean Energy LLC and SCS Energy California in the energy sector (see Table A.3).

Creation of the industry-level dataset I aggregate firm-level records from Subsidy Tracker to 6-digit NAICS industries. The 6-digit NAICS classification is very granular. For example, "Hydroelectric Power Generation" and "Fossil Fuel Electric Power Generation," belong to two distinct categories, NAICS code 221111 and 221112, respectively. I specify and standardise all data to the 6-digit NAICS 2002 nomenclature, using Census concordance tables and Autor et al. (2013) employment weights.[9] I focus on CBP industries for compatibility with the other datasets used in this analysis. Ultimately, the industry classification used in this paper includes 1,179 6-digit industry codes (i.e., 1,136 excluding public administration and voluntary associations).

Rarely is the 6-digit NAICS code directly available in Subsidy Tracker. The database reports the recipient firm's industry 6-digit NAICS code as stated in the original documents. Typically, this industry code corresponds to the firm's economic activity directly related to the subsidy. Therefore, if a firm operates under several 6-digit NAICS codes, Subsidy Tracker would report the code that most closely aligns with the subsidised project. For example, Archer-Daniels-Midland Company, a multinational firm in the food industry, has several industry codes reported by Subsidy Tracker, each corresponding to different subsidy schemes and activities of the company (e.g., 11150 - Corn Farming, and 424590 - Farm Product Raw Material Merchant Wholesalers). Whenever available, I rely on the industry code reported by Subsidy Tracker. If an entry does not have an industry code but the same company has another NAICS code reported in relation to a different programme, I use that industry code. The 6-digit NAICS codes reported by Subsidy Tracker are based on the year the subsidy was awarded. Consequently, the codes must be tracked over time, aligning them with the 2002 NAICS classification used in this paper.

The 6-digit NAICS code is not readily available for 68,473 companies (out of 73,159). I retrieve this missing information using several data sources. Firstly, I have matched Subsidy Tracker to Compustat North America and Compustat Global, using the recipient company's name (see the previous paragraph). Through a fuzzy matching algorithm (that I have also manually checked), I match 843 firms to Compustat (US and Global). As these NAICS codes are based on the

[9] Firms' industry codes, and therefore subsidies, are reported by Subsidy Tracker using the NAICS classification in place at the time of the subsidy. When the NAICS code is unavailable, I assign industry codes from Compustat.

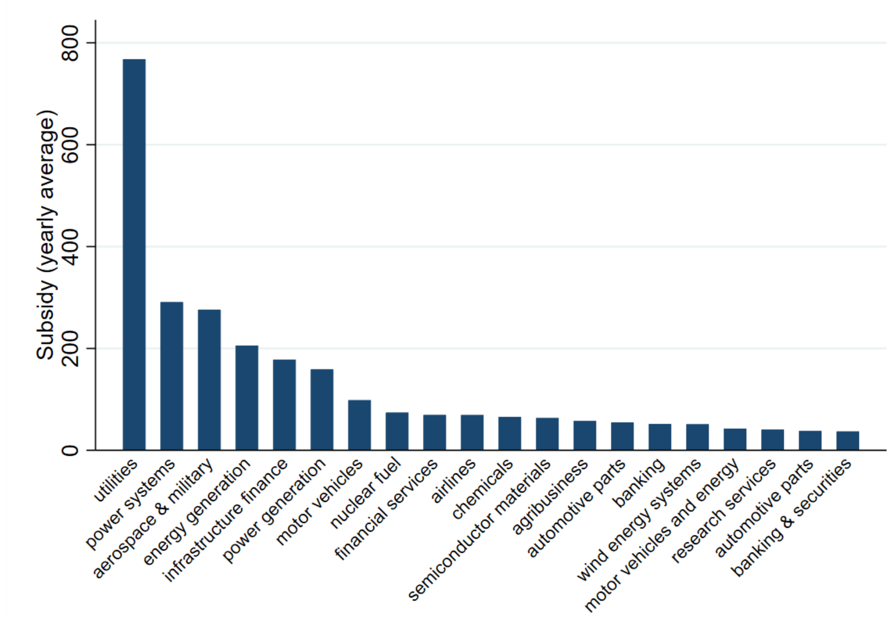
2017 classification, I concord them over time to the 2002 NAICS classification. Secondly, I have retrieved the original documents related to the federal subsidy programmes from the official Government Spending Open Data website (see USAspending.gov), retrieving information on the NAICS codes of 4,660 firms. As these 6-digit NAICS codes are reported using the 2022 NAICS classification, I concord them over time to the 2002 NAICS classification. To the remaining firms with missing information, I have manually assigned a 6-digit NAICS industry code. This assignment was based on the broad industry classification reported by Subsidy Tracker (which covers over 720 industries) and on corporate website descriptions. I have also refined the match using the NAICS Keyword search tool (available at: https://www.naics.com/search/).[10]

In Figure 2, I report the distribution of subsidies by broad industry code. From 2000 to 2020, the power generation industry received the largest subsidies, followed by power systems, aerospace, and military. The navigational instrument industry, apparel, and spring and wire products manufacturing had the highest portion of subsidies in gross output (see Figure A.6). To examine the distribution of subsidies along production networks, in Figure 3, I plot subsidies at the industry-year level of aggregation against the industry's upstreamness. Upstreamness is defined as the average distance of an industry from final use, as in Antràs et al. (2012). Subsidies extend throughout the entire supply chain, with many being in upstream industries. Within industries, subsidies cluster around a few firms, with an average of just 21 subsidised firms per industry (see Figure A.7).

Figure 4 and Table A.4 present some summary and descriptive statistics on federal subsidies granted to tradable and non-tradable industries. Tradable industries are industries for which I observe strictly positive exports (or imports) in at least one year of my sample. Non-tradable industries are industries that did not engage in exports or imports at any time during my sample period. On average, tradable industries received almost 1.6 million USD in federal subsidies per year between 2000 and 2020 (non-tradable industries 2.9 million USD), with considerable heterogeneity across industries. Subsidies followed a relatively stable trend up to 2008 and became more volatile, with peaks in 2010 and 2018. Subsidies to non-tradable industries experienced a notable increase during periods of high volatility.

[10]Details on the manual match are available upon request.

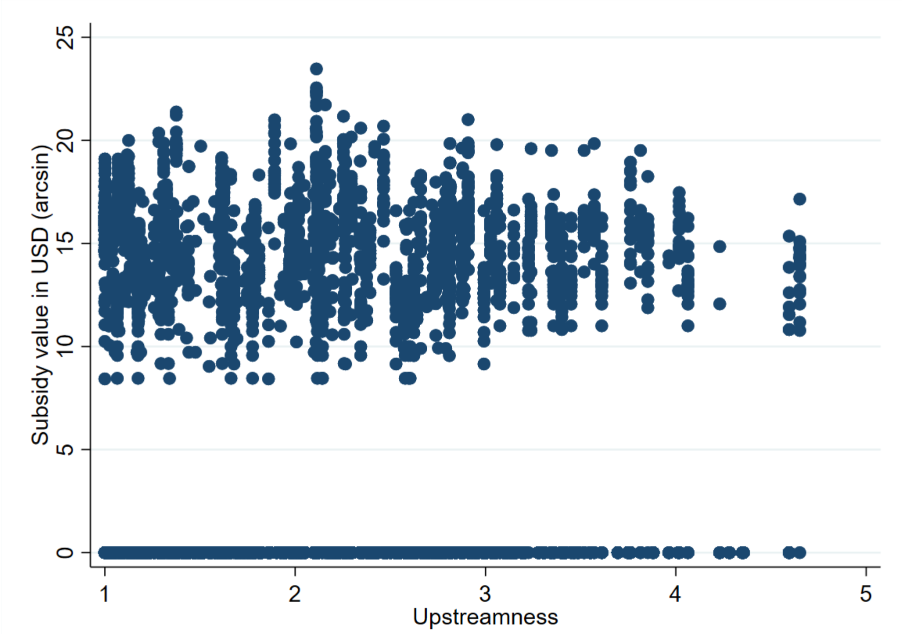
Figure 2: Top 20 Industries With the Highest Value of Subsidies, 2000-2020



Notes: Subsidies granted over one year to each industry (top 20 industries), average between 2000 and 2020. Subsidies include federal grants and federal tax credits and exclude loans. Industries are defined according to the coarser industry classification present in Subsidy Tracker, which entails 49 industries.

Subsidies' reporting to the WTO My second data contribution is to match subsidy programmes from Subsidy Tracker to WTO subsidy notifications, creating a novel dataset of US subsidy notifications to the WTO (see Appendix A.1). To this end, I use information on the subsidy's programme and type, as well as on the awarding authority. The match is done using a fuzzy matching algorithm and manual checks. First, I web-scraped all the subsidy notifications by the United States to the WTO using Python. Then, I applied Natural Language Processing (NLP) techniques to integrate the complete set of US subsidies available in Subsidy Tracker through the FOIA with the subsidy notifications submitted to the WTO. I merged subsidy programmes based on the similarity of their programme description, subsidy type, and granting authority. Comparing US subsidies to their notifications to the WTO, I document a lack of transparency in subsidy notifications to the WTO. Only a fraction (around 30%) of US federal subsidies have been reported to the WTO, namely the largest ones. Export subsidies, prohibited by the SCMA, are only a tiny fraction of these subsidies (see Figure A.3). The same transparency issue applies to state-level subsidies, with only 60% of programmes reported.

Figure 3: Subsidies Along Supply Chains, 2000-2020



Notes: The figure plots the total value of subsidies (USD) at the year-industry level (the value has been transformed using an inverse hyperbolic sine transformation to handle outliers) against the industry upstreamness. Upstreamness is defined as the average distance of an industry from final use, as computed by Antràs et al. (2012): 1 represents final goods and 5 raw materials. Subsidies include federal grants and federal tax credits and exclude loans.

Variables and descriptive statistics I define Direct subsidy exposure$_{j,t}$ of industry j in year t as the total value of subsidies granted to firms f belonging to the 6-digit NAICS industry j.

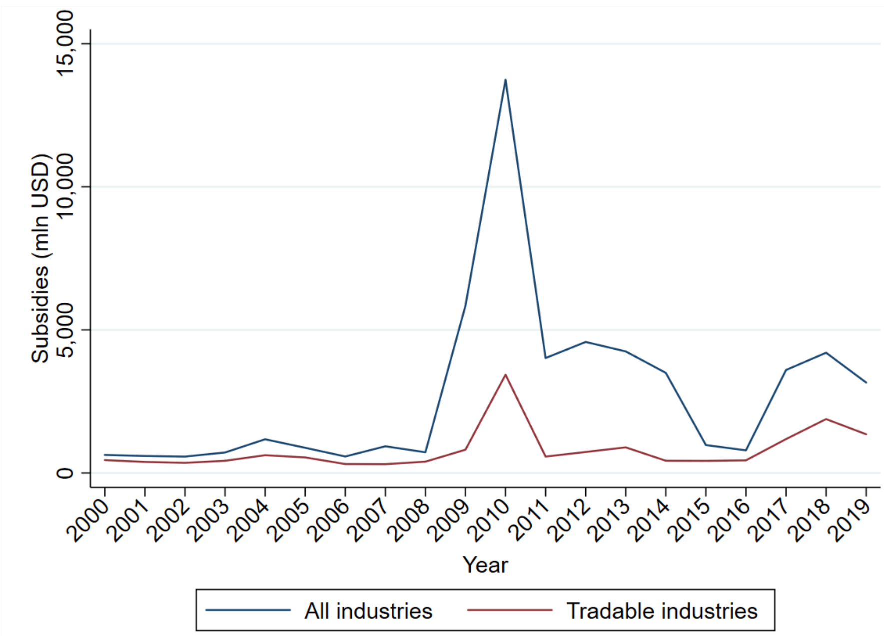
$$Direct\ subsidy\ exposure_{j,t} = \sum_{f \in j} Subsidy_{f,j,t}. \tag{1}$$

In an alternative specification, I use a definition of subsidies that also includes the face value of federal loans:

$$Direct\ subsidy\ and\ loan\ exposure_{j,t} = \sum_{f \in j} Subsidy_{f,j,t} + \sum_{f \in j} Face\ value_{f,j,t} \tag{2}$$

where Subsidy$_{f,j,t}$ represents the USD value of federal subsidies (i.e., federal grants and federal tax credits) and Face value$_{f,j,t}$ represents the USD face value of federal loans, federal loan

Figure 4: Total Subsidies Over Time, Tradable Industries 2000-2020



Notes: Industry-level federal subsidies, total and tradable industries only. Tradable industries are industries for which I observe strictly positive exports in at least one year of my sample. Non-tradable industries are industries that did not engage in exports at any time during my sample period. The peak in 2010 is due to subsidies to the utilities and power generation sectors (e.g., the Electricity Delivery and Energy Reliability, Research, Development and Analysis program; the Payments for Specified Energy Property (ARRA Section 1603 tax credit program), as well as subsidies to financial services and, to a lesser extent, to subsidies to the automotive sector.

guarantees, federal tax-exempted bonds, and federal insurances.

3.2 I-O Linkages and Indirect Subsidy Exposure

I now define indirect exposure to subsidies. Following Acemoglu et al. (2012)'s terminology, I define downstream subsidy exposure as the indirect exposure of customers of subsidised industries (i.e., customer shocks). On the other hand, I label upstream subsidy exposure as the indirect exposure of suppliers of subsidised industries (i.e., supplier shocks).

To construct the downstream and upstream subsidy exposure variables, I use I-O linkages. I measure industry linkages using the US national I-O tables from the BEA. I employ the "Use of Commodities by Industries after Redefinitions" tables from 2002, at the beginning of the sample, to guarantee the exogeneity of supply linkages (BEA, 2002). These I-O tables encompass 439 industries, classified at the 6-digit BEA industry level based on NAICS codes. I-O tables are extensively used in the literature (e.g., Acemoglu et al., 2009; Acemoglu et al., 2012; Alfaro et al., 2019) due to their high level of disaggregation. However, using I-O tables to track industry linkages requires making some assumptions. Firstly, the tables assume that production technologies and input requirements remain constant over the analysed period, facilitating a static representation of the economy. Second, the model assumes industry homogeneity, implying that all firms within an industry share a common production process. Finally, as a requirement of the technology assumption, industry byproduct coefficients are constant (i.e., an industry produces the same mix of goods regardless of production levels).

I harmonise industry codes using the BEA concordance tables. Firstly, I convert subsidies expressed in 6-digit NAICS codes into their equivalent 6-digit BEA industry codes. As the BEA industry codes are derived from NAICS, measurement error is minimised.[11] Then, I define direct requirement coefficients to track supplier and customer relationships up to the first tier of the supply chain. This emphasis on the first degree of the supply chain minimises the separation between inputs and outputs. In robustness checks, I incorporate higher-order linkages. Finally, I exclude the diagonal of the I-O matrix, which captures within-industry linkages. This exclusion helps to distinguish the indirect effect from the direct effect.

To define downstream subsidy exposure, I compute the cost share $w_{i,j}$ of input i in the production of j by dividing the commodity input by the total industry output. For every industry pair (i,j), $w_{i,j}$ provides the amount of the commodity i required to produce one dollar of the industry's output j (see Equation 3).

$$Downstream\ subsidy\ exposure_{j,t} = \sum_{i \neq j} w_{i,j} * Subsidy_{i,t}. \tag{3}$$

Downstream subsidy exposure$_{j,t}$ captures total subsidies granted in year t to each industry i (both tradable and non-tradable industries) that is upstream to industry j, excluding industry j. I identify upstream subsidy linkages for 1150 6-digit NAICS industries (out of 1179), 500 of which are tradable.

To define upstream subsidy exposure, instead, I compute the sales share $\theta_{k,j}$ of j that are used

[11] The BEA industry codes are coarser than 6-digit NAICS codes. While this approach poses no issues when using the NAICS to BEA concordance tables, it does require the establishment of weights when converting the data back to the NAICS classification.

as inputs in the production of k by dividing the commodity input j used in the production of the industry output k by its total sales. For every industry pair (k, j), $\theta_{k,j}$ represents the share of industry j's total sales used as inputs in the production of industry k (see Equation 4).

$$Upstream\ subsidy\ exposure_{j,t} = \sum_{k \neq j} \theta_{k,j} * Subsidy_{k,t}. \tag{4}$$

Upstream subsidy exposure$_{j,t}$ captures total subsidies granted in year t to each industry k (both tradable and non-tradable industries) that is downstream to industry j, excluding industry j. I identify downstream subsidy linkages for 1,125 6-digit NAICS industries (out of 1,179), 500 of which are tradable.

3.3 Other data

Trade Data on exports are sourced from the United Nations Comtrade database as reported by the World Integrated Trade Solution Platform (WITS). Using the Census concordance tables,[12] I harmonise the data over time, expressed using the 4-digit SIC classification (1987 edition), to the 6-digit NAICS 2002 classification. From Comtrade, I also retrieve data on both the value of exports, export prices,[13] and exported quantity, which is defined as units of quantity exported. I also use data on imports (value, USD).

I define Exports$_{j,t}$ as the total export value of the United States towards the rest of the world in year t of tradable industry j. I define tradable industries as industries with strictly positive exports for at least one year in the sample period (2000-2020).[14]

Gross output Sectoral output data is sourced from the BLS. In cases where gross output is not available at the 6-digit NAICS level, I allocate the production of a 4-digit industry equally among the corresponding 6-digit codes. I concord data over time to the 2002 NAICS nomenclature.

[12] Available at: https://www.census.gov/naics/?68967.

[13] In some robustness, I use the unit value of exports as estimated by Berthou and Emlinger (2011) from the Trade Unit Value Database, instead of export prices. The unit value of exports is a proxy for trade prices. Compared to other databases that estimate the unit value of exports, the Trade Unit Values dataset improves the differentiation of trade prices within product categories and reduces aggregation bias in estimating trade unit values at the 6-digit Harmonised System (HS) level of aggregation. I concord unit values data from the HS6 digit nomenclature to the 6-digit NAICS 2002 classification using the US HS-SIC/NAICS concordances tables by Pierce and Schott (2009) and Liao et al. (2020)'s concordance package.

[14] The dummy variable resulting from this definition of tradable industries exhibits a high correlation of 0.85 with the one based on Mian and Sufi (2014) classification (corr=0.85).

Employment The source for employment data is the CBP database, which tracks employment by county (and state) and industry from 1946 to date. I supplement this source with imputed employment data by Eckert et al. (2021), who developed a linear programming method to impute employment data suppressed in the CBP dataset for confidentiality reasons. I harmonise data over time to the NAICS 2002 nomenclature using Census concordance tables and Autor et al. (2013) employment weights. I exclude the 6-digit NAICS codes not covered by the CBP from the analysis.[15] The use of employment data in this paper is two-fold. Firstly, I use employment aggregated at the state-industry level for 2000 (at the beginning of the sample) to construct the employment shares used in the shift-share IV (Bartik, 1991). Secondly, I aggregate this data at the federal level for each year from 2000 to 2020 to analyse the direct and indirect effects of subsidies on employment.

Prices To explore the mechanisms through which the effects of subsidy are conveyed along supply chains, I study their impact on industry prices, sourced from the Producer Price Index (PPI) of the BLS. The PPI measures the average change over time (monthly) in the selling prices received by domestic producers for their output (excluding import prices) at the industry level.[16] I employ the Producer Price Index Revision - Current Series (PC) database of the BLS, which includes current indexes by industry defined according to the NAICS 2022 revision. The database covers most US industries (i.e., around 500 mining and manufacturing 6-digit industries and around 150 service industries), corresponding to approximately 69% of the service sector's output. I harmonise industries over time to the NAICS 2002 revision using Census concordance tables and Autor et al. (2013) weights. Combining the PPI database with I-O tables, I construct an index for the price of inputs of industry j, $Input\ prices_{j,t}$, as well as an index for the output prices of industry j's customers, $Customer\ prices_{j,t}$.

Investment, value-added, and productivity I use data on investment (total capital expenditure in USD), value-added (total value-added in USD), and productivity (4-factor TFP index) from the NBER-CES Manufacturing Industry Database. This database only covers manufacturing industries (364 six-digit 2012 NAICS industries) and years up to 2018. I harmonise

[15] The following industries are excluded from CBP: 111 (Crop Production), 112 (Animal Production), 482 (Rail Transportation), 491 (Postal Service), 5251 (Insurance and Employee Benefit Funds), 52592 (Trusts, Estates, and Agency Accounts), 6111 (Elementary and Secondary Schools-Only private schools are included), 6112 (Junior Colleges-Only private schools are included), 6113 (Colleges, Universities, and Professional Schools-Only private schools are included), 814 (Private Households), 92 (Public Administration).

[16] It differs from the Consumer Price Index (CPI), which measures price change from the purchaser's perspective.

industries over time to the NAICS 2002 revision using Census concordance tables and Autor et al. (2013) weights.

Electoral outcomes To construct the IV for politically motivated subsidies, whose exogenous variation is given by changes in the identity of states classified as swing in presidential elections, I use the vote outcomes of Democratic and Republican candidates from Atlas Election. I focus on five presidential elections, from 2004 to 2020. For the 2024 elections, I use electoral polls. Moreover, I use the number of electoral votes allocated to each state in 2000 (at the beginning of the sample) to determine the relevance of each swing state in presidential elections (see Figure A.10).

Trade protection I use the Temporary Trade Barriers (TTB) database of Bown et al. (2020) database to control for trade protection. I define Trade protection$_{j,t}$ as the average anti-dumping duty across all 6-digit HS products within a 6-digit NAICS industry j.[17] Combining information on anti-dumping duties and the BEA I-O tables and following the same approach used in Equations (3) and (4), I construct two additional variables: Downstream trade protection exposure$_{j,t}$ and Upstream trade protection exposure$_{j,t}$. Downstream trade protection exposure$_{j,t}$ is the weighted average of the duties imposed in year t to products in the industry i that is upstream to industry j. Upstream trade protection exposure$_{j,t}$ is the weighted average of the duties imposed in year t to products in industry i that is downstream to industry j. After mapping duties from the 6-digit HS nomenclature to SIC industry codes, I use the BEA I-O cost and usage shares converted by Acemoglu et al. (2009) to define downstream and upstream exposure to trade protection. Finally, I harmonise these variables from the 6-digit SIC code (1987 edition) nomenclature to 6-digit NAICS (2002 edition) industry codes, using Census concordance tables.

[17] The TTB database contains detailed information on the products covered by the AD, as identified by their 10-digit HS codes. To retrieve the Standard Industrial Classification (SIC4) industry (j) that includes this product, we harmonise data in the following way. First, HTS codes are first aggregated up to the universal 6-digit HS level. Each HS6 code is then matched with one or more 4-digit SIC codes using a crosswalk provided by Autor et al. (2013), with the aim of assigning each product to only one industry. The majority of observations are mapped using this correspondence table. However, if a product's HS6 code corresponds to multiple SIC4 codes, the one accounting for the largest share of US imports is chosen. Unmatched HS6 products are then mapped to SIC codes by aggregating information to the HS4 level. If a product's HS4 family maps to only one SIC4 industry, it is matched accordingly. Any remaining unmatched HS6 products are manually matched to corresponding SIC4 industries by retrieving information from the International Trade Commission (ITC) case descriptions. This process ensures that TTBD data is aligned with SIC4 classification, facilitating analysis and research on the impact of trade barriers on specific industries. Finally, I concord SIC codes to NAics, 6-digit, codes from the 2002 nomenclature.

Lobbying In some robustness checks, I include controls for industry-level lobbying. The US Lobbying Disclosure Act of 1995 requires individuals and associations to file quarterly reports specifying their lobbying activities. Lobbying reports, officially available in scannable pdf format from the website of the Senate's Office Public Records (SOPR), are made accessible from the LobbyView dataset by Kim (2008) in several formats. Using detailed information on the industry code of lobbying by US firms, as well as lobbying expenses (in USD) and timing of lobbying, I construct a variable capturing total lobbying expenditures (in USD) in the industry.

4 Identification Strategy

In this section, I explain the identification strategy to estimate the causal effects of politically motivated subsidies on exports directly and in industries connected through I-O linkages.

4.1 OLS Regressions and Endogeneity Bias

Even subsidies that are not directly trade-related can have a positive effect on trade. For subsidies that are politically motivated, the size of the effects is an empirical question. When looking at OLS correlations, federal subsidies are associated with larger exports of the subsidised industries and industries indirectly linked to them through supply linkages (see Table A.5). However, there are several reasons why OLS estimations may suffer from endogeneity. As pointed out by Lane (2020): "*Not only is randomisation unlikely, but also, by construction, industrial policies are meant to promote special industries, products, and places*" (Lane, 2020, p. 4). The design of subsidy policies may reflect, among others, government interests in addressing market imperfections, pursuing welfare objectives, catering to lobbying interests, or serving electoral political motives. The selection of the firms receiving these subsidies can also be swayed, for example, by lobbying or political considerations. These omitted variables are a source of endogeneity in OLS estimates.

The direction of the bias in OLS estimates, compared to the unbiased average treatment effect (ATE) of subsidies, varies depending on the unobserved motives behind policies. Politicians may employ subsidies to support declining or poorly performing industries, resulting in a negative bias in OLS estimates. In the absence of subsidies, these industries would perform worse than average. OLS estimates would also be negatively biased if subsidy policies aim to address negative externalities or encourage unprofitable investment in public goods. Conversely, if the government deploys subsidies to enhance the performance of strategic industries or those with high multiplier effects through subsidies, OLS estimates would be an upward bias. For politically motivated subsidies, the bias of OLS estimates is due to the government's incentive to subsidise industries that could garner more votes from swing states in presidential elections. If these industries are the ones experiencing declining growth trends or unobserved negative productivity shocks, OLS coefficients would be negatively biased (i.e., a lower-bound estimate). In this paper, I tackle the endogeneity issue stemming from unobservable political motivations of subsidies by employing an IV approach based on swing-state politics. The IV captures the effects of politically motivated subsidies. Hence, the coefficients resulting from the two-stage least squares (2SLS) regression can be interpreted as a Local Average Treatment Effect (LATE) (Imbens & Angrist, 1994; Imbens, 2010).[18]

4.2 Instrumental Variables

The IV approach used in this paper addresses the concern that subsidies may be driven by unobservable electoral and political motives. The identification is based on swing-state politics, in the spirit of **Bown2024<empty citation>**. As federal subsidies are given to industries (not to states), the IV exploits variation in the salience of industries in politically competitive states, measured in terms of employment. These states, often referred to as "swing" or "battleground" states, are states where the two major political parties (i.e., the Democratic Party and the Republican Party) have similar levels of voter support. Consequently, voters in these states wield significant influence over the outcomes of presidential elections.[19] The logic of the instrument is that variation in federal subsidies depends on the incumbent politician's pre-election incentive to support industries crucial for securing votes in swing states.

The instrument, IV^{Swing}, is constructed as a shift-share instrument (Bartik, 1991), exploiting exogenous variation arising from the impact of a set of state-level shocks (shifters) on industries that are differently exposed to them (shares). The identity of states as swing, which varies across electoral terms, drives the shocks. Exposure to these shocks depends on the industry's relative

[18]LATE estimates the average impact of an intervention on a specific subgroup rather than the entire population, recognizing that treatment effects can differ among various groups.

[19]In the US presidential election, citizens registered in each state vote for members of the Electoral College, who then cast electoral votes for president and vice president. The candidate who secures a majority of electoral votes (at least 270 out of 538) is elected. From this indirect election system, it follows that certain states carry more political significance than others. While candidates can count on some states as "safe," the most critical states are those in which no single candidate or party has overwhelming support.

importance in each state (as captured by initial employment shares).

Swing states I identify swing states in the last five presidential elections using the difference in vote shares of Democratic and Republican candidates in presidential elections at the end of the term.[20] The Swing state$_{s,T}$ dummy classifies a state s as swing during a presidential term T if the difference in the two candidates' vote shares in the presidential elections at the end of term T is less than 5%.[21] Variations in the identity of swing states across terms identify exogenous shocks in the $\text{IV}_{j,T}^{Swing}$ (shifters). In Figure 5, I indicate in pink the states classified as swing during the last five presidential terms and the current term.[22] Because states expected to be swing states in presidential elections, by definition, lack a clear majority favouring one party over the other, incumbent politicians tend to allocate federal resources and prioritise policies that cater to the interests of these states (e.g., Muûls & Petropoulou, 2013; Conconi et al., 2017; Ma & McLaren, 2018). *Politico* reported about the 2020 presidential elections: "Some states that may be competitive in November's election raked in millions in infrastructure grants awarded Wednesday by the Department of Transportation, while blue states like New York got comparatively little.[..] Arizona, Minnesota and North Carolina, all-important swing states, led the pack too, with over 10 per cent of the $1 billion haul among them" (*Politico*, 2020).

To empirically test whether subsidies are skewed towards swing states, I examine the geographical distribution of subsidy recipients. I leverage the richness and detail of the subsidy data, available at the level of the recipient firm. I aggregate subsidies at the term-state level, based on the HQ location of the recipient firms. Swing states host a greater number of recipient firms compared to others and attract the largest amounts of federal subsidies (see Figure A.9). Most notably, recipient firms are concentrated and more subsidised in swing states during that term (see Table A.7).

Electoral votes In the US electoral system, voters choose their state representatives who vote for the president. Each state appoints as many electors as its members in the congressional delegation (one for each Member in the House of Representatives and two Senators). These electoral votes are allocated among the states based on the Census. Depending on the number of

[20]I the baseline specification, I consider 2004, 2008, 2012, 2016, and 2020 elections. In an alternative specification, I also include the upcoming 2024 election, using election polls.

[21]This cutoff is the one used by other papers in the swing states literature (e.g., Conconi et al., 2017; Ma & McLaren, 2018)

[22]For example, Arizona was a swing state only in the fourth and fifth terms, ending with the 2016 and 2020 elections, respectively.

electoral votes, states (and swing states) may hold varying degrees of significance in presidential elections. For example, based on the 2000 Census, Texas was assigned 54 electoral votes, whereas Nevada only had 4 (see Figure A.10)). Hence, the intensity of the swing shifters depends on each state's importance during elections, which I measure using the number of electoral votes assigned to each state based on the 2000 Census at the beginning of the sample (EV_s^{2000}).

Employment shares Exposure to the shocks varies by industry, depending on their relative importance for voters within states. I define the relative importance of industries within states in terms of employment, as voters care about employment. I use initial employment shares ($\alpha_{s,j}^{2000}$) from 2000, which is the year at the beginning of the sample.[23] Fixing employment shares at the beginning of the sample dismisses reverse causality concerns (i.e., the fact that subsidies might influence the shares). Hence, the IV captures subsidies to industries with initially higher employment shares in swing states.

$$\alpha_{s,j}^{2000} = \frac{L_{s,j}^{2000}}{\sum_j L_{s,j}^{2000}}. \tag{5}$$

$\alpha_{s,j}^{2000}$ represents the 2000 share of employment in industry j in state s over total employment in both tradable and non-tradable industries in that state. $L_{s,j}^{2000}$ at the numerator measures employment in state s in 6-digit NAICS industry j in 2000 and the denominator represents total employment in state s in 2000.

IV$_{j,T}^{Swing}$ IV$_{j,T}^{Swing}$ is a Bartik (shift-share) instrument in which the shifters are determined by changes in the identity of swing states across electoral terms, weighted by the electoral votes assigned to them, and shares are employment shares from 2000 (see Equation 6).

$$IV_{j,T}^{Swing} = \sum_s \frac{L_{s,j}^{2000}}{\sum_j L_{s,j}^{2000}} * Swing\ state_{s,T} * EV_s^{2000}. \tag{6}$$

IV$_{j,T}^{Swing}$ is the weighted sum of the employment shares of industry j in states s that are swing during the electoral term T. Weights are given by the electoral votes assigned to state s based on

[23] The results would not change significantly by using data from earlier or later years, as the distribution of industries across states remains stable over time.

the 2000 Census, at the beginning of the sample. Electoral votes capture the different relevance of swing states in presidential elections.[24]

Downstream IV$_{j,T}^{Swing}$ When defining the shift-share IV for Downstream subsidy exposure-subsidy exposure$_{j,T}$, I employ an additional share, namely cost shares, $w_{i,j}$, computed from the I-O tables. Downstream exposure to political shocks depends on the cost share of input i in output j, with $i \neq j$. Downstream IV$_{j,T}^{Swing}$ can also be regarded as the weighted sum of the IVs in upstream industries:

$$Downstream\ IV_{j,T}^{Swing} = \sum_{i \neq j} w_{i,j} * IV_{i,T}^{Swing}. \tag{7}$$

Upstream IV$_{j,T}^{Swing}$ I construct the IV for upstream subsidy exposure using sales shares, $\theta_{k,j}$, computed from the I-O tables. Upstream exposure to the shocks depends on the sale share of the commodity input j used in producing the output of industry k, with $k \neq j$. Upstream IV$_{j,T}^{Swing}$ can also be regarded as the weighted sum of the IVs in downstream industries:

$$Upstream\ IV_{j,T}^{Swing} = \sum_{k \neq j} \theta_{k,j} * IV_{k,T}^{Swing}. \tag{8}$$

4.3 IV Assumptions

The identification strategy relies on the classic main assumptions of the IV approach, namely exogeneity (i.e., independence and exclusion restriction) and relevance, as well as the possible threats to these assumptions.

First, the IV must be independent, namely uncorrelated with the error term. The independence assumption requires first that the political shocks are exogenous: subsidies granted during a presidential term must not affect whether the difference in vote shares between the Democratic and Republican candidates at the end of the term is below the threshold (i.e., whether a state is swing or not). While there is no formal test for the exogeneity of an IV, in Table A.8, I provide some evidence that subsidies are not correlated with the 5% threshold for defining swing states.

[24] Differently from this paper, **Bown2024<empty citation>** use a non-linear transformation of the standard Bartik instrument to instrument trade protection and add an anti-dumping experience-specific shares.

There is no significant evidence that subsidies that have been granted to industries that are relevant in a state predict whether that state is swing or not. The coefficients are insignificant, indicating that whether a state is swing or not is independent of the subsidies that have been previously granted to its industries.

Second, the instrument must have no direct effect on exports (i.e., exclusion restriction). This hypothesis might be threatened if $\text{IV}_{j,T}^{Swing}$ picked up the effects of other federal policies than subsidies. Other than subsidies, the primary federal policy in the US is trade policy. Most notably, $\text{IV}_{j,T}^{Swing}$ might be correlated with trade protection (i.e., anti-dumping duties). To address this concern, in Table A.12, I control for the average anti-dumping duty imposed on all US imports (and imports of inputs) in the industry j. The independence and exclusion restrictions must also be satisfied for the second component of $\text{IV}_{j,T}^{Swing}$, namely employment shares. Using employment data from 2000, at the beginning of the sample, ensures the exogeneity of the employment shares.

Third, each instrument must be relevant in predicting the corresponding endogenous variable (i.e., Direct subsidy exposure$_{j,T}$, Downstream subsidy exposure$_{j,T}$, Upstream subsidy exposure$_{j,T}$). I test the relevance of each instrument (i.e., $\text{IV}_{j,T}^{Swing}$, Downstream $\text{IV}_{j,T}^{Swing}$, Upstream $\text{IV}_{j,T}^{Swing}$) separately by estimating Equations (9)-(11):

$$Direct\ subsidy\ exposure_{j,T} = \alpha + \beta\ IV_{j,T}^{Swing} + \delta_j + \delta_T + \epsilon_{j,T}, \tag{9}$$

$$Downstream\ subsidy\ exposure_{j,T} = \alpha + \beta\ Downstream\ IV_{j,T}^{Swing} + \delta_j + \delta_T + \epsilon_{j,T}, \tag{10}$$

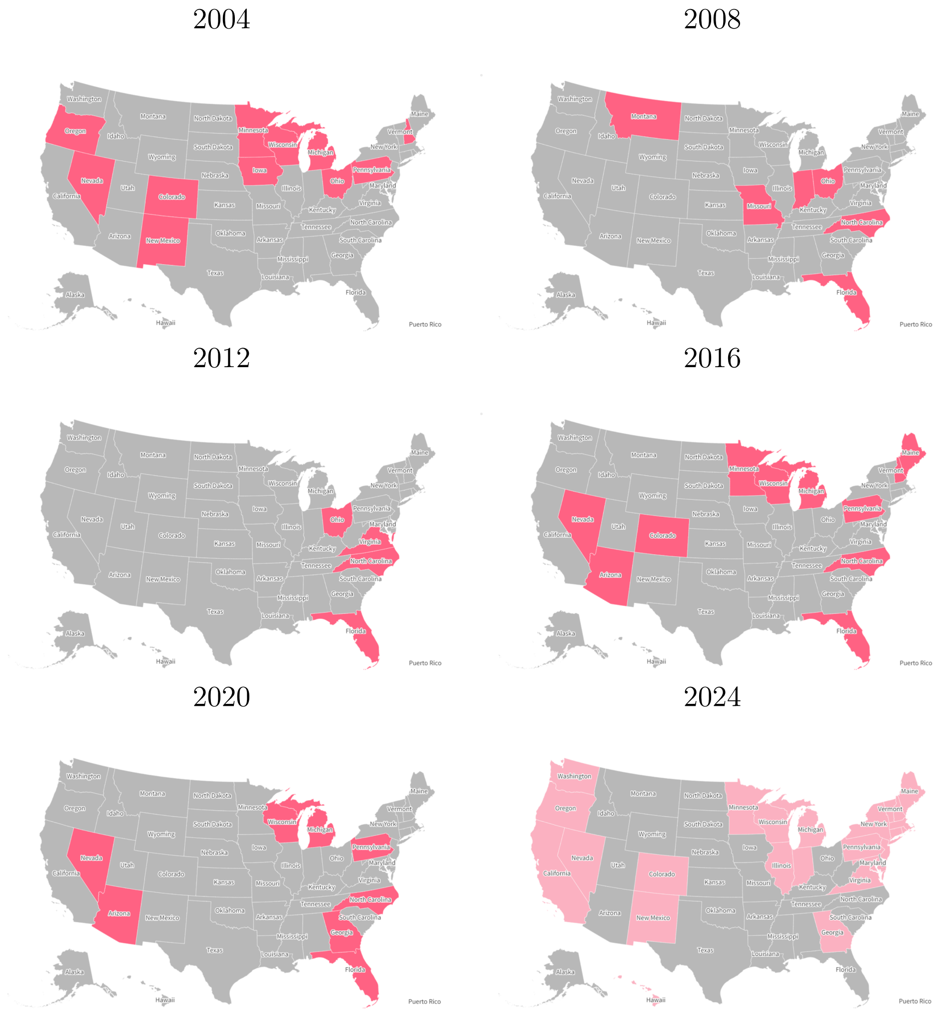
$$Upstream\ subsidy\ exposure_{j,T} = \alpha + \beta\ Upstream\ IV_{j,T}^{Swing} + \delta_j + \delta_T + \epsilon_{j,T}. \tag{11}$$

Since the IVs exploit variation across electoral terms, I aggregate subsidies over each term T.[25] Direct subsidy exposure$_{j,T}$ is the total value of subsidies granted to industry j, averaged over term T. Downstream subsidy exposure$_{j,T}$ is the weighted average of total subsidies granted to industries i (tradable and non-tradable) that supply industry j, averaged over term T. Upstream subsidy exposure$_{j,T}$ is the weighted average of total subsidies granted to industries k (tradable and non-tradable) that are supplied by industry j, averaged over term T.[26] δ_T and δ_j are term and industry-fixed effects to account for time-invariant and industry-invariant characteristics. The instrumental variables for direct and indirect subsidy exposure significantly predict the respective endogenous variables (see Table A.9). Subsidies are skewed towards the most relevant industries in swing states and towards states with high electoral votes. The R^2 indicates how much each instrument explains in the overall subsidy variance. In the model with fixed effects and IHS-transformed variables, politically motivated subsidies account for approximately 35% of federal subsidies. The relevance of the instruments is confirmed by the first stages of the 2SLS regressions, which show positive and significant coefficients for the IVs as predictors of the corresponding endogenous variables (see Table A.10).

[25] Aggregating (instead of averaging) subsidies and exports over time does not change the results. The results are also robust when considering only subsidies awarded during the last year of the electoral term, namely the election year.

[26] See Section 3.2 for further details on the construction of these variables.

Figure 5: Swing States in US Presidential Elections, 2004-2024



Notes: The maps indicate in pink the states classified as swing during the last five US presidential elections (2004 to 2020) and the upcoming 2024 election. A state is classified as swing during term T if the difference in the vote shares of Democratic and Republican candidates in the presidential election at the end of that term is below 5%. For the 2024 presidential election, I use results from the three most recent polls from Atlas US Elections before the change in the Democratic candidate from Mr. Biden to Ms. Harris. Swing states in the last five elections were: in 2004, Colorado, Iowa, Michigan, Minnesota, Nevada, New Hampshire, New Mexico, Ohio, Oregon, Pennsylvania, and Wisconsin; in 2008, Florida, Indiana, Missouri, Montana, North Carolina, and Ohio; in 2012, Florida, North Carolina, Ohio, and Virginia; in 2016, Arizona, Colorado, Florida, Maine, Michigan, Minnesota, Nevada, New Hampshire, North Carolina, Pennsylvania, and Wisconsin; in 2020, Arizona, Florida, Georgia, Michigan, Nevada, North Carolina, Pennsylvania, and Wisconsin. Expected swing states in 2024 are California, Colorado, Connecticut, District of Columbia, Georgia, Hawaii, Illinois, Indiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Nevada, New Hampshire, New Jersey, New Mexico, New York, Oregon, Pennsylvania, Rhode Island, Vermont, Virginia, Washington, and Wisconsin.

5 Results

In this section, I estimate the effects of politically motivated subsidies on exports directly and in vertically connected industries. Section 5.1 reports the main results about the effects of politically motivated subsidies on exports, while Section 5.2 addresses related robustness checks. Additionally, Section 5.3 explores the direct and indirect effects of subsidies on other outcome variables.

5.1 The Effects of Politically Motivated Subsidies on Exports

To begin, I examine the effects of politically motivated subsidies on the value of exports using the IV strategy described in Section 4.2. As the IV leverages shocks occurring on a four-year cycle (corresponding to a presidential term), I average the independent and the dependent variables over a four-year period, namely a term T. I regress industry-level exports on the direct and indirect subsidy exposure variables,[27] including a set of controls and industry and term fixed effects (see Equation 12). I estimate the following model using a 2SLS regression:

$$\begin{aligned} Exports_{j,T} = \alpha + \beta_1\ Direct\ subsidy\ exposure_{j,T} + \beta_2\ Upstream\ subsidy\ exposure_{j,T} + \\ + \beta_3\ Downstream\ subsidy\ exposure_{j,T} + X_{j,T} + \delta_j + \delta_T + \epsilon_{j,T} \end{aligned} \tag{12}$$

Exports$_{j,T}$ is the yearly value of exports (in USD) of tradable industry j, averaged over term T. Direct subsidy exposure$_{j,T}$ is the yearly value of federal subsidies granted to tradable industry j, averaged over term T. In the baseline specification, subsidies include grants and tax credits but exclude loans, tax-exempted bonds, and insurance. The Direct subsidy exposure$_{j,T}$ is instrumented by IV$_{j,T}^{Swing}$. Downstream subsidy exposure$_{j,T}$ is the yearly value of federal subsidies granted to each industry i (both tradable and non-tradable industries) that is upstream to industry j (excluding industry j itself), averaged over term T. I define this variable using the cost shares $w_{i,j}$ computed from the BEA I-O direct requirements tables, excluding the diagonal of the I-O matrix (defined at the 6-digit level). It is instrumented by Downstream IV$_{j,T}^{Swing}$. Upstream subsidy exposure$_{j,T}$ is the yearly value of federal subsidies granted to each industry k

[27] To address concerns regarding omitted variable bias, I include all explanatory variables capturing exposure to subsidies along supply chains.

(both tradable and non-tradable industries) that is downstream to industry j (excluding industry j itself), averaged over term T. I define this variable using the sales shares $\theta_{k,j}$ computed from the BEA I-O direct requirements tables, excluding the diagonal of the I-O matrix (defined at the 6-digit level). It is instrumented by Upstream $\text{IV}_{j,T}^{Swing}$.

$X_{j,T}$ is a set of industry-time specific controls. My baseline specification includes in $X_{j,T}$ the GDP price deflator (average index over term T), the share of subsidised firms in industry j (average over term T), and the share of lobbying expenditure in industry j (average over term T).[28] δ_T and δ_j are term and industry fixed effects to account for time-invariant and industry-invariant characteristics that may influence the level of subsidies within an industry or term. With these fixed effects, the regression coefficient is driven by the variation in subsidies within a term T and industry j.

To account for the skewness of the subsidy data (see Figure A.8), I transform both the dependent and independent variables using an inverse hyperbolic sine (IHS) transformation before estimating Equation 12. The IHS transformation is an alternative to taking logarithms when the data includes zeros or negative values. Instead of $\ln(y+1)$, the IHS transformation is defined as $\text{asinh}(y) = \ln\left(y + \sqrt{y^2+1}\right)$ and it can be interpreted in the same way as a standard logarithmic transformation (i.e., if both the outcome and explanatory variables are IHS transformed, the β coefficients represent elasticities).[29]

Table 1 reports the second-stage results from estimating Equation 12. The sample includes five presidential terms from 2000 to 2020 and 456 tradable industries. In Columns (1) and (2), I include term and industry fixed effects, defined at the 2-digit and 4-digit level, respectively. In Columns (3) and (4), which also include term and industry fixed effects at the 2-digit and 4-digit levels, respectively, I control for the GDP deflator, the share of subsidised firms over total firms in the industry, and lobbying expenditure in the industry. I cluster standard errors at the 2-digit NAICS industry level.

[28] Controlling for the share of lobbying expenditure on tax-related issues in the industry, rather than the share of overall lobbying expenditure, does not change the results.

[29] Some papers have suggested that the estimates can be sensitive to the unit of measure of the outcome variable (e.g., Bellemare & Wichman, 2019; Aihounton & Henningsen, 2020). To address this issue, I transform both the dependent and independent variables. Moreover, as suggested by Bellemare and Wichman (2019), I measure the outcome variable in units (e.g., USD) rather than thousands of dollars so that the elasticities are stable. Finally, as a robustness check, in Table A.11, I rescale both the dependent and independent variables and show that the results are robust.

The positive and significant coefficients show that politically motivated subsidies improve exports in the subsidised industries (see Table 1). These subsidies also have spillover effects along supply chains, benefiting both upstream producers and downstream customers. The larger effect is observed in directly exposed industries, with a 1% increase in subsidies leading to a 0.32% increase in exports. In addition, a 1% increase in subsidies to suppliers leads to a 0.28% rise in exports downstream, while a 1% increase to customers results in a 0.09% rise in exports upstream. These findings are particularly interesting given that the largest federal subsidies are allocated to non-tradable industries (see Table A.4).

The 2SLS performs well in terms of the instrument's strength in all the specifications. The Kleibergen-Paap (KP) Wald F-statistics, which tests the identification of the equation as a whole, is above the critical value of 10.[30] Moreover, the first-stage results indicate that the instrumental variables effectively predict the endogenous variables, as evidenced by a high, positive, and statistically significant coefficient, along with an R^2 above 0.35 (see Table A.10).

When comparing the second-stage results to those of the corresponding OLS regressions, the coefficient of Direct subsidy exposure$_{j,T}$ is higher in the IV-estimated model than in the OLS specification (see Table A.6). This difference suggests that the OLS estimates are negatively biased. Subsidies are more likely to be allocated to industries with high initial employment levels that later experience a decline or are impacted by unobserved negative shocks. Instead, the coefficients of Upstream subsidy exposure$_{j,T}$ and Downstream subsidy exposure$_{j,T}$ are smaller in the 2SLS than in the OLS model, although the difference is minimal. The comparison suggests a positive bias of OLS when predicting the effect of indirect exposure to subsidies on exports. One possible interpretation is that the government may strategically target key inputs of well-performing and exporting industries.[31]

Building on these results, I further explore the effects of politically motivated subsidies on trade through several additional specifications. In Table 2, I broaden the definition of subsidies to encompass not only grants and tax credits but also the face value of loans, loan guarantees,

[30]The KP Wald F-statistics is a version of the Cragg-Donald statistic adjusted for clustered standard errors.

[31]As a more general observation, one should recall that the second-stage estimates of the 2SLS represent a LATE (as opposed to the ATE). Unless swing shocks caused an equal change in subsidies across all industries, the β coefficients of the second-stage regression represent the impact of politically motivated subsidies on exports. If swing shocks lead to larger changes in subsidies for industries with relatively high returns to subsidies, the LATE would be larger than the ATE. In other words, the IV would capture the effect of subsidies on the subset of industries that benefit the most from them. See Card (2001) for a similar interpretation of the effect of schooling on wages.

Table 1: The Effects of Politically Motivated Subsidies on Exports, 2000-2020

	Exports$_{j,T}$			
	(1)	(2)	(3)	(4)
Direct subsidy exposure$_{j,T}$	0.317***	0.401***	0.283***	0.369***
	(0.03)	(0.06)	(0.05)	(0.07)
Upstream subsidy exposure$_{j,T}$	0.086*	0.015	0.082*	0.033
	(0.05)	(0.02)	(0.04)	(0.02)
Downstream subsidy exposure$_{j,T}$	0.288***	0.108	0.300***	0.068
	(0.05)	(0.13)	(0.06)	(0.12)
Controls	NO	NO	YES	YES
Term FE	YES	YES	YES	YES
Industry FE	NAICS-2	NAICS-4	NAICS-2	NAICS-4
Obs.	2,280	2,280	2,280	2,280
KP F-statistic	27.56	23.32	26.14	28.60

Notes: Second-stage coefficients from the estimation of Equation (12) with 2SLS. The outcome variable and the main explanatory variables are transformed by IHS to handle outliers. The dependent variable, Exports$_{j,T}$, is the yearly export value (USD) in the tradable industry j, averaged over the presidential term T (mean: 2,023.38 mln USD; mean of IHS-transformed variable: 20.70 USD). Direct subsidy exposure$_{j,T}$ (mean: 1.74 mln USD; mean of IHS-transformed variable: 2.80 USD) captures direct exposure to subsidies. Downstream subsidy exposure$_{j,T}$ (mean: 17 mln USD; mean of IHS-transformed variable: 16.47 USD) captures subsidies to customers of industry j. Upstream subsidy exposure$_{j,T}$ (mean: 3.50 mln USD; mean of IHS-transformed variable: 13.09 USD) captures subsidies to suppliers of industry j. Subsidies include grants and tax credits but exclude loans, tax-exempted bonds, and insurance. Direct subsidy exposure$_{j,T}$ only includes subsidies granted to tradable industries, while indirect subsidies include subsidies to tradable and non-tradable industries. Columns (3) and (4) include controls for the annual GDP-deflator, the share of subsidised firms in industry j, and the share of lobbying expenditure in industry j (IHS transformed). The sample includes five presidential terms from 2000 to 2020 and 456 tradable industries. I cluster standard errors at the 2-digit NAICS industry level. Significance codes: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

tax-exempt bonds, and insurance provided to firms in the industry. Although the instrument effectively predicts federal loans based on the swing state theory, these subsidies differ significantly from grants and tax credits. Specifically, the repayment status of their face value is unclear, which is why I do not include them in the main specification. Furthermore, the term of loans may differ from the programme duration of typical subsidies, leading to asymmetries in the timing of when firms receive and spend the funds. When examining the effects of loans and subsidies on exports, the direct impact of both loans and subsidies together is slightly higher than those of subsidies alone (see Table 2). However, the effects of subsidies along the supply chain are weaker and generally not significant in most specifications, with upstream subsidy and loan exposure sometimes showing a negative sign.

Table 3 replicates Table 1, expanding the analysis to 2024 elections (data are available up

Table 2: The Effects of Politically Motivated Subsidies and Loans on Exports, 2000-2020

	Exports$_{j,T}$			
	(1)	(2)	(3)	(4)
Direct subsidy and loan exposure$_{j,T}$	0.316***	0.516***	0.280***	0.549***
	(0.050)	(0.051)	(0.069)	(0.059)
Upstream subsidy and loan exposure$_{j,T}$	0.032	-0.169***	0.033	-0.176***
	(0.10)	(0.02)	(0.10)	(0.03)
Downstream subsidy and loan exposure$_{j,T}$	0.501***	0.196	0.502***	0.125
	(0.074)	(0.193)	(0.072)	(0.198)
Controls	NO	NO	YES	YES
Term FE	YES	YES	YES	YES
Industry FE	NAICS-2	NAICS-4	NAICS-2	NAICS-4
Obs.	2,280	2,280	2,280	2,280
KP F-statistic	292.9	16.32	111.4	9.59

Notes: Second-stage coefficients from the estimation of Equation (12) with 2SLS. The outcome variable and the main explanatory variables are IHS transformed to handle outliers. The dependent variable, Exports$_{j,T}$, is the yearly export value (USD) in the tradable industry j, averaged over the presidential term T (mean: 2,023.38 mln USD; mean of IHS-transformed variable: 20.70 USD). Direct subsidy and loan exposure$_{j,T}$ (mean: 71.68 mln USD; mean of IHS-transformed variable: 11.24 USD) captures direct exposure to subsidies. Downstream subsidy and loan exposure$_{j,T}$ (mean: 2,178.99 mln USD; mean of IHS-transformed variable: 19.60 USD) captures subsidies to customers of industry j. Upstream subsidy and loan exposure$_{j,T}$ (mean: 211.63 mln USD; mean of IHS-transformed variable: 15.85 USD) captures subsidies to suppliers of industry j. Subsidies include grants, tax credits, loans, tax-exempted bonds, and insurance. Direct subsidy exposure$_{j,T}$ only includes subsidies granted to tradable industries, while indirect subsidies include subsidies to tradable and non-tradable industries. Columns (3) and (4) include controls for the annual GDP-deflator, the share of subsidised firms in industry j, and the share of lobbying expenditure in industry j (IHS transformed). The sample includes five presidential terms from 2000 to 2020 and 456 tradable industries. I cluster standard errors at the 2-digit NAICS industry level. Significance codes: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

to 2023). As a result, the number of observations increases from 2,280 to 2,736. For the 2024 presidential election, the IV is defined based on swing state projections according to Atlas US Elections Polls. Since data on lobbying and the number of firms is only available up to 2020, I only control for the GDP price deflator in columns (3) and (4). The results are consistent with the baseline specification but show a more pronounced positive effect on exports for industries that sell to subsidised customers (i.e., upstream exposed industries).

Table 4 replicates the results from Table 1, using exports as a percentage of industry output as the dependent variable.[32] Politically motivated subsidies increase exports as a share of total output. Specifically, a 1% increase in subsidies leads to a 0.06% increase in exports per unit of output in directly subsidised industries. This effect also propagates along the supply chain:

[32]The lower number of observations is due to missing data on gross output for some industries.

Table 3: The Effects of Politically Motivated Subsidies on Exports, 2000-2024

	Exports$_{j,T}$			
	(1)	(2)	(3)	(4)
Direct subsidy exposure$_{j,T}$	0.268***	0.390***	0.268***	0.390***
	(0.04)	(0.08)	(0.04)	(0.08)
Upstream subsidy exposure$_{j,T}$	0.155***	0.152***	0.155***	0.152***
	(0.04)	(0.03)	(0.04)	(0.03)
Downstream subsidy exposure$_{j,T}$	0.240*	0.118	0.240*	0.118
	(0.14)	(0.22)	(0.14)	(0.22)
Controls	NO	NO	YES	NO
Term FE	YES	YES	YES	YES
Industry FE	NAICS-2	NAICS-4	NAICS-2	NAICS-4
Obs.	2,736	2,736	2,736	2,736
KP F-statistic	28.56	12.47	28.56	12.47

Notes: Second-stage coefficients from the estimation of Equation (12) with 2SLS. The outcome variable and the main explanatory variables are IHS transformed to handle outliers. The dependent variable, Exports$_{j,T}$, is the yearly export value (USD) in the tradable industry j, averaged over the presidential term T (mean: 2,023.38 mln USD; mean of IHS-transformed variable: 20.70 USD). Direct subsidy exposure$_{j,T}$ (mean: 1.95 mln USD; mean of IHS-transformed variable: 2.89 USD) captures direct exposure to subsidies. Downstream subsidy exposure$_{j,T}$ (mean: 13.59 mln USD; mean of IHS-transformed variable: 16.07 USD) captures subsidies to customers of industry j. Upstream subsidy exposure$_{j,T}$ (mean: 2.56 mln USD; mean of IHS-transformed variable: 12.14 USD) captures subsidies to suppliers of industry j. Subsidies include grants and tax credits, but do not include loans, tax-exempted bonds, and insurance. Direct subsidy exposure$_{j,T}$ only includes subsidies granted to tradable industries, while indirect subsidies include subsidies to tradable and non-tradable industries. Columns (3) and (4) control for the annual GDP-deflator (data on lobbying and the number of firms is not available for the most recent years). The sample includes six presidential terms from 2000 to 2024 and 456 tradable industries. I cluster standard errors at the 2-digit NAICS industry level. Significance codes: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

industries using subsidised inputs experience a 0.02% increase in exports per unit of output produced, for each 1% increase in subsidies. However, this effect is not observed in industries supplying subsidised customers, in which the share of exports in gross output decreases. The negative coefficient of Upstream subsidy exposure$_{j,T}$ may be due to a relative increase in domestic sales (to subsidised producers) compared to exports.

Finally, Figure A.11 presents the predicted values of exports, derived from a heterogeneity analysis based on sector-specific estimates of Equation 12. Industries in the manufacturing and services sectors experience the largest export gains from direct subsidies. Conversely, industries in upstream sectors, such as mining and transportation, show positive export returns downstream. Notably, the positive impact of upstream subsidy exposure primarily results from subsidies provided to customers in the professional services sector.

Table 4: The Effects of Politically Motivated Subsidies on Exports (Output Share), 2000-2020

	Exports over Output$_{j,T}$			
	(1)	(2)	(3)	(4)
Direct subsidy exposure$_{j,T}$	0.017***	0.059***	0.011***	0.052***
	(0.00)	(0.00)	(0.00)	(0.00)
Upstream subsidy exposure$_{j,T}$	-0.018***	-0.0004	-0.017***	0.003**
	(0.00)	(0.00)	(0.00)	(0.00)
Downstream subsidy exposure$_{j,T}$	0.050***	0.021***	0.050***	0.015***
	(0.00)	(0.00)	(0.00)	(0.00)
Controls	NO	NO	YES	NO
Term FE	YES	YES	YES	YES
Industry FE	NAICS-2	NAICS-4	NAICS-2	NAICS-4
Obs.	2,215	2,215	2,215	2,215
KP F-statistic	73.82	27.49	72.95	37.38

Notes: Second-stage coefficients from the estimation of Equation (12) with 2SLS. The outcome variable and the main explanatory variables are IHS transformed to handle outliers. The dependent variable, Exports over Output$_{j,T}$, is the yearly export value over gross output in the tradable industry j, averaged over the presidential term T (mean: 0.286; mean of IHS-transformed variable: 0.248). Direct subsidy exposure$_{j,T}$ (mean: 1.74 mln USD; mean of IHS-transformed variable: 2.80 USD) captures direct exposure to subsidies. Downstream subsidy exposure$_{j,T}$ (mean: 17 mln USD; mean of IHS-transformed variable: 16.47 USD) captures subsidies to customers of industry j. Upstream subsidy exposure$_{j,T}$ (mean: 3.50 mln USD; mean of IHS-transformed variable: 13.09 USD) captures subsidies to suppliers of industry j. Subsidies include grants and tax credits but exclude loans, tax-exempted bonds, and insurance. Direct subsidy exposure$_{j,T}$ only includes subsidies granted to tradable industries, while indirect subsidies include subsidies to tradable and non-tradable industries. Columns (3) and (4) include controls for the annual GDP-deflator, the share of subsidised firms in industry j, and the share of lobbying expenditure in industry j (IHS transformed). The sample includes five presidential terms from 2000 to 2020 and 456 tradable industries. I cluster standard errors at the 2-digit NAICS industry level. Significance codes: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

5.2 Robustness Checks

The results presented in Table 1 about the effects of politically motivated subsidies on exports are corroborated by a battery of robustness checks. The first set of robustness checks addresses potential identification threats. The second one shows that the results are robust to alternative econometric specifications and methods of variable construction.

Robustness of the IV A valid instrument should satisfy the hypothesis of exclusion restriction, relevance, and exogeneity.

The exclusion restriction of the IV might be threatened if the instrument captures other time-varying federal policies or industry characteristics that are correlated with exports. I address these concerns by controlling for possible omitted variables that might be correlated with the instrument and exports. Another federal policy that might be influenced by swing-state politics is trade policy. Trade protection, in particular, might affect exports through reduced import competition, and could be disproportionately targeted towards swing states (**Bown2024**). To address this concern, in Table A.12, I control for anti-dumping duties protecting subsidised industries and their suppliers and customers. I define AD protection$_{j,T}$ as the average anti-dumping duty across all 6-digit HS products within a 6-digit NAICS industry j in term T. Downstream AD exposure$_{j,t}$ is the weighted average of the duties imposed to industry i upstream to industry j during term T. Upstream AD exposure$_{j,t}$ is the weighted average of the duties imposed to industry i upstream to industry j during term T. To construct these variables, I use direct coefficients from the BEA I-O tables and exclude the I-O matrix's diagonal. When controlling for trade protection, the impact of subsidies on exports remains positive and significant. Although the anti-dumping exposure variables are primarily control variables in these specifications and are not instrumented, it is reassuring that their coefficient signs align with those found by **Bown2024<empty citation>**, who focus on employment.

The relevance of the IVs has been tested in the first stages of the 2SLS regressions (see Table A.10). A potential concern is that swing state policy is only relevant during the first presidential term. The US Constitution limits the number of times a person can be elected to the office of President of the United States to two terms. Hence, incumbent presidents have less incentive to provide politically motivated subsidies when ineligible for re-election. In Table A.13, I exclusively consider executive first terms. In particular, I exclude the second election of Obama (2012) and the second election of Bush (2004). I show that, even when focusing only on the first terms, the results remain positive and significant.

Alternative specifications The results presented in Table 1 are robust to various alternative variable and econometric specifications. In Table A.14, I construct the Downstream and Upstream subsidy exposure$_{j,T}$ variables using different specifications of the I-O matrix. In Columns (1)-(2) of Table A.14, I include the diagonal of the I-O matrix. In this way, the variables also account for subsidies granted to suppliers and customers within the same 6-digit NAICS industry as j. For this reason, I estimate Equation 12 with the key independent variables separately and report the results for each variable individually, as including them all together in the same regression would lead to multicollinearity. As expected, the indirect effects of subsidies are larger in terms of magnitude than in the baseline specification (even when compared to a model with the three variables separated). In Columns (3) and (4) of Table A.14, I show that the results are also robust to the use of total requirements from the inverted Leontief matrix in the construction of cost ($w_{i,j}$) and sales ($\theta_{k,j}$) shares.The Leontief I-O matrix reflects higher-order supply linkages (i.e., all tiers), namely the amount of output (input) from an industry i (k) that is produced to satisfy a unit of final demand of industry j. For the same reason as before, I present the results separately. When considering subsidies granted to suppliers along the entire supply chain, the estimated 2SLS effects are similar to those that only consider direct linkages. Instead, the 2SLS estimates for the effects of upstream subsidy exposure on exports are larger and more significant in the Leontief case than when considering only direct linkages. Overall, the comparison with the baseline results underscores the predominant role of first-tier linkages. It indicates that, especially in the case of subsidies given to suppliers, the effects primarily stem from subsidies to directly connected industries. Finally, in Table A.15, I exclude the 4-digit diagonal of the I-O matrix to account for the possibility that subsidies might be designed with a broader industry code in mind. On a related note, I have replicated the analysis, aggregating all variables to 4-digit industry codes, and the results are still valid.

5.3 Additional Results

This section explores the effects of politically motivated subsidies on imports and employment.

Following the same approach as in Section 5.1, I study the direct and indirect effects of federal subsidies on imports by estimating the following equation:

$$\begin{aligned} Imports_{j,T} = \alpha + \beta_1 \; Direct\ subsidy\ exposure_{j,T} + \beta_2 \; Upstream\ subsidy\ exposure_{j,T} + \\ + \beta_3 \; Downstream\ subsidy\ exposure_{j,T} + X_{j,T} + \delta_j + \delta_T + \epsilon_{j,T} \end{aligned} \tag{13}$$

where the dependent variable, $\text{Imports}_{j,T}$, is the value of imports of the tradable industry j, averaged over term T. Other variables are defined as before. Subsidies have a direct and statistically significant positive impact on imports (see Table 5). However, the effect of indirect subsidy exposure on imports is less clear and varies depending on the econometric specification used. When including fixed effects for time and 4-digit industry levels, downstream subsidy exposure appears to reduce imports. This reduction may occur because industrial policy can substitute for trade policies aimed at protecting domestic industries. On the other hand, supplying subsidised customers leads to an increase in imports.

Table 5: The Effects of Politically Motivated Subsidies on Imports, 2000-2020

	$\text{Imports}_{j,T}$			
	(1)	(2)	(3)	(4)
Direct subsidy $\text{exposure}_{j,T}$	0.219***	0.373***	0.172***	0.340***
	(0.02)	(0.04)	(0.04)	(0.05)
Upstream subsidy $\text{exposure}_{j,T}$	0.057	0.131***	0.055	0.151***
	(0.04)	(0.01)	(0.04)	(0.00)
Downstream subsidy $\text{exposure}_{j,T}$	0.109**	-0.300***	0.121***	-0.345***
	(0.04)	(0.11)	(0.05)	(0.10)
Controls	NO	NO	YES	NO
Term FE	YES	YES	YES	YES
Industry FE	NAICS-2	NAICS-4	NAICS-2	NAICS-4
Obs.	2,280	2,280	2,280	2,280
KP F-statistic	28.79	23.17	25.94	28.26

Notes: Second-stage coefficients from the estimation of Equation (12) with 2SLS. The outcome variable and the main explanatory variables are transformed by IHS to handle outliers. The dependent variable, $\text{Imports}_{j,T}$, is the yearly import value (USD) in the tradable industry j, averaged over the presidential term T (mean: 4,154.95 mln USD; mean of IHS-transformed variable: 21.38 USD). Direct subsidy $\text{exposure}_{j,T}$ (mean: 1.74 mln USD; mean of IHS-transformed variable: 2.80 USD) captures direct exposure to subsidies. Downstream subsidy $\text{exposure}_{j,T}$ (mean: 17 mln USD; mean of IHS-transformed variable: 16.47 USD) captures subsidies to customers of industry j. Upstream subsidy $\text{exposure}_{j,T}$ (mean: 3.50 mln USD; mean of IHS-transformed variable: 13.09 USD) captures subsidies to suppliers of industry j. Subsidies include grants and tax credits but exclude loans, tax-exempted bonds, and insurance. Direct subsidy $\text{exposure}_{j,T}$ only includes subsidies granted to tradable industries, while indirect subsidies include subsidies to tradable and non-tradable industries. Columns (3) and (4) include controls for the annual GDP-deflator, the share of subsidised firms in industry j, and the share of lobbying expenditure in industry j (IHS transformed). The sample includes five presidential terms from 2000 to 2020 and 456 tradable industries. I cluster standard errors at the 2-digit NAICS industry level. Significance codes: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

The positive impact of subsidies on exports (and imports) may reflect a general enhancement in overall industry performance. In Table 6, I report the second-stage results from estimating the following equation:

$$Employment_{j,T} = \alpha + \beta_1 \ Direct\ subsidy\ exposure_{j,T} + \beta_2 \ Upstream\ subsidy\ exposure_{j,T} + \\ + \beta_3 \ Downstream\ subsidy\ exposure_{j,T} + X_{j,T} + \delta_j + \delta_T + \epsilon_{j,T} \quad (14)$$

where the dependent variable, $\text{Employment}_{j,T}$, is total employment in industry j, averaged over term T. Other variables are defined as before. For consistency with the export results, I focus on employment in the tradable industry j (although employment data is also available for non-tradable industries). An increase in employment accompanies the increase in exports in subsidised industries. The direct impact of subsidies on employment is large and statistically significant. The elasticity of Direct subsidy exposure$_{j,T}$ is 0.60, whereas that of Upstream subsidy exposure$_{j,T}$ is 0.58. Interestingly, employment decreases in downstream exposed industries, which indirectly benefit from subsidies in terms of exports but do not grow in size.

Table 6: The Effects of Politically Motivated Subsidies on Employment, 2000-2020

	Employment$_{j,T}$			
	(1)	(2)	(3)	(4)
Direct subsidy exposure$_{j,T}$	0.601***	0.767***	0.655***	0.748***
	(0.07)	(0.08)	(0.07)	(0.06)
Upstream subsidy exposure$_{j,T}$	0.587***	0.082***	0.555***	0.103***
	(0.06)	(0.01)	(0.06)	(0.02)
Downstream subsidy exposure$_{j,T}$	-1.269***	-0.141***	-1.239***	-0.221***
	(0.05)	(0.03)	(0.06)	(0.02)
Controls	NO	NO	YES	YES
Industry FE	NAICS-2	NAICS-4	NAICS-2	NAICS-4
Term FE	YES	YES	YES	YES
Obs.	2,280	2,280	2,280	2,280
KP F-statistic	28.79	23.17	25.94	28.26

Notes: Second-stage coefficients from the estimation of Equation (12) with 2SLS. The outcome variable and the main explanatory variables are transformed by IHS to handle outliers. The dependent variable, Employment$_{j,T}$, is the yearly total employment in the tradable industry j, averaged over the presidential term T (mean: 26,540; mean of IHS-transformed variable: 10). Direct subsidy exposure$_{j,T}$ (mean: 1.74 mln USD; mean of IHS-transformed variable: 2.80 USD) captures direct exposure to subsidies. Downstream subsidy exposure$_{j,T}$ (mean: 17 mln USD; mean of IHS-transformed variable: 16.47 USD) captures subsidies to customers of industry j. Upstream subsidy exposure$_{j,T}$ (mean: 3.50 mln USD; mean of IHS-transformed variable: 13.09 USD) captures subsidies to suppliers of industry j. Subsidies include grants and tax credits but exclude loans, tax-exempted bonds, and insurance. Direct subsidy exposure$_{j,T}$ only includes subsidies granted to tradable industries, while indirect subsidies include subsidies to tradable and non-tradable industries. Columns (3) and (4) include controls for the annual GDP-deflator, the share of subsidised firms in industry j, and the share of lobbying expenditure in industry j (IHS transformed). The sample includes five presidential terms from 2000 to 2020 and 456 tradable industries. I cluster standard errors at the 2-digit NAICS industry level. Significance codes: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

6 Mechanisms

Several mechanisms, which are not necessarily mutually exclusive, can explain the positive effects of subsidy direct and indirect exposure on international trade and employment. Firstly, subsidies may lower the variable production costs for the beneficiary industries. I label these subsidies as "variable-cost reducing" subsidies. In the presence of pass-through of subsidies to prices, subsidies would result in cheaper inputs for downstream industries. For example, subsidising the steel industry can reduce the price of steel (i.e., pass-through of the subsidy to price), hence the production cost of cars and their exports.

Secondly, subsidies may reduce investments and financing costs of the beneficiary industries, even if without affecting prices. I label these subsidies as "investment promoting" subsidies. Subsidy programmes that lower financing costs and encourage fixed-scale investments may boost production in recipient industries, expand the variety and scale of products, foster innovation, and improve product quality. These subsidies may eventually reduce variable costs thanks to productivity gains after new investments. Quality enhancements and efficiency improvements resulting from these investments may spill over along the supply chain, benefiting vertically-related industries both upstream and downstream (Møllgaard, 2005). For example, subsidies aimed at fostering innovation in clean energy efficiency[33] require awardees to commercialise their inventions, providing innovative intermediate goods to downstream industries. Similarly, R&D subsidies may lead to higher-quality outputs and increase the demand for higher-quality inputs in upstream industries. Thirdly, subsidies increase production and scale in subsidised industries. Larger production requires more inputs and produces more output. Increasing returns to scale may lower costs in export markets and improve overall export performance in directly and indirectly exposed industries.

6.1 Indirect Harm From Subsidies in the SCMA

Understanding the mechanisms through which subsidies affect exports along supply chains is also important from the perspective of international law. In the SCMA, indirect harm from subsidies is a potential reason for imposing a CVD on the imports of (indirectly) subsidised products. More specifically, the SCMA mentions that "the term countervailing duty shall be understood to mean a special duty levied to offset any subsidy bestowed directly or indirectly upon the manufacture, production or exports of any merchandise, as provided for in paragraph 3 of Article VI of GATT 1994" (see SCMA, pg. 241, footnote 36, and art. 6.3(c)). However, the Agreement lacks clear guidance on substantiating subsidy pass-through (Shadikhodjaev, 2012; Hoekman et al., 2023).

[33] i.e., The"National Industrial Competitiveness Through Energy, Environment, and Economics" by the U.S. Department of Energy and the U.S. Environmental Protection Agency.

In the existing case law,[34] the proof of indirect harm from subsidies primarily revolves around "price suppression," as per art. 6.3(c) of the SCMA.[35] This reasoning has been applied to input subsidies and their transmission to downstream industries (e.g., US–Canadian Pork, WT/DS7/R), as well as to privatisation cases when subsidies persisted after state-owned firms were privatised (e.g., Lead Bismuth cases, WT/DS138). In some cases, to establish the pass-through of subsidies downstream in arm's-length relationships, the complaining country was required to determine the extent to which the input subsidy translated into a cost advantage for the downstream producer. For example, in the US-Canada Pork GATT case, the panel ruled that the United States could have imposed CVDs on Canadian pork only by proving that Canadian swine subsidies resulted in below-market swine prices for pork producers.[36]

The Lead Bismuth cases (WT/DS138) finally determined that countries can claim to be indirectly harmed by foreign subsidies as long as they can prove the pass-through of the subsidy to prices.[37] However, the lack of clear guidance on pricing indirect harm from subsidies has posed challenges to member states in substantiating these claims. For example, in the US–Softwood Lumber IV case (WT/DS236), the Appellate Body (AB) concluded that the investigating authority must calculate the precise amount of the subsidy transmitted.[38] However, in the subsequent US-Brazil Upland Cotton case (WT/DS267), the WTO AB considered this analysis not critical.[39] Similar challenges arose in the Mexico-Olive Oil dispute settlement (WT/DS341/R). Moreover, the AB's call for the identification of a subsidised product Lead Bismuth cases (WT/DS138) is confined only to the purposes of significant price suppression under Article 6.3(c) of the SCMA, with no implications for other adverse effects (Shadikhodjaev, 2012).

[34] E.g., WTO Appellate Body (AB) Report, WT/DS267/AB/R, US–Upland Cotton, paras. 419-495; WTO AB Report, WT/DS353/AB/R, US–Large Civil Aircraft 2nd complaint, paras. 1050-1125.

[35] According to art. 6.3(c) of the SCMA, serious prejudice from subsidies may arise in the presence of "a significant price suppression, price depression or lost sales in the same market." The WTO Panel Report provides a legal interpretation of the term "price suppression", WT/DS267/RW, US–Upland Cotton, para. 7.1279.

[36] See GATT Panel Report, WT/DS7/R, US–Canadian Pork, paras. 4.1–10.

[37] See WTO AB Report, WT/DS138/AB/R, US–Subsidies on Upland Cotton, para. 3, and Grossman and Mavroidis (2003).

[38] See WTO AB Report, WT/DS257/AB/R, US–Final Countervailing Duty Determination with Respect to Certain Softwood Lumber from Canada.

[39] See WTO Panel Report, WT/DS267/R, US–Subsidies on Upland Cotton, paras. 7.1180–81.

6.2 Prices

Building on existing WTO case law on subsidies, I examine whether the increase in exports resulting from the subsidy is associated with input price suppression. In particular, I study the impact of subsidies on producer prices ($\text{PPI}_{j,T}$) and export prices ($\text{Export Prices}_{j,T}$). The aim is to understand how subsidies impact prices throughout the supply chain as a mechanism through which they boost exports in vertically connected industries. To this end, I study whether input subsidies (i.e., Downstream subsidy $\text{exposure}_{j,T}$) result in lower input prices. I also look at whether output subsidies (i.e., Upstream subsidy $\text{exposure}_{j,T}$) reduce customer prices.[40] Combining data on producer prices with I-O tables from BEA, I define two variables, namely Input $\text{Prices}_{j,T}$ and Customer $\text{Prices}_{j,T}$. Input $\text{Prices}_{j,T}$ is the weighted average of producer prices of industries i that supply industry j. Customer $\text{Prices}_{j,T}$ is the weighted average of prices of industries k that buy from industry j.

Table 7 presents the second-stage coefficients from estimating several 2SLS regressions, where the dependent variables are different categories of prices, and the independent variables include direct and indirect exposure to subsidies. For visualization purposes, the table displays only the specifications with no controls and NAICS 4-digit industry and time-fixed effects. However, the results are robust across various specifications with alternative control sets and fixed effects. Specifically, Columns (1) and (2) report the effects of politically motivated subsidies on producer prices, with Direct subsidy $\text{exposure}_{j,T}$ being the primary variable of interest. In Columns (5) and (6), the dependent variable is customer prices, and the primary variable of interest is Upstream subsidy $\text{exposure}_{j,T}$. Conversely, in Columns (3) and (4), I focus on input prices, with Downstream subsidy $\text{exposure}_{j,T}$ as the key explanatory variable. Column (7) examines the impact of direct and indirect subsidy exposure on export prices. Since exporting industries can indirectly benefit from subsidies given to tradable and non-tradable industries, I estimate the impact of prices on the total sample of industries and a subsample of tradable industries. However, export prices are defined only for tradable industries. For this reason, and due to differences in data availability across the price categories, the sample size varies across the specifications.

When controlling for indirect subsidy exposure and industry and term fixed effects, subsidies

[40] The SCMA only addresses input subsidies in the context of demonstrating indirect harm from subsidies through pass-through effects.

increase PPI (Producer Price Index) within recipient industries. This positive effect is observed in both tradable and non-tradable industries (see Columns (1) and (2)). In Columns (3) and (4), I regress customer prices on upstream subsidy exposure, controlling for Direct subsidy exposure$_{j,T}$ and Downstream subsidy exposure$_{j,T}$, as well as industry and time fixed effects. The results indicate that subsidies to customers increase average customer prices. By raising prices in industries directly exposed to them, subsidies increase production costs in downstream industries. Columns (5) and (6) specifically test this effect. Controlling for Direct subsidy exposure$_{j,T}$ and Upstream subsidy exposure$_{j,T}$, as well as industry and time-fixed effects, the results show that downstream subsidies lead to higher input prices. This finding challenges the WTO's assumption that input subsidies pass through to lower prices. Finally, I investigate how these dynamics translate to export prices (see Column (7)). Direct and upstream exposure to subsidies increases the price of exports. By contrast, input subsidies decrease export prices.

A possible explanation for the increase in domestic and export prices is quality enhancements in subsidised industries. Although quality cannot be observed, export quality can be inferred from prices. Indeed, export prices capture the quality of exports under the assumption that price differences reflect differences in quality. To this end, I have also estimated the effect of subsidies on trade unit values, using estimates by (Berthou & Emlinger, 2011), and the results are consistent with those on domestic and export prices.

The results presented in Table 7 rationalise the effects of politically motivated subsidies on exports, directly and along supply chains. For directly exposed industries, producers in subsidised industries raise their selling prices domestically (PPI) and internationally (Export Price). Export prices generally increase more than domestic prices on average, but for tradable industries, the increase in export prices is less than that of domestic prices. These results could be interpreted as subsidies leading to higher quality products in subsidised industries. Thanks to the subsidy, directly exposed industries employ more workers and boost exports, both in absolute terms and relative to their output (see Tables 1 and 4). Subsidies to suppliers lead to increased input prices for downstream industries. Downstream industries reduce employment in response to the higher input costs (see Table 6). Despite the more expensive domestic inputs, they manage to increase exports in both absolute terms and as a percentage of output (see Tables 1 and 4), albeit at lower export prices. The increase in exports could stem from efficiency gains from using higher-quality inputs. When subsidies are provided to customers, they raise the prices of outputs sold by downstream industries, consistent with the direct effect observed. Industries selling to subsidised customers experience an increase in exports, though not as significant as the increase in domestic sales to subsidised industries (see Tables 1 and 4). Additionally, employment in these downstream industries rises to meet the higher demand for inputs from subsidised customers (see Table 6).

Table 7: The Effects of Politically Motivated Subsidies on Prices, 2000-2020

	Producer $\text{Prices}_{j,T}$		Customer $\text{Prices}_{j,T}$		Input $\text{Prices}_{j,T}$		Export $\text{Prices}_{j,T}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Direct subsidy $\text{exposure}_{j,T}$	0.257***	0.172***	-0.048***	-0.028	0.021**	-0.006	0.186***
	(0.01)	(0.07)	(0.01)	(0.04)	(0.01)	(0.01)	(0.02)
Upstream subsidy $\text{exposure}_{j,T}$	0.094***	0.090***	0.818***	0.900***	-0.040***	-0.014	0.240***
	(0.01)	(0.02)	(0.00)	(0.02)	(0.00)	(0.01)	(0.01)
Downstream subsidy $\text{exposure}_{j,T}$	0.067***	0.139**	0.284***	0.059	0.983***	0.924***	-0.229***
	(0.01)	(0.06)	(0.01)	(0.06)	(0.06)	(0.05)	(0.08)
Controls	NO	NO	NO	NO	NO	NO	NO
Term FE	YES	YES	YES	YES	YES	YES	YES
Industry FE	NAICS-4	NAICS-4	NAICS-4	NAICS-4	NAICS-4	NAICS-4	NAICS-4
Sample	Tradable	All	Tradable	All	Tradable	All	Tradable
Obs.	2,141	3,383	2,280	5,340	2,280	5,460	2,280
KP F-statistic	16.44	1.621	23.32	1.077	23.32	1.117	23.32

Notes: Second-stage coefficients from estimating several 2SLS regression models. The outcome and main explanatory variables are transformed by IHS to handle outliers. The dependent variable in Columns (1) and (2) is Producer $\text{Prices}_{j,T}$ (PPI), averaged over the presidential term T. The dependent variable in Columns (3) and (4) is Customer $\text{Prices}_{j,T}$, averaged over the presidential term T. The dependent variable in Columns (5) and (6) is Input $\text{Prices}_{j,T}$, averaged over the presidential term T. The dependent variable in Columns (7) is Export $\text{Prices}_{j,T}$, averaged over the presidential term T. Direct subsidy $\text{exposure}_{j,T}$ captures direct exposure to subsidies. Downstream subsidy $\text{exposure}_{j,T}$ captures subsidies to customers of industry j. Upstream subsidy $\text{exposure}_{j,T}$ captures subsidies to suppliers of industry j. Subsidies include grants and tax credits but exclude loans, tax-exempted bonds, and insurance. The sample includes five presidential terms from 2000 to 2020. I cluster standard errors at the 2-digit NAICS industry level. Significance codes: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

6.3 Investment, Value-Added, and TFP

Section 6.2 has demonstrated that price suppression alone cannot account for the propagation of subsidy effects along supply chains. In an analysis of the US–Lead and Bismuth II case, Grossman and Mavroidis (2003) highlight that "non-recurring" subsidies[41] are aimed to support fixed-scale investments. These subsidies have complex effects within industries, affecting competition, investment size, and market entry that can affect trade.

Table 8 presents the second-stage coefficients from estimating several 2SLS regressions, where the dependent variables are investment, value-added, and productivity, and the independent

[41] The difference between "recurring" and "non-recurring" subsidies relates to the nature and duration of the policy. "Non-recurring" subsidies involve initiatives like R&D for new product design or the construction of manufacturing facilities operating at their most efficient scale (Grossman & Mavroidis, 2005).

variables include direct and indirect exposure to subsidies. These outcome variables are sourced from the NBER-CES Manufacturing Industry Database, which only covers manufacturing industries (364 six-digit 2012 NAICS industries) and the years up to 2018. Therefore, the models are estimated on the sub-sample of manufacturing industries and presidential terms from 2000 to 2016 (which explains the lower number of observations in the sample). In particular, I define $\text{Investment}_{j,T}$ as the total capital expenditure in manufacturing industry j, averaged over term T; $\text{Value-added}_{j,T}$ represents the total value-added in manufacturing industry j, averaged over term T; $\text{TFP}_{j,T}$, represents the 4-factor productivity index in tradable manufacturing industry j, averaged over term T. For visualization purposes, Table 8 displays only the specifications with no controls and NAICS 4-digit industry and time-fixed effects. However, the results are robust across various specifications with alternative control sets and fixed effects. Specifically, Columns (1) and (2) report the effects of direct and indirect subsidies on investment. The dependent variable in Columns (3) and (4) is value-added. In Columns (5) and (6), I focus on TFP. Similarly to the specifications presented in Table 7, I estimate the 2SLS model on both the total sample of industries and a subsample of tradable industries.

Subsidies increase investment, value-added, and productivity in directly exposed industries. The positive effect of subsidies on investment aligns with the fact that the vast majority of US federal programmes (63%) implemented between 2000 and 2020 are geared towards investment promotion.[42] New investment by subsidised industries may boost the availability of new or higher-quality products and generate total factor productivity (TFP) spillovers that benefit upstream and downstream industries. The positive and significant direct effects of subsidies on investment, value-added, and productivity also hold when including non-tradable manufacturing industries (see Columns (2), (4), (6)), whose investment and TFP gains might indirectly affect exporters through supply chain effects. These findings explain the positive effects on exports observed in Table 12. By fostering higher investment and value-added in subsidised industries, subsidies increase exports in upstream and downstream industries.

When looking at the effects of indirect exposure to subsidies, there is no evidence that downstream or upstream subsidy exposure increases investment or value-added. However, vertically

[42] I classify subsidy programs into investment-promoting (e.g., subsidies to adopt new technologies, R&D tax credits, and investment funding) and variable cost-reducing (e.g., subsidies conditional on quantity produced or workers employed) and provide some examples of these programs in Table A.16. The proposed classification into investment promotion and cost reduction should not be interpreted as a rigid dichotomy, as subsidies designed to stimulate investment may concurrently yield cost efficiencies.

connected industries experience productivity gains from subsidies granted to their suppliers or customers.

Table 8: The Effects of Politically Motivated Subsidies on Investment, Value-Added, and TFP, 2000-2020

	$\text{Investment}_{j,T}$		$\text{Value-Added}_{j,T}$		$\text{TFP}_{j,T}$	
	(1)	(2)	(3)	(4)	(5)	(6)
Direct subsidy $\text{exposure}_{j,T}$	0.684***	0.743***	0.657***	0.720***	0.069***	0.075***
	(0.07)	(0.06)	(0.06)	(0.06)	(0.02)	(0.02)
Upstream subsidy $\text{exposure}_{j,T}$	0.039	0.145***	0.079*	0.183***	0.009**	0.026***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.00)	(0.01)
Downstream subsidy $\text{exposure}_{j,T}$	-0.109	-0.227	-0.164	-0.267*	0.0414**	0.021*
	(0.15)	(0.15)	(0.14)	(0.15)	(0.02)	(0.01)
Controls	NO	NO	NO	NO	NO	NO
Term FE	YES	YES	YES	YES	YES	YES
Industry FE	NAICS-4	NAICS-4	NAICS-4	NAICS-4	NAICS-4	NAICS-4
Sample	Tradable	All	Tradable	All	Tradable	All
Obs.	2,085	2,360	2,085	2,360	2,085	2,360
KP F-statistic	9.04	13.35	9.04	13.35	9.04	13.35

Notes: Second-stage coefficients from estimating several 2SLS regression models. The outcome and main explanatory variables are transformed by IHS to handle outliers. The dependent variable in Columns (1) and (2) is $\text{Investment}_{j,T}$, averaged over the presidential term T. The dependent variable in Columns (3) and (4) is $\text{Value-Added}_{j,T}$, averaged over the presidential term T. The dependent variable in Columns (5) and (6) is $\text{TFP}_{j,T}$, averaged over the presidential term T. Direct subsidy $\text{exposure}_{j,T}$ captures direct exposure to subsidies. Downstream subsidy $\text{exposure}_{j,T}$ captures subsidies to customers of industry j. Upstream subsidy $\text{exposure}_{j,T}$ captures subsidies to suppliers of industry j. Subsidies include grants and tax credits but exclude loans, tax-exempted bonds, and insurance. The sample includes four presidential terms from 2000 to 2016 and only manufacturing industries available in the NBER-CES Manufacturing Industry Database. I cluster standard errors at the 2-digit NAICS industry level. Significance codes: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

7 Conclusion

New industrial policies and their implications for international trade are at the forefront of the current global policy debate. Focusing on the United States, this paper provides novel causal evidence on the impact of politically motivated subsidies on the exports of recipient industries and vertically-related industries. To address endogeneity, I employ an IV approach that lingers on a political source of exogenous variation between states and industries in the United States. In a regression of federal subsidies on exports, with industry and term fixed effects, I estimate that a 1% increase in subsidies results in a 0.32% rise in exports. The positive impact of subsidies on exports propagates through supply chains both downstream and, to a lesser extent, upstream. In contrast to existing WTO case law regarding indirect harm from subsidies, which typically associates indirect harm from subsidies with input price suppression, I find that politically motivated subsidies lead to an increase in prices and input prices. Export prices also increased in subsidised industries and industries selling to subsided customers, whereas they decreased in downstream exposed industries. Additionally, subsidies lead to higher investments, increased value-added, and improved productivity in subsidised industries. Vertically-connected industries indirectly benefit from these effects in terms of productivity gains. This paper contributes to the ongoing policy debate about reforming multilateral trading rules on subsidies by spotlighting two primary concerns with the current framework. On the one hand, it sheds light on the need to strengthen transparency in subsidy notifications to the WTO. On the other hand, it emphasises the importance of intra-industry linkages (both upstream and downstream) and suggests broadening the interpretation of pass-through effects. SCMA-related disputes have traditionally focused on input subsidies and price suppression to prove indirect harm from subsidies. The results of this paper suggest that subsidies can have spillover effects along supply chains even without decreasing prices.

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Appendices

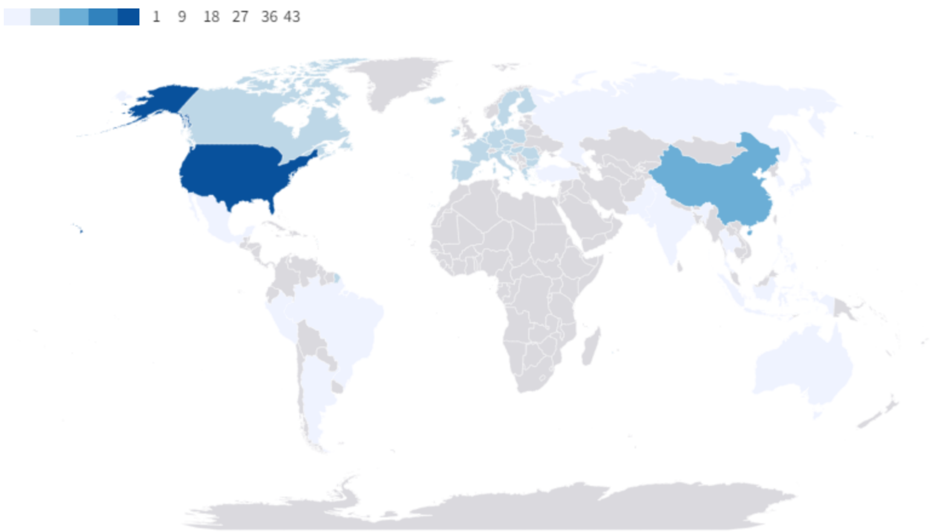
A Appendix

A.1 The SCMA and the Gap in Subsidy Notifications

In the context of globalisation and international competition, discriminatory industrial policies can distort the allocation of resources and generate friction in international trade. Subsidies can undermine the "level playing field" in international markets by providing competitive advantages based on the support received. If government support is granted to exporting firms, subsidised firms would be favoured when competing in foreign markets. If subsidies are awarded to domestic firms in import-competing industries, foreign exporters could face "unfair local competition." Subsidies are regulated at the multilateral level by the SCMA. The Agreement prohibits export subsidies and local content subsidies, while it requires member states to notify specific subsidies, which are considered actionable (art 25.1, SCMA). In particular, Article 25.1 requires that all WTO Members submit a new and full notification of all specific subsidies every three years. The Agreement defines specific subsidies as financial contributions (see art. 1.1, SCMA) by any public body within the territory of a WTO Member which confers a benefit and can be deemed to be specific to an enterprise (i.e., enterprise-specificity), industry (i.e., industry-specificity), or specified parts of the territory (i.e., regional-specificity). Specific subsidies that cause adverse effects on another member can be offset by imposing CVD on the imports of subsidised products.[43] The mechanisms and notification systems of the SCMA have been highly contested. The 17-year-old WTO Boeing case is just one example of a lengthy subsidy dispute that cost the airline company a fine of 244 million USD and resulted in a trade war between the United States and the EU. Most notably, the SCMA does not apply to subsidies related to trade in services, subsidies related to the establishment and operation of undertakings abroad that do not entail any trade in goods, subsidies facilitating the acquisition of local undertakings, and subsidies for which no causal link can be proved with the injury to domestic industries. There have also been claims about the lack of transparency by member states in notifying subsidies.

[43] The full text of the SCMA is available at here.

Figure A.1: Number of WTO Subsidy-Related Cases by Alleged Country



Source: Own construction based on the dispute settlement cases involving the SCMA from the WTO (see https://www.wto.org/english/tratop_e/dispu_e/dispu_agreements_index_e.htm).

Subsidy notifications to the WTO To verify the transparency of subsidy notifications to the WTO in the case of the United States, I have constructed a new dataset of US subsidy notifications to the WTO, including both federal and state subsidy policies. First, through a text-mining algorithm, I have web-scraped information from the WTO SCMA Gateway website. For each subsidy notification, I have coded information on the subsidy programme, type of subsidy, awarding authority, and year of notification. Figure A.2 displays an example of the information available on the WTO SCMA Gateway website for some US state-level subsidy notifications.[44] Secondly, I employed NLP techniques and a fuzzy matching algorithm to merge this data with the universe of US federal subsidy programs. The algorithm is based on similarities in the programme description, type of subsidy, and granting authority. I do not consider the year when the subsidy was granted because of possible administrative delays in reporting. I shed light on a gap in US subsidy notifications to the WTO. Only around 30% of US subsidy programmes are notified, the largest ones (Table A.1). The same is true for state subsidies, with 60% of programmes being reported. To understand the reasons for this gap, I classify subsidies into *prohibited*, *specific*, and *non-specific* based on their programme description. The notification requirement only applies to specific subsidies. I find that 1.3% of federal subsidies would be considered prohibited subsidies according to the SCMA, whereas almost 80% entail

[44] Recently, this information has also been coded by the WTO and made available on their website.

elements of specificity (see Figure A.3).

Figure A.2: Example of Subsidy Notifications to the WTO

Attachment III (revised)
Notification of State-Level Measures

State	Programme Title	Programme Authority	Form of Subsidy	Policy Objective	To Whom	Amount
Alabama	Property Tax Abatement		Tax Exemption (state/county/ municipal property tax)	To encourage economic growth.	Manufactures of aluminum, aluminum products, or calcium cyanamide.	The maximum period of an abatement of non-educational property taxes is ten years.
Alabama	Poultry Environmental Enhancement Project	Agricultural Development Authority	Loans	To support environmental projects.	Poultry Industry	$750,000 environmental enhancement programme. Project provides low-interest loans for construction of poultry compost structures and installation of freezer units to be used for the disposal of dead birds.

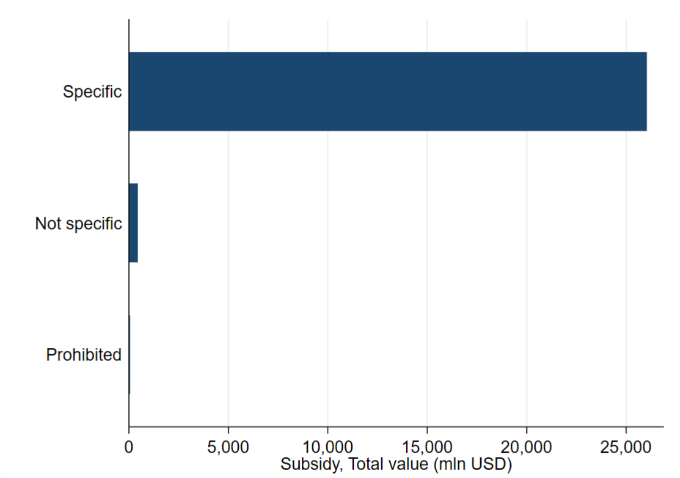
Source: Own data collection via web-scraping of the WTO SCMA Gateway website.

Table A.1: Subsidies and WTO Notifications: Summary Statistics, 2000-2020

Variables	Obs.	Mean (mln USD)	Std. Dev.	Min	Max
Notified subsidies	3,756	218	2,850	0	167,000
Non-notified subsidies	4,308	85.9	648	0	13,200

Note: Unit of observation: 4-digit NAICS.

Figure A.3: US Federal Subsidies According to the SCMA Taxonomy, 2000-2020



Notes: Through a text analysis of the programme descriptions of US federal subsidies in Subsidy Tracker, I classified US federal subsidies according to the SCMA taxonomy. The SCMA prohibits direct trade-related measures (export and local-content subsidies) and requires states to notify the WTO of specific subsidies (i.e., those targeted to a firm, industry, or region). Non-specific subsidies are not subjected to the notification requirement.

A.2 Data and Variables

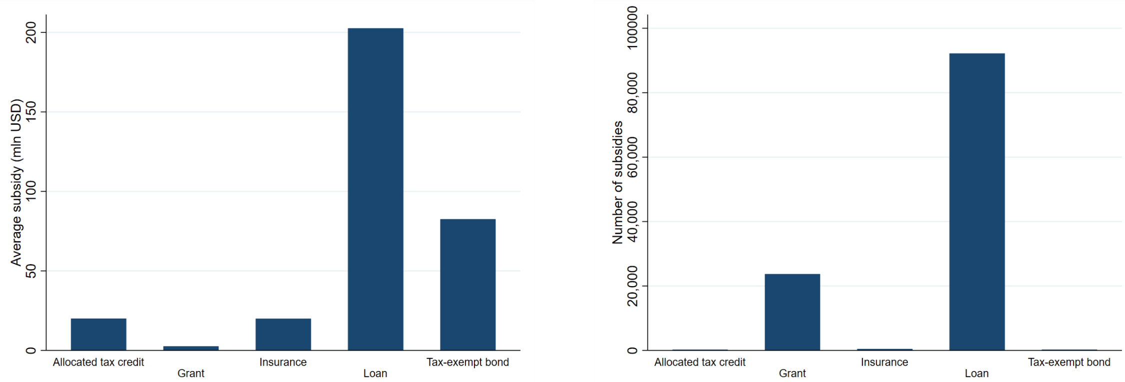
Table A.2: Federal Subsidies by Type

Type	Description
Federal grant	Federal award of a specific amount of money.
Federal allocated tax credit	Tax credit allocated to specific companies.
Federal loan or loan guarantee	Programmes that provide financing that needs to be repaid.
Federal insurance	E.g., Political risk insurance.
Federal tax-exempt bonds	E.g., Gulf Opportunity Zone bonds.

Notes: Subsidy types of federal subsidies as classified by Subsidy Tracker. I exclude federal loans, loan guarantees, insurance, and bond financing from the analysis because the reported amounts represent the face value or principal without indicating whether the loans have been repaid or the government had to fulfil a loan guarantee.

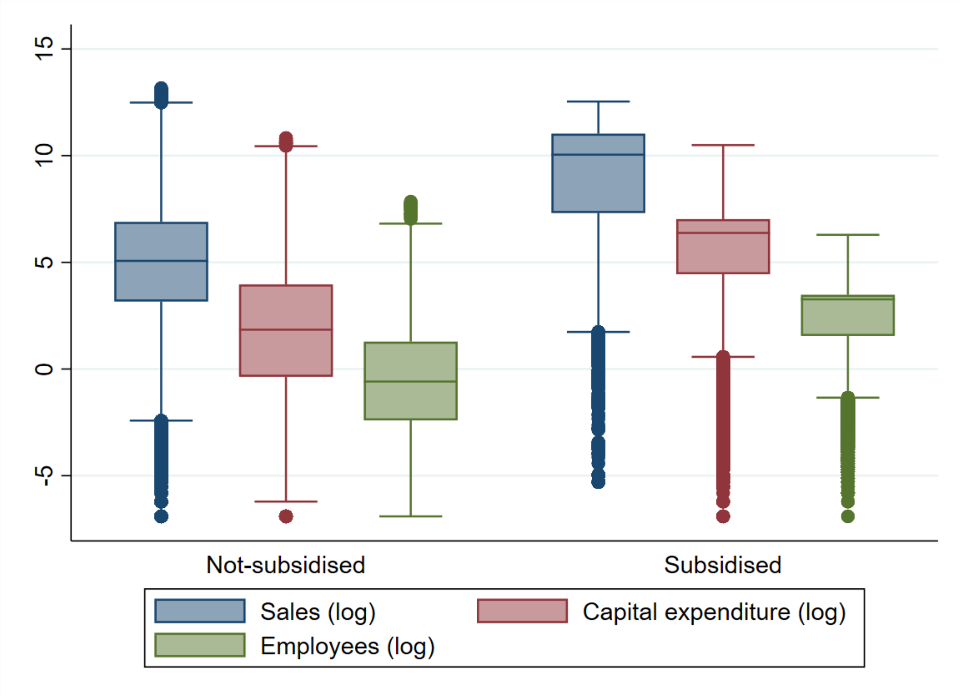
Figure A.4: Federal Subsidies by Type, 2000-2020.

(a) Average subsidy ***(b)*** Number of subsidies



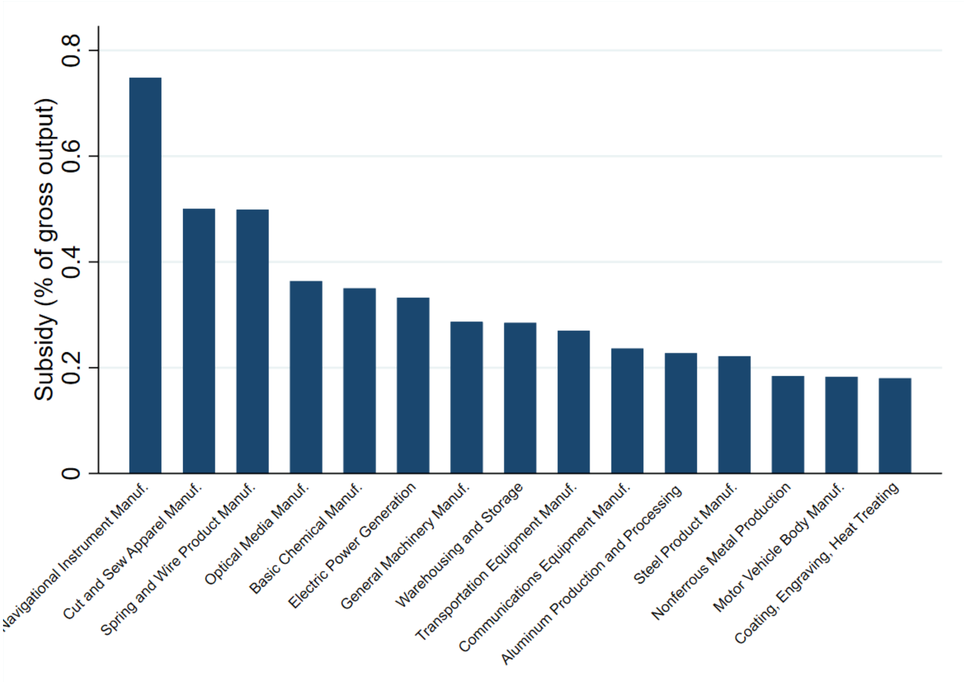
Notes: Figure (a) shows the average value of subsidies for subsidies awarded between 2000 and 2020, by subsidy type. Figure (b) depicts the number of subsidies awarded between 2000 and 2020 by subsidy type. Subsidies issued under the same programme but awarded to different firms are considered separate subsidies. See Table A.2 for a more detailed definition of subsidy types.

Figure A.5: Comparison of Subsidised and Non-Subsidised Firms in Compustat, 2000-2020



Notes: The sample consists of 27,207 publicly listed firms from 2000 to 2020, including 716 firms that received federal subsidies. The boxplot illustrates the distribution of log-transformed sales, capital expenditures, and employees for subsidised and non-subsidised firms. The difference in means between subsidised and non-subsidised firms is statistically significant at the 0.01 confidence level.

Figure A.6: Top Industries with the Highest Value of Subsidies over Output, 2000-2020



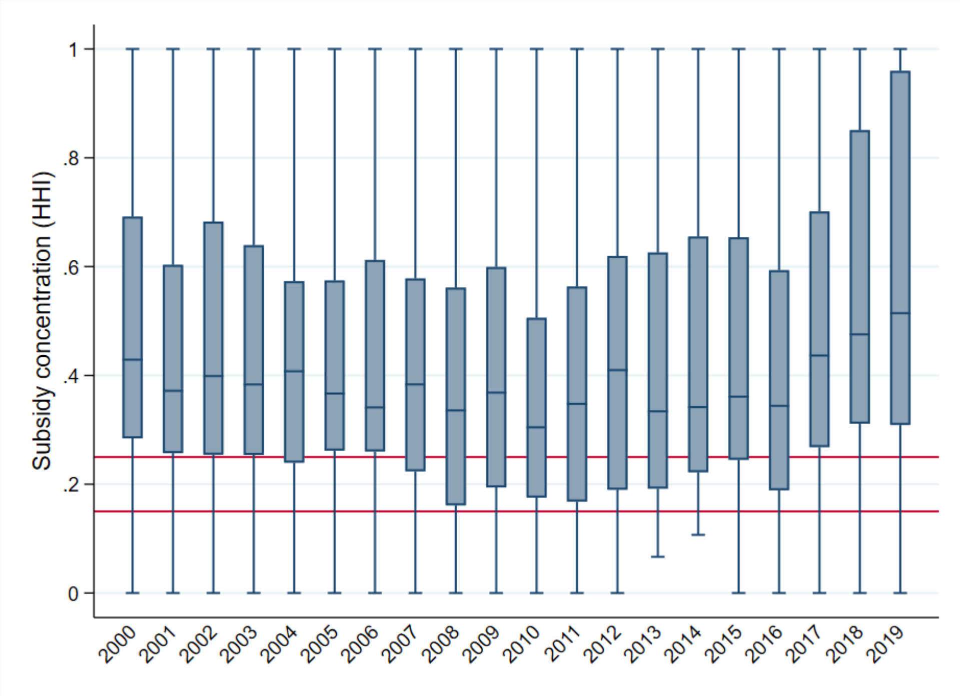
Notes: Total annual subsidies as a share in gross output by 4-digit NAICS, average over 2000-2020. Top 15 industries by broad industry classification from Subsidy Tracker. Gross industry output, available only at the 4-digit NAICS level, is sourced from the US Bureau of Labor Statistics (BLS).

Table A.3: Companies With the Highest Average Yearly Subsidies, 2000-2020

Company	Avg. subsidy per year (mln USD)
Wells Fargo Bank, NA	402.90
Summit Texas Clean Energy, LLC	404.60
SCS Energy California, LLC	334.50
Mojave Solar LLC	376.80
JPMorgan Chase subsidiaries	435.30
Bank of America N.A.	417.10
Arizona Solar One LLC	464.00
America Electric Power Service Corp.	492.50
American Energy Resources Company	589.70

Note: Companies receiving the highest average yearly subsidies by the federal government and agencies, between 2000 and 2020.

Figure A.7: Subsidies' Concentration Within Industries, 2000-2020



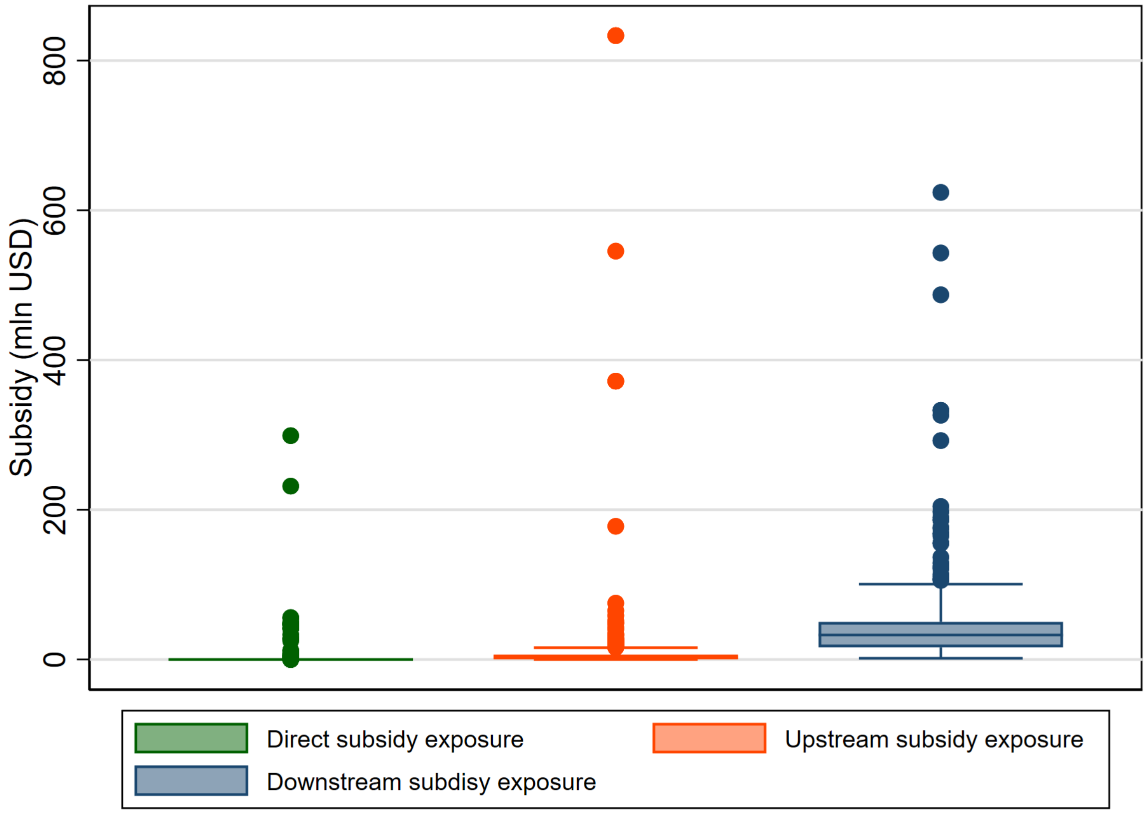
Notes: Subsidies' concentration as measured by the HHI for each 4-digit NAICS industry (the sample includes only recipient firms). The red bars represent the thresholds for highly concentrated (above 0.25) and moderately concentrated (above 0.15) industries, respectively. The average number of recipient firms in a 4-digit NAICS per given year is 21 firms.

Table A.4: Descriptive Statistics for Subsidy Exposure, 2000-2020

Variable	Obs.	Mean (USD)	Std. Dev.	# 0s	% 0s
		All industries (1179)			
Direct subsidy exposure$_{j,t}$	21,360	2,584,655	32,800,000	17,931	83.95
Downstream subsidy exposure$_{j,t}$	21,360	1,328,865	6,569,044	80	0.37
Upstream subsidy exposure$_{j,t}$	21,360	3,721,750	30,400,000	563	2.64
		Tradable industries (456)			
Direct subsidy exposure$_{j,t}$	9,120	1,747,313	19,900,000	7,823	85.78
Downstream subsidy exposure$_{j,t}$	9,120	5,273,686	38,800,000	20	0.22
Upstream subsidy exposure$_{j,t}$	9,120	1,203,317	6,110,789	268	2.94
		Non-tradable industries (612)			
Direct subsidy exposure$_{j,t}$	12,240	3,208,557	39,700,000	10,108	82.58
Downstream subsidy exposure$_{j,t}$	12,240	1,422,410	6,889,463	60	0.49
Upstream subsidy exposure$_{j,t}$	12,240	2,565,405	22,100,000	295	2.41

Notes: The unit of observation is a 6-digit NAICS code (for tradable and non-tradable industries). Industries are defined according to the 6-digit NAICS codes included in the CBP dataset, using the 2002 nomenclature. Downstream subsidy exposure$_{j,t}$ captures total subsidies granted in year t to industries i_s (both tradable and non-tradable industries) that are upstream to industry j, excluding industry j. I define this variable using the cost shares from the BEA I-O tables' direct requirements ($w_{i,j}$) and excluding the diagonal of the I-O matrix. Non-tradable industries are industries that never export in the period considered. This definition is highly correlated (0.85) with that of Mian and Sufi (2014).

Figure A.8: Distribution of Subsidies, 2000-2020



Notes: The boxplots display the distributions of Direct subsidy exposure$_{j,T}$, Upstream subsidy exposure$_{j,T}$, and Downstream subsidy exposure$_{j,T}$, with intervals indicating the 25th percentile (bottom line), the median (middle line), and the 75th percentile (top line) of the distributions. The figure shows non-transformed variables. Large subsidy packages can significantly influence the results and may appear as outliers in the data. For instance, in the case of upstream subsidy exposure, the NAICS code 212112 (coal industry) stands out. Its primary customer, the electricity sector, received a substantial 7.7 million USD in 2010, accounting for 64.7% of coal sales, well above the industry average.

A.3 OLS Regressions

Table A.5: Subsidies and Exports, OLS estimates, Yearly Level, 2000-2020

	Exports$_{j,t}$			
	(1)	(2)	(3)	(4)
Direct subsidy exposure$_{j,t}$	0.095***	0.046***	0.080***	0.040***
	(0.02)	(0.01)	(0.01)	(0.01)
Upstream subsidy exposure$_{j,t}$	0.0497	0.041*	0.059	0.034*
	(0.03)	(0.02)	(0.03)	(0.02)
Downstream subsidy exposure$_{j,t}$	0.487***	0.393***	0.432***	0.356***
	(0.09)	(0.11)	(0.11)	(0.10)
Controls	NO	NO	YES	YES
Year FE	YES	YES	YES	YES
Industry FE	NAICS-2	NAICS-4	NAICS-2	NAICS-4
Obs.	9,140	9,140	9,140	9,140
R^2	0.163	0.353	0.186	0.361

Notes: The table reports the OLS coefficients from estimating the equation: $Exports_{j,t} = \alpha + +\beta_1\ Direct\ subsidy\ exposure_{j,t} + \beta_2\ Downstream\ subsidy\ exposure_{j,t}\beta_3\ Downstream\ subsidy\ exposure_{j,t} + X_{j,t} + \delta_j + \delta_t + \epsilon_{j,t}$. The dependent variable, Exports$_{j,t}$, is the total export of tradable industry j in year t. Downstream subsidy exposure$_{j,t}$ is the weighted average of subsidies granted to all the industries i (tradable and non-tradable) that supply industry j in year t. Upstream subsidy exposure$_{j,t}$ is the weighted average of subsidies granted to all the industries i (tradable and non-tradable) that are supplied by industry j in year t (see Equation (3)). These two variables are constructed using BEA I-O direct requirements and excluding the diagonal of the I-O tables. δ_j and δ_t are industry and time-fixed effects to absorb industry-invariant and time-invariant unobservable characteristics. The dependent and independent variables are IHS transformed to handle outliers. $X_{j,t}$ is a set of industry-time specific controls, including the share of lobbying expenditure in industry j (IHS transformed), the GDP price deflator, and the share of subsidised firms in industry j. Standard errors are clustered at the 2-digit NAICS level. Significance codes: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table A.6: Subsidies and Exports, OLS estimates, Term Level, 2000-2020

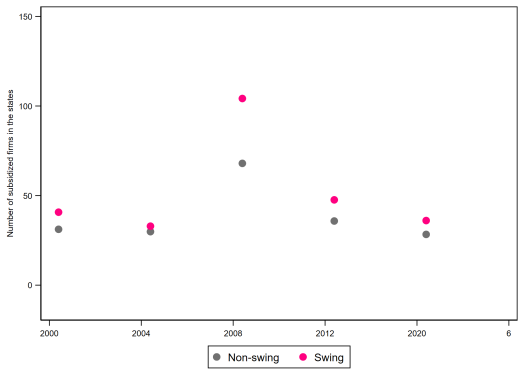
	$\text{Exports}_{j,T}$			
	(1)	(2)	(3)	(4)
Direct subsidy $\text{exposure}_{j,T}$	0.090***	0.037***	0.077***	0.033***
	(0.00)	(0.00)	(0.00)	(0.00)
Upstream subsidy $\text{exposure}_{j,T}$	0.075**	0.044***	0.078**	0.036***
	(0.03)	(0.00)	(0.02)	(0.01)
Downstream subsidy $\text{exposure}_{j,T}$	0.448***	0.408**	0.423***	0.372**
	(0.09)	(0.11)	(0.08)	(0.11)
Controls	NO	NO	YES	YES
Term FE	YES	YES	YES	YES
Industry FE	NAICS-2	NAICS-4	NAICS-2	NAICS-4
Obs.	2,280	2,280	2,280	2,280
R^2	0.131	0.381	0.190	0.391

Notes: The table reports the OLS coefficients from estimating the equation: $Exports_{j,t} = \alpha + +\beta_1\ Direct\ subsidy\ exposure_{j,T} + \beta_2\ Downstream\ subsidy\ exposure_{j,T} \beta_3\ Downstream\ subsidy\ exposure_{j,T} + X_{j,T} + \delta_j + \delta_T + \epsilon_{j,t}$. The dependent variable, $\text{Exports}_{j,T}$, is the total exports of tradable industry j in year t. Downstream subsidy $\text{exposure}_{j,T}$ is the weighted average of subsidies granted to all the industries i (tradable and non-tradable) that supply industry j in year T. Upstream subsidy $\text{exposure}_{j,T}$ is the weighted average of subsidies granted to all the industries i (tradable and non-tradable) that are supplied by industry j in year T . These two variables are constructed using BEA I-O direct requirements and excluding the diagonal of the I-O tables. δ_j and δ_T are industry and time-fixed effects to absorb industry-invariant and time-invariant unobservable characteristics. The dependent and independent variables are IHS transformed to handle outliers. $X_{j,T}$ is a set of industry-time specific controls, including the share of lobbying expenditure in industry j (IHS transformed), the GDP price deflator, and the share of subsidised firms in industry j. Standard errors are clustered at the 2-digit NAICS level. Significance codes: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

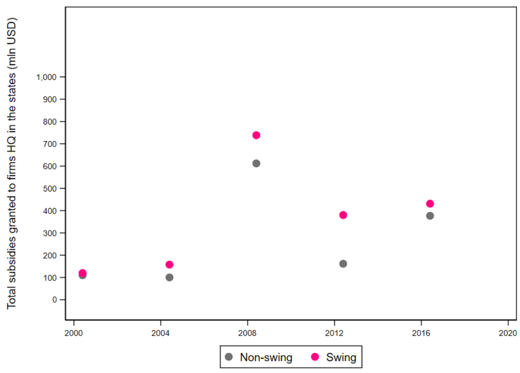
A.4 Swing Statistics and IV Assumptions

Figure A.9: Subsidies to Firms Located in Swing States, 2000-2020

(a) Number of Subsidised Firms

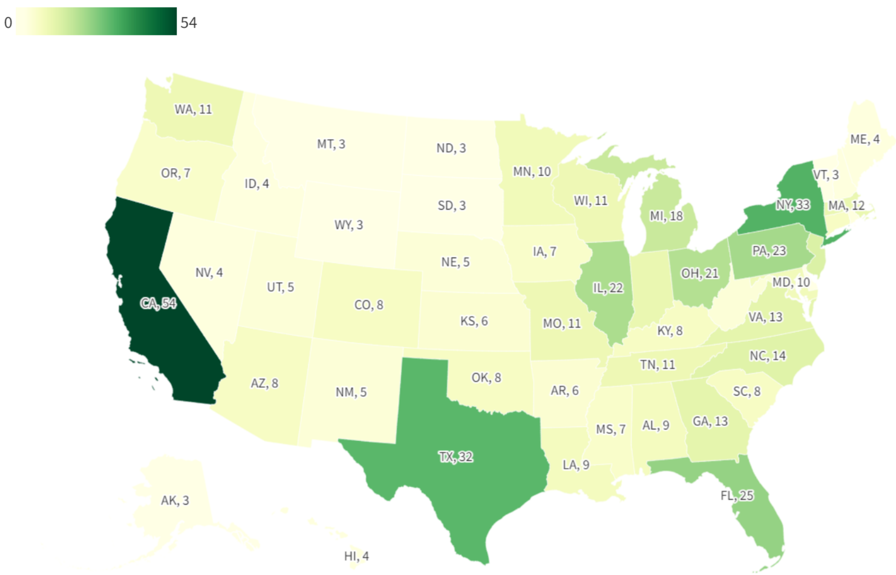


(b) Average Subsidies in Swing States



Notes: Sub-figure A: Total number of subsidised firms over a term T in the HQ states, averages by state group (swing vs. non-swing). Sub-figure B: Total value of subsidies granted to firms by HQ state over a term T in the HQ states, average by state group (swing vs non-swing). A state is classified as swing during term T if the difference in candidates' vote shares is $< 5\%$. Swing states in the last five elections were: in 2004, Colorado, Iowa, Michigan, Minnesota, Nevada, New Hampshire, New Mexico, Ohio, Oregon, Pennsylvania, and Wisconsin; in 2008, Florida, Indiana, Missouri, Montana, North Carolina, and Ohio; in 2012, Florida, North Carolina, Ohio, and Virginia; in 2016, Arizona, Colorado, Florida, Maine, Michigan, Minnesota, Nevada, New Hampshire, North Carolina, Pennsylvania, and Wisconsin; in 2020, Arizona, Florida, Georgia, Michigan, Nevada, North Carolina, Pennsylvania, and Wisconsin. I winsorise variables in the untransformed model to handle outliers (see Figure A.8), but my results prove robust without this adjustment. Period of analysis: 2000-2020.

Figure A.10: US States' Congressional Delegation, Electoral Votes, 2000



Notes: The map shows the number of electoral votes (EVs) assigned to each state of the United States, based on the 2000 Census. Darker states have more EVs.

Table A.7: Subsidies to Firms and Swing States, 2000-2020

	Subsidies to firms$_{s,T}$	Number of subsidised firms$_{s,T}$
	(1)	(2)
Swing shifter$_{s,T}$	0.878***	0.187***
	(0.22)	(0.04)
Obs.	255	255
R^2	0.288	0.038

Notes: Columns (1) reports the OLS coefficients from estimating the equation: $Subsidies\ to\ firms_{s,T} = \alpha + \beta\ Swing\ shifter_{s,T} + \epsilon_{s,T}$. Column (2) reports OLS coefficients from estimating the equation: $Number\ of\ subsidised\ firms_{s,T} = \alpha + \beta\ Swing\ shifter_{s,T} + \epsilon_{s,T}$. Swing shifter$_{s,T}$ is the interaction between the Swing state$_{s,T}$ dummy (equal to 1 if the difference in the candidates' vote shares in <5%) and electoral votes EV$_s$ assigned to that state. Subsidies to firms$_{s,T}$ is the total value of subsidies granted to firms headquartered in state s over term T. Number of subsidised firms$_{s,T}$ is the total number of subsidised firms headquartered in state s over term T. Subsidies are transformed using an IHS transformation to handle outliers (see Figure A.8). Robust standard errors in parenthesis. Significance codes: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table A.8: Identity of Swing States and Direct Subsidy Exposure, 2000-2020

	Swing state dummy$_{s,T}$	Difference in vote shares$_{s,T}$
	(1)	(2)
Direct subsidy exposure$_{s,T}$	4.53e-09	-3.63e-09
	(1.03e-08)	(2.60e-09)
State FE	YES	YES
Term FE	YES	YES
Obs.	255	255
R^2	0.441	0.843

Notes: Column (1) reports OLS coefficients from estimating the equation: $Swing\ state_{s,T} = \alpha + \beta\ Direct\ subsidy\ exposure_{s,T} + \delta_s + \delta_T + \epsilon_{s,T}$. Swing state$_{s,T}$ is a dummy equal to 1 if state s is classified as swing in term T (i.e., if the difference in candidates' vote shares is <5%). The dependent variable, Direct subsidy exposure$_{j,T}$, is the average subsidy granted to the tradable 6-digit NAICS industry j during term T. Column (2) reports coefficients from estimating the equation: $Votes\ difference_{s,T} = \alpha + \beta\ Direct\ subsidy\ exposure_{s,T} + \delta_s + \delta_T + \epsilon_{s,T}$. Votes difference$_{s,T}$ is the difference in the candidates' vote shares in presidential elections held at the end of term T. Five presidential terms from 2000 to 2020 are considered. Industry fixed effects are defined at the 4-digit NAICS level. Standard errors are clustered at the 2-digit NAICS level. Significance codes: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table A.9: Relevance of the IVs, 2000-2020

	Direct subsidy exposure$_{j,T}$	Down. subsidy exposure$_{j,T}$	Up. subsidy exposure$_{j,T}$
	(1)	(2)	(3)
$\text{IV}^{Swing}_{j,T}$	17.34***		
	(1.83)		
Downstream $\text{IV}^{Swing}_{j,T}$		2.503***	
		(0.075)	
Upstream $\text{IV}^{Swing}_{j,T}$			2.266***
			(0.019)
Industry FE	YES	YES	YES
Term FE	YES	YES	YES
Obs.	2,280	2,280	2,280
R^2	0.353	0.939	0.767

Notes: OLS estimates corresponding to the first stage of the 2SLS regression. Downstream subsidy exposure, is the average subsidy granted during term T to all the industries supplying the tradable 6-digit NAICS industry j. Upstream subsidy exposure, is the average subsidy granted during term T to all the tradable industries supplied by the 6-digit NAICS industry j. The variables Downstream $\text{IV}^{Swing}_{j,T}$ and Upstream $\text{IV}^{Swing}_{j,T}$ are defined in Equations (7) and (8). Five terms from 2000 to 2020 are considered. Industry fixed effects are defined at the 4-digit NAICS level. Standard errors are clustered at the 2-digit NAICS level. Significance codes: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

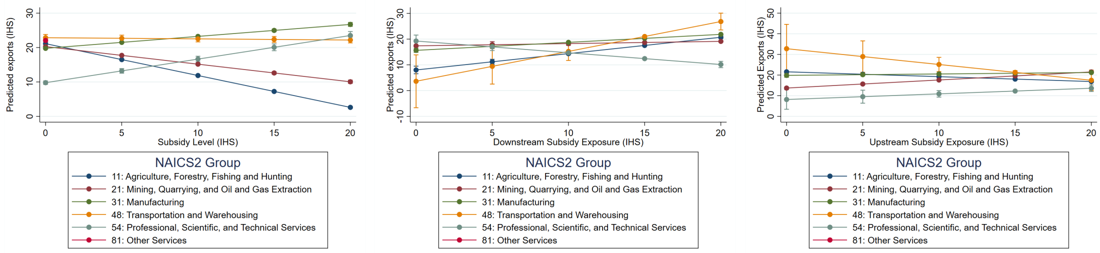
Table A.10: The Effects of Subsidies on Exports, 2000-2020, First Stage

		Direct subsidy exposure$_{j,T}$		
	(1)	(2)	(3)	(4)
Direct subsidy exposure$_{j,T}$	17.72***	16.53***	15.56***	15.60***
	(1.77)	(1.80)	(1.77)	(1.51)
Upstream subsidy exposure$_{j,T}$	-1.448***	0.0834*	-1.151***	0.107
	(0.05)	(0.04)	(0.10)	(0.06)
Downstream subsidy exposure$_{j,T}$	4.989***	1.427***	4.376***	1.510***
	(0.11)	(0.18)	(0.06)	(0.13)
R^2	0.091	0.354	0.115	0.359
		Upstream subsidy exposure$_{j,T}$		
	(1)	(2)	(3)	(4)
Direct subsidy exposure$_{j,T}$	3.869***	0.317*	3.707***	-0.358*
	(0.26)	(0.15)	(0.24)	(0.16)
Upstream subsidy exposure$_{j,T}$	2.382***	2.405***	2.379***	2.436***
	(0.02)	(0.01)	(0.02)	(0.01)
Downstream subsidy exposure$_{j,T}$	3.277***	2.014***	3.250***	1.985***
	(0.10)	(0.13)	(0.08)	(0.13)
R^2	0.205	0.760	0.205	0.763
		Downstream subsidy exposure$_{j,T}$		
Direct subsidy exposure$_{j,T}$	-1.549***	-0.496*	-1.558***	-0.646**
	(0.25)	(0.25)	(0.24)	(0.24)
Upstream subsidy exposure$_{j,T}$	0.189**	0.137***	0.188**	0.145***
	(0.06)	(0.01)	(0.06)	(0.01)
Downstream subsidy exposure$_{j,T}$	2.797***	2.423***	2.796***	2.404***
	(0.05)	(0.07)	(0.05)	(0.0)
7 R^2	0.838	0.936	0.839	0.937
Controls	NO	NO	YES	YES
Term FE	YES	YES	YES	YES
Industry FE	NAICS-2	NAICS-4	NAICS-2	NAICS-4
Obs.	2,280	2,280	2,280	2,280

Notes: First-stage coefficients from the estimation of Equation (12) with 2SLS. The first panel reports the first stage regression of direct subsidy exposure. The second panel reports the first stage regression of downstream subsidy exposure. The third panel reports the first stage regression of upstream subsidy exposure. The dependent and independent variables are IHS transformed to handle outliers. The sample includes five presidential terms from 2000 to 2020. Columns (1) and (3) include NAICS-2 and term fixed-effects; Columns (2) and (4) include NAICS-4 and term fixed-effects; Columns (3) and (4) include controls for the annual GDP-deflator, the share of subsidised firms in industry j, and the share of lobbying expenditure in industry j. I cluster standard errors at the 2-digit NAICS industry level. Significance codes: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Figure A.11: Effects of Subsidies on Exports by Sector, 2000-2020

(a) Direct Subsidy Exposure (b) Downstream Subsidy Exposure (c) Upstream Subsidy Exposure



Notes: The graphs illustrate the predicted effects of subsidy exposure on exports, including confidence intervals, derived from estimating the following equation with 2SLS: $Exports_{j,T} = \alpha + \beta_1\ Direct\ subsidy\ exposure_{j,T} * \delta_j + \beta_2\ Upstream\ subsidy\ exposure_{j,T} * \delta_j + \beta_3\ Downstream\ subsidy\ exposure_{j,T} * \delta_j + \delta_T + \epsilon_{j,T}$. The model features interactions between the main explanatory variables and NAICS 2-digit fixed effects to capture sector-specific heterogeneity. The explanatory variables are IHS-transformed to facilitate interpretation. The model also incorporates term fixed effects and clustered standard errors by NAICS 2-digit codes.

A.5 Robustness Checks

Table A.11: Effects of Subsidies on Exports, Rescaled Variables, 2000-2020

	Exports$_{j,T}$			
	(1)	(2)	(3)	(4)
Direct subsidy exposure$_{j,T}$	0.361***	0.618**	0.375***	0.626**
	(0.12)	(0.31)	(0.13)	(0.31)
Upstream subsidy exposure$_{j,T}$	0.122*	0.005	0.105*	0.008
	(0.07)	(0.04)	(0.06)	(0.05)
Downstream subsidy exposure$_{j,T}$	0.040	-0.076	0.055	-0.119
	(0.26)	(0.12)	(0.26)	(0.14)
Controls	NO	NO	YES	YES
Term FE	YES	YES	YES	YES
Industry FE	NAICS-2	NAICS-4	NAICS-2	NAICS-4
Obs.	2,280	2,280	2,280	2,280
KP F-statistic	5.873	2.049	5.296	2.178

Notes: Second-stage coefficients from the estimation of Eq. (12) with 2SLS. I rescale the outcome variable and the main explanatory variables as follows: $X^{'} = X*10,000$. The variables have then been IHS transformed. The dependent variable, Exports$_{j,T}$, is the yearly export value (USD) in the tradable industry j, averaged over the presidential term T. Direct subsidy exposure$_{j,T}$ captures direct exposure to subsidies. Downstream subsidy exposure$_{j,T}$ captures subsidies to customers of industry j. Upstream subsidy exposure$_{j,T}$ captures subsidies to suppliers of industry j. Subsidies include grants and tax credits but exclude loans, tax-exempted bonds, and insurance. Direct subsidy exposure only includes subsidies granted to tradable industries, while indirect subsidies include subsidies to tradable and non-tradable industries. Columns (3) and (4) include controls for the annual GDP-deflator, the share of subsidised firms in industry j, and the share of lobbying expenditure in industry j. The sample includes five presidential terms from 2000 to 2020 and 456 tradable industries. I cluster standard errors at the 2-digit NAICS industry level. Significance codes: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table A.12: Effects of Subsidies on Exports, Controlling for Trade Protection, 2000-2020

	$\text{Exports}_{j,T}$			
	(1)	(2)	(3)	(4)
Direct subsidy $\text{exposure}_{j,T}$	0.332***	0.399***	0.298***	0.365***
	(0.03)	(0.06)	(0.04)	(0.08)
Upstream subsidy $\text{exposure}_{j,T}$	0.067*	0.010	0.066*	0.029
	(0.04)	(0.02)	(0.04)	(0.02)
Downstream subsidy $\text{exposure}_{j,T}$	0.377***	0.082	0.379***	0.050
	(0.06)	(0.13)	(0.07)	(0.14)
Direct AD $\text{exposure}_{j,T}$	0.196***	0.316***	0.246**	0.357***
	(0.07)	(0.10)	(0.11)	(0.12)
Upstream AD $\text{exposure}_{j,T}$	0.190*	0.657**	0.151	0.579**
	(0.11)	(0.28)	(0.13)	(0.27)
Downstream AD $\text{exposure}_{j,T}$	-0.956**	-0.623***	-0.789**	-0.578***
	(0.39)	(0.19)	(0.33)	(0.19)
Industry FE	YES	YES	YES	YES
Term FE	YES	YES	YES	YES
Obs.	2,280	2,280	2,280	2,280
KP F-statistic	25.36	20.27	24.05	24.42

Notes: Second-stage coefficients from the estimation of Eq. (12) with 2SLS. The dependent variable, $\text{Exports}_{j,T}$, is the yearly export value (USD) in the tradable industry j, averaged over the presidential term T. Direct subsidy $\text{exposure}_{j,T}$ captures direct exposure to subsidies. Downstream subsidy $\text{exposure}_{j,T}$ captures subsidies to customers of industry j. Upstream subsidy $\text{exposure}_{j,T}$ captures subsidies to suppliers of industry j. Subsidies include grants and tax credits but exclude loans, tax-exempted bonds, and insurance. Direct subsidy exposure only includes subsidies granted to tradable industries, while indirect subsidies include subsidies to tradable and non-tradable industries. Columns (3) and (4) include controls for the annual GDP-deflator, the share of subsidised firms in industry j, and the share of lobbying expenditure in industry j. All regressions control for direct and indirect anti-dumping duties (AD) exposure. The sample includes five presidential terms from 2000 to 2020 and 456 tradable industries. I cluster standard errors at the 2-digit NAICS industry level. Significance codes: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table A.13: The Effects of Subsidies on Exports, First Terms, 2004-2020

	$\text{Exports}_{j,T}$			
	(1)	(2)	(3)	(4)
Direct subsidy $\text{exposure}_{j,T}$	0.313***	0.426***	0.272***	0.393***
	(0.03)	(0.08)	(0.05)	(0.09)
Upstream subsidy $\text{exposure}_{j,T}$	0.092***	0.067***	0.079**	0.075***
	(0.03)	(0.01)	(0.03)	(0.01)
Downstream subsidy $\text{exposure}_{j,T}$	0.322***	-0.009	0.348***	-0.046
	(0.05)	(0.17)	(0.05)	(0.18)
Industry FE	YES	YES	YES	YES
Term FE	YES	YES	YES	YES
Obs.	1,368	1,368	1,368	1,368
KP F-statistic	22.35	28.39	20.08	34.29

Notes: Second-stage coefficients from the estimation of Eq. (12) with 2SLS. The dependent variable, $\text{Exports}_{j,T}$, is the yearly export value (USD) in the tradable industry j, averaged over the presidential term T. Direct subsidy $\text{exposure}_{j,T}$ captures direct exposure to subsidies. Downstream subsidy $\text{exposure}_{j,T}$ captures subsidies to customers of industry j. Upstream subsidy $\text{exposure}_{j,T}$ captures subsidies to suppliers of industry j. Subsidies include grants and tax credits but exclude loans, tax-exempted bonds, and insurance. Direct subsidy exposure only includes subsidies granted to tradable industries, while indirect subsidies include subsidies to tradable and non-tradable industries. Columns (3) and (4) include controls for the annual GDP-deflator, the share of subsidised firms in industry j, and the share of lobbying expenditure in industry j. The sample includes only first terms (Obama, 2008; Trump, 2016; Biden, 2020) and 456 tradable industries. I cluster standard errors at the 2-digit NAICS industry level. Significance codes: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table A.14: The Indirect Effects of Subsidies on Exports, I-O Robustness, 2000-2020

	$\text{Exports}_{j,T}$			
	Including the I-O Diagonal		*Leontief Inverse Matrix*	
	(1)	(2)	(3)	(4)
Downstream subsidy $\text{exposure}_{j,T}$	0.475***		0.617***	
	(0.08)		(0.09)	
Upstream subsidy $\text{exposure}_{j,T}$		0.120**		0.357***
		(0.04)		(0.06)
Industry FE	YES	YES	YES	YES
Term FE	YES	YES	YES	YES
Obs.	2,280	2,280	2,280	2,280
KP F-statistic	1,129	13,613	1,907	16.30

Notes: Second-stage 2SLS coefficients, second-stage. In Columns (1) and (2), I regress exports on Downstream subsidy $\text{exposure}_{j,T}$, with industry and term fixed effects. In Columns (3) and (4), I regress exports on Upstream subsidy $\text{exposure}_{j,T}$, with industry and term fixed effects. I transform both the dependent and independent variables using an IHS transformation to handle outliers, but my results prove robust without this adjustment. The dependent variable, $\text{Exports}_{j,T}$, is the average export value in tradable 6-digit NAICS industry j in presidential term T. Downstream subsidy $\text{exposure}_{j,T}$ and Upstream subsidy $\text{exposure}_{j,T}$ are instrumented by Upstream $\text{IV}_{j,T}^{Swing}$, and Downstream $\text{IV}_{j,T}^{Swing}$, respectively. In Columns (1)-(2), I include the diagonal of the I-O tables when constructing Downstream subsidy $\text{exposure}_{j,T}$ and Upstream subsidy $\text{exposure}_{j,T}$ and their instruments. In Columns (3)-(4), I take a full-value chain approach, including higher-order linkages in the construction of Downstream subsidy $\text{exposure}_{j,T}$ and Upstream subsidy $\text{exposure}_{j,T}$ (I use the Leontief Inverse Matrixes, but I exclude the diagonal). To construct these variables, I use cost shares (total requirements) from the BEA I-O tables and total sales shares from Acemoglu et al. (2009). Standard errors are clustered at the 2-digit NAICS level. Significance codes: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table A.15: The Effects of Subsidies on Exports, 4-digit NAICS I-O Matrix, 2000-2020

	$\text{Exports}_{j,T}$			
	(1)	(2)	(3)	(4)
Direct subsidy $\text{exposure}_{j,T}$	0.326***	0.403***	0.290***	0.370***
	(0.03)	(0.06)	(0.05)	(0.07)
Upstream subsidy $\text{exposure}_{j,T}$	0.078*	0.004	0.076*	0.021
	(0.04)	(0.02)	(0.04)	(0.02)
Downstream subsidy $\text{exposure}_{j,T}$	0.299***	0.125	0.310***	0.085
	(0.05)	(0.12)	(0.05)	(0.12)
Industry FE	YES	YES	YES	YES
Term FE	YES	YES	YES	YES
Obs.	2,280	2,280	2,280	2,280
KP F-statistic	28.04	23.28	26.74	28.47

Notes: Second-stage coefficients from the estimation of Eq. (12) with 2SLS. The dependent variable, $\text{Exports}_{j,T}$, is the yearly export value (USD) in the tradable industry j, averaged over the presidential term T. Direct subsidy $\text{exposure}_{j,T}$ captures direct exposure to subsidies. Downstream subsidy $\text{exposure}_{j,T}$ captures subsidies to customers of industry j. Upstream subsidy $\text{exposure}_{j,T}$ captures subsidies to suppliers of industry j. The variables representing indirect exposure to subsidies are constructed using BEA I-O coefficients, excluding the 4-digit diagonal of the table. Subsidies include grants and tax credits but exclude loans, tax-exempted bonds, and insurance. Direct subsidy exposure only includes subsidies granted to tradable industries, while indirect subsidies include subsidies to tradable and non-tradable industries. Columns (3) and (4) include controls for the annual GDP-deflator, the share of subsidised firms in industry j, and the share of lobbying expenditure in industry j. The sample includes 5 first terms and 456 tradable industries. I cluster standard errors at the 2-digit NAICS industry level. Significance codes: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table A.16: Classification of Subsidies Based on Programs, Examples

Program	**Category**	**Description**
Bioenergy programme for advanced biofuels	Variable-cost reducing	Quarterly payments made for the actual quantity of eligible advanced biofuel produced during the quarter.
Oil recovery demonstration programme	Variable-cost reducing	Multi-year cost-shared enhanced oil-recovery contracts to increase production.
Payments for essential air services	Variable-cost reducing	Per passenger subsidy
Small Shipyards Grant programme	Investment promoting	Funding to make capital improvements to foster efficiency and quality ship construction and repair in small shipyards.
Advanced energy manufacturing tax credit (48cprogram)	Investment promoting	Tax credit for investments in advanced energy projects.
Biomedical Resource and Technology Development Grants	Investment promoting	For researchers who want to develop new technologies and tools (including informatics tools and software).

Note: Own-constructed classification based on the subsidy programme description, as available in Subsidy Tracker or federal agencies' websites.