



## 23-15 Modern industrial policy and the WTO

Chad P. Bown

December 2023

---

### ABSTRACT

This paper surveys the economics of industrial policy as it relates to the World Trade Organization (WTO). Motivated by concern that the modern use of industrial policy is emerging in ways that threaten cooperation in the international trading system, the paper begins with the basic historical economic framework for tying industrial policy to underlying market failures. It then introduces the dominant economic understanding of the role played by the WTO, it examines the WTO's rules on subsidies (and thus industrial policy), the unease with the evolution of the trading system's subsidy rules, gaps in knowledge, and important data and measurement shortcomings. The main part of the paper examines four areas motivating why modern industrial policy is different and why it has become so important for the trading system: China, supply chain resilience, supply chain responsiveness, and climate change. The paper identifies the evidence to date, open questions, and potential paths forward for economic research to help inform policymaker efforts to restore international economic cooperation in trade and industrial policy.

Chad P. Bown is the Reginald Jones Senior Fellow at the Peterson Institute for International Economics.

**JEL Codes:** F13, L52

**Keywords:** WTO, industrial policy, subsidies, China, supply chains, resilience, climate change

**Author's Note:** A revised version of this paper is forthcoming in the *Annual Review of Economics*. The author thanks seminar participants at Duke Law as well as Panle Jia Barwick, Thomas Bollyky, Rachel Brewster, Gene Grossman, Douglas Irwin, Nicolas Lamp, Tim Meyer, Nathan Nunn, Maury Obstfeld, Tom Prusa, Michele Ruta, Robert Staiger, Alan Sykes, Alan Wolff, and Mark Wu for useful conversations and suggestions and Jing Yan for excellent research assistance. Madona Devasahayam, Barbara Karni, and Melina Kolb provided editorial assistance. Nia Kitchin and Alex Martin assisted with graphics. Any remaining errors are the author's.

## 1. INTRODUCTION

To remain relevant in the international trading system, the World Trade Organization (WTO) may need its members to engage directly over the issue of industrial policy. The staff at the major international organizations—the International Monetary Fund (IMF), the Organization for Economic Cooperation and Development (OECD), the World Bank, and the WTO—have put out an explicit plea for a renewed work program and policymaker engagement on the issue.<sup>1</sup> This paper explains the new emphasis on industrial policy and explores priority areas for economic research to help inform policymakers at the front lines of the rules-based trading system.

For a number of overlapping reasons, today's industrial policy seems different from policy in the past. It is often forcefully pursued by major high-income industrial economies, including the United States, the European Union, and Japan, as opposed to emerging economies. China's use of industrial policy is both motivating these new users—sometimes to deploy industrial policy themselves, sometimes to defend their economies from China—and driving some of the associated WTO challenges. Today's industrial policy objective is also often less about learning for the first time how to competitively produce a good or acquire the necessary technological absorptive capacity to do so, which is what often motivated past infant industry policies for developing countries. Instead, the objective appears aimed at returning parts of a supply chain for industries ranging from semiconductors to personal protective equipment (PPE) that were once present but that have since been offshored.

Industrial policy today is also sometimes motivated by objectives other than increasing firm-level productivity or generating spillovers to other sectors and thus enhancing national economic growth. Instead, industrial policy is aimed at diversification in the name of supply chain resilience, fear over the weaponization of exports by trading partners, maintenance of technological supremacy, or the desire to offer future policymakers more control over economic activity in response to expected shocks. In the presence of cross-border supply chains, some governments are seeking to coordinate their industrial policies with key partners, as opposed to implementing everything at the national level in an attempt at reshoring. Overlaying other considerations is the existential threat of climate change, an important driver behind many modern industrial policy initiatives.

To explore these interrelated motivations for today's industrial policy and its numerous implications for the WTO, this paper is organized as follows. The next section briefly introduces the historical economic approach to industrial policy, borrowing from Harrison and Rodríguez-Clare (2010). The starting point of this literature is typically market failures, developing countries, and how industrial policy can improve firm-level productivity growth and possibly national economic growth.

Section 3 turns to the dominant economic framework motivating the WTO. It draws on Bagwell and Staiger (1999, 2002) as well as key WTO rules and the role of enforcement. The WTO is interpreted as providing an institutional setting

**This paper explains the new emphasis on industrial policy and explores priority areas for economic research to help inform policymakers at the front lines of the rules-based trading system.**

---

<sup>1</sup> See IMF, OECD, World Bank, and WTO, *Subsidies, Trade, and International Cooperation*, IMF Analytical Note 2022/001, April 22, 2022.

for large countries to coordinate policies and set rules on behavior to neutralize the international externality implications of their actions and solve a prisoner's dilemma problem. This section also explores the economic understanding of current subsidy rules with implications for industrial policy. It describes unease with the evolution of those rules, gaps in knowledge, and important data and measurement shortcomings.

The subsequent two sections form the heart of the paper. They introduce four areas in which modern industrial policy has emerged as a major issue for the WTO. Section 4 tackles the myriad challenges introduced by China. Section 5 examines areas of supply chain resilience, supply chain responsiveness, and climate change. The four issues are not cleanly separable; the last three are independent areas of concern, but China plays a critically important role in each. The last section concludes by motivating the need for further economic research.

## 2. INDUSTRIAL POLICY

Harrison and Rodríguez-Clare (2010) provide the core theoretical underpinnings for the economics of industrial policy, defined as deviations from policy neutrality.<sup>2</sup> Historically, much of the research on industrial policy was conducted through the lens of economic development, with a focus on economic growth, improvements in firm-level productivity, and sometimes diversification to prevent excessive concentration in commodities associated with boom-bust cycles. This framework provides an important starting point, although it has limitations for understanding today's industrial policy, for reasons described below.

The primary *economic* motivation for government intervention is typically a local economic externality or market failure. One is Marshallian, or intra-industry, externalities that are external to any firm; i.e., it is not simply a firm learning by doing or reducing its average costs as it expands output (Marshall 1920). These spillover benefits arise from the geographical agglomeration of an industry, perhaps tied to the emergence of a large pool of skilled labor from which multiple firms may be able to draw. Benefits can also occur because of local knowledge spillovers—i.e., a worker at one firm learns something it transmits to a worker at another firm through local interaction. Such externalities may also arise because of geographical proximity of specialized input suppliers.

Examples of Marshallian externalities include the agglomeration of high-tech industries into Silicon Valley or the Route 128 corridor outside Boston. They may also characterize the North American automotive supply chain—located around Detroit before expanding along a North American corridor nicknamed “auto alley” (Klier and Rubinstein 2008). These effects are not limited to high-tech goods. In China, for example, Qiaotou became the manufacturing location of 60 percent of the world's buttons and Wenzhou ended up making 95 percent of the world's cigarette lighters (Krugman 2011).

A second type of local spillovers are inter-industry externalities (sometimes referred to as *vertical spillovers*), whereby the expansion of one sector provides benefits to another. For example, a local financial or software industry—arguably

**The primary economic motivation for government intervention is typically a local economic externality or market failure.**

---

2 This definition is loose, as policy neutrality does not necessarily mean free trade, nondiscriminatory tax treatment between multinational and domestic companies, or a uniform tax rate across sectors. Grossman (1990) provides a useful early articulation.

important inputs for other parts of the economy—might generate productivity gains for downstream sectors. Alternatively, the emergence of a downstream industry could help upstream input providers expand and enjoy productivity gains of their own. This issue may be increasingly important and complex in an era in which production processes become more fragmented, with more input-output links in a lengthening supply chain, via both outsourcing and offshoring to a different country.

Other types of market failures include sector-specific coordination failures, such as convincing all local firms to adopt a similar standard so that they can jointly access a foreign market, when that foreign market makes a nontariff barrier determination at the country level, such as after an animal disease outbreak.<sup>3</sup> Another is information spillovers, or the “self-discovery” of newly profitable activities.<sup>4</sup>

Given such market failures, Harrison and Rodríguez-Clare (2010) illustrate conditions under which industrial policy can benefit a small, price-taking country. The first-best policy is often a Pigouvian subsidy, following the targeting principle (Bhagwati and Ramaswami 1963). An industrial policy can convert a country’s latent comparative advantage into a realized one if the underlying conditions clear two hurdles. The first is the Mill test (named after John Stuart Mill), which requires that the sector benefiting from the industrial policy can eventually survive on its own as a successful exporter once the policy is removed. The second is the more stringent Bastable test (named after Charles Bastable), which requires that the discounted future benefits exceed the costs of the industrial policy.<sup>5</sup>

There is emerging evidence that some episodes of industrial policy from recent history likely pass the Mill test.<sup>6</sup> For example, Manelici and Pantea (2021) find that tax breaks to workers in Romania’s information technology sector beginning in 2001 contributed to the expansion of its software industry, with spillover benefits to downstream sectors that use software intensively. Lane (forthcoming) revisits South Korea’s Heavy and Chemical Industry (HCI) Drive of 1973–79. He finds that, relative to firms in sectors that did not get access to subsidized credit, Korea’s industrial policy affected the firms’ input choices, productivity, output growth, output prices, and exports; shifted their comparative

**There is emerging evidence that some episodes of industrial policy from recent history likely pass the Mill test.**

3 Hausman, Rodríguez-Clare, and Rodrik (2005) point to the foot and mouth disease (FMD) outbreak in Uruguay as a coordination failure that, once resolved, allowed for access to the US beef market. Similar examples of coordination failures include the FMD outbreak in Argentina (Bown and Hillman 2017) and the melamine scandal that affected infant formula in the Chinese dairy industry (Bai, Gazze, and Wang 2022).

4 See, for example, Hausmann and Rodrik (2003).

5 These tests can be further complicated if the externality (or part of the externality) is ongoing, in which case even in the long run the subsidy will provide a benefit and the value of the policy does not depend on the industry being able to survive once the policy is removed. For other theoretical complications, see the analysis in Melitz (2005).

6 For episodes of industrial policy before the General Agreement on Tariffs and Trade (GATT)/WTO, Juhász (2018) examines the impact of the Napoleonic blockade (1803–15) on the long-run economic development of France’s mechanized cotton spinning industry. Irwin (2000) investigates whether US tariffs in the 19th century provided effective infant industry protection for the tinplate industry. Mitrunen (2023) focuses on Finland’s war reparations to the Soviet Union in 1944–52, which forced the largely agrarian country to temporarily support Soviet-prioritized industries. Juhász and Steinwender (forthcoming) and Juhász, Lane, and Rodrik (forthcoming) are recent surveys.

advantage; and spilled over to benefit downstream industries.<sup>7</sup> Few of these studies, however, examine whether the industrial policy passes a Bastable test.

For several reasons, including capture by special interest politics and corruption, some economists maintain a healthy skepticism about the ability of governments to implement industrial policy effectively (see Ades and Di Tella 1997). Furthermore, when industrial policy calls for subsidies, governments must levy additional taxes elsewhere in the economy, which may be distortive or put excess pressure on the state's administrative capacity. Finally, as will become clear in examples cited below, targeting industrial policy successfully may require policymakers have access to information—including input-output linkages up and down supply chains, the nature of market failures, and the conditions of market competition—that is either unrealistically detailed or that will require additional public investment in (and sharing of private sector) data that have previously been unavailable to government officials.

### 3. THE GATT, THE WTO, AND SUBSIDIES

To see how industrial policy fits into the WTO, this section introduces the dominant economic framework behind the rules-based multilateral system, its provisions on subsidies, how the rules are enforced in practice, as well as what (little) is known empirically about the prevalence of subsidies across countries and over time.

#### 3.1. The GATT and the WTO

The dominant economic framework for the WTO (and the GATT before it) involves governments of large countries using the institutional setting to coordinate policies to reduce the negative externalities they would otherwise impose on one another (Bagwell and Staiger 1999, 2002).<sup>8</sup> Negotiations between governments have led to the reciprocal reduction of tariffs, allowing market access (trade volumes) to expand to levels closer to global efficiency, neutralizing what would have otherwise been negative terms-of-trade (price) impacts resulting from unilateral tariff reductions. Under this modeling approach, the WTO helps solve a prisoner's dilemma problem by coordinating policies to move from a noncooperative to a cooperative equilibrium among governments. This view of the WTO is sufficiently general that it can accommodate governments retaining considerable national sovereignty over their domestic policies, including political pressure to use trade policy to redistribute between

**The dominant economic framework for the WTO (and the GATT before it) involves governments of large countries using the institutional setting to coordinate policies to reduce the negative externalities they would otherwise impose on one another.**

7 Other recent explorations into the HCI drive include Choi and Levchenko (2023) and Kim, Lee, and Shin (2022).

8 The other dominant motivation is the commitment theory (Maggi and Rodríguez-Clare 1998, 2007), where a government may benefit from external enforcement of trade policy to convince agents that it will not renege in the future even it has a unilateral incentive to do so. For a commitment theory of agreements limiting subsidies, see Brou and Ruta (2013).

local interest groups. A growing body of empirical evidence, from a wide range of settings, broadly supports this interpretation of the WTO.<sup>9</sup>

This research also documents how certain WTO principles help governments negotiate and sustain reciprocally open trade in practice. For example, the nondiscrimination across trading partners implied by the most-favored-nation (MFN) principle can help a world of more than two countries—where free-riding and other concerns emerge—get to and sustain efficient bargains. Nondiscrimination between foreign and domestically produced goods (once the foreign good has paid the tariff) implied by the national treatment principle contributes to preventing a government from taking away the market access implied by an earlier tariff reduction commitment through subsequent resort to domestic tax or regulatory policy that may otherwise shift the costs of such policies abroad.<sup>10</sup>

The GATT/WTO also has guidelines that apply when governments seek to change policies in response to shocks. Governments should expect to compensate trading partners; as such, many legal scholars view the GATT/WTO as having liability rules, some of which can promote efficient breach, which allow parties to break a contract when the costs of compliance (to the policy-changing country) exceed its benefits (to trading partners).<sup>11</sup>

For example, a government can raise a tariff above its WTO legal commitment without having to explain why. Under GATT Article XXVIII, the tariff increase must be notified to trading partners and is then subject to negotiation, in which the default compensation rule is for adversely affected partners to be permitted a limited tariff retaliation to rebalance market access reciprocally if no other form of compensation can be agreed.

Countries can also change their domestic policies. In some cases, the WTO provides guidelines on how to do so in ways that do not run afoul of its rules. However, even if a new policy violates WTO rules, the government needs to be prepared to bear the consequences (after challenges through formal dispute settlement proceedings) stemming from tariff retaliation only, which is typically limited to restoring a reciprocal balance of market access.

In both instances, the WTO does not prevent countries from making changes to their policies, and the recourse it permits is not punitive.<sup>12</sup> The WTO reduces uncertainty by helping to define the limits to the costs for policy changes, broadly ensuring that the government has designed the policy for the “right” reasons—such as to address market failures or local externalities—and not to shift its costs onto trading partners through international price movements, thereby creating a new international externality.

**The GATT/  
WTO also has  
guidelines that  
apply when  
governments  
seek to change  
policies in  
response to  
shocks.**

9 See Broda, Limão and Weinstein (2008), Ludema and Mayda (2013), and Nicita, Olarreaga, and Silva (2018) for tariffs; Bown and Crowley (2013) for triggering exceptions to tariffs under trade remedies; Bagwell and Staiger (2011) and Bagwell, Staiger and Yurukoglu (2020) for outcomes and bargaining under GATT/WTO negotiations; and Bown and Reynolds (2017) for outcomes under WTO dispute settlement. Bagwell, Bown and Staiger (2016) provide a survey.

10 See Horn (2006) and also Staiger and Sykes (2011).

11 For a discussion, see Staiger (2022, pp. 162-163), Schwartz and Sykes (2002), and Pauwelyn (2008). For a theory of the WTO as an incomplete contract, see Horn, Maggi and Staiger (2010).

12 For an early modeling approach and empirical evidence, see Bown (2002, 2004).

### 3.2. Evolving subsidy rules and enforcement: From the GATT to the WTO

The approach described thus far broadly applied under the GATT period (1947–94), as detailed by Sykes (2005). A government subsidy in place at the time of the many GATT negotiating rounds, for example, did not require removal (i.e., market access expectations that resulted from the round’s new reciprocal tariff cuts took them into account).

The GATT rules did seek to discipline the application of new subsidies. Consider the interactions among three countries: 1 (the subsidizing country), 2, and 3. New subsidies could affect access in three markets, with different implications for available recourse.

First, suppose country 1 has previously negotiated a market access concession (tariff binding) with country 2 and that, subsequent to these market access negotiations, country 1 introduces a new domestic production subsidy to its import-competing industry. The new subsidy reduces the export market access expected by country 2 that had been implied by country 1 taking on its tariff-binding commitment. GATT rules allowed country 2 to challenge such subsidies through a non-violation nullification and impairment (NVNI) claim under dispute settlement. Simply put, NVNI involves arguing that a government action resulted in a harmful, unexpected loss of market access, even though no explicit trade rules may have been broken. The prospect of such an NVNI complaint (and compensation) dealt with the concern that, in the absence of facing the true costs of its action, country 1 would introduce new subsidies to frustrate the market access expectations implied by tariff concessions that had just been negotiated.<sup>13</sup>

Second, suppose country 1’s production subsidy increases its exports to country 2’s import market and that country 2 objects to the injury caused to its import-competing industry by that subsidy. GATT rules permit country 2 to use a countervailing duty (CVD)—a tariff set at the size of country 1’s subsidy—to unilaterally restore the original conditions of competition between country 2’s import-competing producers and country 1’s (now subsidized) exporters, without need for a formal dispute adjudicated by a third party. (Foreign subsidies that lower the price of imports provide static gains to importing countries, as the benefits to consumers are larger than the immediate losses to domestic producers. Thus, resort to CVDs needs to be motivated on other grounds, such as adjustment costs, the political importance of the competing industry in the government’s objective function, or long-run market power concerns if the conditions were ripe for predation.)

Third, suppose country 1’s subsidy increases its exports to country 3’s import market, to which country 2 also exports. Country 2 is made worse off, because the subsidy also lowers the price received by its exporters in country 3’s market. The GATT had no provisions to handle this case, as neither a formal trade dispute (and NVNI claim) nor the CVD approach could tackle the problem faced by country 2.

The trading system’s rules on subsidies were tightened significantly in 1995 with the inception of the WTO and its new Agreement on Subsidies and

**The GATT rules did seek to discipline the application of new subsidies.**

<sup>13</sup> Staiger and Sykes (2013, 2017) explore NVNI claims in general. Bagwell and Staiger (2001) examine NVNI combined with market failures and thus a role for domestic policy.

Countervailing Measures (SCM). One contribution was introduction of the concept of “serious prejudice”—economic harm arising from subsidies affecting competing exporters in third country markets, where the NVNI doctrine did not reach under the GATT (Sykes 2005).<sup>14</sup> By the time of the Uruguay Round of negotiations, in the 1980s, subsidies affecting third-market competition, such as between the United States and Europe in commercial aircraft (Boeing versus Airbus), had become an area of concern. Farm subsidies in Europe, the United States, and elsewhere—sometimes leading to dumping in third-country markets—were worrisome enough that members introduced the separate WTO Agreement on Agriculture.

The SCM Agreement tightened subsidy disciplines in other ways. Bagwell and Staiger (2006) stress that subsidies suddenly became delinked from the market access implications of tariff negotiating rounds, because the SCM Agreement did not distinguish between new subsidies and subsidies that existed at the time of tariff negotiations or that applied to industries in which no tariff commitment had been made.<sup>15</sup>

Furthermore, only “specific” subsidies would be subject to WTO constraints; funding that is generally available to all firms would not. Specificity creates a tension with the notion of a Pigouvian subsidy to correct a particular externality that might arise only for certain industries or firms (and which might be first best, from the perspective of economic welfare).

The SCM Agreement also prohibits subsidies contingent on exports and local content (domestic as opposed to imported inputs).<sup>16</sup> Banning certain subsidies and making others “actionable”—and thus subject to trading partner recourse—may have been prompted by the practical challenges to prosecute NVNI claims and thus enforcement under dispute settlement. By 1995, it would have been increasingly difficult to link a new subsidy to a change in market access implied by a tariff concession made potentially decades earlier, in an early GATT round, given that so much else had changed (affecting supply and demand) in the interim. Furthermore, NVNI cases rely intensively on data, models, and economic evidence; WTO arbitrators have subsequently struggled when forced to credibly estimate the amount of lost market access to determine levels of authorized retaliation in the handful of disputes reaching that stage of the process.<sup>17</sup>

Subsidy policies became different from other policies challenged in formal WTO dispute along two additional dimensions. First, in principle, the dispute could reach the recourse (cost-imposing) phase sooner than other types of

**The SCM Agreement tightened subsidy disciplines in other ways.**

14 Serious prejudice could also apply to a loss of exports from the complaining country to the subsidizing country market (where previously the NVNI doctrine would have applied).

15 Bagwell and Staiger (2006) suggest that the stringency of the new rules has efficiency costs for the system relative to the GATT by making it more difficult for governments to negotiate and sustain low tariffs.

16 Sykes (2005) notes that local content subsidies are prohibited but that the content could have been subsidized directly by the government through a slightly different approach, to equivalent effect, and not been prohibited. For example, under the WTO, a government may be prohibited from offering subsidies to an automaker contingent on it using locally produced steel. However, the WTO does not prohibit a government from offering an equivalent scheme in which it subsidizes production of local steel.

17 Bown and Brewster (2017), for example, find that the estimates of lost market access and thus the tariff retaliation authorized in the *US-COOL* dispute seemed implausibly large, as they failed to control for factors affecting trade growth other than the policy during the period of interest, such as the macroeconomic fundamentals of the 2008 trade collapse.



disputes. Second, for prohibited subsidies, the language for compensation is for the complainant to adopt “appropriate countermeasures,” which, in principle could be larger than the authorization for nonsubsidy disputes.<sup>18</sup>

Although the WTO cannot stop any government action, its authorization of quicker and/or larger trading partner retaliation could shape policymaking behavior. This authorization could be beneficial if it halted subsidization that was inefficient or pushed the form of subsidies into those that do not generate international spillovers. It could also prove costly, however, if the rules inadvertently discouraged governments from first-best subsidies to address market failures or pushed them toward less efficient policy instruments simply because those other policies (e.g., tariffs or export restrictions) had either weaker disciplines or no disciplines at all. For example, GATT Article XI limits the use of quantitative restrictions on exports, but it does not constrain export taxes. Although China was required to take on commitments to limit its use of export taxes as part of its protocol of accession, efforts to enforce limits on China’s deployment of export restrictions have often proven ineffective, as described below.

### 3.3. Industrial policy theory in the WTO framework

The discussion so far has defined the country imposing the industrial policy as “small,” meaning that its policies have no impact on world prices and no discernible adverse effect on trading partners. For WTO purposes, this assumption can be interpreted in two ways. First, it makes little sense—at least under the terms-of-trade theory of trade agreements—for WTO rules to constrain a small countries’ policies, raising the question of who would have negotiated them in the first place. Second, if the subsidizing country were small, trading partners would also not be concerned with its use of industrial policy; any such rules would be superfluous as there would be no one to lodge a dispute settlement challenge anyway.<sup>19</sup>

Now assume that the countries are not small.<sup>20</sup> Harrison and Rodríguez-Clare (2010) explore the conditions under which the country imposing the industrial policy has the potential to affect world prices and therefore impose costs on trading partners. They show that sometimes this ability can result in negative international externalities—i.e., a deterioration of the other country’s terms-of-trade—which could lead to a reduction in its export market access. For this reason, the other country should be concerned and potentially want to resort to its rights under the WTO.<sup>21</sup>

**Although the WTO cannot stop any government action, its authorization of quicker and/or larger trading partner retaliation could shape policymaking behavior.**

18 Some subsidy disputes have authorized tariffs equivalent to the size of the subsidy (Bown and Ruta 2010; see also Grossman and Sykes 2011).

19 There may be alternative motivations for the government to want to tie its own hands, such as under the commitment theory (Brou and Ruta 2013). However, Bown and Hoekman (2008) note that, even in such settings, small countries require the credible external enforcement that is unlikely to emerge in the current WTO dispute settlement system.

20 This discussion considers only local market failures and externalities. The paper later examines how industrial policy is being used to tackle climate change, a particularly important global (cross-border) externality.

21 This research has parallels to the literature on strategic trade policy, in which the market is zero sum and the policy mainly shifts rents (or profits) from firms in one country to firms in another (for a survey, see Brander 1995).

In this case, the Bastable test—which considers only the financing and efficiency costs of imposing the industrial policy—would seem to be insufficient under fully enforceable WTO rules. If the industrial policy has adverse effects, trading partners could demand compensation that might involve lost export market access for a different good as a result of a trading partner being authorized to retaliate with higher tariffs.<sup>22</sup> Put differently, if the benefits to a country of an industrial policy just outweigh the cost, so that from a national perspective the Bastable test is passed, but some of the costs of the industrial policy are being passed onto trading partners through terms-of-trade movements, from an international perspective, the policy would not pass the Bastable test.

### 3.4. Measurement challenges to subsidies, industrial policy, and inference

For interconnected reasons, surprisingly little is known about the prevalence and importance of industrial subsidies across sectors and countries or their impacts on trading partners. Assembling such data is not impossible, given that the OECD has been providing estimates of support for the farm sector for many countries for decades.<sup>23</sup>

One challenge, however, is definitional. The SCM Agreement defines a subsidy as a financial contribution, by a government or any public body within the territory of a Member, that confers a benefit. But economically impactful subsidies can emerge outside of this definition. Suppose, for example, that there are two firms each in two countries, Home and Foreign (\*), respectively: firms A and A\* produce inputs, and firms B and B\* produce outputs from those inputs. The equivalent economic effect of an input subsidy to B (hurting B\*) could emerge under each of the following scenarios:

- The Home country imposes an export restriction on firm A.
- The Home country fails to enforce the intellectual property of the foreign firm, A\*.
- Firm A is a state-owned enterprise (SOE), with a welfare function that includes social objectives (e.g., employment, national security, maximization of market share, maximization of exports, etc.) that differ markedly from those of firm A\*, a profit-maximizing firm.

One important US complaint at the WTO has been definitional. China has argued that its SOEs are not “public bodies” and thus cannot confer subsidies to downstream firms. The United States has argued that they are public bodies; as a result, since 2007 it has imposed countervailing duties on imports from China

For interconnected reasons, surprisingly little is known about the prevalence and importance of industrial subsidies across sectors and countries or their impacts on trading partners.

22 A handful of disputes resulted in respondent countries agreeing to cash transfers in lieu of suffering tariff retaliation. In *United States-Section 110(5) of the US Copyright Act*, the United States paid the European Union a lump sum of \$3.3 million; in *US-Upland Cotton*, the United States paid Brazil \$147.3 million a year for a number of years.

23 OECD Agricultural Support (indicator), doi: 10.1787/6ea85c58-en, accessed on September 8, 2023.

benefiting from subsidized inputs from those SOEs.<sup>24</sup> China's SOEs are pervasive across a variety of input-providing sectors to the economy (e.g., banking, energy, other upstream industries) and have grown over time. But it is not only Chinese SOEs. The Chinese state controls access to land, another critical input, and the Chinese Communist Party may place members on the boards of companies or otherwise influence firm decisions away from profit maximization toward other objectives (Wu 2016). A related definitional issue for policymakers is whether, for the purposes of the often substitutable trade remedy of antidumping, China is a nonmarket economy.<sup>25</sup>

Yet, stepping back from the China case, these definitional issues of input subsidies are nontrivial and raise a number of thorny questions. For example, when it comes to subsidizing critical inputs, many governments in high-income economies prioritize the funding of education. Suppose one country prioritizes vocational training and apprenticeships—which may disproportionately affect manufacturing—whereas another funds research universities that affect R&D and innovation. Public funding to lower the costs of education can be expected to benefit some sectors more than others. Is the public provision of human capital acquisition also a subsidy that WTO rules should have to consider?

Going back to China, another concern involves the country's explicit use of state-led industrial policy. It continues to deploy five-year plans, including the highly controversial "Made in China 2025" policy rolled out in 2015. Its subsidies can arise through additional policy instruments. Its export restrictions on inputs subsidize downstream parts of a supply chain, including by selectively targeting rebates of value-added taxes, in sectors like aluminum (OECD 2019a). State-banked financial capital funds have been deployed for strategic sectors like semiconductors (OECD 2019b). Trading partners have accused China of actively forcing the transfer of foreign technology through joint ventures with local, state-owned firms, as highlighted in the US government's Section 301 reports motivating the trade war.<sup>26</sup>

The combination of Chinese policies and state-centric objectives exacerbates existing challenges for standard WTO dispute settlement to tackle enforcement of subsidy disciplines. China's interventions may be more difficult than other countries' subsidies to detect. Furthermore, a Chinese subsidy may hurt a trading partner, but without any observable transfer of funds between the government

**The combination of Chinese policies and state-centric objectives exacerbates existing challenges for standard WTO dispute settlement to tackle enforcement of subsidy disciplines.**

---

24 The US government began to grapple with this issue when it faced requests to reverse a 1986 decision (*Georgetown Steel*) that had decided against using CVDs to address imports from nonmarket economies such as the Soviet Union and China. In 2007, it reversed the decision and developed methodologies to assess when Chinese firms were benefiting from subsidies and thus began to impose CVDs (see Department of Commerce, *Antidumping Duty Investigation of Certain Lined Paper Products from the People's Republic of China (China)*, *China's Status as a Non-Market Economy (NME)*, A-570-901, August 30, 2006; *The People's Republic of China (PRC) Status as a Non-Market Economy (NME)*, A-570-901, May 15, 2006; and *Countervailing Duty Investigation of Coated Free Sheet Paper from the People's Republic of China. Whether the Analytical Elements of the Georgetown Steel Opinion Are Applicable to China's Present-Day Economy*, C-570-907, March 29, 2007).

25 For a discussion of the issues surrounding China's nonmarket economy status, see Bown (2016).

26 Office of the United States Trade Representative (USTR), "Findings of the Investigation into China's Acts, Policies, and Practices Related to Technology Transfer, Intellectual Property, and Innovation under Section 301 of the Trade Act of 1974," March 27, 2018; "Update Concerning China's Acts, Policies, and Practices Related to Technology Transfer, Intellectual Property, and Innovation," November 20, 2018.

and the agents engaging in economic transactions, it is difficult to measure the size of that subsidy and then link it to the harm experienced in the other country.

These features of the Chinese economy matter for at least three reasons. First, China may be more likely—relative to other countries or to itself under a different system—to subsidize. Second, the pervasiveness of and uncertainty over China’s subsidies may lead trading partners (like the United States) to impose trade remedies on more products and at higher rates in response because they are provided additional institutional flexibility to do so. (Allowing China to be treated as a nonmarket economy, for example, provides government officials discretion to turn to third-country cost data to represent Chinese industry.) Third, given how trade remedies work, the first two reasons combine to make it more likely that third-country exporters will be caught up in other countries’ trade restrictions imposed on China, putting additional stress on their trade relations as well as the trading system.

**These features of the Chinese economy matter for at least three reasons.**

### **3.5. Limited information on subsidies, industrial policy, and which inferences to draw**

Surprisingly little is known about the size and prevalence of subsidies or their impact on trading partners. However, at least three potential sources of data—use of trade remedies, subsidies themselves, and formal WTO disputes—provide a starting point.

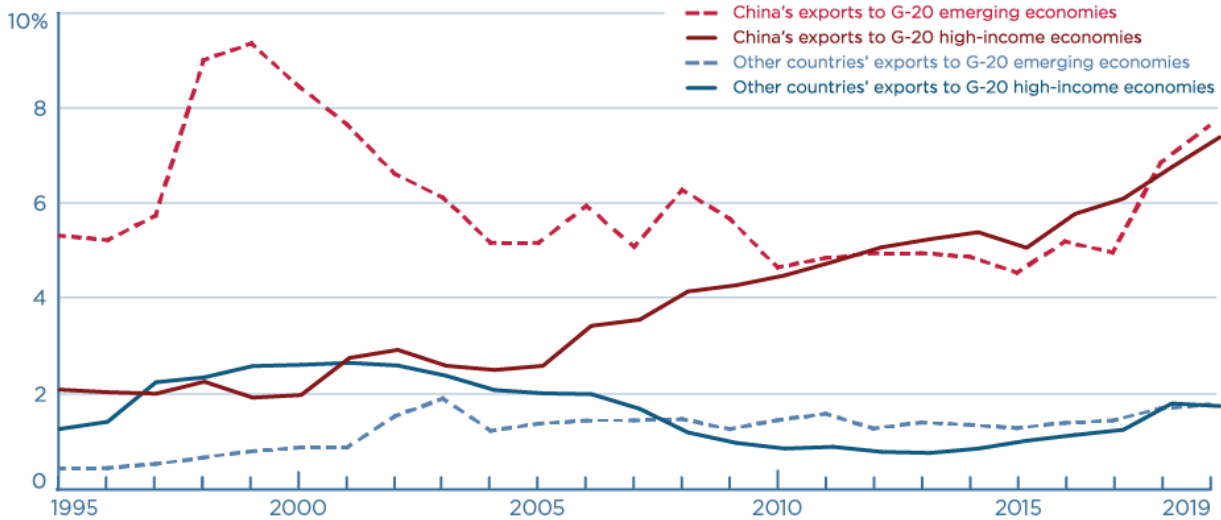
First, a telling sign about the importance of China’s industrial policy and its economic system to generate conflict comes from other countries’ use of trade remedies to address those subsidies. By 2019, more than 7 percent of China’s exports to the Group of 20 (G-20) economies had become subject to CVDs or one of the other, substitutable, trade remedies, and the share has been growing (figure 1, panel a). Despite differences in their legal criteria, the nature of the Chinese economy has allowed foreign governments to substitute across trade remedy instruments. The most common instrument is antidumping, though for many countries, CVDs are growing in use, following the US lead described earlier (panel b).

There is evidence consistent with the negative spillover identified above: Exporters in third countries increasingly face trade restrictions over the same product as China’s exporters (figure 2). China’s subsidies may thus not only cause its exporter to get caught up in a foreign trade remedy but third-country exporters (who lower their prices in that foreign market to compete with China) can be accused of dumping (antidumping) or at least causing injury (safeguards) and also face trade restrictions. It is these trade restrictions—imposed on third-country exporters but traced back to China—that have generated some of the most contentious disputes in the WTO system to date. For example, the US tariffs that were imposed on third-country exports of steel and aluminum beginning in 2018 resulted in both immediate, extra-WTO retaliation by US allies and formal WTO disputes with controversial legal rulings.<sup>27</sup> (Figure 2 does not capture those tariffs because they were imposed under a national security law rather than as a trade remedy; figure 2 therefore provides a lower bound on the empirical importance of this phenomenon.)

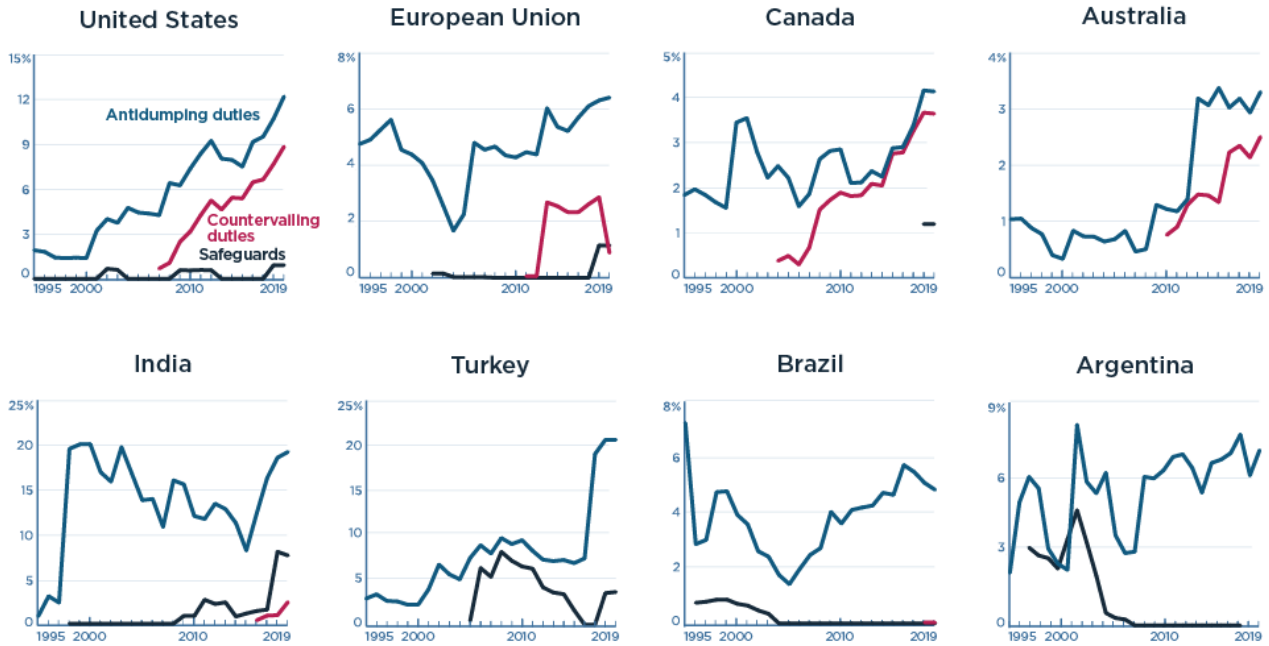
27 See Chad P. Bown, “To Build Back Better, Biden Needs to Fix Trade. Trump Has Left a Ticking Time Bomb at the WTO,” *Foreign Affairs*, January 21, 2021; and Chad P. Bown, “The Dreaded WTO Ruling on Trump’s National Security Tariffs,” *Trade Talks*, Episode 175, January 22, 2023.

**Figure 1**  
Trade remedies have increasingly targeted China's exports since 2010

a. Percent of exports to G-20 covered by trade remedies by source, 1995–2019



b. Percent of imports from China subject to safeguards, antidumping, or countervailing duties, 1995–2019



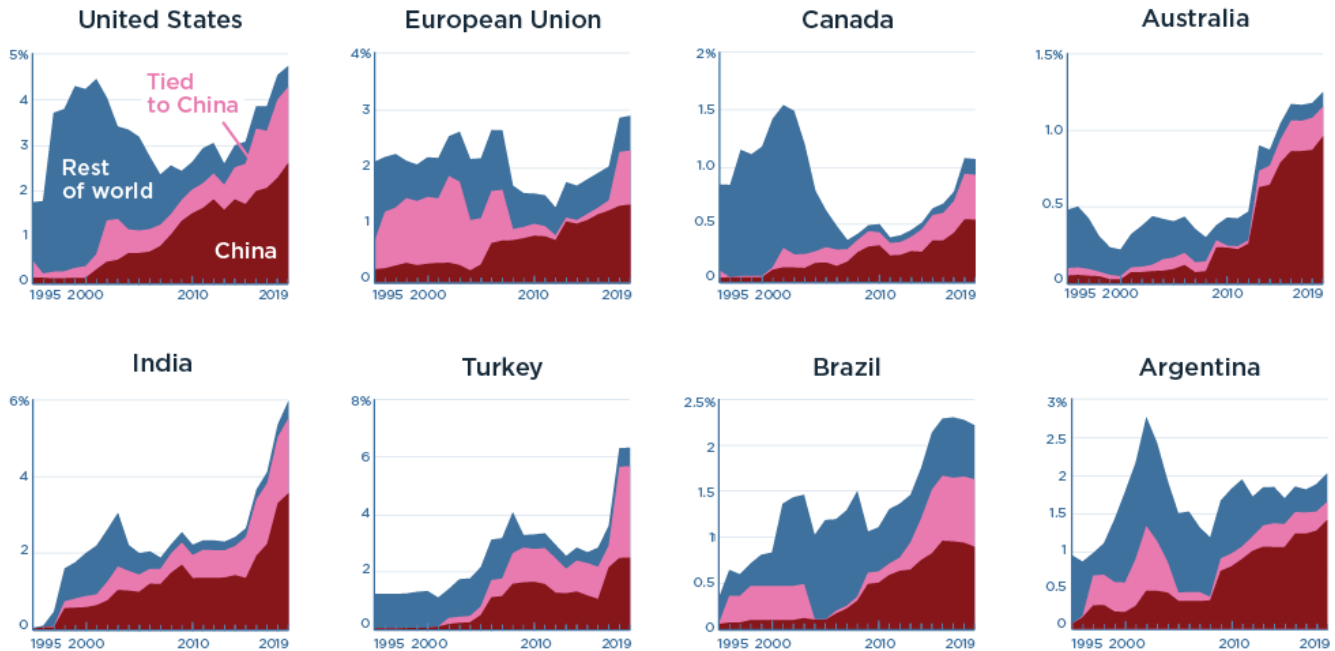
G-20 = Group of Twenty

Note: Trade remedies include antidumping, countervailing duties, and safeguards. Saudi Arabia is omitted because its data were not available. Data do not capture the US-China trade war tariffs, the US steel and aluminum (national security) tariffs, or the counter-tariffs imposed in retaliation in 2018–19.

Source: Bown (2022c, figure 2 and figure 3).

**Figure 2**  
**China’s exports are the main target of all the major G-20 users of trade remedies, but third-country exporters may increasingly face trade remedy spillovers**

Percent of imports subject to trade remedies by source, 1995–2019



G-20 = Group of Twenty

Note: Trade remedies include antidumping, countervailing duties, and safeguards. Tied to China refers to products from other countries subject to trade remedies that simultaneously or earlier targeted China’s exports.

Source: Bown (2022c, figure 4).

Second, in theory, many sources of data could be combined to provide useful information about the prevalence of subsidies. For example, the Global Trade Alert (GTA) has created a database on changes to government measures since 2008 (Evenett 2009).<sup>28</sup> The GTA is only a gateway to an improved empirical accounting for subsidies, however, especially when seeking to draw inferences from aggregate data across countries or over time. One challenge is definitional. (As described earlier, US policy is distinct in its transparency; Chinese subsidies lie at the other extreme.) Another is that evidence of more subsidies could be associated with policymaking improvements—e.g., shifting from a third-best import tariffs to a second-best instrument—or even to governments deploying first-best policies that target externalities or market failures. For example, the large government subsidies supporting the acceleration and capacity enhancement of COVID-19 vaccine supply chains in 2020–21 was a positive signal; if anything, governments significantly undersubsidized relative to the size of the coronavirus externality (Athey et al. 2022).

28 Juhász et al. (2023) use machine learning to draw inference regarding GTA data for policymaker intent on using industrial policy.

Third, only limited inference can be drawn from formal WTO dispute settlement activity involving subsidies.<sup>29</sup> Between 1995 and 2019, WTO members filed 593 disputes total against one another. Of those, 129 involved “subsidies,” with the complaining country referring to the SCM Agreement. However, fewer than 80 of those disputes challenged the underlying subsidy. The rest challenged the trade remedy—i.e., an importing government’s response to the subsidy.

WTO members requested dispute settlement consultations with China over its subsidies only 16 times between 2001 and 2019. Over this period, trading partners brought over 60 disputes against US trade remedies, with China alone bringing 10 of them.

Very few subsidies have been challenged at the WTO for several reasons. First, the dispute settlement system requires state-to-state enforcement but demands that evidence be made available by private sector interests. Governments often lack subpoena power, and multinational companies with investment interests in the subsidizing country may be making a large enough profit on those other interests to be loath to complain.

Second, the free-rider problem means that the system may underinvest in dispute settlement cases needed to keep subsidy use in check. Suppose a government with limited resources to spend on WTO litigation must choose which of two foreign market access violations to litigate. One would fix an MFN violating policy that hurts only its exporters; the other is a national treatment violation (like a subsidy), which hurts multiple countries’ exporters.<sup>30</sup> Disputes of the latter type will be less likely to arise, because the benefits of the removal of such policies spill over and are not fully captured by any one complainant.

Third, such WTO disputes are data intensive; by the time the evidence showing that there were adverse effects materializes, it is too late to matter: The foreign subsidized industry is established (the subsidy has done its job), and even a dispute the complainant wins allows only for retaliation until the subsidy is removed. (WTO recourse is prospective and not retrospective in nature.)

**Very few subsidies have been challenged at the WTO for several reasons.**

#### **4. CHINA, INDUSTRIAL POLICY, AND THE WTO**

The size and role of the state in the Chinese economy has increased over the last decade, especially under President Xi Jinping, after initially declining after the country’s accession to the WTO in 2001 (Lardy 2014, 2019). This reversal has dispelled any notion that China would transition into a market-oriented economy and that the associated challenges for the trading system of its nonmarket system would dissipate organically over time. China’s economy is now so large and intertwined with others through buying and selling (imports and exports) and supply chains that even its domestic policies can impose considerable externalities on trading partners.

29 Maggi and Staiger (2018) provide a theory of trade disputes that shows the difficulty of drawing inferences from the existence of WTO disputes more generally.

30 See, for example, Bown (2005) and Bown and Reynolds (2015).

#### 4.1. Economic research into China's industrial policy

Economists have begun to grapple with China's use of industrial policy and its implications for trading partners and the rules-based trading system.

Consider the illustrative case study of Chinese shipbuilding. At the turn of the century, China had only about 10 percent of global shipbuilding, which was dominated by firms in Japan and Korea. As part of its 11th (2006–10) and 12th (2011–15) national five-year plans, China implemented a series of industrial policies to promote the sector. By 2009, it had become the largest shipbuilder in the world, with roughly 50 percent of global market share.

Kalouptsidi (2018) and Barwick, Kalouptsidi, and Zahur (forthcoming) present novel approaches to detect the existence of the Chinese subsidies, estimate their size, and begin to assess their impact. Lacking access to detailed information on the exact policy instruments but knowing their timing, the research approach relies on a structural model of the global shipbuilding industry that is able to recover the size of the subsidies by estimating the cost structure of Chinese firms before and after policy implementation and then to use that information, along with the model, to examine the subsidies' impact.

Barwick, Kalouptsidi, and Zahur (forthcoming) find that Chinese industrial policy between 2006 and 2013 was effective, more than doubling China's domestic investment and firm entry. However, the policy resulted in only a slight increase in Chinese firm profitability and worldwide consumer surplus gains through lower prices. Interestingly, the policy introduced global inefficiency, with excessive fragmentation of the industry and low levels of capacity utilization. There was also no evidence of learning by doing, calling into question one important potential motivation behind the policy in the first place. (They find that marginal costs tended to increase, rather than decrease, in past production, measured at both the firm and industry levels.)

From the potential perspective of the WTO, the evidence is consistent with China being a large country, whose industrial policy has ramifications for its trading partners. Although China's policy had a positive, albeit small, impact on the world's consumers, by lowering freight rates, the major impact arose through the global reallocation of production, as China's market share in shipbuilding increased by 42 percent between 2006 and 2013. Only 30 percent of China's expansion translated into higher world output, however; 70 percent was business stealing from Japan and South Korea. Chinese subsidies caused market share to fall from 48 percent to 39 percent in South Korea and from 23 percent to 20 percent in Japan, with significant reductions in their firms' profits. Third-market competition was also important, as export shares of domestic ship production in 2016 were over 80 percent for China, 90 percent for South Korea, and over 50 percent for Japan (Gourdon 2019).

Batteries for electric vehicles (EVs) are a second important example of China's industrial policy. Between 2010 and 2020, battery prices for EVs fell by nearly 90 percent. Barwick et al. (in progress) model the global EV and battery industry supply chains. They find strong evidence of firm-level learning by doing, with production costs falling as a company gains manufacturing experience. Because many governments—including in China, the United States, Japan, and countries in Europe—during this period implemented nondiscriminatory consumer subsidies for EVs to incentivize potential buyers to switch over from

**Economists have begun to grapple with China's use of industrial policy and its implications for trading partners and the rules-based trading system.**



internal combustion engine vehicles, such subsidies can potentially accelerate learning by doing.

In 2016, China also implemented a discriminatory local content policy, through a “whitelist” that made its EV subsidies contingent on the vehicle’s battery being provided by a small set of only (it would turn out) Chinese firms, such as BYD and CATL. This policy remained in place until mid-2019.<sup>31</sup> Barwick et al. (in progress) estimate that the Chinese whitelist policy increased sales of Chinese battery firms considerably, mostly through business stealing at the cost of non-Chinese firms, with Korean battery companies (including LG Energy Solution, SK On, and Samsung SDI) suffering the most.

In the downstream industry, EVs with BYD and CATL batteries experienced faster price reductions than other automakers—suggesting that the whitelist policy for batteries may have worked like an implicit subsidy to EVs—as EV companies were able to pass on much of the battery cost reduction (the result of learning by doing) onto car buyers. The authors also find that China’s whitelist policy negatively affected global EV sales and efficiency, however, as it shifted EV automaker sourcing from battery firms that were initially low cost to higher-cost suppliers.

#### 4.2. Implications for WTO enforcement of subsidy rules

Evidence of business stealing for shipbuilding and EV batteries means that Japan and South Korea may have had their WTO market access rights violated by China’s industrial policy. Puzzlingly, neither pursued a WTO dispute against China over either issue. These decisions were not simply domestic collective action problems; Japan initiated formal WTO disputes against Korea’s shipbuilding industry in 2018 and 2020. And the South Korean battery companies were part of *chaebols*—giant multinational conglomerates—and were politically organized enough to engage the implementation of the US industrial policymaking process for EV supply chains shortly thereafter, for example.<sup>32</sup> Furthermore, there have been other high-profile disputes over use of industrial policy at the WTO, most notably the lengthy and costly US–EU disputes over subsidies to Boeing and Airbus.<sup>33</sup>

Why countries other than the United States were mostly unwilling to use WTO dispute settlement to challenge China’s domestic policies, including its discriminatory subsidies and industrial policy, has long been a puzzle (Bown and Keynes 2020). Possible explanations include the WTO system’s demand for economic evidence implying the participation of business interests. Multinational companies with a presence in China may have been fearful to engage, given China’s history of using economic coercion and its acts of extra-WTO retaliation,

**Evidence of business stealing for shipbuilding and EV batteries means that Japan and South Korea may have had their WTO market access rights violated by China’s industrial policy.**

31 See S&P Global Market Intelligence, “China Continues Support for New-Energy Vehicles Despite Subsidy Phaseout,” *News & Insights*, November 11, 2019; Qichao Hu, “In Honor of John B. Goodenough’s 100th Birthday: What America Can Learn from China’s Success in EV batteries,” *SES*, July 22, 2022.

32 These companies publicly responded to requests for information by the fall of 2022, when the US Treasury was seeking stakeholder feedback to inform the regulations to implement the Inflation Reduction Act (Bown 2024).

33 In simulation results, Irwin and Pavcnik (2004) find that EU subsidies to develop the Airbus A-380 lowered prices to consumers but with a negative impact on Boeing’s sales, thus motivating a dispute.

including against Japanese and Korean firms. In its 2010 response to Japan's detention of a shipping trawler over disputed territorial waters, for example, China restricted exports of rare earth metals needed for EVs and other high-tech products. At the height of the China batteries policy period, in 2017, China separately began using acts of economic coercion against Korean companies following the Korean government's decision to implement the THAAD missile system.<sup>34</sup> In 2023, when the European Union self-initiated a CVD investigation into subsidized Chinese EVs that could result in tariffs, China immediately retaliated by announcing export restrictions on graphite, a material critical for battery manufacturing.<sup>35</sup>

The explanation may be even more complicated for China's subsidies. For prohibited subsidies (e.g., local content and export subsidies), there is less of an evidentiary burden, so the dispute resolution process may be quicker. Yet, for other subsidies, it is often necessary to show economic effects. It can take years for the effects to turn up in the data, with evidence arriving only with a lag. By then, the capacity has been installed, and it may be too late to stop (or reverse) the economic effects. Thus, although multiple studies find evidence of serious market access implications of discriminatory subsidies, such cases may have been too difficult to prosecute under the WTO, as the evidence relies heavily on (a) structural economic models that may not be amenable to litigation between sovereign states and (b) a legal process that is short on economic expertise and dispute settlement panels that may not be adept at handling complex economic fact patterns.<sup>36</sup>

Nevertheless, these new research approaches to study industrial policy provide an important starting point for understanding challenges facing the WTO, given the China problem.<sup>37</sup> A fruitful research agenda would be to examine other sectors—including steel, aluminum, and solar panels—in which policymakers have raised similar concerns that Chinese industrial policy resulted in sizable, negative international externalities with implications for other WTO members, in which Chinese firms are allegedly benefiting from industrial policy where the trading partner policy response to date has been limited to tariffs. Of course, tariffs do not tackle the source of the problem associated with China's industrial policy, leaving trading partners with additional concerns in both the Chinese domestic market and in third-country markets as competing exporters.

**These new research approaches to study industrial policy provide an important starting point for understanding challenges facing the WTO, given the China problem.**

34 See Keith Bradsher, "Amid Tension, China Blocks Vital Exports to Japan," *New York Times*, September 22, 2023; Darren J. Lim and Victor Ferguson, "Chinese Economic Coercion During the THAAD Dispute," *ASAN Forum*, December 28, 2019.

35 See Alice Hancock, Henry Foy, Hudson Lockett, and Peter Campbell, "EU to Launch Anti-Subsidy Probe into Chinese Electric Vehicles," *Financial Times*, September 13, 2023; Edward White, William Langley, and Harry Dempsey, "China Imposes Export Curbs on Graphite," *Financial Times*, October 20, 2023.

36 For a discussion, see Bown (2010).

37 In an alternative approach, Branstetter, Li, and Ren (2022) and Branstetter and Li (2022) provide formal econometric analysis of China's industrial policy since 2007, particularly its "Made in China 2025" policy. They not find no evidence that firms targeted by such policies perform better than nontargeted firms on several standard economic criteria. Aghion et al. (2015) examine the impact of industrial policy on Chinese medium-size and large firms in an earlier era (1998–2007). They find productivity growth associated with industrial policies targeting sectors that were competitive or fostered competition. These analyses do not formally examine the international implications of such policies in terms of their impact on trading partners.

Furthermore, the partner's tariff response has often generated new trade conflicts when it also hits third-country exports (see figure 2).

Another politically and technologically important sector is semiconductors. OECD (2019b) used creative data collection techniques to back out the size of subsidies received by firms by examining firm balance sheets and income statements.<sup>38</sup> Advanced economies other than China are now targeting the semiconductor industry with industrial policy of their own (see below), where Chinese firms have struggled to manufacture the most sophisticated chips at the technological frontier.

### 4.3. Motivations for WTO engagement

The WTO will need to grapple with China's industrial policy for multiple reasons. On the positive side are potential development lessons for poorer countries. Having seen China lift hundreds of millions of people from extreme poverty to middle-income status in under four decades, many countries want to adopt aspects of the Chinese model for their own development strategies. WTO rules may need to be adapted to accommodate (or even facilitate) elements of such policies on development grounds. Research could help rule designers better understand which parts of the Chinese approach drove that success and which did not and should therefore be avoided. Studies like Barwick, Kalouptsi, and Zahur (forthcoming) provide a useful template, as their formal modeling also helps sort through the effectiveness of different industrial policy instruments, such as entry, investment, and production subsidies.

The second and more imminent threat to the WTO system, however, is the conflict with the rules that China's approach has provoked, most notably (but not exclusively) by the United States. The US tariffs on steel, aluminum, and solar panels, as well as the US-China tariff escalation of 2018-19 and the new status quo codified into the "Phase One" agreement (and failure to deescalate hostilities since), have led to a situation in which both sides are imposing tariffs in a manner that is inconsistent with the WTO's MFN principle of nondiscrimination (Bown 2021). The trade war was at least partially caused by US dissatisfaction with the multilateral system's ability to curtail the externalities that China was imposing.<sup>39</sup>

The system was showing signs of stress before the trade war, however, including for many of China's other trading partners (see figures 1 and 2). Furthermore, the US decision to end WTO dispute settlement was driven in part by its view that the problem was worsening, that the system was increasingly unable to constrain Chinese policy (which led to the need for US trade remedies) and at the same time keen on constraining the US ability to defend itself from Chinese imports through trade remedies (Bown and Keynes 2020). WTO legal decisions announced well into the US-China trade war illustrate the challenge: in *US-Anti-Dumping Methodologies (China)* and *US-Countervailing Measures (China)*, WTO arbitrators authorized China to retaliate against US exports annually for \$3.6 billion and \$645 million, respectively, because of what it

**The WTO will need to grapple with China's industrial policy for multiple reasons.**

38 Thurk (2022) provides a dynamic oligopoly model of the global semiconductor industry.

39 Mattoo and Staiger (2020) provide an alternative interpretation of the trade war, arguing that the US targeting of countries with which it runs a bilateral trade deficit is a shift from working within a rules-based approach to tariff bargaining to one based on power.

decided was US misuse of trade remedies affecting Chinese exports.<sup>40</sup> There have been no recent WTO disputes effectively challenging China's subsidies.

Another argument is that some of the industrial policy that other major economies are pursuing today—which may also challenge the bounds of WTO rules—is a noncooperative policy response to China. For example, the United States has motivated its use of industrial policy—and designed its details, described in more depth below—in sectors ranging from semiconductors to EVs—partially as a reaction to China's policies.<sup>41</sup>

This argument raises two related questions. First, are the countries imposing these new industrial policies acting rationally? Even if China's industrial policy is not making its firms more productive, other countries can still be negatively affected, as the evidence in Barwick, Kalouptsidi, and Zahur (forthcoming) shows for shipbuilding. Does this perception that China is acting noncooperatively explain the industrial policy reaction? Put differently, to what extent are countries simply shifting from implementation of cooperative to noncooperative policy?<sup>42</sup>

Second, if these countries are acting rationally, can the trading system's rules be adjusted to both accommodate an economy like China and restore cooperation among governments in policymaking? If so, how?

At one extreme have been proposals to add even more specificity to the WTO disciplines in an attempt to better address the international externality concerns of China's industrial policy, subsidies, and SOEs.<sup>43</sup> At the other extreme is Staiger (2022), who suggests engaging with China directly over its market access commitments, with less emphasis on its policy behavior. The argument is that, under the terms-of-trade framework for the WTO, what matters for any country, including China, is reciprocity for changes to its imports and exports and the securitization of market access, to prevent externalities from being imposed on trading partners.

Although certainly not on the scale of China, there is historical precedent for an approach focused more on multilateral trade outcomes than policy behavior. When Poland and Romania, for example, entered the GATT in the late 1960s, there was no expectation that they would become market economies. Instead, they took on quantitative commitments to expand their imports (Haus 1991). Poland agreed to grow imports by the same 7 percent a year that it reciprocally anticipated would be its export growth to the rest of the GATT countries (Douglass 1972). An open question is whether a similar approach could provide a useful starting point for restoring some form of cooperation between China and its key trading partners in a modern trading system.

**Although certainly not on the scale of China, there is historical precedent for an approach focused more on multilateral trade outcomes than policy behavior.**

40 These WTO retaliation authorization decisions may have made little practical difference as they were announced in November 2019 and January 2022, respectively—i.e., long after China had likely exhausted its capacity for optimal retaliation by raising tariffs on nearly \$100 billion of US exports, or roughly 60 percent of its total imports from the United States (Bown 2021).

41 See, for example, White House, "Remarks by President Biden on the Inflation Reduction Act of 2022," July 28, 2022; and White House, "Fact Sheet: CHIPS and Science Act Will Lower Costs, Create Jobs, Strengthen Supply Chains, and Counter China," August 9, 2022.

42 Ferrari and Ossa (2023) explore related questions regarding noncooperative versus cooperative subsidy behavior in a quantitative model across localities within one country—i.e., the United States. For quantitative models of noncooperative versus cooperative tariff behavior internationally, see Ossa (2011, 2012, 2014). See also Lashkaripour and Lugovskyy (2023).

43 On proposals to add legal specificity, see Bown and Hillman (2019) and Mavroidis and Sapir (2021).

## 5. OTHER MODERN INDUSTRIAL POLICY MOTIVATIONS FOR THE WTO

This section examines three additional areas where industrial policy is emerging as a policy issue for the WTO: supply chain resilience, supply chain responsiveness and control, and climate change.

### 5.1. Supply chain resilience in the face of shocks

Resilience is often defined as the ability of markets to adapt once a shock occurs. National policymakers are now concerned that the current pattern of supply chains is not resilient. The WTO recognizes the salience of the issue, devoting two recent *World Trade Reports* to it (WTO 2021, 2023).<sup>44</sup>

Supply chain resilience has arisen as a policy question in part because of the success of the multilateral trading system at lowering trade barriers. As a result of innovations in transportation technology and information and communications technology (ICT), production fragmented, leading to the creation of global supply chains. Parts of global production processes sometimes concentrated geographically, however, potentially taking advantage of agglomeration and scale economies. (Industrial policy by China and other countries may have contributed to the concentration.) This equilibrium may have resulted in an efficient allocation of resources and sufficient resilience for the distribution of shocks expected at the time. Nevertheless, given evidence that economic shocks can propagate from one country to another along supply chains,<sup>45</sup> if the world changed, a new distribution of climate, health, and geopolitical shocks could mean that the existing pattern of geographic concentration was suddenly problematic. Three examples highlight how the world may have changed.

Climate shocks have increased the frequency and intensity of severe storms, leading to flood and wind damage, as well as periods of less precipitation, leading to droughts and wildfires. Much of high-end semiconductor production is concentrated at TSMC in Taiwan, an island off the coast of mainland China that is subject to typhoons and has been hit with water shortages (Bown 2020).

The COVID-19 pandemic suggested a future of more serious public health shocks. The initial epicenter of that public health emergency was China, where production of medical supplies like PPE was geographically concentrated, creating a perfect storm of negative shocks to supply (and exports) and positive shocks to demand (and imports). Supplies were taken off global markets just as import demand for PPE from the rest of world increased (Bown 2022b).

Geopolitical conflict and tensions reemerged with Russia's invasion of Ukraine, China's threatened takeover of Taiwan after political capture of Hong Kong, and China's increased military activity (including through trade routes) in the East and South China Seas. The fear of China's monopoly power over inputs into the EV battery supply chain, for example, has shaped US industrial policy in the Inflation Reduction Act (Bown 2023a, 2024) and is contributing to concerns over semiconductors.

**Supply chain resilience has arisen as a policy question in part because of the success of the multilateral trading system at lowering trade barriers.**

44 See also the survey in Baldwin and Freeman (2022).

45 Boehm, Flaaen, and Pandalai-Nayar (2019) find that following the 2011 Tōhoku earthquake, output of Japanese affiliates in the United States fell roughly one-for-one with declines in US imports.

What if the geographic footprint of these supply chains is not sufficiently resilient even from a global social planner's perspective, let alone from the perspective of any individual country? If it is not, an adjustment of supply chains could improve global welfare. (Of course, an important empirical question is also whether the distribution of shocks has really changed.)

Supportive of this possibility are numerous examples of today's industrial policy being different from simply (national) reshoring. Sometimes countries are coordinating their industrial policy with others, as governments seek to retain at least some of the benefits of fragmentation and comparative advantage. Japan, for example, recently budgeted nearly \$160 million of "China exit" subsidies for firms to move from China to Southeast Asia.<sup>46</sup> For semiconductors, US subsidies under the CHIPS and Science Act of 2022 may also fund new assembly, packaging and testing plants (a separate, labor-intensive element of the supply chain) in Costa Rica, Panama, or Vietnam.<sup>47</sup> With a common goal of diversifying semiconductor manufacturing away from certain parts of Asia, the United States, Japan, and the European Union have sought to coordinate their subsidization. Information-sharing and cooperation may help prevent redundancy across semiconductor nodes and excess industry-level capacity.<sup>48</sup> Finally, to qualify for a \$3,750 tax credit under the US Inflation Reduction Act, South Korean companies must source their inputs for EV batteries from countries with which the United States has a free trade or critical minerals agreement. This requirement led the South Korean government to lobby the US government to sign such critical minerals agreements with Indonesia and Argentina, countries from which Korean battery companies source inputs.<sup>49</sup>

Are such policies necessary? Consider the evidence on supply chain resilience based on firm behavior in the absence of policy interventions. Khanna, Morales, and Pandalai-Nayar (2022) examine Indian firm responses to COVID-19-related lockdowns, measuring resilience in three ways: whether input usage and output drops, whether supplier links are maintained, and whether it is easy to find new suppliers to replace existing suppliers if links are broken. Their first findings confirm what theory would predict: More exposed firms are more likely to break links with their suppliers, have difficulty finding new suppliers when links are broken, and therefore experience declines in their total input purchases and output. The second part of their research explores which features of supply chains make them more resilient. Their evidence suggests that the most resilient supply chains arise when suppliers are larger, the inputs purchased are more differentiated, and the number of alternative suppliers is low. Perhaps surprisingly, they find that more complex supply chains are not less resilient to

**Sometimes countries are coordinating their industrial policy with others, as governments seek to retain at least some of the benefits of fragmentation and comparative advantage.**

46 See "Japan Reveals 87 Projects Eligible for 'China Exit' Subsidies," *Nikkei Asia*, July 17, 2020.

47 See US Department of State, "New Partnership with Costa Rica to Explore Semiconductor Supply Chain Opportunities," Press Release, July 14, 2023; "New Partnership with Panama to Explore Semiconductor Supply Chain Opportunities," Press Release, July 20, 2023; "New Partnership with Vietnam to Explore Semiconductor Supply Chain Opportunities," Press Release, September 11, 2023.

48 See Yuka Hayashi, "US, EU Agree to Coordinate Semiconductor Subsidy Programs," *Wall Street Journal*, December 5, 2022; "Washington and Tokyo Vow Closer Chip Cooperation," *Reuters*, May 26, 2023; Riho Nagao, "Japan and EU to Share Chip Subsidy Info to Disperse Production," *Nikkei Asia*, June 29, 2023.

49 See Seok-min Oh, "S. Korea Seeks US Expansion of Key Minerals Supplier List under IRA," *Yonhap News Agency*, June 29, 2023.

shocks. Such firms may understand their exposure and thus be more likely to invest in resilience ex ante.

Castro-Vincenzi (2022) studies how the global auto industry responded to historical flood events in research designed to draw inferences about climate change. The evidence also suggests that auto companies invest in resilience. Multi-plant firms respond to a flood at one plant by reallocating some production to another making the same model. Over time, firms have constructed more (but smaller) plants and hold some capacity idle so that it can be deployed in response to a negative shock hurting production elsewhere. Their efforts at increasing resilience allow automakers to produce more output in the aftermath of a shock, but these supply chain adjustments are costly, as firms are less productive (with more, smaller plants, operating at lower levels of capacity utilization). As a result, consumers pay higher prices.

Firms respond to incentives about resilience; qualitatively, they are adjusting in the right direction. But open policy questions include whether firms face *sufficient* incentives. If not, what is the role for government, and what are the appropriate policy instruments?

New theoretical work by Grossman, Helpman, and Lhuillier (forthcoming) and Grossman, Helpman, and Sabal (2023) has begun to explore industrial policy designed to achieve the optimal level of resilience. A complete assessment of the still emerging theory is beyond the scope of this paper, but one message is that the answer is likely to be nuanced and depend on supply chain details.<sup>50</sup> An important effort is being made to identify where firm-level and social incentives about resilience may be misaligned and why. The answer is not trivial: Consumers are hurt (through lost consumer surplus) when a supply chain disruption makes a good unavailable, but firms also often lose producer surplus or profits, which should incentivize them to invest to avoid such scenarios.<sup>51</sup> A key question is under what conditions they fail to do so at the socially desirable level.

For the WTO, this literature will also need to explore conditions under which nationally optimal resilience policy diverges from globally optimal resilience policy and why. Do countries acting unilaterally impose (negative) externalities on one another in ways that create a role for the WTO? If so, should the role involve international rule-making efforts to discipline subsidies or to coordinate subsidies?

## 5.2. Supply chain responsiveness and control in the face of shocks

If supply chain resilience is the ability to re-achieve the status quo after a shock, “responsiveness” involves the ability to do more and/or to act more quickly in response to an emergency. This responsiveness includes speedy and sizable

**Firms respond to incentives about resilience; qualitatively, they are adjusting in the right direction.**

50 Caution is warranted recalling the evolution of the strategic trade policy literature in the 1980s where, in oligopoly models where firms were competing on quantities (Cournot), the optimal policy was a subsidy (Brander and Spencer 1985) whereas competition on prices (Bertrand) led to optimal policy being a tax (Eaton and Grossman 1986). See also Maggi (1996).

51 In some models, counterintuitively, firms may over-invest in resilience to take advantage of potential business-stealing opportunities when such negative shocks hit. In these cases, the optimal policy may be an optimal diversification tax to correct for the business-stealing externality and prevent excessive investment in diversification that would be socially wasteful. See also Elliott, Golub, and Leduc (2022) for a network theory approach.

production of new goods and may sometimes involve policymakers exerting control over a supply chain.

The extraordinary use of industrial policy to accelerate and scale up vaccine production in response to COVID-19 provides one motivation.<sup>52</sup> As new goods, COVID-19 vaccines could not have been stockpiled in advance. There was a societal (human health) objective to achieve scale and speed of production, under tremendous uncertainty, creating a divergence between firm-level and social incentives. As expected, without an advanced global arrangement on vaccine sharing, it was difficult to implement one during the ongoing pandemic. Governments wanted access to locally produced vaccines to treat their citizens first; promises to share the vaccine internationally became a time-inconsistent policy. The predictable result was vaccine nationalism (Bollyky and Bown 2020).

At the same time, new supply chains emerged in short order, international trade played a complex role in those supply chains, and government policy interventions were rampant (Bown and Bollyky 2022). The US government, for example, acted as a social planner through novel, priority-rated contracting and industrial policy implemented through emergency powers under the Defense Production Act (DPA). Among other features, priority-rated contracting provided policymakers unusual informational insights into supply chains, allowed the government to compel economic activity up and down those chains and even force firms to temporarily act against their private interests (Bown 2022a). In theory, such powers could have allowed policymakers to allocate scarce inputs to their most productive social use—e.g., expanding production for an effective vaccine about to be authorized for public use—that may not have arisen if the input allocation had been left to the market.

The vaccine experience raises at least two overarching questions for policy and the WTO.<sup>53</sup> First, what are the tradeoffs to having cross-border as opposed to purely local supply chains in the face of such an emergency? Did the benefits associated with the fact that the (pre-emergency) backbone of the supply chain was local, which allowed for a greater responsiveness, outweigh the cost reduction associated with a cross-border supply chain? If, for example, price signals cannot be transmitted upstream to input suppliers when supply chains cross borders, subsidies to the end output producer may have more rapid (or more efficient) effects when supply chains are local.<sup>54</sup> Governments may also under-subsidize if they anticipate the benefits of those subsidies will leak to firms operating abroad. Given the US government's experience under the DPA, another rationale may be the reduction of asymmetric information in terms of identifying which input makers to subsidize and how to subsidize them when the supply chain is local rather than cross-border (Bown 2022a). Finally, policymakers can compel firms in their own legal jurisdiction to act against their

**The vaccine experience raises at least two overarching questions for policy and the WTO.**

52 Vaccines are not the only example. During a pandemic, novel tests and treatments are another. Other “emergencies” motivating this research include military responsiveness (production of armaments) and climate change. See Susan Athey, Rachel Glennerster, Nan Ransohoff, and Christopher Snyder, “Advance Market Commitments Worked for Vaccines. They Could Work for Carbon Removal, Too,” *Politico*, December 22, 2022.

53 Bown, Snyder, and Staiger (2022) explore some of these formally.

54 For one reason why price signals may not fully cross borders along a supply chain to upstream input providers, see the contracting difficulties in Antràs and Staiger (2012).



own private interest in an emergency in ways that may not be possible if they are located abroad.

Second, is there a role for cooperation (and thus the WTO) in such emergencies? Balancing the advantages of lower costs of production (abroad) and yet maintaining access to control over the supply chain to quickly expand the speed and scale of output production after an emergency, governments may need to cooperate over different instruments, such as the triggering of expansionary subsidy policies and the prevention of export restrictions. To date, the WTO has sought only to discipline subsidy policies, not necessarily coordinate their deployment across countries (Bown 2023b).

PPE is a second example where policy responsiveness and control emerged during COVID-19.<sup>55</sup> Before the pandemic, relatively simple to manufacture products like hospital gloves and N-95 respirators were mostly made abroad, for cost-saving reasons. US policymakers could thus not accelerate their domestic production by triggering surge clauses in contracts with local firms (as one US official put it, “you can’t surge zero”).<sup>56</sup>

The tragic shortages of PPE that emerged in early 2020 resulted in a novel combination of industrial policies seeking to gain access to emergency supplies. The US government ended up providing over \$1 billion to ultimately create a US manufacturing industry and domestic supply chain for PPE. In the short term, it turned to other policy instruments, imposing export controls to keep the small quantity of PPE that was produced domestically from leaving the country. Under a different part of the DPA, the United States compelled 3M, a US-headquartered multinational, to supply the United States from its Chinese plants under the threat that 3M would not otherwise be allowed to export to long-time hospital customers in Canada and Mexico from its US plants.<sup>57</sup> These policies could have turned out quite costly if trading partners had responded in an escalatory fashion. The experiences—driven by the lack of policymaker insight into and control over a supply chain—raise a number of questions about information-sharing, stockpiling, and international policy cooperation that are relevant for the WTO, given the possibility of international (economic) externalities.

### 5.3. Climate change mitigation

Climate change is an important impetus behind modern industrial policy. It differs from the motivations for market intervention considered thus far because it involves a global externality.

The United States is using industrial policy to subsidize a number of clean energy industries through the Inflation Reduction Act. There may be learning-by-doing externalities (see Bistline, Mehrotra, and Wolfram 2023 for estimates). Other major economies are putting a price on carbon directly, which may be more economically efficient if the industry-wide learning-by-doing effects are small. For the WTO, trade conflicts may emerge that will need to be managed,

**The tragic shortages of PPE that emerged in early 2020 resulted in a novel combination of industrial policies seeking to gain access to emergency supplies.**

55 Bown (2022b) provides a more detailed discussion.

56 See Chad P. Bown and Soumaya Keynes, “How America Responded to Its PPE Shortage,” *Trade Talks*, Episode 158, October 11, 2021.

57 The United States was not alone. France and Germany stopped exports to other EU member states until the European Commission intervened by imposing an extra-EU set of export policy controls (Bown 2022b).

because of some of the secondary outcomes resulting from these different policy approaches.

One concern is that the two policy approaches have divergent competitiveness impacts on downstream, energy-intensive sectors like steel, aluminum, chemical, fertilizers, and cement (Clausing and Wolfram 2023, Bown and Clausing 2023). Investment or production subsidies to clean energy may move energy use toward clean energy, which provides a social benefit. However, subsidies tend to lower the price of energy overall, providing a competitive benefit to local energy-intensive industries downstream. (There is no externality associated with “energy,” so lowering the price of energy encourages excessive energy consumption.) In contrast, a carbon tax tends to raise the price of energy, hurting the competitiveness of the local downstream industry, all else equal.

For WTO purposes, a key issue is that a country using a second-best policy (industrial policy to subsidize clean energy) may be imposing negative externalities on trading partners through their loss of market access in such tradable, downstream industries, especially in countries using a first-best policy (a tax on dirty energy). Addressing the trade-related externalities, without disrupting the pro-climate policies that may be creating them is another important area for trade rules to tackle.

## 6. CONCLUSION

This paper describes why the WTO should be tasked with coming to grips with modern industrial policy. Nevertheless, numerous proposals for major new issue areas have come (and sometimes gone) from the WTO’s agenda. They include multilateralism grappling with the rise of preferential trade agreements, then deep integration of those agreements, regulatory convergence, trade in services, digital trade, and more.<sup>58</sup>

Modern industrial policy does seem different. This paper illustrates some of those differences as well as key international externality concerns that industrial policies can generate that are most relevant for the WTO system. It raises more questions than it answers, however, indicating that more research is needed to help policymakers clamoring to deal with today’s pressing challenges.

One demand is for measurement—perhaps akin to what the OECD did for agricultural subsidies beginning in the 1980s. Another is for research to help understand the size of externalities (where they exist) relative to the size of the subsidies, as well as the size of the impacts of industrial policy on domestic economic activity and on the market access of trading partners.

More also needs to be learned to inform institutional design. In the currently fractured environment of multilateral trade relations, restoring sustainable cooperation over trade policy may require additional cooperation and understanding of industrial policy, as well as the particular challenges to enforcement.

**This paper describes why the WTO should be tasked with coming to grips with modern industrial policy.**

---

58 See Limão (2006) and Freund and Ornelas (2010) for early research on preferential trade agreements; Mattoo, Rocha, and Ruta (2020) and Maggi and Ossa (2021) for deep trade agreements; Grossman, McCalman, and Staiger (2021) for regulatory convergence; Staiger and Sykes (2021) for trade in services; and Staiger (2022) for digital trade agreements.

Governments seem intent on using industrial policy to tackle the world's most pressing market failures and externalities and to at least tweak the footprint of global supply chains. Researchers can help by identifying the size and shape of policies and the role of international cooperation—where it calls to discipline subsidies, where it calls for coordinated policies to jointly expand subsidies—so that the world can continue to benefit from the efficiency gains of trade and the international fragmentation of production, competition, and comparative advantage.

The original impetus behind the GATT in 1947 was to coordinate reciprocal tariff reductions in light of the beggar-thy-neighbor and globally inefficient trade restrictions of the 1930s. Any industrial policy excesses of today may someday trigger governments to agree to develop new international rules on which subsidies to coordinate, which to greenlight, and which to limit. As was the case in the 1940s during the GATT's development, policymakers would benefit from well-informed economic research to help them sort through the most important tradeoffs.<sup>59</sup>

## REFERENCES

- Ades, Alberto, and Rafael Di Tella. 1997. National Champions and Corruption: Some Unpleasant Interventionist Arithmetic. *Economic Journal* 107, no. 443: 1023–42.
- Aghion, Philippe, Jing Cai, Mathias Dewatripont, Luosha Du, Ann Harrison, and Patrick Legros. 2015. Industrial Policy and Competition. *American Economic Journal: Macroeconomics* 7, no. 4: 1–32.
- Antràs, Pol, and Robert W. Staiger. 2012. Offshoring and the Role of Trade Agreements. *American Economic Review* 102, no. 7: 3140–83.
- Athey, Susan, Juan Camilo Castillo, Esha Chaudhuri, Michael Kremer, Alexandre Simoes Gomes, and Christopher M. Snyder. 2022. Expanding Capacity for Vaccines against Covid-19 and Future Pandemics: A Review of Economic Issues. *Oxford Review of Economic Policy* 38, no. 4: 742–70.
- Bai, Jie, Ludovica Gazze, and Yukun Wang. 2022. Collective Reputation in Trade: Evidence from the Chinese Dairy Industry. *Review of Economics and Statistics* 104, no. 6: 1121–37.
- Bagwell, Kyle, Chad P. Bown, and Robert W. Staiger. 2016. Is the WTO Passé? *Journal of Economic Literature* 54, no. 4: 1125–31.
- Bagwell, Kyle, and Robert W. Staiger. 1999. An Economic Theory of GATT. *American Economic Review* 89, no. 1: 215–48.
- Bagwell, Kyle, and Robert W. Staiger. 2001. Domestic Policies, National Sovereignty, and International Economic Institutions. *Quarterly Journal of Economics* 116, no. 2: 519–62.
- Bagwell, Kyle, and Robert W. Staiger. 2002. *The Economics of the World Trading System*. Cambridge, MA: MIT Press.
- Bagwell, Kyle, and Robert W. Staiger. 2006. Will International Rules on Subsidies Disrupt the World Trading System? *American Economic Review* 96, no. 3: 877–95.
- Bagwell, Kyle, and Robert W. Staiger. 2011. What Do Trade Negotiators Negotiate about? Empirical Evidence from the World Trade Organization. *American Economic Review* 101, no. 4: 1238–73.

---

<sup>59</sup> See Irwin, Mavroidis, and Sykes (2008) for the role of economists in the 1940s in shaping the GATT.

- Bagwell, Kyle, Robert W. Staiger, and Ali Yurukoglu. 2020. Multilateral Trade Bargaining: A First Look at the GATT Bargaining Records. *American Economic Journal: Applied Economics* 12, no. 3: 72–105.
- Baldwin, Richard, and Rebecca Freeman. 2022. Risks and Global Supply Chains: What We Know and What We Need to Know. *Annual Review of Economics* 14: 153–80.
- Barwick, Panle Jia, Myrto Kalouptsi, and Nahim Zahur. Forthcoming. Industrial Policy Implementation: Empirical Evidence from China's Shipbuilding Industry. *Review of Economic Studies*.
- Barwick, Panle Jia, Hyuk-soo Kwon, Shanjun Li, and Nahim Zahur. In progress. Drive Down the Cost: Learning by Doing and Government Policy in the Electric Vehicle Battery Industry. University of Wisconsin, Madison.
- Bhagwati, Jagdish N., and V. K. Ramaswami. 1963. Domestic Distortions, Tariffs and the Theory of Optimum Subsidy. *Journal of Political Economy* 71, no. 1: 44–50.
- Bistline, John, Neil Mehrotra, and Catherine Wolfram. 2023. [Economic Implications of the Climate Provisions in the Inflation Reduction Act](#). *Brookings Papers on Economic Activity*. Washington: Brookings Institution.
- Boehm, Christoph E., Aaron Flaaen, and Nitya Pandalai-Nayar. 2019. Input Linkages and the Transmission of Shocks: Firm-Level Evidence from the 2011 Tōhoku Earthquake. *Review of Economics and Statistics* 101, no. 1: 60–75.
- Bollyky, Thomas J., and Chad P. Bown. 2020. The Tragedy of Vaccine Nationalism: Only Cooperation Can End the Pandemic. *Foreign Affairs* 99, no. 5: 96–109.
- Bown, Chad P. 2002. The Economics of Trade Disputes, the GATT's Article XXIII and the WTO's Dispute Settlement Understanding. *Economics and Politics* 14, no. 3: 283–323.
- Bown, Chad P. 2004. Trade Disputes and the Implementation of Protection under the GATT: An Empirical Assessment. *Journal of International Economics* 62, no. 2: 263–94.
- Bown, Chad P. 2005. Participation in WTO Dispute Settlement: Complainants, Interested Parties and Free Riders. *World Bank Economic Review* 19, no. 2: 287–310.
- Bown, Chad P. 2010. The WTO Secretariat and the Role of Economics in DSU Panels and Arbitrations. In *The Law, Economics and Politics of Retaliation in WTO Dispute Settlement*, ed. Chad P. Bown and Joost Pauwelyn, 391–433. Cambridge: Cambridge University Press.
- Bown, Chad P. 2016. [Should the United States Recognize China as a Market Economy?](#) PIIE Policy Brief 16–24. Washington: Peterson Institute for International Economics.
- Bown, Chad P. 2020. How the United States Marched the Semiconductor Industry into Its Trade War with China. *East Asian Economic Review* 24, no. 4: 349–88.
- Bown, Chad P. 2021. The US–China Trade War and Phase One Agreement. *Journal of Policy Modeling* 43, no. 4: 805–43.
- Bown, Chad P. 2022a. COVID-19 Vaccine Supply Chains and the Defense Production Act. *Oxford Review of Economic Policy* 38, no. 4: 771–96.
- Bown, Chad P. 2022b. How COVID-19 Medical Supply Shortages Led to Extraordinary Trade and Industrial Policy. *Asian Economic Policy Review* 17, no. 1: 114–35.
- Bown, Chad P. 2022c. Trump Ended WTO Dispute Settlement. Trade Remedies Are Needed to Fix It. *World Trade Review* 21, no. 3: 312–29.
- Bown, Chad P. 2023a. Industrial Policy for Electric Vehicle Supply Chains and the US–EU Fight over the Inflation Reduction Act. In *Sparking Europe's New Industrial Revolution: A Policy for Net Zero, Growth and Resilience*, ed. Simone Tagliapietra and Reinhilde Veugelers, 210–55. Brussels: Bruegel.

- Bown, Chad P. 2023b. The WTO and Vaccine Supply Chain Resilience During a Pandemic. *Journal of International Economic Law* 26, no. 2: 343-62.
- Bown, Chad P. 2024. How the United States Solved South Korea's Problems with Electric Vehicle Subsidies under the Inflation Reduction Act. *Journal of World Trade* 58, no. 1: 1-34.
- Bown, Chad P., and Thomas J. Bollyky. 2022. How COVID-19 Vaccine Supply Chains Emerged in the Midst of a Pandemic. *World Economy* 45, no. 2: 468-522.
- Bown, Chad P., and Rachel Brewster. 2017. US-COOL Retaliation: The WTO's Article 22.6 Arbitration. *World Trade Review* 16, no. 2: 371-94.
- Bown, Chad P., and Kimberly A. Clausing. 2023. *How Trade Cooperation by the United States, European Union, and China Can Fight Climate Change*. PIIE Working Paper 23-8. Washington: Peterson Institute for International Economics. <https://www.piie.com/publications/working-papers/how-trade-cooperation-united-states-european-union-and-china-can-fight>.
- Bown, Chad P., and Meredith A. Crowley. 2013. Self-Enforcing Trade Agreements: Evidence from Time-Varying Trade Policy. *American Economic Review* 103, no. 2: 1071-90.
- Bown, Chad P., and Jennifer A. Hillman. 2017. Foot-and-Mouth Disease and Argentina's Beef Exports: The WTO's US-Animals Dispute. *World Trade Review* 16, no. 2: 253-77.
- Bown, Chad P., and Jennifer A. Hillman. 2019. WTO'ing a Resolution to the China Subsidy Problem. *Journal of International Economic Law* 22, no. 4: 557-78.
- Bown, Chad P., and Bernard M. Hoekman. 2008. Developing Countries and Enforcement of Trade Agreements: Why Dispute Settlement Is Not Enough. *Journal of World Trade* 42, no. 1: 177-203.
- Bown, Chad P., and Soumaya Keynes. 2020. Why Trump Shot the Sheriffs: The End of WTO Dispute Settlement 1.0. *Journal of Policy Modeling* 42, no. 4: 799-819.
- Bown, Chad P., and Kara M. Reynolds. 2015. Trade Flows and Trade Disputes. *Review of International Organizations* 10, no. 2: 145-77.
- Bown, Chad P., and Kara M. Reynolds. 2017. Trade Agreements and Enforcement: Evidence from WTO Dispute Settlement. *American Economic Journal: Economic Policy* 9, no. 4: 64-100.
- Bown, Chad P., and Michele Ruta. 2010. The Economics of Permissible WTO Retaliation. *The Law, Economics and Politics of Retaliation in WTO Dispute Settlement*, ed. Chad P. Bown and Joost Pauwelyn, 149-93. Cambridge: Cambridge University Press.
- Bown, Chad P., Christopher M. Snyder, and Robert W. Staiger. 2022. Vaccine Supply Chain Resilience and International Cooperation. Dartmouth College working paper.
- Brander, James A. 1995. Strategic Trade Policy. In *Handbook of International Economics*, vol. 3, ed. Gene Grossman and Kenneth Rogoff, 1395-455. Amsterdam: Elsevier Science Publishers B.V.
- Brander, James A., and Barbara J. Spencer. 1985. Export Subsidies and International Market Share Rivalry. *Journal of International Economics* 18, no. 1-2: 83-100.
- Branstetter, Lee G., and Guangwei Li. 2022. *Does "Made in China 2025" Work for China? Evidence from Chinese Listed Firms*. NBER Working Paper 30676, November.
- Branstetter, Lee G., Guangwei Li, and Mengjia Ren. 2022. *Picking Winners? Government Subsidies and Firm Productivity in China*. NBER Working Paper 30699, December.
- Broda, Christian, Nuno Limão, and David E. Weinstein. 2008. Optimal Tariffs and Market Power: The Evidence. *American Economic Review* 98, no. 5: 2032-65.
- Brou, Daniel, and Michele Ruta. 2013. A Commitment Theory of Subsidy Agreements. *BE Journal of Economic Analysis and Policy* 13, no. 1.

- Castro-Vincenzi, Juanma. 2022. Climate Hazards and Resilience in the Global Car Industry. Princeton University, working paper.
- Choi, Jaedo, and Andrei A. Levchenko. 2023. *The Long-Term Effects of Industrial Policy*. NBER Working Paper 29263, August (revised).
- Clausing, Kimberly A., and Catherine Wolfram. 2023. Carbon Border Adjustments, Climate Clubs, and Subsidy Races When Climate Policies Vary. *Journal of Economic Perspectives* 37, no. 3: 137–62.
- Douglass, Andrew Ian. 1972. East-West Trade: The Accession of Poland to the GATT. *Stanford Law Review* 24, no. 4: 748–64.
- Eaton, Jonathan, and Gene M. Grossman. 1986. Optimal Trade and Industrial Policy under Oligopoly. *Quarterly Journal of Economics* 101, no. 2: 383–406.
- Elliott, Matthew, Benjamin Golub, and Matthew V. Leduc. 2022. Supply Network Formation and Fragility. *American Economic Review* 112, no. 8: 2701–47.
- Evenett, Simon J. 2009. Global Trade Alert: Motivation and Launch. *World Trade Review* 8, no. 4: 607–09.
- Ferrari, Alessandro, and Ralph Ossa. 2023. A Quantitative Analysis of Subsidy Competition in the US. *Journal of Public Economics* 224: 104919.
- Freund, Caroline, and Emanuel Ornelas. 2010. Regional Trade Agreements. *Annual Review of Economics* 2, no. 1: 139–66.
- Gourdon, Karin. 2019. *An Analysis of Market-Distorting Factors in Shipbuilding: The Role of Government Interventions*. OECD Science, Technology and Industry Policy Paper 67.
- Grossman, Gene M. 1990. *Promoting New Industrial Activities: A Survey of Recent Arguments and Evidence*. OECD Economic Study 14: 87–126.
- Grossman, Gene M., Elhanan Helpman, and Hugo Lhuillier. Forthcoming. Supply Chain Resilience: Should Policy Promote International Diversification or Reshoring? *Journal of Political Economy*.
- Grossman, Gene M., Elhanan Helpman, and Alejandro Sabal. 2023. Resilience in Vertical Supply Chains. NBER Working Paper 31739, September.
- Grossman, Gene M., Philip McCalman, and Robert W. Staiger. 2021. The “New” Economics of Trade Agreements: From Trade Liberalization to Regulatory Convergence? *Econometrica* 89, no. 1: 215–49.
- Grossman, Gene M., and Alan O. Sykes. 2011. “Optimal” Retaliation in the WTO: A Commentary on the Upland Cotton Arbitration. *World Trade Review* 10, no. 1: 133–64.
- Harrison, Ann E., and Andrés Rodríguez-Clare. 2010. Trade, Foreign Investment, and Industrial Policy for Developing Countries. In *Handbook of Development Economics*, vol. 5, ed. Dani Rodrik and Mark Rosenzweig. Amsterdam: Elsevier.
- Haus, Leah. 1991. The East European Countries and GATT: The Role of Realism, Mercantilism, and Regime Theory in Explaining East-West Trade Negotiations. *International Organization* 45, no. 2: 163–82.
- Hausmann, Ricardo, Andrés Rodríguez-Clare, and Dani Rodrik. 2005. *Towards a Strategy for Economic Growth in Uruguay*. Economic and Social Study Series. Washington: Inter-American Development Bank.
- Hausmann, Ricardo, and Dani Rodrik. 2003. Economic Development as Self-Discovery. *Journal of Development Economics* 72, no. 2: 603–33.
- Horn, Henrik. 2006. National Treatment in the GATT. *American Economic Review* 96, no. 1: 394–404.
- Horn, Henrik, Giovanni Maggi, and Robert W. Staiger. 2010. Trade Agreements as Endogenously Incomplete Contracts. *American Economic Review* 100, no. 1: 394–419.

- Irwin, Douglas A. 2000. Did Late-Nineteenth-Century US Tariffs Promote Infant Industries? Evidence from the Tinplate Industry. *Journal of Economic History* 60, no. 2: 335–60.
- Irwin, Douglas A., and Nina Pavcnik. 2004. Airbus versus Boeing Revisited: International Competition in the Aircraft Market. *Journal of International Economics* 64: 223–45.
- Irwin, Douglas A., Petros C. Mavroidis, and Alan O. Sykes. 2008. *The Genesis of the GATT*. Cambridge: Cambridge University Press.
- Juhász, Réka. 2018. Temporary Protection and Technology Adoption: Evidence from the Napoleonic Blockade. *American Economic Review* 108, no. 11: 3339–76.
- Juhász, Réka, Nathan Lane, Emily Oehlsen, and Verónica C. Pérez. 2023. *The Who, What, When, and How of Industrial Policy: A Text-Based Approach*. University of British Columbia, working paper.
- Juhász, Réka, Nathan Lane, and Dani Rodrik. Forthcoming. The New Economics of Industrial Policy. *Annual Review of Economics*.
- Juhász, Réka, and Claudia Steinwender. Forthcoming. Industrial Policy and the Great Divergence. *Annual Review of Economics*.
- Kalouptsi, Myrto. 2018. Detection and Impact of Industrial Subsidies: The Case of Chinese Shipbuilding. *Review of Economic Studies* 85, no. 2: 1111–58.
- Khanna, Gaurav, Nicolas Morales, and Nitya Pandalai-Nayar. 2022. *Supply Chain Resilience: Evidence from Indian Firms*. NBER Working Paper 30689, November.
- Kim, Minho, Munseob Lee, and Yongseok Shin. 2022. *The Plant-Level View of an Industrial Policy: The Korean Heavy Industry Drive of 1973*. NBER Working Paper 29252, June (revised).
- Klier, Thomas H., and James M. Rubenstein. 2008. *Who Really Made Your Car? Restructuring and Geographic Change in the Auto Industry*. Kalamazoo, MI: W.E. Upjohn Institute for Employment Research.
- Krugman, Paul. 2011. Increasing Returns in a Comparative Advantage World. In *Comparative Advantage, Growth, and the Gains from Trade and Globalization: A Festschrift in Honor of Alan V Deardorff*, ed. Robert M. Stern, 43–51. Singapore: World Scientific Publishing.
- Lane, Nathan. Forthcoming. Manufacturing Revolutions: Industrial Policy and Industrialisation in South Korea. *Quarterly Journal of Economics*.
- Lardy, Nicholas R. 2014. *Markets over Mao: The Rise of Private Business in China*. Washington: Peterson Institute for International Economics.
- Lardy, Nicholas R. 2019. *The State Strikes Back: The End of Economic Reform in China?* Washington: Peterson Institute for International Economics.
- Lashkaripour, Ahmad, and Volodymyr Lugovskyy. 2023. Profits, Scale Economies, and the Gains from Trade and Industrial Policy. *American Economic Review* 113, no. 10: 2759–808.
- Limão, Nuno. 2006. Preferential Trade Agreements as Stumbling Blocks for Multilateral Trade Liberalization: Evidence for the United States. *American Economic Review* 96, no. 3: 896–914.
- Ludema, Rodney D., and Anna Maria Mayda. 2013. Do Terms-of-Trade Effects Matter for Trade Agreements? Theory and Evidence from WTO Countries. *Quarterly Journal of Economics* 128, no. 4: 1837–93.
- Maggi, Giovanni. 1996. Strategic Trade Policies with Endogenous Mode of Competition. *American Economic Review* 86, no. 1: 237–58.
- Maggi, Giovanni, and Ralph Ossa. 2021. The Political Economy of Deep Integration. *Annual Review of Economics* 13: 19–38.

- Maggi, Giovanni, and Andrés Rodríguez-Clare. 1998. The Value of Trade Agreements in the Presence of Political Pressures. *Journal of Political Economy* 106, no. 3: 574–601.
- Maggi, Giovanni, and Andrés Rodríguez-Clare. 2007. A Political-Economy Theory of Trade Agreements. *American Economic Review* 97, no. 4: 1374–406.
- Maggi, Giovanni, and Robert W. Staiger. 2018. Trade Disputes and Settlement. *International Economic Review* 59, no. 1: 19–50.
- Manelici, Isabela, and Smaranda Pantea. 2021. Industrial Policy at Work: Evidence from Romania’s Income Tax Break for Workers in IT. *European Economic Review* 133: 103674.
- Marshall, Alfred. 1920. *Principles of Economics*. London: MacMillan.
- Mattoo, Aaditya, Nadia Rocha, and Michele Ruta, eds. 2020. *Handbook of Deep Trade Agreements*. Washington: World Bank.
- Mattoo, Aaditya, and Robert W. Staiger. 2020. Trade Wars: What Do They Mean? Why Are They Happening Now? What Are the Costs? *Economic Policy* 45, no. 103: 561–84.
- Mavroidis, Petros C., and Andre Sapir. 2021. *China and the WTO: Why Multilateralism Still Matters*. Princeton, NJ: Princeton University Press.
- Melitz, Marc J. 2005. When and How Should Infant Industries Be Protected? *Journal of International Economics* 66, no. 1: 177–96.
- Mitrunen, Matti. 2023. *War Reparations, Structural Change, and Intergenerational Mobility*. University of Helsinki, working paper.
- Nicita, Alessandro, Marcelo Olarreaga, and Peri Silva. 2018. Cooperation in WTO’s Tariff Waters? *Journal of Political Economy* 126, no. 3: 1302–38.
- OECD (Organization for Economic Cooperation and Development). 2019a. Measuring Distortions in International Markets: The Aluminium Value Chain. *OECD Trade Policy Paper 218*. Paris.
- OECD (Organization for Economic Cooperation and Development). 2019b. Measuring Distortions in International Markets: The Semiconductor Value Chain. *OECD Trade Policy Paper 234*. Paris.
- Ossa, Ralph. 2011. A “New Trade” Theory of GATT/WTO Negotiations. *Journal of Political Economy* 119, no. 1: 122–52.
- Ossa, Ralph. 2012. Profits in the “New Trade” Approach to Trade Negotiations. *American Economic Review* 102, no. 3: 466–69.
- Ossa, Ralph. 2014. Trade Wars and Trade Talks with Data. *American Economic Review* 104, no. 12: 4104–446.
- Pauwelyn, Joost. 2008. *Optimal Protection of International Law: Navigating between European Absolutism and American Volunteerism*. Cambridge: Cambridge University Press.
- Schwartz, Warren F., and Alan O. Sykes. 2002. The Economic Structure of Renegotiation and Dispute Resolution in the World Trade Organization. *Journal of Legal Studies* 31, no. 1: S179–S204.
- Staiger, Robert W. 2022. *A World Trading System for the Twenty-First Century*. Cambridge, MA: MIT Press.
- Staiger, Robert W., and Alan O. Sykes. 2011. International Trade, National Treatment and Domestic Regulation. *Journal of Legal Studies* 40, no. 1: 149–203.
- Staiger, Robert W., and Alan O. Sykes. 2013. Nonviolations. *Journal of International Economic Law* 16, no. 4: 741–75.
- Staiger, Robert W., and Alan O. Sykes. 2017. How Important Can the Non-Violation Clause Be for the GATT/WTO? *American Economic Journal: Microeconomics* 9, no. 2: 149–87.



- Staiger, Robert W., and Alan O. Sykes. 2021. The Economic Structure of International Trade-in-Services Agreements. *Journal of Political Economy* 129, no. 4: 1287-317.
- Sykes, Alan O. 2005. The Economics of WTO Rules on Subsidies and Countervailing Measures. In *The World Trade Organization: Legal, Economic, and Political Analysis*, vol. 2, ed. Patrick F.J. McCrory, Arthur E. Appleton, and Michael G. Plummer. New York: Springer.
- Thurk, Jeff. 2022. Outsourcing, Firm Innovation, and Industry Dynamics in the Production of Semiconductors. University of Georgia, working paper.
- WTO (World Trade Organization). 2021. *World Trade Report: Economic Resilience and Trade*. Geneva.
- WTO (World Trade Organization). 2023. *World Trade Report: Re-globalizing for a Resilient, Inclusive and Sustainable Future*. Geneva.
- Wu, Mark. 2016. The “China, Inc.” Challenge to Global Trade Governance. *Harvard International Law Journal* 57, no. 2: 261-324.



---

© 2023 Peterson Institute for International Economics. All rights reserved.

This publication has been subjected to a prepublication peer review intended to ensure analytical quality. The views expressed are those of the author. This publication is part of the overall program of the Peterson Institute for International Economics, as endorsed by its Board of Directors, but it does not necessarily reflect the views of individual members of the Board or of the Institute's staff or management.

The Peterson Institute for International Economics is a private nonpartisan, nonprofit institution for rigorous, intellectually open, and indepth study and discussion of international economic policy. Its purpose is to identify and analyze important issues to make globalization beneficial and sustainable for the people of the United States and the world, and then to develop and communicate practical new approaches for dealing with them. Its work is funded by a highly diverse group of philanthropic foundations, private corporations, and interested individuals, as well as income on its capital fund. About 14 percent of the Institute's resources in its latest fiscal year were provided by contributors from outside the United States.

A list of all financial supporters is posted at  
<https://piie.com/sites/default/files/supporters.pdf>.