Global Production Sharing and the New Demands for Deep Preferential Trade Agreements

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Abstract

Why do contemporary trade agreements invest so heavily in controlling a complex and disparate set of non-trade policy areas? In this paper, I argue that the rise of global value chains (GVCs) explains the evolving institutional design of preferential trade agreements (PTAs). GVC-integrated firms, whose cross-border production strategies are highly vulnerable to changes in foreign governments' regulatory policies, demand deeper commitments in non-trade policy areas. Non-GVC exporters are concerned only with market access and so prefer shallow PTAs; domestic-only firms don't support PTAs at all. To test this argument, I employ a novel decomposition of global input-output tables which measures the extent of GVC and non-GVC trade integration across countries. I find that the level of GVC-integrated production is positively associated with the level of regulatory policies in PTAs, while non-GVC exporting is only positively associated with market access provisions in PTAs. The paper, therefore, highlights how changes in the structure of global production shape the scope of regulatory commitments in trade agreements.

Introduction

Modern trade agreements include a diverse and ever-growing set of policy commitments governing non-trade regulatory areas. For example, CAFTA-DR (Dominican Republic-Central America FTA) contains provisions on anti-corruption, fair competition, government procurement, intellectual property rights, dispute settlement, and much more. These are all examples of 'behind-the-border' measures, because they fall far outside the bounds of traditional trade policies that govern issues taking place at the border (e.g. tariffs, sanitary examinations at customs). The average number of such provisions in PTAs has more than doubled in the past two decades (Hofmann et al., 2017). In recognition of these changes, scholars have developed a new typology for PTAs and call PTAs with behind-the-border provisions *deep* PTAs, and PTAs focused on market access *shallow* PTAs (Dür et al., 2014; Osnago et al., 2015; Orefice and Rocha, 2014). Why do contemporary trade agreements invest so heavily in managing such a complex and disparate set of policy areas?

In this paper, I argue that the rise of global production networks, and new demands for regulatory governance from firms dependent on these networks, explain the growing institutional complexity in PTAs. The most prominent feature of the contemporary global economy is that many firms' production activities are spread across many countries. A typical consumer products company might design their products at home, source raw materials and parts from one set of countries, incrementally assemble those parts in other countries and then re-import back for final sale using packaging and marketing designed at the home market headquarters. These networks of the global production are referred to as global value chains (GVCs), emphasizing the incremental accumulation of value across countries in the many stages of production. Recent studies have argued that the emergence of GVCs has contributed to demands for more trade agreements, without specifying the nature or content of those agreements (Baccini et al., 2018; Kim and Spilker, 2019; Zeng et al., 2020).

Firms splitting production across many countries face unique vulnerabilities which lead them to demand particular types of trade agreement provisions. A disruption that occurs at any one stage of production leads to disruption to the entire process, and GVC-integrated firms are much more vulnerable on this point than non-GVC exporting firms or firms that

focus on domestic production. While these disruptions may result from the strategic choices of other firms or bad luck, I emphasize that the nature of GVC-integration and inflated costs of disruption particularly invite opportunistic behaviors by foreign governments with regulatory policies. Governments may seek to attract GVC-integrated firms to promote development, but later try to wield regulatory policies for political advantages, for example, to benefit politically favored domestic firms or to secure the support of voters. These time-inconsistency problems require regulations and limits on sovereignty beyond the tariff cuts of traditional trade agreements (Antràs and Staiger, 2012; Maggi and Ossa, 2021).

As a result, firms integrated into GVCs have strong interests in securing greater commitments to regulatory policy areas in PTAs. Studies have illustrated this point with investment provisions (Kim et al., 2019; Kim, 2021), intellectual property rights (Osgood and Feng, 2018) and technical barriers to trade (Kim, 2013). The accounts of existing studies, however, focus on specific chapters of PTAs, without offering a comprehensive account of the vulnerabilities that GVC-firms experience. Moreover, relatively less attention has been paid to firms operating outside of GVCs. What are their preferences and how do they shape the scope of regulatory commitments in PTAs as they compete with GVC-integrated firms?

To address this gap, this paper proposes a new model of firm preferences toward PTAs in the context of GVCs. Specifically, I define three types of production: *purely domestic*, *autonomous export*, and *GVC-integrated*. Firms engaging in purely domestic production operate totally domestically such that they source domestically-produced inputs and deliver final goods for the home market only. Firms engaged in autonomous export use domestically produced inputs but export the final goods to foreign markets (Kim et al., 2019).[1] GVC-integrated production is done by firms in many stages across the globe. PTAs with regulatory policy commitments have varying distributional implications for the three types of producers. While regulatory provisions can address vulnerabilities that GVC-integrated producers face, they inevitably constrain the policy autonomy of the signatory governments. The benefits of the policy commitments accrues disproportionately to GVC-integrated producers while the cost of constrained policy space is felt most acutely by firms whose production is primarily

[1] In this sense, they fit the description of export-oriented firm in the conventional trade politics framework, with the additional condition that they do not rely on foreign inputs.

domestic.

I draw three testable predictions from the distributional implications of regulatory commitments for the three groups of producers. First, firms engaged in purely domestic production will oppose any kind of PTA. Second, both autonomous export producers and GVC-integrated producers benefit from market access provisions in PTAs, and therefore firms engaged in both types of production will favor market access aspects of PTAs, like cuts in tariffs. Finally, since autonomous export producers face costs of policy constraints without compensating benefits, these firms clash with GVC-integrated firms over regulatory policy provisions in PTAs. Only firms engaging in GVC-integrated production will display a clear preference for commitments to regulatory policies in PTAs.

To test the above propositions, I measure the extent to which countries' firms engage in purely domestic, autonomous export, and GVC-integrated production. To do so, I employ the multi-regional input-output table (MRIO) from the Eora global supply chain database (Lenzen et al., 2013). MRIO data traces the exchange of inputs between a comprehensive list of countries and industries from 1990-2015. Unlike existing studies on GVCs that use parts and components trade data to measure GVC integration, I directly compute value-added contributions from MRIO. This was motivated by the recent finding that traditional data suffers from the "double counting" problem where an intermediate input is counted twice in the trade data, once as the parts and components export and twice as a part of a final goods export (Koopman et al., 2014). That is, the face value of export data does not reflect the actual contribution to the production of goods and services. I adopt the decomposition of MRIO proposed in Wang et al. (2017b) to directly obtain value-added contributions by different types of domestic producers.

The findings of the paper support the theoretical propositions. I first find that countries with a greater share of purely domestic production oppose all types of PTAs. Second, I find that countries with a greater share of autonomous export and GVC-integrated production have a greater number of market access provisions in their PTAs. Finally, countries that have more GVC-integrated production introduce more regulatory provisions in their PTAs.

This paper makes three contributions. First, it unifies the chapter-by-chapter approach of existing studies by synthesizing the many vulnerabilities that GVC-integrated firms ex-

perience into a coherent framework. Existing literature on PTAs tends to offer accounts of behind-the-border provisions in an ad hoc manner, focusing on only one area of regulation at a time.[2] This paper focuses on a set of underlying challenges that GVC firms face vis-à-vis governments' use of regulatory policies and connect them to the broader scope of regulatory provisions in PTAs.

Second, this paper connects the literature on GVC firm preferences with studies of global trade cooperation. A growing number of studies point out that the conventional cleavages between import-competing and export-oriented businesses are outdated due to the rise of GVC (Anderer et al., 2020; Baccini et al., 2018; Osgood, 2017, 2018; Zeng et al., 2020). This line of studies, however, primarily addresses tariff liberalizations and therefore is disconnected from studies on the growing complexity of PTA design. This paper bridges the two strands of literature and proposes a theoretical framework that predicts firms' preferences over different types of PTAs in the context of deepening GVCs.

Third, the paper makes an empirical contribution by employing value-added analysis of trade data over conventional trade data. Integration into GVCs in existing studies is often measured with parts and components trade as the share of total exports or imports (Baccini et al., 2018; Kim et al., 2019; Manger, 2015). These figures can be misleading because imported parts and components themselves were produced with inputs from other countries. Since this depth in production networks is the key feature of GVCs, measuring this accurately is key to understanding the political effects of GVCs, which is underexplored in IPE studies.

Theoretical framework

Existing explanations for PTA spread and deepening

Conventional explanations for PTA formation have centered on the competing preferences of different domestic interest groups. The Heckscher-Ohlin (HO) model predicts that owners

[2]See Kim et al. (2019) and Kim (2021) on investment protections and dispute settlement mechanisms, Kim (2013) on technical barriers to trade(TBT), Osgood and Feng (2018) on intellectual property rights, Lechner (2016), Ederington and Minier (2003) and Trebilcock et al. (2005) on environmental and labor policies in PTAs.

of abundant factors will prefer trade liberalization while owners of scarce factors will oppose it. The Ricardo-Viner (RV) model, on the other hand, predicts a sectoral cleavage in which export-oriented sectors favor trade liberalization whereas import-competing sectors lobby for more protection.

However, recent studies find that the cleavages predicated in HO and RV are growing to be less relevant with the rise of GVCs (Baccini et al., 2018; Osgood, 2018; Yildirim et al., 2018; Kim et al., 2019). Instead, they find a new coalition of interests around GVCs. For instance, Osgood (2018) argues that some firms in import-competing industries may source overseas or supply local exporters, suggesting an alignment of economic preferences between non-exporting and exporting firms. Likewise, Yildirim et al. (2018) emphasizes that firms participating in global production together, regardless of their importing or exporting status, form a united front within WTO disputes. Meckling and Hughes (2017) raises a similar point: firms jointly linked in GVCs have common interests to safeguard against governments' expropriation threats.

In recognition of the rise of GVCs, a growing number of studies focus on the preferences of economic actors in GVCs for trade liberalization (Blanchard et al., 2016; Bown et al., 2021; Kim and Spilker, 2019; Meckling and Hughes, 2017; Osgood, 2017, 2018; Zeng et al., 2020). Zeng et al. (2020) and Blanchard et al. (2016) find that sectors that use a higher level of foreign inputs are more likely to support trade liberalization. This is corroborated in Osgood (2018) which finds that increased export opportunity through foreign direct investment and better sourcing of foreign inputs encourage GVC-integrated firms in the US to support PTAs. These studies examine trade liberalization in a broad sense (as general support for PTAs) and put less focus on how the preferences of GVC firms connect to specific provisions within PTAs. This paper, therefore, extends this line of research by connecting the rise of GVCs with the new face of trade liberalization: regulatory policy provisions in PTAs.

Other studies complement the above research by connecting specific provisions in PTAs with the economic preferences of firms embedded in GVCs. Osgood and Feng (2018), for instance, highlights that high-tech industries such as pharmaceuticals and biotech have an interest in including provisions on intellectual property rights in PTAs. The importance of provisions on investment protection and dispute settlement mechanisms in PTAs for MNCs is

emphasized in Kim et al. (2019) and Kim (2021). Manger (2012) and Manger (2015) similarly argue that investment protection is one of the key pieces in PTAs that connect MNCs in developed countries with labor-intensive forces in developing countries. I extend these studies by theoretically unifying the issue-specific accounts into a common set of vulnerabilities that GVC-firms face, and explaining how regulatory commitments in PTAs serve as institutional remedies. Additionally, this paper also looks into the preferences of domestic actors that are not integrated into GVCs, and how they might conflict with firms in GVCs over PTA formation.

This paper contributes to the growing literature of GVCs and trade liberalization in two main ways. First, I highlight a new form of trade liberalization – *deep PTA*s with a growing number of regulatory policy provisions – which has been relatively unexplored. Second, I propose a new framework that explores previously unrecognized disagreements among domestic actors based on their level of integration into GVCs. To do so, I describe in the next section a set of vulnerabilities that GVC-firms experience in common due to the government's strategic use of regulatory policies. I explain how these shared vulnerabilities shape their preferences over PTA provisions. In doing so, I also examine further the preferences of non-GVC firms and the potential for conflicts with GVC-integrated firms.

GVC and firm vulnerability

Spread of global value chains Over the past four decades, dramatic advances in information, communication, and transportation (ICT) technologies have substantially lowered operational costs for firms. These forces have intensified the globalization of production (Baldwin, 2016). The global fragmentation of production has been described by international trade scholars as "made in the world" (Yildirim et al., 2018), "factories that span international borders"(Anderer et al., 2020), and "the second unbundling" (Baldwin, 2016), in reference to the breakup and distribution of the steps of production across many countries. Globally fragmented production entails global production sharing, which is defined broadly as a system in which economic actors of different countries depend on each other for the production of goods or services.

Toyota's "just-in-time production" system illustrates this trend. The just-in-time system

emphasizes that inputs arrive at the next production site just in time and just in the right amount. All involved actors and environments have to fit the plan exactly to facilitate the smooth passage of parts and components across borders. Exporting the Toyota Corolla to Europe, for example, takes place by sourcing parts and components from local firms in Turkey, Thailand, and South Africa which are transported to Toyota's foreign affiliates in Europe for packaging, which is then shipped to South Africa for assembly and export. To establish such an expansive global production network, Toyota has made significant foreign direct investments (FDI) in Southeast Asia. It also contracts with foreign firms in Asia and Europe for needed inputs and engineering and design services.

The global expansion of production stages is not limited to technologically sophisticated goods, either. Ferrero International S.A. has also established foreign affiliates in dozens of countries across the world that source inputs such as hazelnuts, palm oil, and cocoa from firms in nearby countries to produce Nutella, a popular chocolate spread which is exported to over 160 countries (Miroudot and De Backer, 2013).

Vulnerabilities of GVC firms The major flaw in the just-in-time system, and global value chains generally, is that they are highly vulnerable to interruptions at any of the production stages. Inefficiencies introduced at any production stage damage all involved actors – including foreign affiliates and contracted foreign partners both upstream and downstream of where hold-up has occurred (Johns and Wellhausen, 2016; Meckling and Hughes, 2017; Osgood, 2018). This can induce a bullwhip effect, for example, where a failure in marketing and packaging in downstream stages leads to lower sales of final products which then affects all upstream suppliers with increasing severity.[3]

The vulnerability of GVC firms to supply chain disruptions is often treated as a mainly

[3]A relevant concept is relation-specificity. Firms involved in internationally fragmented production are subject to varying degrees of relation-specificity. Relation-specificity in trade is proportional to the extent to which exchanged goods (intermediate inputs) are customized to the need of the related parties (Nunn, 2007). If inputs are fully customized to fit a final good, then it is difficult for input producers to find an alternative market for their products. The same goes for the buyers such that the cost of finding alternative suppliers grow proportionally with the degree of input customizations. A recent event of Apple paying Samsung Display for the display panels that they never used for production serves as good anecdotal evidence of relation-specificity. Samsung Display provided customized OLED panels for Apple's iPhone 12 mini that sold much less than expected. Apple decided to pay Samsung Display for $684 million in 2019 and $950 million in 2020 for OLED panels that were never used since those panels are fully customized to fit a specific Apple product. See "Samsung Display likely to receive compensation from Apple over order shortfall." *The Korea Herald.* Mar 23, 2021. http://www.koreaherald.com/view.php?ud=20210323000184.

economic problem. Mistakes by upstream suppliers or unexpected economic shocks may disrupt production, for example. But in this paper, I emphasize that global production sharing and the vulnerabilities of firms in GVCs *specifically incentivize* governments to engage in opportunistic behaviors using regulatory policies (Grossman et al., 2021).

Governments strategically interacting with GVC-integrated firms know that they are especially sensitive to disruptions to production. A *hold-up* in one part of the supply chain ripples through the rest of the supply chain, causing chaos across the production network. GVC-integrated firms are particularly vulnerable to *uncertainty* around the timing or enforcement of regulatory policies. Their global integration, either as multinationals or as contracting parties with foreign firms, also leaves them vulnerable to *expropriation* and *discriminatory treatment*. Each of these vulnerabilities leaves GVC-integrated firms with reduced bargaining power, and deep exposure, to the decisions of foreign governments.

But why are governments motivated to interfere with the operations of vulnerable foreign firms in the first place? First, governments may seek to extract rents from firms integrated into GVCs. This may take direct monetary forms, such as taxation or corruption, or non-monetary forms, like demands to increase hiring or source locally. Second, governments may seek to advance political agendas by weaponizing the inter-linkage of GVC-integrated firms. This may be to secure political support from important interest groups or voters by extracting concessions from, or beating up on, GVC-firms. Third, governments in pursuit of developmental goals may use policies such as subsidies or taxation to nurture infant domestic firms at the expense of foreign firms. Finally, governments typically prioritize the concerns of domestic firms in designing and enforcing regulatory policies, again at the expense of foreign affiliates. Promises made to foreign firms are always subject to revision after an investment has occurred, should new priorities arise.[4]

[4]I emphasize that this is not limited to developing countries. For example, Hyundai made a series of FDIs in the US, poised to set their American factories to be the manufacturing hub of their products for Canada, the US, and South American countries. Hyundai's decision was motivated by the promised support of the Biden administration. However, after the first wave of investment was made, president Biden signed the Inflation Reduction Act, essentially a subsidies program for US-made cars, but Hyundai was excluded from the list. This puts Hyundai at a great disadvantage, and both Hyundai and the South Korean government called the act a 'betrayal.' Hyundai did not anticipate the act (*information asymmetry*) and the nature of discrimination it entails (*discriminatory treatment*). See "South Korea Sees 'Betrayal' in Biden's Electric Vehicle Push." *Bloomberg*. 1 Sep 2022. https://www.bloomberg.com/news/articles/2022-09-02/south-korea-sees-betrayal-in-biden-s-electric-vehicle-push.

In what follows, I synthesize these points (why are GVC-integrated firms more vulnerable? And why do governments wish to target them?) by examining four exemplary problems faced by GVC-integrated firms. I explain how each of these problems leads to GVC-integrated firms' demands for a variety of trade agreement provisions that offer institutional safeguards to these vulnerabilities.

Political hold-up: The complex inter-linkage in GVCs suggests that hold-up at any stage of production can impact all participating firms, both upstream and downstream. Governments may weaponize such inter-linkage to push their non-economic agendas (Carnegie, 2014; Drezner et al., 2021). For example, the Japanese government in 2019 put an indefinite halt on the export of key chemical materials to semiconductors manufacturers in South Korea, claiming that those materials were being illegally leaked to North Korea and Iran to build chemical weapons. Although the Japanese government denied the connection, experts and pundits commonly pointed out that the hold-up was political retaliation for the ruling by the Korean Supreme court ordering Japanese firms to compensate Korean laborers who were forced to work during World War II.[5] GVC-firms in this context seek to introduce provisions that clearly state the rules of customs administration or sanitary and phytosanitary standards, limiting the scope of foreign government's policy maneuver over the flow of inputs.

Discriminatory treatment: Governments may use regulatory policies to impose unequal costs of operation for firms integrated into GVCs. For instance, governments have incentives to alter production standards compatibility to i) extort rents from foreign firms looking to set up affiliates in the domestic market or ii) protect domestic firms by imposing stricter requirements on foreign firms (Klimenko, 2009). Governments can also apply more relaxed labor and environmental regulations exclusively for domestic firms as a secondary barrier (Carrère et al., 2022; Ederington and Minier, 2003). While these measures hurt foreign firms in general, they can be particularly excruciating for firms integrated into GVCs due to the inter-linkages. In this light, it was reported that firms enmeshed in GVCs are concerned about discriminatory treatments and strongly demand the inclusion of national treatment or

[5] "Japan escalates trade war with South Korea, deepening rift and raising security concerns." *Reuters*. 2 Aug 2019. https://www.latimes.com/world-nation/story/2019-08-02/japan-escalates-trade-war-with-south-korea-deepening-rift-and-raising-security-concerns.

non-discrimination provisions as part of investment protection in PTAs (Kim et al., 2019).

Expropriation: For firms in GVC, investment protection is arguably one of the most important areas in their production (Kim et al., 2019; Kim, 2021). Governments with ties to domestic firms may impose a higher local content requirement, possibly with conditions of knowledge and technology transfer. Similarly, governments with developmental objectives can seek indirect expropriations through mandatory joint ventures with local companies. On rare occasions, some governments have directly seized parts of foreign direct investments to push forward nationalist agendas.[6] In this light, Kim et al. (2019) finds from the firm-level survey that investment protection is one of the most salient issues that firms demand in trade agreements, and the strength of the demand is proportional to their involvement in GVCs.

Information asymmetry: Asymmetric information is predominant when one party in a transaction possesses more knowledge than the other party such that the party with greater information can take advantage of the other. Information asymmetry is especially prevalent between foreign affiliates and governments because the timing and the extent of regulatory policy enforcements are private information. This leaves room for host governments to design and enforce regulatory policies such as subsidies, and environmental and labor regulations tailored to the interests of select domestic firms (Ederington and Minier, 2003; Lee, 2007; Trebilcock et al., 2005). In this light, studies have suggested that political transparency is one of the core factors in multinational corporations' FDI decisions, which motivates them to lobby to include transparency clauses in the investment chapters of PTAs (Busse and Hefeker, 2007; Kim, 2021).

Firms integrated into GVCs seek to address their vulnerabilities by limiting the scope of regulatory policies that governments may use against them. In this light, PTA provisions such as transparency, national treatment, anti-corruption, competition, investment protection, and dispute settlement serve to tie the hands of the signing governments by stipulating the conditions and the scope of the use of regulatory policies.

[6] "Venezuela's Chavez Orders Seizure of Owens-Illinois." *CNBC*. 26 Oct 2010.https://www.cnbc.com/id/39849019.

GVC-firm vulnerability	Government interests	Relevant PTA provisions
Political hold-up		
Inflated cost of hold-up at any production stages	- inflict economic damage to foreign countries to pursue political agenda (e.g. Korea-Japan trade dispute in 2019)	Regional cooperation Customs administration Sanitary and phytosanitary Standard harmonization Technical barriers to trade
Expropriation		
direct and indirect seize of foreign properties	- obtain sophisticated technology and knowhow - rent-seeking from foreign firms	Investment protection Dispute settlement Intellectual property rights Capital taxation Capital movement
Discriminatory treatment		
Unequal treatment of foreign firms in domestic markets	- protect domestic industries against foreign intermediaries - nurture infant domestic firms to increase domestic presence in GVC	Anti-corruption Competition Public procurement Transparency Protection of infant industry Subsidies
Information Asymmetry		
Uncertainty in the timing and the extent of enactment/enforcement of regulatory policies	- prioritize domestic firm interests in policy designs/enforcements	Transparency Public procurement Subsidies Exchange rate restriction Structural adjustment

Table 1: GVC-firms' vulnerabilities, government interests and regulatory provisions in PTAs.

Deep PTAs and regulatory policy autonomy

PTAs with comprehensive commitments to regulatory policies help alleviate the vulnerabilities that GVC-integrated firms face by tying the hands of the signing governments. As studies point out, however, the credible commitment aspect of PTAs entails a trade-off in which the signing governments forego their policy autonomy for the economic benefits of the trade liberalization (Thompson et al., 2019). This paper emphasizes that PTAs with regulatory policy commitments have varying distributional implications for firms embedded in GVCs and firms separated from them. Specifically, I highlight that the economic benefits of regulatory provisions in PTAs accrue disproportionally to firms enmeshed in GVCs whereas the costs of them fall mostly on the firms operating outside of GVCs.

The preexisting regulatory policy system of a country represents the domestic political equilibrium (Drezner, 2008). Therefore, any alteration away from the status quo incurs adjustment costs for domestic firms. For firms embedded in GVCs, a move from the status quo toward global regulatory standards offers economic benefits that can compensate for adjustment costs. The same, however, cannot be extended to other firms. Firms operating outside of GVCs are forced to recalibrate their operations in compliance with new regulatory

frameworks without economic gains to compensate for their adjustments.

Additionally, hands-tying regulatory policy provisions in PTAs represent a reduced policy autonomy which could be important for domestic firms operating separately from GVCs. For example, firms operating purely domestically (sourcing domestically for sales in domestic markets) may put greater value on governments' flexibility to use policies such as subsidies or procurement to shield them against short-term economic shocks (Maggi and Ossa, 2021). Similarly, Frieden (1991) theorizes that producers of nontradable goods and services will prefer greater government autonomy in the areas of monetary and exchange rate policies. For firms engaging in final-goods export, labor and environmental regulations are other well-documented areas where governments relax regulations for domestic firms to improve their export competitiveness (Ederington and Minier, 2003; Lee, 2007).

In summary, while regulatory policy provisions in PTAs remedy the vulnerabilities of firms integrated into GVCs, such benefit is not greatly shared by non-GVC producers. On the other hand, the policy constraining aspect of these PTAs is likely to hurt domestic producers whose operations stay within the national border. In the next section, I show how the distributional implications of deep PTAs shape the preferences of these firms.

Preferences for deep PTAs

Traditional IPE theories have predicted cleavages that pit import-competing against export-oriented. However, as existing studies claimed, the divide between these two groups is becoming less clear as importing firms can be a part of GVC that indirectly exports (Osgood, 2018). To account for growing complexity in institutional designs of trade agreements, I propose a new framework that focuses on the distributional implications of different types of PTAs for three types of production groups: *Purely Domestic*, *Autonomous Export* and *GVC-integrated*.

I define purely domestic as the segment of production that uses domestic inputs for sales in the domestic market. Firms engaging in purely domestic production do not rely on foreign inputs and thus are strongly import-competing. They do not have indirect export opportunities as described in Osgood (2018). These firms do not have interests in foreign market access and hold a strong preference for domestic policy autonomy. Therefore, their

preferences toward PTAs can be clearly distinguished from other domestic producers. I predict that firms whose production are purely domestic will be against all types of PTAs.

Autonomous export is defined as the segment of domestic production that use domestic inputs to make final goods for exports (Kim et al., 2019). They do engage in export activities, but they are distinguished from firms embedded in GVCs as they do not rely on foreign inputs for their production. Firms engaging in autonomous export use domestic inputs and make final goods targeting foreign markets. Since they target foreign markets, they will prefer trade liberalization for greater market access. However, as explained in the above section, these producers have incentives to favor domestic policy autonomy. In this sense, they will not welcome regulatory policy provisions in PTAs that put constraints on domestic policy autonomy without much gains in market access.

Finally, firms integrated to GVCs will favor both types of PTAs. As Bruhn (2014) and Koopman et al. (2014) points out, GVC-integrated firms also have an interest in lowering tariffs since even small tariffs accumulate through supply chains. What is known as the "magnification effect" describes how tariffs are applied to gross imports such that tariffs can accumulate to pose a significant cost as inputs cross multiple borders. This suggests that GVC-integrated firms can be subject to tariffs for parts they did not produce. Therefore, tariff-reducing PTAs can also benefit GVC-integrated production to a great extent, and I predict that GVC-integrated producers will favor tariff-reducing PTAs. On top of this, GVC-integrated firms also favor commitments to regulatory policies in PTAs that address their vulnerabilities. Therefore, I predict that GVC-integrated firms will favor deep PTAs as well. The preferences of these producers on different types of PTAs are summarized in Table 2.

To yield empirically testable hypotheses, I make two large assumptions on the government's utility toward PTA formation. First, following Grossman and Helpman (1997), I assume that the government utility function for PTA formation takes in political contributions by domestic special interest groups. Second, I assume that the size of political contributions is proportional to the productive capacities of domestic interest groups. That is, the government's decision on PTA formation is more likely to align with the preference of domestic interest groups with the highest productive capacity in the national economy.

	Tariff Liberalization	Regulatory Policy	PTA Preference	
			Shallow	Deep
Purely Domestic	Against	Maintain Policy Autonomy	Against	Against
Autonomous Export	Favor	Maintain Policy Autonomy	Favor	Against
GVC Integrated	Favor	Constrain Policy Space for GVC Stability	Favor	Favor

Table 2: Firms by production focus and their preference toward different types of PTAs. Shallow PTAs refer to PTAs that primarily address market access. Deep PTAs refer to PTAs that include provisions on behind-the-border regulatory policies.

From the above, I yield three sets of country-level empirical implications as follows. First, on types of domestic production and the existence of PTAs, I predict

H1a: *Countries that have more purely domestic production will be less likely to join PTAs.*

H1b: *Countries that have more autonomous export production will be more likely to join PTAs.*

H1c: *Countries that have more GVC-integrated production will be more likely to join PTAs.*

Next, on the market access aspect of PTAs, I predict that both autonomous exporters and GVC-integrated producers will welcome shallow PTAs, which will be shown as a greater number of market access provisions in PTAs

H2a: *Countries that have more autonomous export production will have more market access provisions in PTAs.*

H2b: *Countries that have more GVC-integrated production will have more market access provisions in PTAs.*

Finally, on the formation of deep PTAs, the preferences of autonomous exporters and GVC-integrated producers do not align. Specifically, producers engaging in autonomous export

production will not welcome regulatory policies in PTAs that put more constraints on domestic policy autonomy without compensating economic gains. Therefore, I predict that

H3a: *Countries that have more autonomous export production will have fewer behind-the-border regulatory policy provisions in PTAs.*

H3b: *Countries that have GVC-integrated production will have more behind-the-border regulatory policy provisions in PTAs.*

Research design

Dependent variables: depth of PTAs

The dependent variables measure commitments to market access and non-market regulatory policies in PTAs. The data for policy provisions in PTAs are obtained from the World Bank Deep Trade Agreements database.[7] World Bank catalogs policy provisions in PTAs in two categories according to how they relate to WTO mandates. The WTO+ category includes policy provisions that fall under the current mandates of WTO and are subject to WTO multilateral agreements. These provisions generally require small or no concessions if the signing parties are already following WTO multilateral mandates. On the other hand, the WTO-X category includes policy provisions that go beyond the current mandates of WTO such that the inclusion of provisions in WTO-X category indicates a substantial commitment to the relevant policy areas.

WTO+ provisions can further be categorized by whether they take place at the border and whether they address tariff reductions (Damuri et al., 2012; Hofmann et al., 2017). Border provisions cover issues taking place when goods cross borders, and they include tariff reductions, anti-dumping, and customs administration. Behind-the-border provisions, on the other hand, address issues taking place inside the borders such as competition, investment, subsidies, and public procurement. Since the second set of hypotheses addresses PTA provisions on market access without significant policy concessions, I use border provisions

[7]The data is publicly available at http://data.worldbank.org/dataâĂŘcatalog/deepâĂŘtradeâĂŘagreements.

on tariffs in WTO+ category to construct the dependent variable for H2. Five provisions fall under this category – tariff reduction on manufacturing, tariff reduction on agriculture, anti-dumping, countervailing measures, and technical barriers to trade. I call these *market access* provisions. The third set of hypotheses covers regulatory provisions that manage issues at the stage of production inside borders, I use all provisions in WTO-X category to construct the dependent variable for H3. There are a total of 38 provisions in WTO-X category, including anti-corruption, capital movement, competition investment protection, intellectual property rights, and public procurement. I call them *regulatory* provisions.

	Market Access (H2)	Regulatory Policy (H3)
Category	Subset of WTO+	All WTO-X
Commitment	Low	High
Location	Border	Border/Behind-the-border
Issue Type	Access to Foreign Market	Production Regulation in Foreign Economy
Examples	Tariff reduction Anti-dumping Technical barriers	Competition Investment Protection Public Procurement

Table 3: Summary of PTA provisions used to construct dependent variables for H2 and H3.

The first set of hypotheses is on the formation of PTAs, and I use the binary indicator of PTA existence. The second set of hypotheses addresses the market access aspect of PTAs, and I use the maximum count of *market access* provisions. For example, y_{it}^{market} denotes the maximum count of *market access* provisions country i is a member of by year t. The third set of hypotheses covers regulatory policy provisions in PTAs, and I use the maximum count of *regulatory* provisions where y_{it}^{reg} indicates the maximum count of *regulatory* provisions country i is a member of by year t. I choose the maximum count of provisions over the mean

or the median count because the dependent variable measures the overall commitment to market access and regulatory policies in PTAs. Since countries enter into PTAs of varying levels of commitment, the use of mean or median count can create a situation where an additional PTA decreases the values of the dependent variable which does not fit the purpose of measuring overall commitment at the country level.

Independent variables: value-added production

The key independent variables measure the productive capacities of the three types of domestic production (purely domestic, autonomous export, and GVC-integrated) at the country level. To compute three distinct types of domestic production, I employ the Multi-regional input-output(MRIO) table collected and organized in UNCTAD's Eora project (Lenzen et al., 2012, 2013).[8] The MRIO table is created by combining national accounts statistics, supply-use tables, product-level international trade statistics, and firm-level surveys to track where values are created and finally absorbed for consumption. MRIO tracks the movement of value-added trade between 188 countries and 24 industry sector pairs from years 1990 to 2015.

This enables a mapping of the complex GVC across the world without missing particular regions. MRIO, to our knowledge, offers the largest coverage of value-added flows in terms of countries and years among other available input-output tables.[9]

MRIO reports transactions of inputs and outputs at the country-industry level in 3 key components: intermediate transaction matrix $\mathbf{T}$, final consumption matrix $\mathbf{Y}$ and value-added matrix $\mathbf{V}$. There are two defining characteristics of MRIO that distinguishes it from traditional trade data. First, MRIO contains transactions in value-added terms. $\mathbf{V}$ represents the factor inputs by domestic producers such as labor (measured as total wages paid) and capital (subsidies, taxes, investments, and etc.). This is an important distinction in light of complex GVC. For example, export of a car engine that appears in trade data can actually be a re-export of the car engine with only mild modifications such as oil-coating.

[8] The data is publicly available at https://www.worldmrio.com.

[9] Alternatively, the World Input-output table database(WIOD) offers more refined industry categorization (64 industries total), but it is limited to 54 relatively developed countries most of which are located in Europe. In the interest of covering larger geographical scope, MRIO is chosen for analysis over WIOD.

This suggests that actors involved in the export of car engines may not be a strong domestic force with their trade preferences proportional to the face value of car engines in the export data. Since the trace of contribution in MRIO begins with $\mathbf{V}$ – domestic value-added contribution – MRIO can capture the actual value-added contributions from oil coating rather than reporting the total value of car engines. This offers a new perspective to understanding trade deficits. For example, 21.3% of China's total export to the US in 2010 was from the textile sector, but in value-added terms, it was only about 5.9%. Likewise, the electronics and machinery sector takes up about 55.6% of China's total export to the US in 2010, but the fraction reduces to 30.6% if measured in value-added terms. This is corroborated in Koech et al. (2013) where the authors show that the US total trade deficit against China is exaggerated.

Second, MRIO differentiates inputs for intermediate and final use. $\mathbf{T}$ traces the movement of inputs that are exported or imported for intermediate use. $\mathbf{Y}$ on the other hand tracks the movement of inputs used for final consumption. That is, $\mathbf{V}$ tracks where value-added is initiated in a given country and industry, $\mathbf{T}$ traces the move of value-added for intermediate inputs, and $\mathbf{Y}$ shows where the value-added was finally consumed. GVC literature often employs an intermediate coefficient matrix $\mathbf{A}$, which is a row-normalized version of $\mathbf{T}$.

Studies of GVC point to $\hat{\mathbf{V}}\mathbf{B}\hat{\mathbf{Y}}$ as one of the most important quantity computed from input-output tables such as MRIO.[10] Each entry in $\hat{\mathbf{V}}\mathbf{B}\hat{\mathbf{Y}}$ represents *the total value-added from a source country-industry directly or indirectly used to produce final goods and services*

[10] $\hat{\mathbf{V}}$ is a diagonal matrix where diagonal entries are length NK vector as a result of column-wise sum of $\mathbf{V}$. Likewise, $\hat{\mathbf{Y}}$ is a diagonal matrix where entries are length NK vector as a result of row-wise summation of $\mathbf{Y}$. $\mathbf{B}$ is computed based on $\mathbf{A}$ which is a row-normalization of $\mathbf{T}$. That is, an entry in $\mathbf{A}$ indicates the share of intermediate inputs from a country-industry used by another country-industry. For more information on these, see Wang et al. (2017a) and Koopman et al. (2014). The nature of fragmented production stages suggests that value-added processes move across national borders multiple times. The Leontief insight is to represent such dynamics through graph theory and geometric series. Since the entries of $\mathbf{A}$ lies between 0 and 1, we can think of $\mathbf{A}$ as a network or a system that represents the intensity of connection between units (country-industry pairs). Graph theory suggests that the adjacency matrix $\mathbf{A}$ represents the direct connection between country-industry pairs and $\mathbf{A}^2$ represents the total indirect connection between the units that could be reached in two steps. Similarly, $\mathbf{A}^3$ shows the total intensity of connections between units that could be reached in three walks. We can continue these to obtain a power series (Miller and Blair, 2009).

$$1 + \mathbf{A} + \mathbf{A}^2 + \mathbf{A}^3 + ... + \mathbf{A}^n + ... = (\mathbf{I} - \mathbf{A})^{-1}$$

Let $\mathbf{B}$ denote this series $\mathbf{B} = (\mathbf{I} - \mathbf{A})^{-1}$. Then $\mathbf{B}$ describes the intensity of all direct and indirect production linkages between country-sector dyads.

in other country-industry.

$\hat{\mathbf{V}}\mathbf{B}\hat{\mathbf{Y}}$ can be further decomposed into three parts according to Wang et al. (2017b).

$$\hat{\mathbf{V}}\mathbf{B}\hat{\mathbf{Y}} = \underbrace{\hat{\mathbf{V}}\mathbf{L}\hat{\mathbf{Y}}^{\mathrm{D}}}_{\text{Purely Domestic}} + \underbrace{\hat{\mathbf{V}}\mathbf{L}\hat{\mathbf{Y}}^{\mathrm{F}}}_{\text{Autonomous Export}} + \underbrace{\hat{\mathbf{V}}\mathbf{L}\hat{\mathbf{A}}^{\mathrm{F}}\mathbf{B}\hat{\mathbf{Y}}}_{\text{GVC-integrated}} \tag{1}$$

$\mathbf{L}$ indicates the transactions of intermediate inputs within the domestic economy. $\mathbf{Y}^D$ traces final consumption in domestic markets, and $\mathbf{Y}^F$ traces final consumption in foreign markets.[11] $\hat{\mathbf{V}}\mathbf{L}\hat{\mathbf{Y}}^{\mathrm{D}}$ records all domestic value-added ($\mathbf{V}$) that circulate among domestic producers ($\mathbf{L}$) to be consumed domestically ($\mathbf{Y}^{\mathrm{D}}$). This segment represents the total value-added contribution for *Purely Domestic*. $\hat{\mathbf{V}}\mathbf{L}\hat{\mathbf{Y}}^{\mathrm{F}}$ contains all domestic value-added ($\mathbf{V}$) that circulate among domestic producers ($\mathbf{L}$) to be exported for final consumption ($\mathbf{Y}^{\mathrm{F}}$). This segment represents the total value-added contribution for *Autonomous Export*. $\hat{\mathbf{V}}\mathbf{L}\hat{\mathbf{A}}^{\mathrm{F}}\mathbf{B}\hat{\mathbf{Y}}$ denotes all domestic value-added ($\mathbf{V}$) that circulate among domestic producers ($\mathbf{L}$) and then are exported as intermediate inputs ($\mathbf{A}^{\mathrm{F}}$) that are exported for further processing ($\mathbf{B}$) and for final consumption ($\mathbf{Y}$). This segment represents the total value-added contribution in multiple international production stages and therefore pertains to *GVC-integrated*.

I sum them across industries to obtain a country-level measure. Then I divide each component by their sums to convert to shares, which generates the key independent variables for empirical analyses. Figure 1 displays shares of purely domestic, autonomous export and GVC-integrated production for 7 example country-industry dyads before aggregating at the country level. It shows that service sectors are usually more domestic-oriented, and light manufacturing such as Textile and Apparel engage more with final goods export.

Control variables

To tease out alternative explanations that connect PTAs and value-added production, I control for the following confounders.

Economic variables: I first include standard gravity variables such as logged population size and GDP to control for the size of the economy. More technologically sophisticated countries are likely to be more capable to enter into deep PTAs. To address this, I control

[11] For details and the proofs of the decomposition, see the Supplementary Information document.

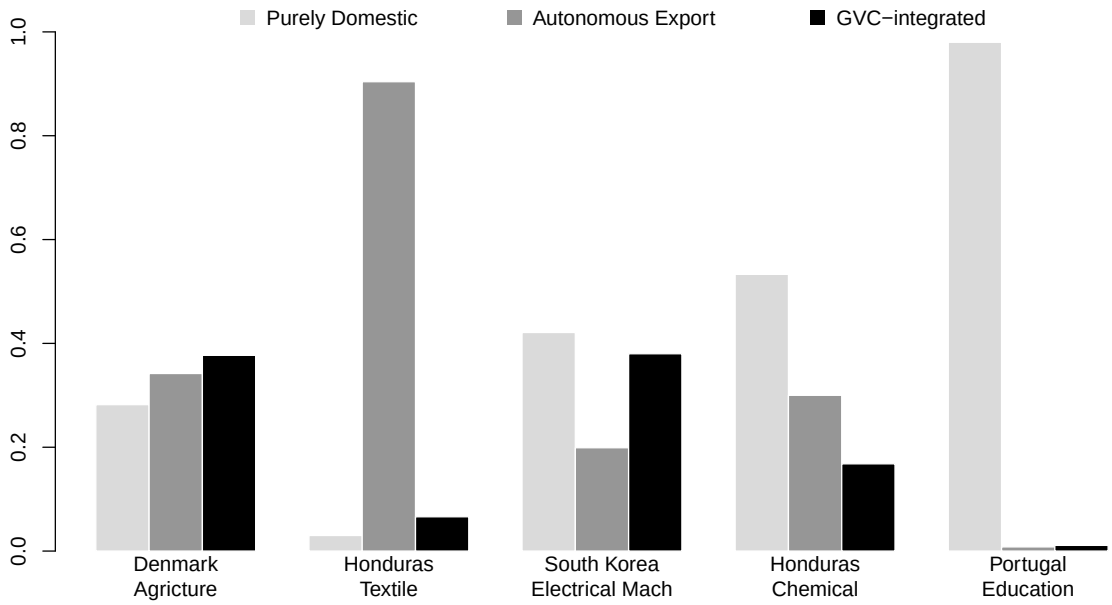


Figure 1: Country-industry examples of $\hat{\mathbf{V}}\mathbf{B}\hat{\mathbf{Y}}$ decomposition. The light gray color denotes the total share of purely domestic value-added, the gray color denotes the total share of autonomous export value-added, and the dark gray color denotes the total share of GVC value-added. For these examples, service sectors tend to be more domestic-oriented, while high-tech industries such as Electrical machinery in South Korea tend to be more GVC-integrated.

for the level of technology with two controls: GDP per capita and economic complexity index obtained from Atlas of Economic Complexity projects (The Growth Lab at Harvard University, 2019).

Political institutions: Extant literature on the political economy of PTAs suggests that domestic political regimes can affect the formation of PTAs, and the operation of various domestic firms (Milner and Kubota, 2005; Milner, 1999; Mansfield and Milner, 2012). To address the impact of political regimes, I include the polity score obtained from the Polity IV project.

BIT formation: International reputation can also serve to increase a country's likelihood of entering deep PTAs as well as its integration to GVC (Tomz, 2012). Relatedly, other studies show that membership to other relevant international institutions such as Bilateral

Investment Treaty(BIT) can improve a country's integration to GVC and lower the cost of entering into deep PTAs. BITs can serve more or less equivalent functions with respect to investment protections in deep PTAs, reducing the cost of negotiations for PTAs with similar provisions (Tobin and Busch, 2010). In this light, I control for the total number of BITs that a given country has entered into up to time t.

Capital market openness: The degree of financial market liberalization can also be a confounding factor for deep PTAs and trade. A country with open capital market receives a greater inflow of foreign direct investment, and a greater number of foreign affiliates that engage in GVC. To address this, I control for the capital market openness (Chinn and Ito, 2008). Similarly, I also control for the inflow of foreign direct investment in the model.

Geography: Geography is also known to shape a country's trade patterns. Landlocked countries without access to large ports, for example, may engage in international trade to a lesser degree, and this may also affect their behaviors on trade-related agreements. In this light, I add dummy variables for landlocked countries and island countries to control for the effect of geography.

Great powers: Finally, existing studies suggest that the contents of PTAs are heavily affected by the PTA "templates" created by EU and the US (Drezner, 2008; Horn et al., 2010; Peacock et al., 2019). To address the specificity for EU and the US, I add a dummy variable for EU members and the US.

While GATT/WTO membership can be a confounder for the model, it is not included as almost all countries in the data are WTO members or become WTO members shortly after the starting year of the sample.

Models and results

I fit the Cox hazard model with country random effect to test the first set of hypotheses. The dependent variable is the years until the given country enters into a PTA. Since many studies report that the proliferation of PTAs is partly due to a domino effect or spillover (Baldwin and Jaimovich, 2012; Manger et al., 2012), I add a linear term in the model to capture the natural spread of PTAs.

Table 4: Cox Hazards regression to test Hypothesis 1.

	Cox Proportional Hazards Regression:		
	(1)	(2)	(3)
Purely Domestic	−0.925**		
	(0.411)		
Autonomous Export		4.332***	
		(1.388)	
GVC-integrated			0.888**
			(0.424)
logGDP	2.841***	2.901***	2.953***
	(1.385)	(1.360)	(1.386)
logGDPc	−2.818***	−2.858**	−2.930***
	(1.372)	(1.353)	(1.377)
logPop	−2.752***	−2.815**	−2.865**
	(1.387)	(1.366)	(1.392)
logFDIin	0.135	0.231	0.133
	(0.265)	(0.267)	(0.267)
Arable Land	1.179***	1.198***	1.186***
	(0.246)	(0.240)	(0.241)
Economic Complexity	0.065	0.101	0.101
	(0.075)	(0.076)	(0.076)
Polity2	−0.015*	−0.016***	−0.015**
	(0.008)	(0.007)	(0.007)
BIT Signed	−0.016***	−0.016***	−0.016***
	(0.000)	(0.002)	(0.002)
Capital Open	0.227***	0.224***	0.227***
	(0.003)	(0.003)	(0.003)
Observations	2,211	2,211	2,211
EU/US	✓	✓	✓
country random effect	✓	✓	✓
Note:		*p<0.1; **p<0.05; ***p<0.01	

Table 4 confirms the first set of hypotheses. That is, a greater share of purely domestic production in the national economy is associated with a decreased chance of PTA formation, whereas a greater share of autonomous export and GVC-integrated production lead to an increased chance of PTA formation. Cox proportional hazards model uses the natural log as the link function, which requires exponentiating the coefficients for direct interpretation. Specifically, one standard deviation increase in the share of purely domestic production in the national economy results in about an 11% (exp(-0.925 × 0.12)) decrease in the chance of PTA formation. One standard deviation increase in the share of autonomous export production

results in about an 18% (exp(4.332 × 0.04)) increase in the chance of PTA formation, and one standard deviation increase in GVC-integrated leads to about an 8% increased chance of PTA formation.

Table 5: Panel regression to test Hypotheses 2 and 3.

	Panel Regression			
	Maximium count of market access provisions		Maximum count of regulatory provisions	
	(1)	(2)	(3)	(4)
Autonomous Export	7.501**		−7.407	
	(3.001)		(8.674)	
GVC-integrated		2.344***		8.031***
		(0.576)		(2.931)
logGDP	7.746	4.152	31.280	29.982
	(8.701)	(4.927)	(25.152)	(25.098)
logGDPc	−5.481	−2.847	−26.688	−25.311
	(8.704)	(4.929)	(25.162)	(25.107)
logPop	−6.953	−3.723	−29.240	−27.697
	(8.705)	(4.930)	(25.165)	(25.111)
logFDIin	0.009	0.021	0.504	0.591
	(0.238)	(0.134)	(0.689)	(0.686)
Arable Land	1.396**	0.809**	−2.784*	−2.833*
	(0.556)	(0.0.314)	(1.607)	(1.603)
Economic Complexity	1.217***	0.686***	2.704***	2.721***
	(0.109)	(0.061)	(0.316)	(0.315)
Polity2	0.003	0.003	0.013	0.015
	(0.013)	(0.007)	(0.039)	(0.039)
BIT Signed	−0.006	−0.004	0.033***	0.022**
	(0.003)	(0.001)	(0.010)	(0.009)
Capital Open	−0.152***	−0.009***	−0.108	−0.103
	(0.038)	(0.002)	(0.112)	(0.112)
Observations	1,947	1,947	1,947	1,947
EU/US	✓	✓	✓	✓
country fixed	✓	✓	✓	✓
year fixed	✓	✓	✓	✓
Note:				*p<0.1; **p<0.05; ***p<0.01

In Table 5, I show that hypotheses 2a,2b, and 3b are also confirmed. The first two columns of Table 5 show that both autonomous export and GVC-integrated production positively associate with a larger number of market access provisions in PTAs. Specifically, one standard deviation increase in the share of autonomous export production results in about 0.3 more market access provisions in PTAs. Likewise, one standard deviation increase in the share of GVC-integrated production results in about 0.2 more market access provisions

in PTAs. Columns 3 and 4 in Table 5 test hypothesis 3. The fourth column reports that a greater share of GVC-integrated production leads to a larger number of behind-the-border provisions in PTAs. Specifically, one standard deviation increase in GVC-integrated production is associated with 1.5 more provisions on regulatory policy constraints. The third column, however, shows that hypothesis 3a is not supported by empirical evidence. One explanation for this could be that deep PTAs typically bring a greater commitment to tariff reduction (Zeng et al., 2020). In other words, while producers engaging in autonomous export are against more constraints on domestic policy autonomy, they may maintain a half-hearted stance on deep PTAs since the loss in policy autonomy can be compensated with greater market access.

Robustness and sensitivity checks

I conduct a series of robustness and sensitivity checks for greater confidence in the validity of the main results. I first test if the results stay robust to a different operationalization of the dependent variable. DESTA dataset developed by Dür et al. (2014) reports regulatory policy provisions at a more refined level compared to World Bank Deep PTA Database. Table 6 shows the list of chapters and detailed regulatory policy clauses that each chapter contains. Unlike World Bank Dataset, DESTA does not record PTAs' policy commitment in relation to WTO mandates. That is, DESTA is more focused on cataloging WTO-X provisions in PTAs. Another distinguishing characteristic of DESTA compared to World Bank PTA dataset is its hierarchical structure. That is, DESTA first distinguishes 18 chapters of regulatory provisions such as Service, Competition, and Investment, and then records detailed clauses for each chapter. For example, Service chapter in DESTA data contains binary indicators for 52 clauses that pertain to the service liberalization. This paper utilizes this hierarchy to gauge a country's commitment to each chapter by conducting a chapter-specific regression. Summary statistics on chapters in DESTA is in Table 6.

With the new dependent variable with DESTA, I test the third set of hypotheses. Since DESTA offers about 300 refined categories of regulatory policy provisions, I use fractions over counts to measure commitment for less inflated coefficient values. For example, in DESTA, the deepest PTA that Chile has entered into by 2005 is the ROK-Chile PTA with 157 clauses

Policy Provision Chapter	Count	Fraction	Mean	Sd
Capital Movement	12	0.04	2.16	1.8
Competition	14	0.05	2.58	3.77
Data Flow	4	0.01	0.38	0.14
Dispute Settlement	37	0.12	13.41	14.74
E-commerce	15	0.05	3.47	1.48
Exchange Rate	2	0.01	0.53	0.72
GVC	4	0.01	0.28	0.08
Investment Protection	56	0.19	13.25	9.76
Intellectual Property	26	0.09	6.81	6.11
NTI	6	0.02	1.51	1.54
Public Procurement	6	0.02	3.67	2.57
Sanitary	4	0.01	1.45	2.14
Service	52	0.17	6.26	5.65
TBT	7	0.02	2.16	1.65
Temporary Entry	9	0.03	2.37	1.64
Trade Defense Institution	28	0.09	4.64	9.29
Transparency	16	0.05	2.39	1.55

Table 6: Summary statistics of the additive measure of PTA depths in DESTA. Each policy category contains a varying number of detailed clauses. `Investment Protection` category contains the greatest number of clauses followed by `Service`.

in 14 chapters including `Capital Movement`, `Exchange Rate`, and `Transparency`. The total number of clauses in the data is 298 and therefore in fraction terms $y_{Chile,2005} = \frac{157}{298} = 0.527$. The full result with DESTA is in Table 7 and they confirm that the main results in Table 5 stay robust.

One could argue that a simple sum of provisions in PTAs may result in information loss due to aggregation. An alternative way to gauge the depth of a PTA is to produce a continuous measure through latent variable models. Bayesian item response theory(IRT) models use a probability model to yield a lower-dimensional summary score for each observation. The summary score, also known as the ideal point, differs from a simple sum of provisions since it accounts for which provisions were selected by other PTAs. Using the ideal points for PTA depths does not change the substantive conclusion from the main results. The results from using ideal points as depth is available in Table B4 in the supplementary information document.

Table 7: Robustness checks on Hypothesis 3 with DESTA dependent variable

	Dependent variable:	
	Maximum count of DESTA provisions (fraction)	
	(1)	(2)
Autonomous Exporters	0.042	
	(0.148)	
GVC-integrated		0.145***
		(0.048)
logGDP	−1.574***	−1.583***
	(0.429)	(0.428)
logGDPc	1.651***	1.662***
	(0.429)	(0.428)
logPop	1.572***	1.585***
	(0.429)	(0.428)
logFDIin 0.003	0.002	0.003
	(0.011)	(0.011)
Arable Land	−0.018	−0.017
	(0.027)	(0.027)
Economic Complexity	0.029***	0.030***
	(0.005)	(0.005)
Polity2	−0.002**	−0.002**
	(0.001)	(0.001)
BIT Signed	0.001***	0.0004***
	(0.0002)	(0.0002)
Capital openness	−0.002	−0.002
	(0.002)	(0.002)
Observations	2,052	2,052
EU/US	✓	✓
country fixed	✓	✓
year fixed	✓	✓
Note:		*p<0.1; **p<0.05; ***p<0.01

Selection on observables

It is important to note that the dependent variable is created following the two-stage process. First, a country decides whether to form a PTA or not. Second, once the country has decided to form a PTA, it decides how deep the PTA is going to be in terms of the behind-the-border provisions. That is, the dependent variable(Depth of a PTA) is conditional on a selection stage (the existence of a PTA). Failure to address the selection stage can lead to a biased estimate (Puhani, 2000).

DESTA dataset suffers less from the selection issue because it reports more PTAs that

are not reported to WTO. This reduces the fraction of country-year dyads not entering into PTAs to about 1% of the sample. After 1990, almost all countries have entered into at least one PTA. In fact, only 22 country-year observations (mostly Mongolia) had no PTAs for several years in the data, which is only about 1% of the observations. While the chance that 1% of missing observations introduce a significant bias to the estimate is small, I test this by fitting Heckman selection model with the selection stage. In the supplementary information document, I report the results from the Heckman selection models in Table B2. Heckman selection model views the selection problem essentially as the omitted variables problem and corrects for the potential bias using the inverse Mills ratio obtained from the model of the selection stage. The coefficients in Table B2 display only a marginal shift in coefficient sizes compared to the OLS results in Table 6, which lends support that selection bias is not significant.

One major problem with the Heckman selection model is that it is challenging to capture country and year-specific unobserved characteristics.[12] To test the significance of the selection issue for panel regression, I fit the Bayesian zero-inflated regression developed by Brooks et al. (2017) with country and year random effects. Zero-inflated models assume that zeros in the dependent variable arise from two separate stages. In the context of the analysis of this paper, zeros in the dependent variable could mean that PTA does not exist, or that PTA exists but without any regulatory policy provisions. Since zero-inflated models are more accessible for count variables, I convert the dependent variable back to counts from fractions. To fit the zero-inflated model, missing values in the dependent variable due to the non-existence of PTAs are converted to zero. The zero-inflated regression first fits a model for zeros in the dependent variable. I include the binary indicator for PTA, a set of gravity variables, and the Polity IV variable to model structural zeros. Then in the second stage, the depth of PTA is modeled with the same set of covariates in the main analysis. Specifically, I use zero-inflated negative binomial regression to account for possible dispersions in the dependent variable. The results stay robust such that they do not deviate much from the

[12]Introducing country and year fixed effects to the selection stage probit model incurs incidental parameters problem. Switching to country and year random effects does not fully address the issue either, as the inverse mills ratio absorbing all variation at the country and year level could induce multicollinearity in the second stage.

main results. The full report of zero-inflated negative binomial regression is in Table B3.

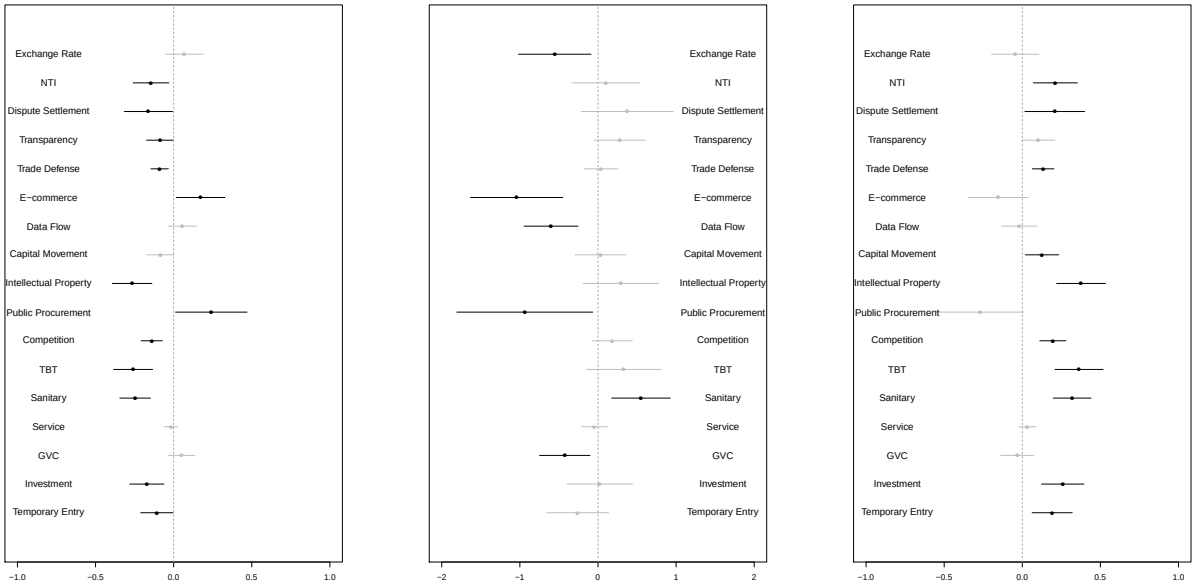
Both the Heckman selection model and the Bayesian zero-inflated negative binomial model do not completely safeguard against the concerns of selection issues because they come in with their own assumptions. Nevertheless, the fact that results stay robust to additional steps for selection stages offers greater support for the main results in Table 6. An additional source of selection issue is the list-wise deletion due to missing observations in covariates. The economic complexity variable displays the largest number of missing observations (1672) which is about 41% of total observations. The main results however stay robust when the economic complexity variable is excluded from the model.

Chapter level analysis

A one-dimensional summary of PTA depth, whether a total count of provisions or a continuous measure from IRT, may seem to be too aggregated. However, focusing on each provision for analysis is too disaggregated such that analyses may suffer from the lack of variation. For example, Civil Protection provision in WTO-X category only appears in 13 PTAs out of 318 PTAs in the data. A possible remedy is to employ a meso-level dependent variable that is not too aggregated nor disaggregated (Orefice and Rocha, 2014).

DESTA's hierarchical structure allows a chapter-specific test of hypothesis 3. In Figure 2, I show how three types of domestic value-added production interact with commitments to each behind-the-border chapter in PTAs. The dependent variable y_{it}^{k} is a maximum fraction of provisions in chapter k for country i up to year t. Each point in Figure 2 is a coefficient estimate from panel regressions for each production type (purely domestic, autonomous export, GVC-integrated) for the corresponding depth measure for each chapter. Note that the dependent variable is normalized to fraction scales, and moves between 0 and 1. 1 means that the given country has a PTA with all policy provisions for that chapter, 0 means that the given country has a PTA that does not commit to any of the provisions in that chapter.

In general, a greater share of purely domestic production and autonomous export reduces the number of provisions in most of the chapters. While the coefficient for autonomous export production in Table 5 was not statistically significant, the chapter-level analysis does report a few statistically significant effects with negative signs. Specifically, panel (b) shows that a



(a) Purely Domestic (b) Autonomous Exporters (c) GVC-integrated

Figure 2: Coefficients from panel regression analysis for each chapter. The dependent variable is the maximum fraction of clauses in the corresponding chapter. Points indicate coefficient values, and horizontal lines are 95% confidence intervals. Coefficients statistically significant at the conventional 0.05 level are colored in black. Coefficients not statistically significant at the conventional 0.05 level are colored in gray.

greater share of autonomous export production decreases the number of provisions on GVC, public procurement, data flow, e-commerce, and exchange rate. The negative coefficient on the exchange rate chapter is more straightforward, as final goods exports can benefit from the depreciated national currency, and autonomous exporters will oppose adding provisions that put constraints on the exchange rate policy autonomy.

For panel (c), a large set of chapters display positive effects that are statistically significant. They are largely consistent with the existing literature. The results show that chapters that primarily address FDI-related concerns – i.e. *expropriation* – such as investment protection (Kim, 2021), dispute settlement (Kim et al., 2019), and intellectual property rights (Osgood and Feng, 2018) increase in PTAs of countries that have more GVC-integrated production. The same has been observed for trade defense and competition chapters which address *discriminatory treatment* and *information asymmetry* in the areas of subsidies, taxation, and structural adjustment (including protection of infant industries). Provisions in

NTI (Non-trade issues) and TBT (Technical barriers to trade) chapters also increase for economies with a greater share of GVC-integrated production. Provisions in NTI govern anti-corruption, labor, and environmental regulations, and provisions in TBT address standards harmonization, all of which can limit the scope of government interventions that create hold-ups (*political hold-up*).

Conclusion

PTAs have become highly heterogeneous in their designs, and yet existing studies have largely focused on tariff-reducing aspects of PTAs, or have taken a chapter-by-chapter approach to explain the growing institutional complexity in PTAs. This paper addresses this gap in the existing studies by highlighting the rise of GVCs and the new problems that GVC-integrated firms face vis-à-vis governments. Specifically, I delineate a comprehensive set of vulnerabilities that GVC firms experience, and explain how they connect to a wide set of regulatory policy provisions in PTAs. This paper then proposes a new dimension in domestic cleavages toward PTA formation and commitments. In criticism of the conventional IPE framework of pitting import-competing against export-oriented, I propose domestic groups whose production is predominantly purely domestic, autonomous export, and GVC-integrated. I emphasize the importance of the new categorization of domestic groups as they differ in their preference for different types of PTAs.

While deep PTAs safeguard GVC-integrated firms with vulnerabilities vis-à-vis governments' use of regulatory policies, they inevitably constrain the domestic policy autonomy which hurts domestic firms. More importantly, the benefit of deep PTAs mostly accrues to GVC-integrated producers while the cost of deep PTAs is shared, or more acutely felt by firms not integrated into GVCs. In this light, I argue that firms primarily engaging in purely domestic production and autonomous exports have incentives to oppose deep PTAs. However, I also point out that deep PTAs generally make stronger commitments on tariff concessions, encouraging firms on autonomous export production to also favor deep PTAs. Facing the mixture of cost and benefits of deep PTAs, firms engaged in autonomous export production may have a half-hearted attitude toward deep PTAs while GVC-integrated firms

will display a clear preference for deep PTAs.

The empirical analysis of this paper lends support to the theoretical predictions. I first show that countries whose economy is predominantly engaged in all types of export (autonomous export or GVC-integrated) favor PTA formation while countries more for purely domestic production oppose PTA formations. Then I show that a greater share of autonomous export and GVC-integrated production leads to a greater preference for market access aspects of PTAs. Finally, I show that such shared preferences for market access provisions are not extended to behind-the-border provisions. Specifically, I find that countries with a higher share of GVC-integrated production associate with a greater number of regulatory policy provisions in their PTAs, but find no such evidence for autonomous export production.

This study connects the design of PTAs and GVCs at the country level. This leaves room for future research, particularly in the areas of industry-level preferences for regulatory policies in PTAs. Specifically, which industry-specific characteristics connect to which regulatory provisions of PTAs? High-tech industries such as manufacturing of machine parts and components may be more concerned about *expropriation*, responding more enthusiastically to the inclusion of investment protection and intellectual property rights provisions than others. Service sectors such as banks, insurance, and investment firms may be the new category of actors with distinct interests. They may take a greater interest in the free movement of capital, data flow, and e-commerce, which are relatively unexplored areas in IPE.

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