Industrial policy and the WTO

Chad P. Bown

Peterson Institute for International Economics & CEPR*

September 2023

Abstract

This paper surveys the economics of industrial policy as it relates to the World Trade Organization (WTO) and is 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. The paper then introduces the dominant economic framework for the role for the WTO, it examines the WTO's rules on subsidies impacting 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 has become so important for the trading system: China, supply chain resilience, supply chain responsiveness, and climate change. The paper highlights available research 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.

JEL: F13, L52

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

* CONTACT: Peterson Institute for International Economics, 1750 Massachusetts Avenue NW, Washington DC 20036 USA. Tel: +1.202.454.1306, Email: cbown@piie.com, Web: www.chadpbown.com.

In preparation for *Annual Review of Economics.* Thanks to seminar participants at Duke Law as well as Panle Jia Barwick, Thomas Bollyky, Rachel Brewster, Nicolas Lamp, Tim Meyer, Tom Prusa, Robert Staiger, Alan Sykes, and Mark Wu for useful conversations. All remaining errors are my own.

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 and subsidies. The staff at the major international organizations – IMF, OECD, World Bank, and WTO – have put out an explicit plea for a renewed work program and for policymaker engagement.[1] This paper explains reasons why, and it explores priority areas for economic research to help inform policymakers at the front lines of the rules-based trading system.

To begin, today's industrial policy seems different from the past. First, it is now being forcefully pursued by major economies like the United States, European Union, and Japan. Second, the experience and impact of China and its use of industrial policy is driving some of the associated WTO challenges and some of its motivations for these new users. Third, today's industrial policy objective is often less about learning for the first time or technological absorptive capacity (as motivated past infant industry policies for developing countries) and instead appears aimed at *returning* parts of a supply chain for certain industries – e.g., semiconductors, personal protective equipment – that was once present but which has since been offshored. Fourth, it is often motivated by economic objectives distinct from increasing firm-level productivity or generating spillovers to other sectors (and thus enhancing national economic growth); instead industrial policy is pitched at diversification in the name of either supply chain resilience, fear over the weaponization of exports by trading partners, or to offer future policymakers more control over economic activity in response to expected shocks. Fifth, in the presence of cross-border supply chains, governments are sometimes seeking to coordinate their industrial policies with key partners, as opposed implementing everything at the national level (reshoring). A final modern reason for industrial policy is the existential threat of climate change.

The rest of this paper proceeds as follows. Section 2 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, drawing from 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 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 our economic understanding of current subsidy rules with implications for industrial policy. It describes unease with the evolution of those subsidy rules, gaps in knowledge, and important data and measurement shortcomings.

The subsequent two sections then form the heart of the paper by introducing four areas where industrial policy has emerged as a major modern policy issue for the WTO. Section 4 tackles the myriad of challenges introduced by China. Section 5 examines areas of supply chain resilience, supply chain responsiveness, and climate change. The four areas are not cleanly separable, however; though the latter three are independent areas of concern, China plays a critically important role in each as well. Section 6 concludes.

[1] See IMF, OECD, World Bank and WTO (2022).

2. INDUSTRIAL POLICY

Harrison and Rodríguez-Clare (2010) provide core theoretical underpinnings for the economics of industrial policy, defined as deviations from policy neutrality.[2] Much of the historical research into industrial policy has been through the lens of economic development, focusing 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, though today's industrial policy it will have limitations 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 due to emergence of a large pool of skilled labor from which multiple firms may be able to draw. They can also occur because of local knowledge spillovers – i.e., a worker at one firm learns something that it transmits to a worker at another firm through local interaction. Such externalities may also arise due to geographic proximity of specialized input suppliers.

Real world examples of Marshallian externalities include the agglomeration of high-tech industries into Silicon Valley or the Route 128 corridor outside of Boston. They may also characterize the North American automotive supply chain – first around Detroit and then expanding along a North American corridor nicknamed "auto alley," (Kleier and Rubinstein 2008). They may emerge not only for 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, whereby the expansion of one sector provides benefits to another.[3] Suppose a *local* financial or software industry – arguably important inputs for other parts of the economy – generates productivity gains for downstream sectors. Alternatively, emergence of a downstream industry could help an upstream sector of input providers expand and enjoy productivity gains. This issue may be increasingly important in an era in which production processes have become more and more fragmented, with outsourcing (and/or offshoring).

Other types of market failures include sector-specific coordination failures – e.g., convincing all local firms to adopt a similar standard so that they can jointly access a foreign market, when that foreign market makes a non-tariff barrier determination at the country level – e.g., after an animal disease outbreak.[4] Another is information spillovers, or the "self-discovery" of newly profitable activities.[5]

---

[2] However, even this is a loose definition 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) is a useful earlier articulation.

[3] These are also sometimes referred to as vertical spillovers.

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

[5] See, for example, Hausmann and Rodrik (2003).

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). In summary, 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, 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 which requires that the discounted future benefits are larger than the costs of the industrial policy.

There is emerging evidence that some historical episodes of industrial policy likely pass a Mills test.[6] 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 further spillover benefits to downstream sectors that use software intensively. Lane (forthcoming) revisits South Korea's Heavy and Chemical Industry Drive of 1973-1979 and similarly finds that, relative to firms in sectors that did not get access to subsidized credit, Korea's industrial policy impacted the firms' input choices, their productivity, their output growth, output prices, exports, it shifted their comparative advantage, and it spilled over to benefit downstream industries. Nevertheless, these studies admittedly do not examine whether the industrial policy passes a Bastable test.

3. THE GATT, 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 WTO

The dominant economic framework for the WTO (and 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).[7] Negotiations between governments have led to the reciprocal reduction of import 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 changes. 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. 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 local interest groups. There is also

[6] Juhász, Lane, and Rodrik (forthcoming) provide a recent survey. Juhász (2018) examines the impact of the Napoleonic blockade (1803-1815) on the long-run economic development of France's mechanized cotton spinning industry.

[7] 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).

a growing body of empirical evidence, from a wide range of settings, to broadly support this interpretation of the WTO.[8]

This research has also documented how certain WTO principles help governments negotiate and sustain this outcome in practice. For example, 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 import 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.[9]

The GATT/WTO also has guidelines that apply when governments seek to *change* policies in the face of 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 allows parties to break a contract when the costs of compliance (to the policy-changing country) exceed its benefits (to trading partners).[10]

As one example, a government can raise an import tariff above its WTO legal commitment without even needing to explain why. However, under GATT Article XXVIII, the tariff increase is subject to negotiation whereby the default compensation rule is that adversely impacted trading partners are permitted a *limited* tariff retaliation to rebalance market access reciprocally.

Similarly, countries can also change their *domestic* policies. The WTO sometimes provide guidelines for 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 only needs to be prepared to bear the consequences (after challenges through formal dispute settlement proceedings) stemming from tariff retaliation, again, that 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 remedies it permits are not punitive.[11] The WTO provides certainty by helping to define the limits to the costs for policy changes. This broadly ensures that the government is implementing the policy for the "right" reasons – such as to regulate to address market failures or local externalities – and not designing a policy change to shift its costs onto trading partners and thus create a new international externality.

[8] 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.

[9] See Horn (2006) and also Staiger and Sykes (2011).

[10] 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).

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

3.2 Evolving subsidy rules and enforcement: from GATT to WTO

In light of this framework, next consider specialized rules for subsidy policies. As described by Sykes (2005), the approach described thus far broadly applied under the GATT period of 1947-1995. A government subsidy in place at the time of a GATT negotiating round, 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. What the GATT rules did seek to discipline, however, was the application of *new* subsidies. Consider potentially three countries: 1 (the subsidizing country), 2, and 3. There were three possible markets whose access could be affected but with different implications for available remedies.

First, suppose country 1 provides a new domestic production subsidy to an import-competing industry. This 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 claiming that while no explicit trade rules may have been broken, a government action still resulted in a harmful, unexpected loss of market access.[12] 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. [13]

Second, suppose country 1's production subsidy increases its exports to country 2's import market instead. GATT rules permit country 2 to use a countervailing duty – an import tariff set at the size of country 1's subsidy – to unilaterally restore the original level of market access, without need for a formal dispute adjudicated by a third party.[14]

Third, suppose country 1's subsidy increases its exports to country 3's import market, where country 2 is also exporting. Neither the GATT's formal trade dispute (and NVNI claim) nor CVD approach could tackle the problem. The subsidy would lower the price received by country 2's exporters in country 3's market making them worse off.

The rules on subsidies were tightened significantly in 1995 with the introduction of the WTO's new Agreement on Subsidies and Countervailing Measures (SCM). One contribution was introduction of the concept of "serious prejudice" or economic harm arising from subsidies affecting competing exporters in third country markets, where the NVNI doctrine did not reach under the GATT (Sykes 2005).[15] By the time of the Uruguay Round of negotiations in the 1980s, subsidies impacting third market competition

[12] See Petersmann (1997, 151-154) for a discussion of early GATT Working Party and panel reports which clarified conditions under which subsidies were understood to upset market access.

[13]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.

[14] Foreign subsidies that lower the price of imports are beneficial to importing countries, as the gains to consumers are larger than the losses to domestic producers. Resort to CVDs would need 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.

[15] 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).

between the US and Europe in commercial aircraft (Boeing-Airbus) or the US and Japan in semiconductors were areas of concern. Farm subsidies in Europe, the United States, and elsewhere – sometimes leading to dumping in third country markets – was worrisome enough that members introduced the separate WTO Agreement on Agriculture.

The SCM Agreement tightened subsidy disciplines in other ways. Bagwell and Staiger (2006), for example, stress that subsidies suddenly became de-linked from market access implications of tariff negotiating rounds because the SCM agreement did not distinguish between new subsidies and those that existed at the time of tariff negotiations.[16]

Furthermore, subsidies contingent on exports and local content (domestic as opposed to imported inputs) became prohibited.[17] Defining certain subsidies as being prohibited and making others "actionable" may have been further 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 are data-, model- and economic evidence intensive; in general, WTO arbitrators have often 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.[18]

Subsidy policies became different from other policies challenged in formal WTO dispute along two additional dimensions. The first involved a potential acceleration of the formal process; in principle, the dispute could reach the remedy (cost-imposing) phase sooner. Second, the language for compensations is for the complainant to adopt "appropriate countermeasures," which, in principle could also be larger than the authorization for non-subsidy disputes.[19]

While the WTO cannot stop any government action, its authorization of quicker and/or larger trading partner retaliation could shape policymaking behavior. This could be beneficial if it halted subsidization that was inefficient or pushed the form of subsidies into those that did not generate international spillovers. However, it could also prove costly if the rules inadvertently discouraged governments from first-best subsidies to address market failures or if they push governments toward less efficient policy

[16] Bagwell and Staiger (2006) suggest the stringency of the new rules has efficiency costs for the system relative to GATT – i.e., excessively stringent rules preventing subsidies may have introduced harm into the system by making it more difficult for governments to negotiate and sustain low tariffs.

[17] Sykes (2005) further notes one inconsistency regarding the prohibition on local content subsidies in 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, it may be prohibited under the WTO for a government to offer subsidies to an automaker contingent on it using locally-produced steel. However, it is not prohibited under the WTO for the government to offer an equivalent scheme whereby it simply subsidized production of local steel directly.

[18] 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 additional factors impacting trade growth aside from the policy during the period of interest, such as the macroeconomic fundamentals of the 2008 trade collapse.

[19] Some subsidy disputes have authorized tariffs equivalent to the size of the subsidy (Bown and Ruta 2010). See also Grossman and Sykes (2011).

instruments, simply because those policies (e.g., import tariffs or export restrictions) had no or weaker disciplines.[20]

3.3 Industrial policy theory in the WTO framework

Consider again the Harrison and Rodríguez-Clare (2010) framework described in section 2. Thus far, we have defined the country imposing the industrial policy as "small" – i.e., policies had no impact on world prices and no discernible adverse effect on trading partners. For WTO purposes, this can be interpreted in two ways. It makes little sense – at least under the terms-of-trade theory of trade agreements – for the WTO to have rules to constrain a small countries' policies, raising the question of who would have negotiated them in the first place. Yet, if the 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 dispute settlement challenge anyway.[21]

Now suppose countries are not small. Harrison and Rodríguez-Clare (2010) also explore conditions when the country imposing the industrial policy has the potential to impact world prices and therefore impose costs on trading partners. They show that sometimes this can lead to negative externalities – i.e., a deterioration of the other country's terms-of-trade – which could lead to a reduction in its export market access and thus why it would be concerned and potentially want to resort to its rights under the WTO. [22]

In this case, the Bastable test, which only consider 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, for example, trading partners could demand compensation, in which the additional cost sometimes emerges in the form of lost export market access for a different good through authorized tariff retaliation.[23]

3.4 Measurement challenges to subsidies, industrial policy, and inference

For interrelated reasons, surprisingly little is known empirically about the prevalence and importance of industrial subsidies or their impacts on trading partners.[24]

One challenge is definitional. The SCM Agreement defines a subsidy as being a financial contribution, by a government or any public body within the territory of a Member, which confers a benefit. But

[20] GATT Article XI limits use of quantitative restrictions on exports, but not export taxes. As part of its protocol of accession, China was required to take on commitments to limit its use of export taxes. As discussed below, limiting China's use of export restrictions has proven difficult for WTO members to enforce in practice.

[21] There may alternative motivations for the government to want to tie its own hands – such as under the commitment theory (Brou and Ruta 2013). However, as pointed out by Bown and Hoekman (2008), even in such settings small countries require credible external enforcement which is unlikely to emerge in the current WTO dispute settlement system.

[22] This 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 another. (For a survey, see Brander 1995.)

[23] A handful of disputes have resulted in respondent countries agreeing to cash transfers in lieu of suffering tariff retaliation – e.g., in *United States – Section 110(5) of the US Copyright Act*, the US paid the EU a lump sum of $3.3 million and in *US -Upland Cotton* the US paid Brazil $147.3 million annually for a number of years.

[24] OECD has been providing estimates of support for the farm sector for many countries for decades (OECD 2023).

economically impactful subsidies can emerge outside of this definition. For example, suppose there are two firms each in two countries, Home and Foreign (*), respectively: firms A and A* produce inputs, and 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: (i) Home imposes an export restriction on firm A; (c) Home fails to enforce the intellectual property of a foreign firm A*; (iii) 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 A* that is a profit-maximizing firm.

One important US complaint with the WTO, for example, has been definitional. China has argued that its SOEs are not "public bodies" and thus cannot offer subsidies to downstream firms. The United States has argued they are and, as a result, since 2007 has imposed countervailing duties on imports from China benefiting from subsidized inputs from those SOEs. [25] This is important given the pervasiveness of China's SOEs across a variety of input-providing sectors to the economy (e.g., banking, energy, other upstream industries) and the growth of its SOEs over time (Lardy 2014, 2019). But it is not only Chinese SOEs, as the state controls access to land, another critical input. The Chinese Communist Party may place members on the boards of companies or otherwise influence firm decisions away from profit maximization and toward fulfilling other objectives (Wu, 2016). Finally, a related definitional issue for policymakers is whether, for the purposes of often substitutable trade remedy of antidumping, China is a non-market economy.[26]

Next, China deploys industrial policy through explicit five-year plans as well as 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 VAT rebates, 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 (USTR 2018a,b). For potential WTO disputes, the combination of policies and state-centric objectives also means that China's interventions may be challenging to detect – i.e., the effect of a subsidy may exist, but without any observable transfer of funds between the government and the agents engaging in economic transactions.

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 and uncertainty over China's subsidies may lead trading partners (like the United States) to impose trade remedies over more products and at higher rates in response because they are provided

[25] The US government began to grapple with this issue when it faced calls to reverse a 1986 decision (*Georgetown Steel*) that had decided against using countervailing duties against non-market 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 it began to impose CVDs. (Commerce 2006a,b; 2007).

[26] For a discussion of the issues surrounding China's non-market economy status, see Bown (2016).

additional institutional flexibility to do so.[27] Third, given how trade remedies work, these 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 the trading system.

3.5 Limited information on subsidies, industrial policy, and what inference to draw

Are subsidies important empirically? Consider three potential sources of data: trade remedies (CVDs), subsidies themselves, and formal WTO disputes.

One telling sign about the importance of China's industrial policy and its economic system to generate conflict in the multilateral system 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 1a). Despite differences in their legal criterion, the nature of the Chinese economy has allowed for foreign governments to substitute across trade remedy instruments. The most common is antidumping, though for many countries, CVDs are growing in use, following the US lead described earlier (figure 1b).

Furthermore, 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.[28]

Second, there are many sources of data that, in theory, could be combined to provide useful information. For example, the Global Trade Alert (GTA) has created a database on changes to government measures since 2008 (Evenett 2009).[29] Yet, the GTA is only a gateway to an improved empirical accounting for subsidies, especially when seeking to draw inference from aggregate data across countries or over time. One reason is, again, definitional. (As described earlier, US policy is distinct in its transparency, Chinese subsidies are at the other extreme.) Finally, evidence of more subsidies could be associated with governments better targeting externalities or market failures. For example, the large government subsidies supporting the acceleration and capacity enhancement of COVID-19 vaccine

[27] 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.

[28] The US tariffs beginning in 2018 on third country exports of steel and aluminum are the most high-profile example as they resulted in both immediate, extra-WTO retaliation and formal WTO disputes with highly contentious legal rulings (Bown 2021a, 2023c). (However, those tariffs are not captured in figure 2 because they were imposed under a national security law as opposed to a trade remedy; as such, figure 2 provides an underestimate of the empirical importance of this phenomenon.) For the impact of those US tariffs for WTO dispute settlement, see Bown (2021a).

[29] Juhász et al (2023) use machine learning to draw inference regarding GTA data for policymaker intent to use industrial policy.

supply chains in 2020-21 was a positive signal – if anything, governments significantly under-subsidized relative to the size of the Coronavirus externality (Athey et al, 2022).

Third, only limited inference can also be drawn by examination of formal WTO dispute settlement activity involving subsidies.[30] Over 1995-2019, 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 involved challenging the trade remedy – i.e., an importing government's response to the subsidy.

To see this point more clearly, WTO members requested consultations with China over its subsidies only 16 times over 2001-2019. Yet, over that same period, trading partners brought over 60 disputes against US trade remedies. China alone brought 10 of those!

Multiple reasons contribute to why so few subsidies have been challenged at the WTO. First, it is a system requiring state-to-state enforcement but with demands for evidence made available by private sector interests (and where governments often lack subpoena power). Second is the free-rider problem – i.e., suppose a government with limited resources to spend on WTO litigation is choosing between two foreign market access concerns to litigate. One would fix a MFN violating policy that hurts only its exporters and the other is, say, a national treatment violation (like a subsidy) hurting multiple countries' exporters.[31] Disputes of the latter type will be less likely to arise because the benefits to their removal spill over and are not fully captured by the complainant. Third, such WTO disputes are data intensive and by the time the evidence materializes to show that there is adverse effects it is too late to matter – i.e., the foreign subsidized industry is established (the subsidy has done its job), and even a dispute that the complainant wins only allows for retaliation until the subsidy is removed. (WTO remedies are prospective and not retrospective in nature.)

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 alongside 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 challenges for the trading system would dissipate over time. Furthermore, China's economy is so large and now so intertwined with others through buying and selling (imports and exports) as well as supply chains that even its domestic policies have the possibility of imposing considerable externalities on its trading partners.

4.1 Economic research into China's industrial policy

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

Start with the illustrative case study of Chinese shipbuilding. At the turn of the century, China had only roughly 10 percent of the global shipbuilding industry, which was dominated by firms in Japan and South Korea. As part of its 11th (2006-2010) and 12th (2011-2015) National Five-Year Plans, China

[30] Maggi and Staiger (2018) provide a theory of trade disputes showing the difficulty of drawing inference from the existence of WTO disputes more generally.

[31] See for example, Bown (2005) and Bown and Reynolds (2015).

implemented a series of industrial policies to promote the sector. By 2009, China 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 then begin to *assess* their impact. Lacking access to detailed information on the exact policy instruments but knowing their timing, the approach relies on a structural model of the Chinese 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 using that information, along with the model, to examine their impact.

The key results of Barwick, Kalouptsidi, and Zahur (forthcoming), for example, are that Chinese industrial policy between 2006-13 was effective, as it more than doubled 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. The policy introduced global inefficiency, with excessive fragmentation of the industry and low levels of capacity utilization. Furthermore, there was no evidence of learning by doing either at the firm or industry level, thus calling into question one important potential underlying motive for the industrial policy in the first place.[32]

Furthermore, the evidence is consistent with China being a large country, whose industrial policy had ramifications for trading partners. China's world market share in shipbuilding increased by 42 percent during 2006-13. Yet, only 30 percent of China's expansion translated into higher world output – 70 percent was business stealing from Japan and South Korea. Chinese subsidies caused South Korea's world market share to fall from 48 to 39 percent, and Japan's to decline from 23 to 20 percent, 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 Korea, and remained over 50 percent for Japan despite the 30 percentage point drop off from 15 years earlier (Gourdon 2019, figure 1).

Batteries for electric vehicles are an important second 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 and find strong evidence of firm-level learning by doing – i.e., that production costs fall as manufacturers gain production experience. Because many governments – including 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 internal combustion engine vehicles, such subsidies can potentially accelerate learning by doing.

However, in 2016, China also implemented a discriminatory, local content policy through a "whitelist" whereby its EV subsidies became 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. (The policy lasted until mid-2019.)[33] Barwick et al (in progress) estimate the Chinese whitelist policy increased sales of Chinese battery firms by over 50 percent, 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.

[32] In particular, they find that marginal costs tend to increase rather than decrease in past production measured at both the firm and industry level.

[33] See S&P Global Market Intelligence (2019).

Furthermore, electric vehicles with BYD and CATL batteries experienced faster price reductions than other automakers as EV companies passed on much of the battery cost reduction (due to the learning by doing) to car buyers. Yet, the authors also find that China's whitelist policy negatively impacted global EV sales 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 electric vehicle batteries means Japan and South Korea may have had their WTO market access rights violated by China's industrial policy.[34] Puzzlingly, neither pursued a WTO dispute against China over either issue. It was not simply a domestic collective action problem; Japan initiated formal WTO disputes against *Korea's* shipbuilding industry in 2018 and 2020. Furthermore, 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 electric vehicle supply chains shortly thereafter.[35]

Why countries aside from 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, including against Japanese and Korean firms.[36]

For subsidy policies, the explanation may be even more complicated. For prohibited subsidies (e.g., local content and export subsidies) there is less of an evidentiary burden and so the dispute resolution process may be quicker. But for other subsidies, it is often necessary to show economic effects – which can take years to develop in the data, data which may only arrive with a lag. By then, the capacity is installed, and it may be too late to stop (or reverse) the economic effects. Finally, despite work like Kalouptsidi (2018), Barwick, Kalouptsidi, and Zahur (forthcoming), and Barwick et al (in progress) revealing evidence of discriminatory subsidies with serious market access implications, such cases may have been too difficult to legally prosecute under the WTO as the evidence relies heavily on structural economic models that may not be amendable to litigation between sovereign states as well as a legal process short on economic expertise.

[34] In 2023, the European Union self-initiated a CVD investigation into Chinese electric vehicles that could result in tariffs (Hancock, et al, 2023).

[35] These companies publicly responded to requests for information by the US Treasury in fall of 2022 when it was seeking stakeholder feedback in order to write the regulations to implement the Inflation Reduction Act of 2022 (Bown 2024). However, prior to 2021, LG Chem and SK On were having an intellectual property rights dispute that may have impeded their technologies from fully deploying in the US market (USTR, 2021).

[36] In its 2010 response to Japan's detention of a shipping trawler over dispute territorial waters, China restricted exports of rare earth metals needed for electric vehicles and other high-tech products (Bradsher 2010). At the height of the China batteries policy period in 2017, China separately began using acts of economic coercion against Korean companies for the Korean government decision to implement the THAAD missile system (Lim and Ferguson, 2019).

Nevertheless, these types of industry-level approaches provide an important starting point for understanding challenges facing the WTO, given the China problem. A fruitful research agenda would be model adaptation to examine sectors where policymakers have raised similar concerns that Chinese industrial policy resulted in sizable, negative international externalities with plications for the WTO.[37] Such industries include steel, aluminum, and solar panels – these are Chinese sectors allegedly benefiting from industrial policy where countries like the United States have addressed the direct (import) impact by imposing new tariffs. However, the underlying concern of China's industrial policy remains unaddressed – leaving trading partners with potentially remaining market access concerns both in the Chinese domestic market as well as in third country markets where they might be competing exporters – and new concerns over the US policy response.

Another politically and technologically important sector is semiconductors – an industry that other advanced economies are now targeting with industrial policy of their own (see below), but where indigenous, Chinese firms have struggled to advance to manufacture the most sophisticated chips at the technological frontier. In that case, OECD (2019b) provides a starting point as it has used creative data collection techniques to back out the size of subsidies received by firms through examination of firm balance sheets and income statements.[38]

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 currently poorer countries. Having seen China successfully lift hundreds of millions of people from extreme poverty to middle income in under four decades, many countries want to adopt aspects of its model for their own development strategies. Thus, WTO rules may need to be adapted to accommodate (or even facilitate) such policies on development grounds. Research could help rules designers better understand what it was about the Chinese model and approach that drove that success and that which did not.[39]

The second and more imminent threat to the WTO system 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 trade war of 2018-19 and the new status quo codified into the "phase one" agreement (and failure to de-escalate hostilities since) – has led to a situation in which both sides are violating the WTO's MFN principle (Bown 2021b). The trade war was at

[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 and its "Made in China 2025" policy in particular and do not find evidence that firms targeted by such policies perform better than non-targeted firms according to a number of standard economic criterion. Aghion et al (2015), on the other hand, examine the impact of industrial policy on Chinese medium and large firms over 1998-2007, an earlier era. They find productivity growth associated with industrial policies targeting sectors that are competitive sectors or that foster competition. These analyses do not, however, examine formally the international implications of such policies, in terms of their impact on trading partners.

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

[39] Again, studies like Barwick, Kalouptsidi, and Zahur (forthcoming) may provide a useful starting point and template, as their formal modeling also helps to sort through the impacts of different industrial policy instruments.

least partially due to US dissatisfaction with the multilateral system's ability to curtail the externalities that China was imposing.[40]

Yet, even prior to the trade war, and for many of China's other trading partners, the system was already showing signs of stress (see again figures 1,2). Furthermore, the US decision to end WTO dispute settlement was driven in part by its view that the problem was worsening over time: the system was increasingly both unable to constrain Chinese policy that led for the need for US trade remedies but at the same time keen on constraining the US ability to defend itself from Chinese imports through trade remedies (Bown and Keynes 2020). For example, the WTO arbitration 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 the US exports annually for $3.6 billion and $645 million, respectively, due to what it decided was US misuse of trade remedies affecting Chinese exports.[41] Yet, there have 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 – that may challenge the bounds of WTO rules – is itself 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 electric vehicles in part in response to China's policies.

This raises two related questions. First, are the countries imposing these new industrial policies – like the United States – acting rationally? I.e., even if China's industrial policy is not making its firms more productive, other countries can still be negatively impacted. Does this explain the industrial policy reaction? Put differently, to what extent is this simply countries shifting from implementation of cooperative to noncooperative policy?[42]

Second, if that is part of the explanation, can the trading system's rules be adjusted to both accommodate an economy like China and restore cooperation 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.[43] At the other extreme is Staiger (2022, pp. 149-164) who suggests contracting 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 – China included – is reciprocity for

[40] Mattoo and Staiger (2020) provide an alternative interpretation of the US-China trade war.

[41] These WTO retaliation authorization decisions likely 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).

[42] Ferrari and Ossa (2023) explores 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] See also Bown and Hillman (2019) and Mavroidis and Sapir (2021).

changes to its imports and exports, and the securitization of market access, to prevent externalities from being imposed on trading partners.

While 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. They took on quantitative commitments to expand their imports (Haus 1991). Poland agreed to import growth by the same 7 percent per year that it reciprocally anticipated would be its export growth to the rest of the Contracting Parties (Douglass 1972). An open question is whether something similar could provide a useful approach for restoring cooperation between China and its trading partners in a modern trading system.

5. OTHER MODERN INDUSTRIAL POLICY MOTIVATIONS FOR THE WTO

This section motivates 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 has recognized its salience as two of its recent flagship *World Trade Reports* were dedicated to the issue (WTO 2021, 2023).[44]

Why is this policy question arising now? Suppose the multilateral trading system successfully lowered trade barriers. Combined with transportation technology and the ICT revolution, production fragmented and global supply chains resulted. However, in certain instances, parts of global production processes concentrated *geographically*, potentially taking advantage of agglomeration and scale economies. (Industrial policy by China or 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. Yet, given evidence that economic shocks can propagate from one country to another along supply chains,[45] 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 now be different.

Climate shocks mean greater frequency and heightened intensity of severe storms leading to flood or wind damage, or other periods of less precipitation leading to extreme droughts and wildfires. Much of high-end semiconductor production, for example, 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, as well as by Samsung in South Korea (Bown 2020).

The COVID-19 pandemic suggested a future of more worrisome public health shocks. In terms of supply chains, the initial epicenter of that public health shock was China – where production of personal protective equipment was geographically concentrated – creating a perfect storm of negative shocks to

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

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

supply (and exports) and positive shocks to demand. Supplies were taken off of global markets at the same time that import demand for PPE from the rest of world increased in an attempt to save lives (Bown 2022b). Even though Chinese PPE exports were eventually sizable (and important for global public health), the geographic concentration of production being in China contributed to initial global shortages that were problematic.

Finally, geopolitical conflict and tensions re-emerged with Russia's invasion of Ukraine, China's threatened takeover of Taiwan after political capture of Hong Kong, and its 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 battery supply chain for electric vehicles, for example, has shaped US industrial policy incentives found in the Inflation Reduction Act (Bown 2023b, 2024). (It is also contributing to concerns over semiconductors.)

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 so, an adjustment of supply chains could improve global welfare.[46]

Supportive of this possibility are numerous examples of today's industrial policy often being different from simply (national) reshoring. Sometimes it involves industrial policy *coordination across countries* – i.e., governments are seeking to retain at least some of the benefits to 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*.[47] 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 Vietnam*.[48] Furthermore, with a common goal of diversifying semiconductor manufacturing away from certain parts of Asia, the United States, Japan and EU have sought to coordinate their subsidization – this may help prevent redundancy across nodes and excess industry-level capacity.[49] Finally, for batteries for electric vehicles, South Korean companies need their inputs to be sourced from countries with which the United States has a critical minerals agreement to qualify for a $3,750 tax credit under IRA. This led the South Korean government to lobby the US government to sign such critical minerals agreements – *with Indonesia and Argentina* – countries from which its battery companies source inputs.[50]

Are such policies necessary? First consider the evidence about supply chain resilience based on firm behavior in the absence of policy interventions. One early empirical paper is Khanna, Morales, and Pandalai-Nayar (2022), who examine Indian firm responses to COVID-19 related lockdowns. They define and measure resilience empirically three different 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 – i.e., more exposed firms are more likely to break links with their suppliers, have difficulty finding new suppliers when links are

[46] Of course, an important empirical question is also whether the distribution of shocks has really changed.

[47] See Nikkei Asia (2020).

[48] See US Department of State (2023).

[49] See Hayashi (2022), Reuters (2023) and Nagao (2023).

[50] See Oh (2023).

broken, and therefore experience declines in their total input purchases and output. The second part of their research explores what features of supply chains make those chains more resilient. Their evidence suggests that the most resilient supply chains arise when suppliers are larger, inputs being purchased are more differentiated, and the number of alternative suppliers is low. Perhaps surprisingly, they find more complex supply chains are *not* less resilient to shocks. This suggests such firms may understand their exposure and thus may be more likely to invest in resilience ex ante.

Castro-Vincenzi (2022) studies how the global auto industry has responded to historical flood events in work designed to draw inference for climate change. Similarly, the evidence 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. With more weather shocks, firms respond over time by constructing more (but smaller) plants and holding some capacity idle to be deployed in response to a negative shock hurting production elsewhere. The effort at increasing automaker resilience allows them to produce more output in the aftermath of a shock, but such supply chain adjustments are also costly, as firms are less productive (with more, smaller plants, operating at lower levels of capacity utilization) and consumers pay higher prices.

The implication of the available evidence is that firms respond to incentives about resilience – i.e., qualitatively they are adjusting in the right direction. However, an open policy question is whether firms face *sufficient* incentives. If not, what is the role for government and what are the appropriate policy instruments?

New theoretical work has begun to explore industrial policy designed to achieve the optimal level of resilience (e.g., Grossman, Helpman and Lhuillier, forthcoming; Grossman, Helpman and Sabal, 2023). It is beyond the scope of this paper to provide a complete assessment of the still emerging theory, but one message is that the answer is likely to be nuanced and depend on supply chain details.[51] But 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 obvious: while consumers are hurt (through lost consumer surplus) when a supply chain disruption makes a good unavailable, firms also often lose producer surplus or profits which should also make them seek to invest to avoid such scenarios when it is profitable to do so.[52] The key question is when and why they do not do so.

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 efforts to discipline or to coordinate subsidies?

[51] 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). For a review, see Brander (1995). See also Maggi (1996).

[52] In some models, counter-intuitively, 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 to prevent excessive investment in diversification that would be socially wasteful.

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 do it more quickly in response to an emergency. This includes speedy and sizeable 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 (Athey et al, 2022).[53] 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 turned out difficult to implement one during the ongoing pandemic. Governments wanted access to locally produced vaccines to treat local citizens first, promises to share internationally became a time-inconsistent policy, and 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, in some ways, acted as a social planner through novel priority-rated contracting and industrial policy implemented through emergency powers under the Defense Production Act (DPA). Amongst 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 forced firms to temporarily act against their private interests (Bown 2022c). In theory, it 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 over-arching questions for policy and the WTO.[54] First, what are the tradeoffs to having cross-border as opposed to purely local supply chains in the face of such an emergency? Anecdotally, having the (pre-emergency) backbone of the supply chain being local allowed for greater responsiveness that might sometimes outweigh the cost reduction benefits of the chain being cross-border. For example, if price signals cannot be transmitted upstream to input suppliers when such chains cross borders for some reason, subsidies to the end output producer may have faster (or more efficient) effects when supply chains are local. Alternatively, governments may also under-subsidize if the benefits of those subsidies leak to firms operating abroad.[55] Given the US government experience under the DPA, another rationale may be the reduction of asymmetric information in terms of identifying who (which input makers) to subsidize and how to subsidize them, when the supply chain is local relative to it crossing borders, (Bown 2022c). Finally, of course, policymakers can compel firms in their own legal

[53] Vaccines are not the only example. During a pandemic, novel tests and treatments are another. Other "emergencies" motivating this research include climate change (Athey, Glennerster, Ranshoff and Snyder 2022) as well as a military responsiveness (production of armaments).

[54] Some of these are explored formally in Bown, Snyder and Staiger (2022).

[55] 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).

jurisdiction to act against their 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 only sought to discipline these policies, not necessarily coordinate their deployment across countries (Bown 2023a).

Personal protective equipment (PPE) is a second example where policy responsiveness and control emerged during COVID-19.[56] Pre-pandemic supply chains meant that products like hospital gloves were mostly not manufactured in the United States at all. For others, like N-95 respirators, little local production meant consumption was heavily dependent on imports. Unlike other goods, US policymakers could thus not accelerate domestic production in the emergency through triggering surge clauses in contracts with local firms because, as one US official put it, "you can't surge zero." I.e., for policymaker responsiveness, there is a major difference between zero capacity and some, minimal level of domestic capacity.

The tragic shortages of PPE to emerge in early 2020 resulted in a novel combination of industrial policies seeking to gain access to emergency supplies. In the long term, the US government provided 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. The US imposed export controls to keep local the few supplies of certain PPE that were produced domestically. Furthermore, again under a different part of the DPA, the US compelled 3M, a US-headquartered multinational, to supply to the United States *from its Chinese plants* under the threat that 3M would not otherwise be allowed to supply (export) to longtime hospital customers in Canada and Mexico from their US plants.[57] These policies could have turned out quite costly if trading partners, in the emergency, 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 involvement of international (economic) externalities.

5.3 Climate change mitigation

Climate change is a final important impetus behind modern industrial policy. The United States, for example, is subsidizing 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. Yet, other major economies are pursuing the more economically efficient approach of putting a price on carbon directly. Trade conflicts may emerge, that will need to be managed, because of the outcomes resulting from these different policy approaches.

One concern is that the two different policy approaches have divergent competitiveness impacts on downstream, energy-intensive sectors like steel, aluminum, chemical, fertilizers or cement (Clausing and

[56] Bown (2022b) provides a more detailed discussion. See also Bown and Keynes (2021).

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

Wolfram 2023, Bown and Clausing 2023). Investment or production subsidies to clean energy may tend to substitute energy use toward clean as opposed to dirty energy; reduced dirty energy use provides a social benefit. However, subsidies tend to lower the price of energy overall, providing a competitive benefit to local downstream industries. (There is no externality associated with "energy," so lowering the price of energy encourages excessive energy consumption.) On the other hand, a carbon tax tends to raise the price of energy, thus hurting the competitiveness of the local downstream industry, all else equal.

For WTO purposes, a key issue is that a country using 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 those using a first-best policy (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 numerous reasons why the WTO should be tasked with coming to grips with modern industrial policy. That being said, there have been many proposals for major new issue areas that have come (and sometimes gone) from the WTO's agenda for one reason or another. These 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.[58]

Nevertheless, industrial policy does seem different. This paper provides a basic framework to address industrial policy in the WTO. While it reviews some of the most relevant research, it is admittedly a cacophony, calling out to economists for more research into what we don't know, but what policymakers need (and are clamoring) to know 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 better understand impacts, the potential sizes of externalities (where existent) relative to the size of the subsidies, and then the market access impacts on trading partners. A final important research area is institutional design; restoring sustainable cooperation over trade policy may require additional cooperation and understanding of industrial policy.

Governments seem intent on using industrial policy to tackle the world's most pressing market failures and externalities. The key for researchers is to help them identify the size and shape of policies, the role of international cooperation – where it calls to discipline subsidies, when it calls for coordinated policies to jointly expand subsidies – so that the world can continue to also benefit from the efficiency gains from trade and the international fragmentation of production, competition, and of course comparative advantage.

Much like 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, such excesses may someday trigger governments agreeing to develop new international rules on which subsidies to

[58] See Limão (2006) and Freund and Ornelas (2010) for early research on preferential trade agreements, see Mattoo, Rocha and Ruta (2020) and Maggi and Ossa (2021) for deep trade agreements, see Grossman, McCalman, and Staiger (2021) for regulatory convergence, see Staiger and Sykes (2021) for trade in services, and see Staiger (2022, chapter 9) for digital trade agreements.

coordinate, which to greenlight, and which to limit. As was the case in the 1940s during the GATT's development, well-informed economic research will hopefully emerge to help policymakers sort through some of the most important the tradeoffs.

REFERENCES

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: 742-770.

Athey, Susan, Rachel Glennerster, Nan Ransohoff, and Christopher Snyder. 2022. Advance Market Commitments Worked for Vaccines. They Could Work for Carbon Removal, Too. *Politico*, December 22.

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: 1121-1137.

Bagwell, Kyle, Chad P. Bown, and Robert W. Staiger. 2016. Is the WTO Passé? *Journal of Economic Literature* 54, no. 4: 1125-1231.

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: The 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.

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: 153-180.

Barwick, Panle Jia, Myrto Kalouptsidi, 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 manuscript.

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.* Brookings Institution. March.

Boehm, Christoph E., Aaron Flaaen, 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. 2024. How the United States solved South Korea's problems with electric vehicle subsidies under the Inflation Reduction Act. *Journal of World Trade*, forthcoming.

Bown, Chad P. 2023a. The WTO and vaccine supply chain resilience during a pandemic. *Journal of International Economic Law* 26, no. 2: 343–362.

Bown, Chad P. 2023b. Industrial policy for electric vehicle supply chains and the US-EU fight over the Inflation Reduction Act. In Simone Tagliapietra and Reinhilde Veugelers (eds.) *Sparking Europe's New Industrial Revolution: A policy for net zero, growth and resilience.* Brussels: Bruegel, 210-255 (chapter 11).

Bown, Chad P. 2023c. The dreaded WTO ruling on Trump's national security tariffs. *Trade Talks*, Episode 175, January 22.

Bown, Chad P. 2022a. Trump ended WTO dispute settlement. Trade remedies are needed to fix it. *World Trade Review* 21, no. 3: 312-329.

Bown, Chad P. 2022b. How COVID-19 medical supply shortages led to extraordinary trade and industrial policy. *Asian Economic Policy Review* 17, no. 1: 114-135.

Bown, Chad P. 2022c. COVID-19 vaccine supply chains and the Defense Production Act. *Oxford Review of Economic Policy* 38, no. 4: 771-796.

Bown, Chad P. 2021a. To Build Back Better, Biden Needs to Fix Trade. Trump Has Left a Ticking Time Bomb at the WTO. *Foreign Affairs*, January 21.

Bown, Chad P. 2021b. The US-China Trade War and Phase One Agreement. *Journal of Policy Modeling* 43, no. 4: 805-843.

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: 349-388.

Bown, Chad P. 2016. Should the United States Recognize China as a Market Economy? Peterson Institute for International Economics Policy Brief 16-24, December.

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. 2004. Trade Disputes and the Implementation of Protection under the GATT: An Empirical Assessment. *Journal of International Economics* 62, no. 2: 263-294.

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. and Thomas J. Bollyky. 2022. How COVID-19 vaccine supply chains emerged in the midst of a pandemic. *The 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: 371-394.

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, September.

Bown, Chad P. and Meredith A. Crowley. 2013. Self-Enforcing Trade Agreements: Evidence from Time-Varying Trade Policy. *American Economic Review* 103, no. 2: 1071-1090.

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: 557-578.

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: 253-277.

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. 2021. How America responded to its PPE shortage. *Trade Talks*, Episode 158, October 11.

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. 2017. Trade Agreements and Enforcement: Evidence from WTO Dispute Settlement. *American Economic Journal: Economic Policy* 9, no. 4: 64-100.

Bown, Chad P. and Kara M. Reynolds. 2015. Trade Flows and Trade Disputes. *Review of International Organizations* 10, no. 2: 145-177.

Bown, Chad P. and Michele Ruta. 2010. The Economics of Permissible WTO Retaliation. In Chad P. Bown and Joost Pauwelyn (eds.), *The Law, Economics and Politics of Retaliation in WTO Dispute Settlement*. Cambridge, UK: Cambridge University Press, 149-193 (chapter 6).

Bown, Chad P., Christopher M. Snyder, and Robert W. Staiger. 2022. Vaccine Supply Chain Resilience and International Cooperation, Manuscript, July.

Bradsher, Keith. 2010. Amid Tension, China Blocks Vital Exports to Japan. *New York Times*, September 22.

Brander, James A. 1995. Strategic trade policy. In Gene Grossman and Kenneth Rogoff (eds.) *Handbook of International Economics*, Vol. 3, 1395-1455 (chapter 27).

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., Guangwei Li, and Mengjia Ren. 2022. Picking Winners? Government Subsidies and Firm Productivity in China. NBER Working Paper No. 30,699, December.

Branstetter, Lee G. and Guangwei Li. 2022. Does "Made in China 2025" Work for China? Evidence from Chinese Listed Firms. NBER Working Paper No. 30,676, November.

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 manuscript, November.

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.

Department of Commerce. 2006a. *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, Washington.

Department of Commerce. 2006b. *The People's Republic of China (PRC) Status as a Non-Market Economy (NME)*, A-570-901, May 15, Washington.

Department of Commerce. 2007. *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, Washington.

Douglass, Andrew Ian. 1972. East-West Trade: The Accession of Poland to the GATT. *Stanford Law Review* 24, no. 4: 748–764.

Eaton, Jonathan and Gene M. Grossman. 1986. Optimal Trade and Industrial Policy under Oligopoly. *Quarterly Journal of Economics* 101, no. 2: 383-406.

Evenett, Simon J. 2009. Global Trade Alert: Motivation and Launch. *World Trade Review* 8, no. 4: 607–609.

Ferrari, Alessandro and Ralph Ossa. 2023. A quantitative analysis of subsidy competition in the U.S. *Journal of Public Economics* 224: 104919.

Freund, Caroline and Emanuel Ornelas. 2010. Regional Trade Agreements. *Annual Review of Economics* 2, no. 1: 139-166.

Gourdon, Karin. 2019. An analysis of market-distorting factors in shipbuilding: The role of government interventions. OECD Science, Technology and Industry Policy Papers, No. 67.

Grossman, Gene M. 1990. Promoting New Industrial Activities: A Survey of Recent Arguments and Evidence. OECD Economic Studies 14: 87–126.

Grossman, Gene M., Elhanan Helpman, and Hugo Lhuillier. Forthcoming. Supply Chain Resilience: Should Policy Promote Diversification or Reshoring? *Journal of Political Economy*.

Grossman, Gene M., Elhanan Helpman, and Alejandro Sabal. 2023. Resilience in Vertical Supply Chains. Princeton University mimeo, 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: 215-249.

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: 133-164.

Hancock, Alice, Henry Foy, Hudson Lockett, and Peter Campbell. 2023. EU to launch anti-subsidy probe into Chinese electric vehicles. *Financial Times*, September 13.

Harrison, Ann E. and Andrés Rodríguez-Clare. 2010. Trade, Foreign Investment, and Industrial Policy for Developing Countries. In Dani Rodrik and Mark Rosenzweig (eds.) *Handbook of Development Economics*, Vol. 5, Elsevier, 4039-4214.

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: 163–182.

Hausmann, Ricardo, Andrés Rodríguez-Clare, and Dani Rodrik. 2005. Inter-American Development Bank, economic and social study series, February: Towards a strategy for economic growth in Uruguay.

Hausmann, Ricardo and Dani Rodrik. 2003. Economic development as self-discovery. *Journal of Development Economics* 72, no. 2: 603-633.

Hayashi, Yuka. 2022. U.S., EU Agree to Coordinate Semiconductor Subsidy Programs. *Wall Street Journal*, December 5.

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.

IMF, OECD, World Bank and WTO. 2022. Subsidies, Trade, and International Cooperation. IMF Analytical Notes 2022/001, April 22.

Juhász, Réka. 2018. Temporary Protection and Technology Adoption: Evidence from the Napoleonic Blockade. *American Economic Review* 108, no. 11: 3339–3376.

Juhász, Réka, Nathan Lane, and Dani Rodrik. Forthcoming. The New Economics of Industrial Policy. *Annual Review of Economics*.

Juhász, Réka, Nathan Lane, Emily Oehlsen and Verónica C. Pérez. 2023. The Who, What, When, and How of Industrial Policy: A Text-Based Approach. Working paper, July.

Kalouptsidi, Myrto. 2018. Detection and Impact of Industrial Subsidies: The Case of Chinese Shipbuilding. *Review of Economic Studies* 85, no. 2: 1111–1158.

Khanna, Gaurav, Nicolas Morales, and Nitya Pandalai-Nayar. 2022. Supply Chain Resilience: Evidence From Indian Firms. NBER Working Paper 30669.

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: Robert M Stern (ed.), *Comparative Advantage, Growth, and the Gains from Trade and Globalization A Festschrift in Honor of Alan V Deardorff.* World Scientific Publishing: 43-51 (chapter 7).

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: 2759-2808.

Lim, Darren J. and Victor Ferguson. 2019. Chinese Economic Coercion during the THAAD Dispute. *ASAN Forum*, December 28.

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: 237-258.

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* v133: 103674.

Marshall, Alfred. 1920. *Principles of Economics*. London: MacMillan.

Mattoo, Aaditya, Nadia Rocha, and Michele Ruta (eds). 2020. *Handbook of Deep Trade Agreements*. Washington, DC: 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: 561-584.

Mavroidis, Petros C. and Andre Sapir. 2021. *China and the WTO: Why Multilateralism Still Matters*. Princeton, NJ: Princeton University Press.

Nagao, Riho. 2023. Japan and EU to share chip subsidy info to disperse production. *Nikkei Asia*, June 29.

Nicita, Alessandro, Marcelo Olarreaga, and Peri Silva. 2018. Cooperation in WTO's Tariff Waters? *Journal of Political Economy* 126, no. 3: 1302-1338.

Nikkei Asia. 2020. Japan reveals 87 projects eligible for 'China exit' subsidies. July 17.

OECD (Organization for Economic Cooperation and Development). 2023. Agricultural support (indicator). doi: 10.1787/6ea85c58-en (Accessed on September 8, 2023).

OECD (Organization for Economic Cooperation and Development). 2019a. Measuring Distortions in International Markets: The Aluminium Value Chain. *OECD Trade Policy Paper 218*, Paris: OECD.

OECD (Organization for Economic Cooperation and Development). 2019b. Measuring Distortions in International Markets: The Semiconductor Value Chain. *OECD Trade Policy Paper 234*, Paris: OECD.

Oh, Seok-min. 2023. S. Korea seeks U.S. expansion of key minerals supplier list under IRA. *Yonhap News Agency*, June 29.

Ossa, Ralph. 2011. A "New Trade" Theory of GATT/WTO Negotiations. *Journal of Political Economy* 119, no. 1: 122-152.

Ossa, Ralph. 2012. Profits in the "new trade" approach to trade negotiations. *American Economic Review* 102, no. 3: 466-469.

Ossa, Ralph. 2014. Trade wars and trade talks with data. *American Economic Review* 104, no. 12: 4104-4146.

Pauwelyn, Joost. 2008. *Optimal Protection of International Law: Navigating between European Absolutism and American Volunteerism*. Cambridge: Cambridge University Press.

Petersmann, Ernst-Ulrich. 1997. *The GATT/WTO Dispute Settlement System: International Law, International Organization and Dispute Settlement.* London: Kluwer Law International.

Reuters. 2023. Washington and Tokyo vow closer chip cooperation. May 26.

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: S179–204.

Staiger, Robert W. 2022. *A World Trading System for the Twenty-First Century*. Cambridge, MA: The 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: 741-775.

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: 149–187.

Staiger, Robert W. and Alan O. Sykes. 2021. The Economic Structure of International Trade-in-Services Agreements. *Journal of Political Economy* 129, no.4: 1287-1317.

Sykes, Alan O. 2005. The Economics of WTO Rules on Subsidies and Countervailing Measures. In Patrick F.J. McCrory, Arthur E. Appleton , and Michael G. Plummer (eds.), *The World Trade Organization: Legal, Economic, and Political Analysis*, Vol. 2, Springer.

S&P Global Market Intelligence. 2019. China Continues Support For New-Energy Vehicles Despite Subsidy Phaseout. News & Insights, November 11.

Thurk, Jeff. 2022. Outsourcing, Firm Innovation, and Industry Dynamics in the Production of Semiconductors. University of Georgia manuscript, December.

US Department of State. 2023. New Partnership with Vietnam to Explore Semiconductor Supply Chain Opportunities. Press Release, September 11.

USTR (Office of the United States Trade Representative). 2018a. 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.

USTR (Office of the United States Trade Representative). 2018b. Update Concerning China's Acts, Policies, and Practices Related to Technology Transfer, Intellectual Property, and Innovation. November 20.

USTR (Office of the United States Trade Representative). 2021. Statement from Ambassador Katherine Tai on the settlement reached between SK and LG, Press release, April 11.

WTO. 2023. *World Trade Report: Re-globalizing for a resilient, inclusive and sustainable future*. Geneva: WTO.

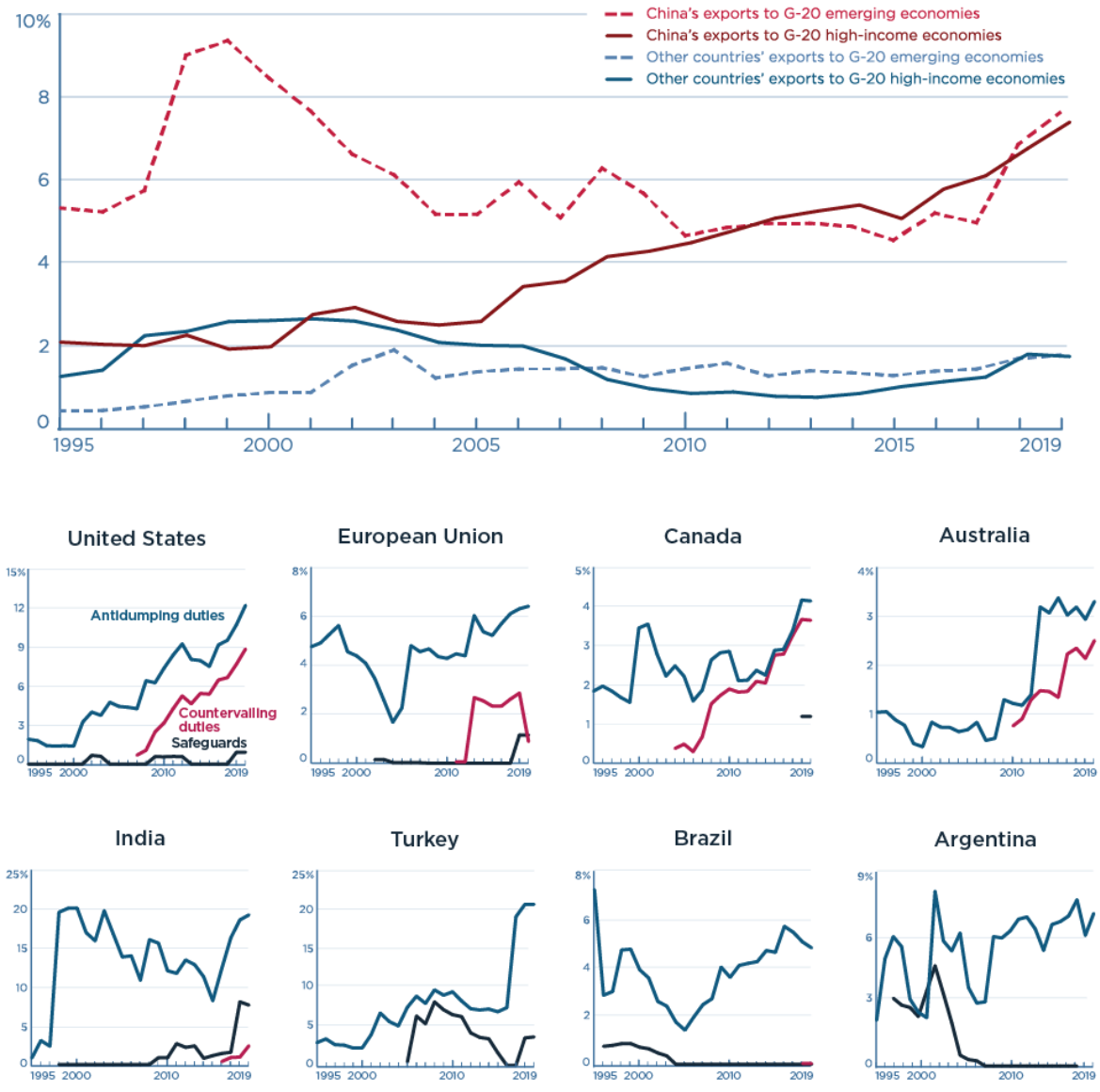
WTO. 2021. *World Trade Report: Economic resilience and trade*. Geneva: WTO.

Wu, Mark. 2016. The 'China, Inc.' Challenge to Global Trade Governance. *Harvard International Law Journal* 57, no. 2: 261–324.

Figure 1

Trade remedies have increasingly targeted China's exports since 2010

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



PIIE

G-20 = Group of Twenty

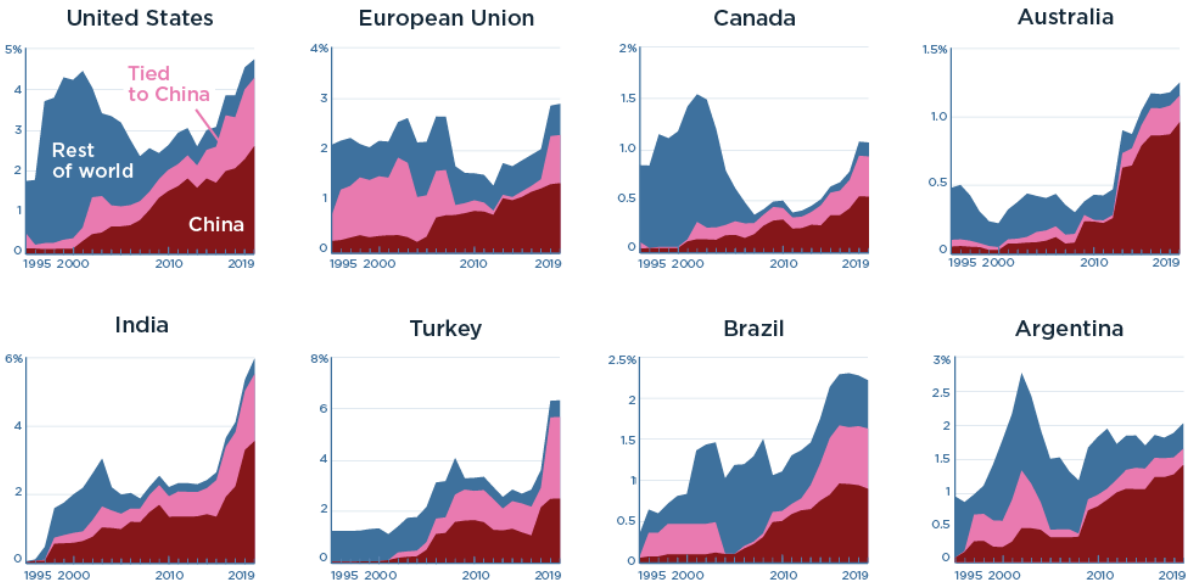
Notes: Trade remedies include antidumping, countervailing duties, and safeguards. Saudi Arabia is omitted because its data were not available. Data do not capture the US–China trade war tariffs, the US steel and aluminum (national security) tariffs, or the counter-tariffs imposed in retaliation in 2018–19.

Source: Author. Based on data from Bown et al. (2020) and UN Comtrade.

Figure 2

China's exports are the main target of all the major G20 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



PIIE

G-20 = Group of Twenty

Notes: 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: Author. Based on data from Bown et al. (2020) and UN Comtrade.