Self-Defeating Treaties: Global Value Chains and the Termination of Bilateral Investment Treaties

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Abstract

Deep integration into global value chains (GVCs) effectively protects foreign investors property rights, making bilateral investment treaties (BITs) less relevant. Hence, countries with deeper GVC integration are more likely to terminate BITs. With GVCs positive spillovers to the host country's economy, governments with great social welfare concerns can credibly commit to respecting property rights. As democratic institutions can serve as a public signal of high social welfare concerns, we expect a stronger substitute effect of GVCs for BITs in democracies than in autocracies. Using value-added in trade indicators at the dyad level to measure GVC integration, this paper finds that dyads with deeper GVC integration are more likely to have BITs termination. Meanwhile, when GVC integration is high, democracies are more likely to unilaterally terminate BITs. Using the investor-state dispute settlements (ISDS) mechanism to measure treaty violations, this paper further shows that at a high level of GVC integration, democracies are less likely to be respondents to ISDS disputes than autocracies are. Given that BITs are originally designed to facilitate the development of GVCs, this paper reveals the self-defeating nature of BITs.

Keywords: Global Value Chains; BITs Termination

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1 Introduction

We have been witnessing a wave of withdrawal from international cooperation. Some of the salient examples include the withdrawal from the World Health Organization (WHO), the Paris Climate Agreement, the Iran nuclear deal, the Trans-Pacific Partnership, and the Open Skies Treaty by the United States of America (US) during the Trump administration. In Europe, we see the United Kingdom's (UK) withdrawal from the European Union (EU). In developing countries, there is a wave of termination of Bilateral Investment Treaties (BITs) and the withdrawal from the International Center for Settlement of Investment Disputes (ICSID).

This is a puzzling phenomenon. Since Robert O. Keohane (1984)'s ground-breaking work *After Hegemony: Cooperation and Discord in the World Political Economy*, scholars have been searching for different mechanisms that make international cooperation possible (Fearon, 1998; Simmons, 2010; Gilligan and Johns, 2012; Voeten, 2019). However, we know little about why the already established cooperation can break down.

This paper proposes a rationalist explanation to this phenomenon of withdrawal from international cooperation: when different international institutions can provide different mechanisms to achieve the same function, states have incentives to withdraw from institutions whose mechanisms are less favorable.

To examine this argument, this paper focuses on the termination of BITs, investment agreements between two states to facilitate the flow of foreign investment. The left panel in Figure 1 shows the overtime trend in BIT signatures and termination. The green line captures the number of new BITs signatures, from which we can see that new BITs signatures surged in the 1990s and have been decreasing sharply since then. The blue line illustrates the increasing trend in BITs termination. This graph poses several questions. First, what explains this wave of BITs termination? Second, note that BITs new signature and termination coexist during the 2010s. Why is that the case? Lastly, will the trend of termination persist in the future?

To answer these questions, this paper builds on the property rights protection function

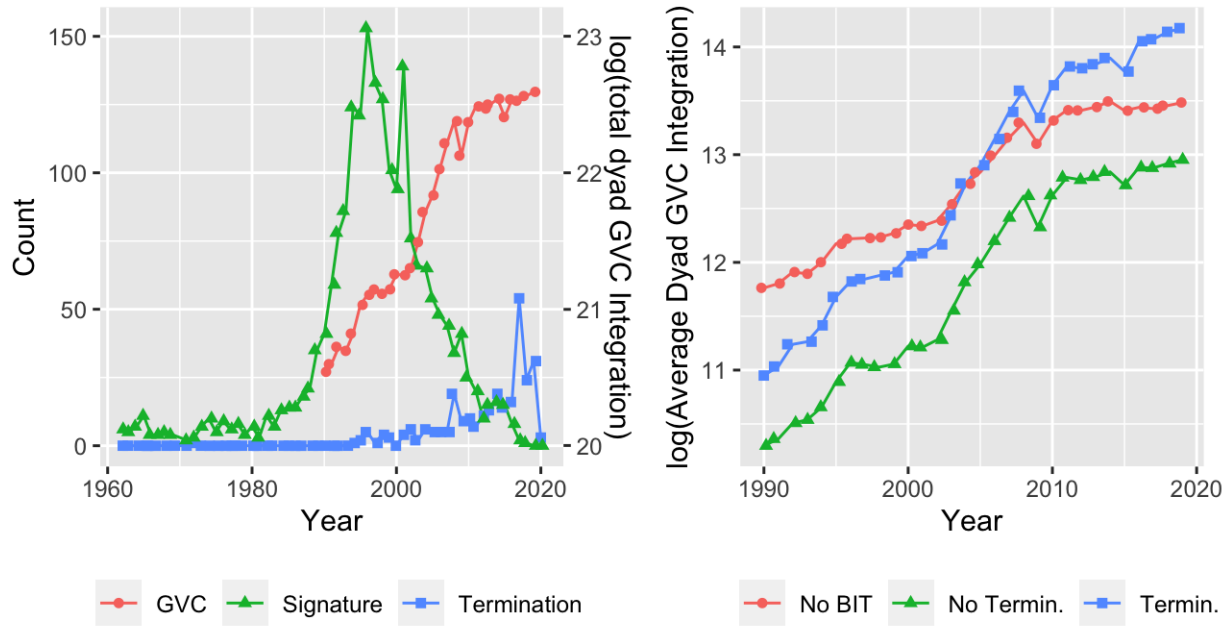

Figure 1: Trend of BIT Status and GVC Integration

of global value chains (GVCs) proposed by Johns and Wellhausen (2016) and argues that states' integration into GVCs provides an alternative mechanism to address the obsolescing bargaining problem for host governments and renders the dispute settlement mechanism in BITs redundant, which leads to the termination of BITs. To compare the overtime variation of GVCs integration with the trend of BITs signature and termination, the red line in the left panel of Figure 1 displays the overtime average GVCs integration between all dyads.[1] Interestingly, the increasing trend of GVCs integration seems to correspond to the decreasing trend in BITs signature and the increasing trend in BITs termination.

To further explore the level of GVCs integration for dyads with different BITs status, the right panel of Figure 1 plots the yearly average GVCs integration for dyads that never signed a BIT, dyads with a never-terminated BIT, and dyads with a terminated BIT. The pattern is impressive. First, by comparing dyads with no BIT (red line) and dyads with no BIT termination (green line), we find that dyads with no BIT always have a deeper GVCs integration, suggesting that once GVCs integration is deep enough, BITs are not necessary

[1] As will be discussed more detailed in Section 4.1, dyadic GVCs integration is measured as trade in value added between two countries. Certain dyads are not included due to the data limitation.

any more. Second, if we compare dyads with no BITs termination (green line) with dyads with a termination (blue line), we can see that the blue line is always higher than the green line, implying that some degree of GVCs integration can be a necessary condition for BITs termination. Lastly, the comparison between dyads with no BIT (red line) and dyads with a terminated BITs (blue line) shows that dyads that ended up with BITs termination have experienced a much greater increase in GVCs integration so that these dyads ended up with even deeper GVCs integration than the rest two groups.

The patterns revealed in Figure 1 displays a substitution relationship between BITs and GVCs integration. To more systematically understand how these two institutions interact with each other, this paper proposes a model between a host government and a foreign investor, in which GVCs integration is conceptualized as a positive spillover effect of foreign investment on the domestic economy. As democracies are more accountable to social welfare concerns, democratic governments are more likely to benefit from the positive spillover effect of BITs integration. Since GVCs integration creates more preference alignment between the host government and the foreign investor in democracies than in autocracies, democratic governments are less likely to impose regulations that harm the value of foreign investments. Knowing such incentive compatibility, foreign investors will demand fewer property rights protection from BITs in democracies than in autocracies, Therefore, democracies do not need as strong BITs to attract foreign investment as autocracies do, leading to more BITs termination in democracies when GVCs integration is high.

The empirical test supports this argument. First, GVCs integration increases the probability of BITs termination. Second, when GVCs integration is deep, democracies are more likely to unilaterally terminate their BITs than autocracies. This paper also examines the effect of GVCs integration on ISDS disputes. The results show that GVCs integration decreases the probability of being a respondent to a dispute. In addition, when GVCs integration is high, democracies are less likely to be respondents to ISDS disputes.

This paper has several contributions. First, this paper provides a new explanation to the phenomenon of BITs termination (Peinhardt and Wellhausen, 2016; Haftel and Thompson,

2018; Johns et al., 2019; Thompson et al., 2019). It reveals the self-defeating nature of the design of BITs. Created to solve the obsolescing bargaining problem in foreign investment, BITs help build up GVCs in the host government, which yet only turns out to make the ISDS mechanism redundant and leads to the termination of the treaty. Second, this paper explores the interaction of GVCs integration with international agreements and provides new empirical evidence in support of the property right protection function of GVCs (Johns and Wellhausen, 2016). Third, this paper may help address the mixed results of the effect of BITs on FDI inflows (Neumayer and Spess, 2005; Allee and Peinhardt, 2011; Pandya, 2016). This model suggests that the host government's choice of BITs is a response to its degree of GVCs integration and always makes investors invest at the equilibrium, which explains why BITs do not increase FDI inflow. Lastly, this paper reveals a new source of selection in ISDS disputes (Pelc, 2017). This paper suggests that host governments' strategic choice of indirect expropriation could be a response to GVCs integration.

2 BITs and the Termination

Bilateral investment treaties (BITs) are international agreements between two states to facilitate foreign investment. The origin of BITs is to provide investors from developed countries with protection from expropriation by host governments. One of the key property rights protection mechanisms in BITs is the investor-state dispute settlement (ISDS), which allows the foreign investors to file a claim against the host government directly at the International Center for Settlement of Investment Disputes (ICSID). This is different from the case of trade disputes at the World Trade Organization (WTO), where foreign investors do not have the legal standing to challenge possible violations and have to sue the host government through their own government. As ISDS imposes *ex post* costs on the host government given a violation (Allee and Peinhardt, 2011), states have strong incentives to sign BITs to credibly commit not to expropriate (Arias et al., 2018) and to compete for foreign investment (Elkins et al., 2008).

However, as is shown in the left panel of Figure 1, we are observing a decreasing trend of

new BIT signatures and an increasing trend of BIT termination since 2000. What explains this wave of BITs termination? The most prevalent explanation for this phenomenon is based on a bounded rationality framework (Poulsen and Aisbett, 2013). The idea is that when states sign the treaties, they are not fully aware of what they have signed up for. Unlike the conventional wisdom that ISDS disputes deal with expropriation by host governments, more recent development suggests that 70% of disputes deal with cases of indirect expropriation where the host government's regulation degrades the value of investment (Pelc, 2017). To avoid costly ISDS disputes, host governments sometimes have to refrain from imposing regulations that are popular among the domestic audience, which is known as the regulatory chilling effect of BITs (Moehlecke, 2020; Pelc, 2017). Hence, the occurrence of potential ISDS disputes helps host governments learn about the boundary in their domestic regulatory space. As is shown by Haftel and Thompson (2018); Thompson et al. (2019), states faced with more ISDS disputes are more likely to renegotiate their BITs.

One limitation of this explanation to BITs termination is that it provides a limited understanding of the design of international institutions. Uncertainty is ubiquitous in international agreements. Due to their incomplete contract nature, many international agreements intentionally incorporate elements of flexibility to increase the stability of the regime (Rosendorff and Milner, 2001; Rosendorff, 2005; Johns, 2014; Pelc and Urpelainen, 2015). The dispute settlement mechanism in BITs is a way for host governments to compensate the investors if their demand for violation is high, making breach efficient. With that, the bounded rationality framework fails to forward our understanding of why such intentional design to incorporate uncertainty can fail.

In response to this puzzle, this paper provides a rationalist explanation to BITs termination: with substitution between different international institutions, states have incentives to withdraw from costly institutions. This paper examines how the property rights protection function provided by GVCs can lead to BITs termination. Johns and Wellhausen (2016) show that when domestic firms are linked to foreign firms through GVCs, domestic firms have incentives to lobby their government not to expropriate foreign firms, which generates

additional revenues for government to honor the contract. Building on the essence of their model that GVCs create preference alignment between the host government and foreign investors, this paper conceptualizes GVCs as positive spillover effects of foreign investments on the domestic economy. Despite a different conceptualization of GVCs, this paper supports their argument with new empirical evidence.

As GVCs have significantly changed the landscape of the international political economy, this paper also contributes to the literature of GVCs (Kim and Rosendorff, 2021). Osgood (2018) shows that integration in GVCs increases firms' support for free trade. GVCs can moderate the state's incentive to file anti-dumping cases (Jensen et al., 2015) and to depreciate its currency (Weldzius, 2021). GVCs also upgrades labor standards in developing countries (Malesky and Mosley, 2018, 2021). Faced with ISDS, the host government may undo its regulations even after it wins the dispute if there is intense GVCs integration (Moehlecke, 2020). This paper contributes to this literature by explicitly exploring how GVCs interact with international agreements.

3 Model

The model features two players: a home firm F and the host government G.

F decides whether to invest in G's territory to maximize its profits. G aims to attract foreign investment to boost its domestic support. G may have incentives to impose regulations after F enters, which hurts F's interests. To solve this time-inconsistency problem, G can maintain a BIT with F's country, which creates a probabilistic opportunity to reverse G's regulation and serves as a insurance for F's investment. However, maintaining a BIT constrains G's domestic regulatory autonomy. Hence, G decides whether to terminate the BIT to regain its autonomy.

In this model, GVCs take the form of positive spillover effect of F's investment on G's employment, which creates preference alignment between G and F, mitigating the time-inconsistency problem.

3.1 Sequence

The sequence of the game is as follows:

1. Nature draws government type $a \in [0,1]$, and GVC intensity $\beta \in [1, \bar{\beta}]$.
2. G decides whether to quit its BIT ($q = 1$) or to maintain it ($q = 0$).
3. F determines whether to invest $k \in \{0, K\}$.
4. G determines its regulation level $r \in [0,1]$.
5. If $r \geq \tau \in [0,1]$, dispute occurs. Nature determines the outcome based on the probability that F wins given a violation $Pr(win|violation) = \lambda(1-q)$. If F wins, r is reversed to τ; otherwise, r remains.

3.2 Payoffs

3.2.1 Firm's Payoff

F aims to maximize its profits by investing in G. Its payoff is as follows:

$$U_F(k) = \begin{cases} \underbrace{W((1-r)K)}_{\text{Production}} - \underbrace{\kappa K}_{\text{Capital cost}} - \underbrace{(1-r)K}_{\text{Labor cost}} & \text{if entry, k=K} \\ 0 & \text{otherwise, k=0} \end{cases}$$

.

F decides whether to invest a fixed amount of capital K in G or not: $k \in \{0, K\}$. Due to G's regulation, the available capital that enters into production is $(1-r)K$. With that, F employs labor $(1-r)K$ from G for production. $W(X)$ is a production function with $W(0) = 0, W'(\cdot) > 0$, and $W''(\cdot) < 0$. I standardize labor's wage as 1 and set the cost of 1 unit of capital as κ.

3.2.2 Government's Payoff

We consider the case where G already has a BIT with F's government and has to suffer from the corresponding autonomy loss. G determines whether to terminate the BIT to regain its

autonomy. Its payoff is as follows:

$$U_G(q,r) = \underbrace{aR(\beta(1-r)k)}_{\text{Political support}} + \underbrace{B(r)}_{\text{Political rents}} + \underbrace{\lambda q}_{\text{Autonomy gains}}$$

, in which G has two choice parameters: the termination decision q and the level of regulation r.

G's utility function has three components. First, $aR(\beta(1-r)k)$ captures G's utility from domestic support, which is determined by the level of employment. Specifically, $R(\cdot)$ is a function that transforms employment to political support. $(1-r)k$ is the amount labor that F employs, which is multiplied by G's GVCs integration with F's country $\beta \in [1, \bar{\beta}]$. The underlying assumption is that deep GVCs integration generates positive spillover effect in the upstream and downsteam industries that F invests in, leading to an enlarging effect on the total employment. a captures G's social welfare concern, which takes the form: $a = d+\epsilon$. $d \in [0,1]$ captures the regime type with higher values indicating democracy, which is public information to both G and F. $\epsilon \sim U(0, 1-d)$ indicates a stochastic shock to G's type, the value of which is private information to G. F only knows the distribution of ϵ. ϵ captures the incomplete contract nature in international treaties.

Second, $B(r)$ indicates G's political rents. Assume that higher r brings in more lobbying revenues, which captures the tension between G and F over the level of regulations. As F prefers to have fewer regulations to reduce its production costs, we want G to have incentives to increase r to create conflict of interest between G and F in the model. Hence, this term specifies the scope condition of the model.

Lastly, G obtains autonomy gains if it terminates the BIT ($q = 1$), the level of which is determined by the BIT strength λ. If G sets regulations r greater than an exogenous threshold $\tau \in [0,1]$, dispute occurs. λ captures the probability that F wins given a violation. If F wins, r is reversed to the level τ. Otherwise, r remains. Hence, greater λ means that G is more likely to lose a dispute. As G's regulatory space is constrained by the size of λ, λ captures the autonomy loss G faces with the presence of a BIT.

For simplicity, we assume that $R(x) = mx$ and $B(x) = bx$.

3.2.3 Information Set

To reiterate the information set, the following exogenous parameters are public information to both G and F: GVC integration β, regime type d, threshold for violation τ, and BIT strength λ. The value of the stochastic shock ϵ is private information to G, and F only knows that $\epsilon \sim U(0, 1-d)$.

3.3 Assumptions

The model has several important assumptions.

First, the model abstracts away from the investors' strategic decision about whether to file an ISDS claim. For example, Pelc (2017) shows that investors may file claims that have a low probability of winning under the consideration that such claims can generate additional payoffs from deterring regulations. The model strips away other factors that may determine the result of disputes (Strezhnev, 2017; Donaubauer et al., 2018; Rao, 2021) and focuses our attention on G's termination choice q.

Second, the model assumes that if investors win the claim, the regulation is reversed. This is inconsistent with the empirical observation by Moehlecke et al. (2019) who show that the host government undos the regulation only when sued by MNCs from states with deep GVCs integration in the host state. This observation is consistent with this paper's argument that GVCs integration can protect the property rights of foreign investors and lead to their investment even in the absence of BITs. The model treats regulation reversion as a mechanic process to demonstrate that even in the absence of GVC privilege in the outcome of a dispute, investors still have incentives to invest once the host government has deep GVCs integration.

Third, the model assumes that BIT is effective in inducing F to invest despite the possibility that G may expropriate: $\lambda \geq \lambda^* = \dfrac{\kappa K}{W((1-\tau)K) - (1-\tau)K}$.[2] This assumption

[2]The threshold of λ is obtained from making F is indifferent between investing and not investing when

allows us to focus on the more interesting and relevant cases.

3.4 Equilibria

The equilibrium concept is weak Perfect Bayesian Equilibrium. The following proposition demonstrates the equilibria of the model, the solution to which is shown in Appendix A.

Proposition 1 *1. When GVCs intensity is low $\beta \leq \beta^* = \frac{B'}{R'K}$: G's termination decision is*

$$q^*(a|\beta \leq \beta^*) = \begin{cases} 1 & \text{if } a \leq \dfrac{1+B(1)-B(\tau)}{R(\beta(1-\tau)K)} = \hat{a} \\ 0 & \text{otherwise} \end{cases}$$

. F's investment decision is

$$k^*(q|\beta \leq \beta^*) = \begin{cases} 0 & \text{if } q = 1 \\ K & \text{if } q = 0 \end{cases}$$

. G sets regulation $r^*(a) = 1$. F's belief about G's type is $a \sim U(d, \frac{1+B(1)-B(\tau)}{R(\beta(1-\tau)K)})$ if $q = 1$ and $d < \frac{1+B(1)-B(\tau)}{R(\beta(1-\tau)K)}$, and $a \sim U(\frac{1+B(1)-B(\tau)}{R(\beta(1-\tau)K)}, 1)$ if $q = 0$.

2. When GVCs intensity is high $\beta > \beta^*$:

- *Separating Equilibrium: For autocracy $d \leq d^* = \frac{W(K)-K}{\kappa K}\tilde{a} - \frac{W(K)-\kappa K-K}{\kappa K}a^* = \tilde{a}(1 - \frac{W(K)-\kappa K-K}{b\kappa K}\lambda)$, G's termination decision is*

$$q^*(a|\beta > \beta^*, d \leq d^*) = \begin{cases} 1 & \text{if } a \leq \dfrac{\lambda + B(1)}{R(\beta K)} = a^* \\ 0 & \text{otherwise} \end{cases}$$

there is a violation for sure.

. *F's investment decision is*

$$k^*(q|\beta > \beta^*, d \leq d^*) = \begin{cases} K & \text{if } q = 0 \\ 0 & \text{if } q = 1 \end{cases}$$

. *G sets regulation*

$$r^*(a) = \begin{cases} 1 & \text{if } a \leq \dfrac{B'}{R'\beta K} = \tilde{a} \\ 0 & \text{if } a > \dfrac{B'}{R'\beta K} \end{cases}$$

. *F's belief about G's type is* $a \sim U(d, \dfrac{\lambda + B(1)}{R(\beta K)})$ *if* $q = 1$, *and* $a \sim U(\dfrac{\lambda + B(1)}{R(\beta K)}, 1)$ *if* $q = 0$.

- *Pooling Equilibrium: For democracy* $d \geq d^{**} = \dfrac{W(K) - K}{\kappa K}\tilde{a} - \dfrac{W(K) - \kappa K - K}{\kappa K}$, *G's termination decision is*

$$q^*(a|\beta > \beta^*, d \geq d^{**}) = 1$$

. *F's investment decision is*

$$k^*(q|\beta > \beta^*, d \geq d^{**}) = K$$

. *G sets regulation*

$$r^*(a) = \begin{cases} 1 & \text{if } a \leq \dfrac{B'}{R'\beta K} \\ 0 & \text{if } a > \dfrac{B'}{R'\beta K} \end{cases}$$

. *F's belief about G's type is* $a \sim U(d, 1)$.

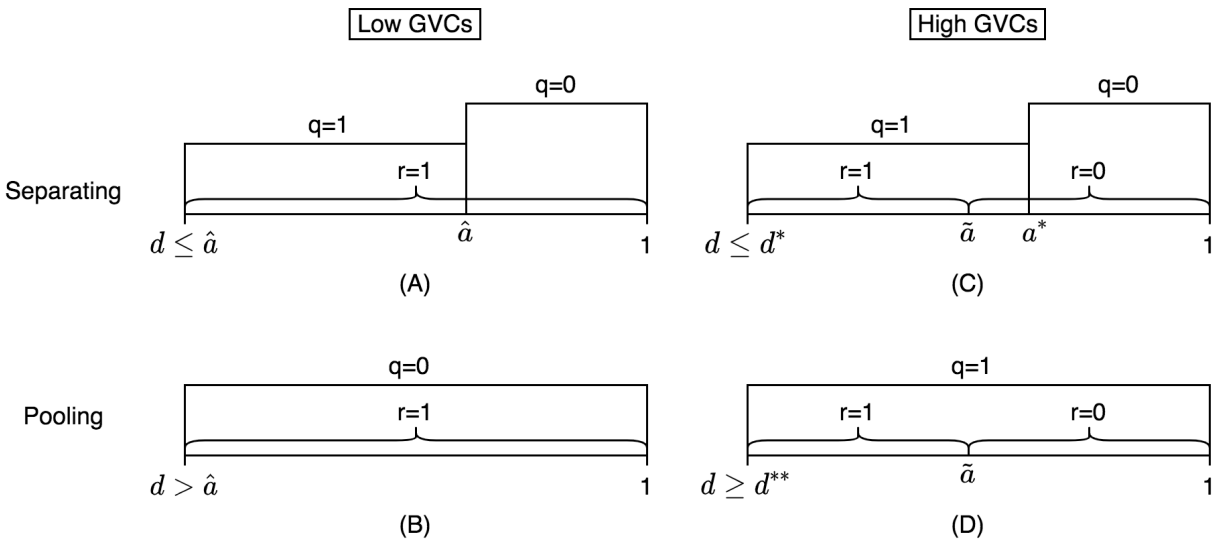

Figure 2: Separating and Pooling Equilibria: G's strategy

Figure 2 demonstrates the equilibria. When GVCs integration is low ($\beta \leq \beta^*$), it is common knowledge that G will impose regulations $r = 1$. With greater social welfare concern, G can benefit more from political support generated by foreign investment and is more likely to sign a BIT to induce foreign investment. Hence, in the separating equilibrium (Panel A), G will maintain the BIT if its social welfare concern is high enough ($a \geq \hat{a}$). Meanwhile, if G's regime type is democratic enough ($d \geq \hat{a}$), G follows a pooling strategy and always maintains the BIT (Panel B).

When GVCs integration is high ($\beta > \beta^*$), whether G imposes high regulation depends on G's type. Without observing G's type, F can make inference based on G's termination decision (q) and its regime type (d). In the separating equilibrim (Panel C), since G is not democratic enough, F faces a large chance of high regulations and will not enter G's market unless there is a BIT to provide insurance against expropriation. In this case, G will maintain the BIT to induce foreign investment if it cares about social welfare enough ($a \geq a^*$). Notice that the threshold of BIT termination (a^*) is greater than the threshold of high regulation ($\tilde{a}$). This is because autocracies with less democratic institutions have to pay an autonomy cost to signal that it has no incentive to expropriate (Arias et al., 2018).

On the contrary, democracies follow a pooling strategy (Panel D) and always terminate their BITs when GVCs integration is high. With high values of regime type d, F can still

benefit from entering G's market even though there is still a chance that G may impose high regulations ($d < \tilde{a}$). As regime type facilitates the communication of G's type to F, G can terminate the BIT and regain its autonomy.

3.5 Hypotheses

To generate testable hypothese from the model, Figure 3 shows how GVCs integration affects the probability of BITs termination and ISDS disputes.

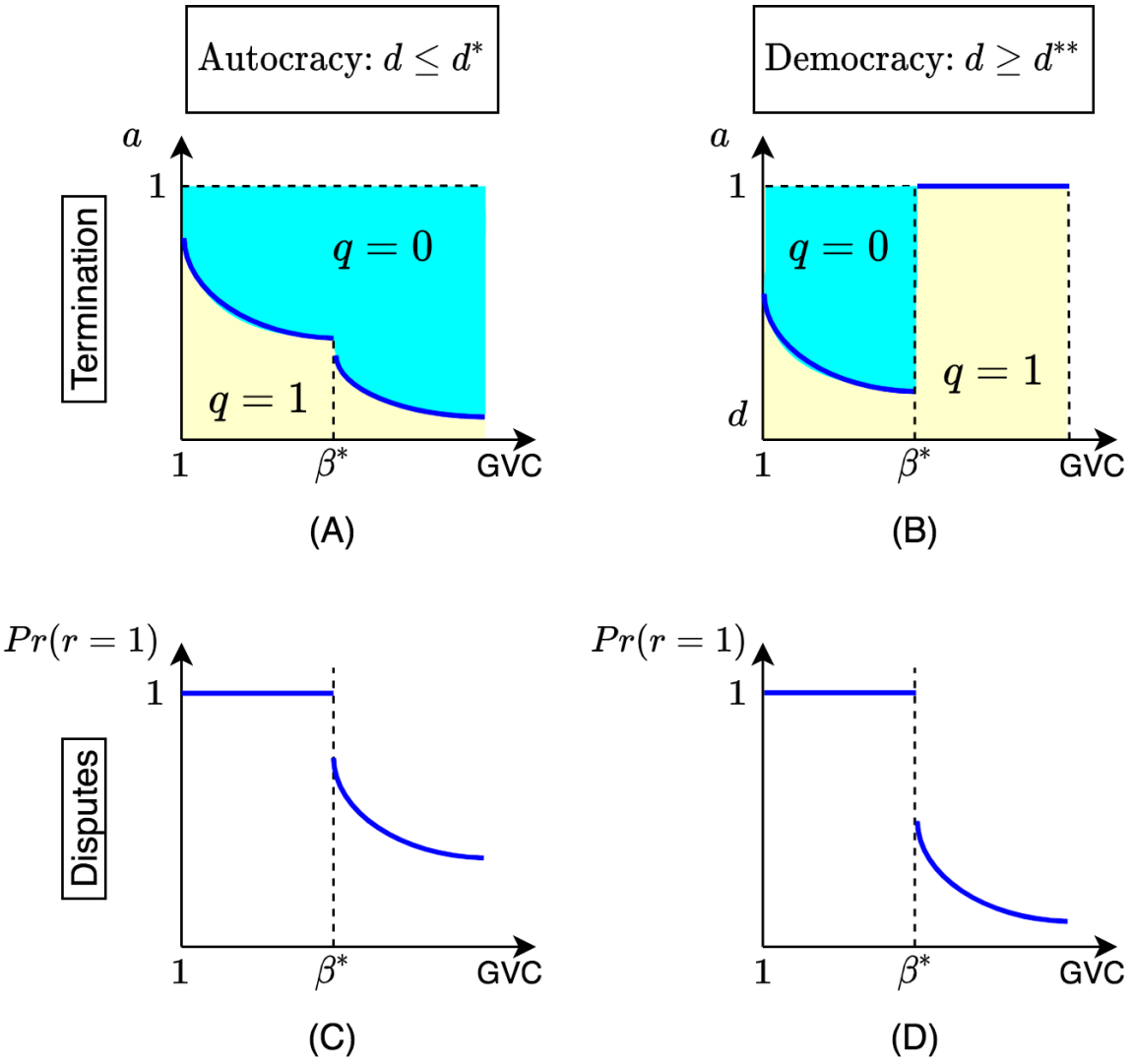

Figure 3: How does GVCs integration affect BITs Temination and Disputes?

GVCs integration has multiple effects on the probability of BITs termination. First, Panel A shows that as GVCs integration increases, autocracies become less likely to termi-

nate their BITs. This is because GVCs integration increases G's utility from political support and makes F's entry more attractive. Second, Panel B shows that GVCs integration makes democracies terminate their BITs. Third, as is shown in Figure 4, high degree of GVCs integration increases the parameter space of the pooling equilibrium with $q = 1$ and constrains the parameter space of the separating equilibrium.[3] This effect increases the probability of BITs termination. As the substitution effect in Panel B in Figure 3 outweighs the effect in Panel A, we should expect to see an overall substitution effect of GVCs integration for BITs. From Panel A and B, we can obtain the following propositions:

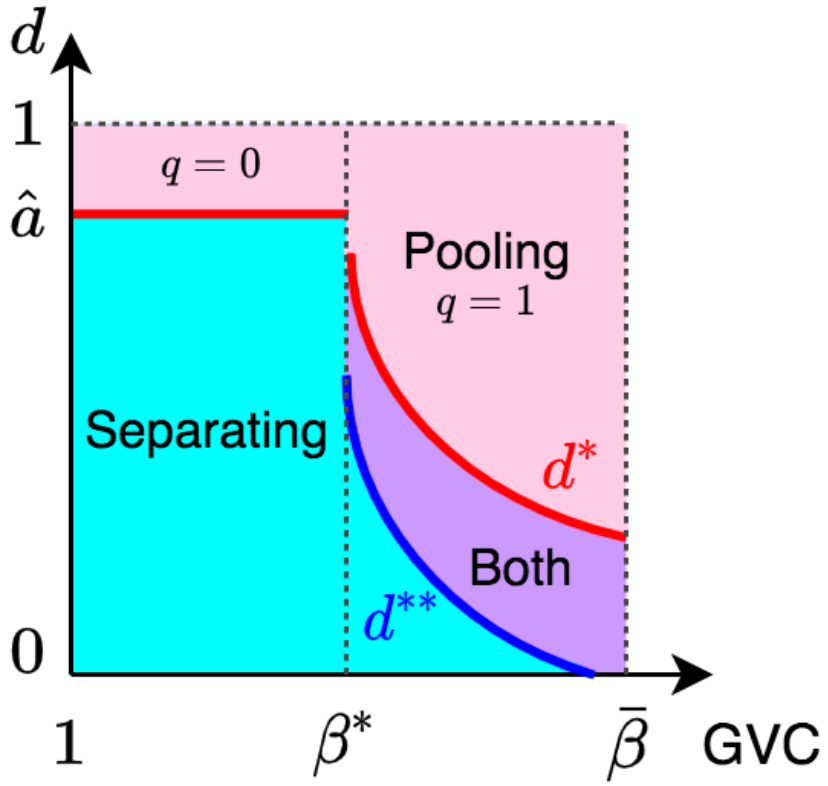

Figure 4: Equilibria and Parameter Space

Proposition 2 *GVCs integration substitutes for BITs.*

Proposition 3 *When GVCs integration is high, democracies are more likely to terminate BITs than autocracies.*

[3]This is obtained from $\frac{\partial p^*}{\partial \beta} < 0$ and $\frac{\partial p^{**}}{\partial \beta} < 0$.

Panel C and D in Figure 3 shows the results with the probability of ISDS disputes. When GVCs integration is low, both democracies and autocracies faces ISDS disputes. As GVCs integration intensifies, the probability of disputes decreases because GVCs creates preference alignment between G and F and makes it profitable for G to not impose regulations. Meanwhile, since democracies have higher social welfare concern, democracies are more likely to set regulation $r = 0$ and face less disputes. The following propositions summarizes the results:

Proposition 4 *GVCs integration reduces ISDS disputes.*

Proposition 5 *When GVCs integration is high, democracies have fewer disputes than autocracies.*

4 Data

4.1 Global Value Chains (GVCs)

Broadly speaking, "a global value chain consists of a series of stages involved in producing a product or service that is sold to consumers, with each stage adding value, and with at least two stages being produced in different countries; a firm participates in a GVC if it produces at least one stage in a GVC" (Antràs, 2020, p. 3).[4] From a narrower perspective, GVCs feature the incomplete contract nature in global production and emphasizes the production with customized inputs and destined exports, which is termed as relational contracting (Antràs, 2016, 2020).

As this paper conceptualizes GVCss integration as positive spillover effects of foreign investment on the host country's employment, an ideal measure of GVCs integration should capture the spillover effect of GVCs on the domestic economy. Among different measures of GVCs,[5] this paper uses value-added in trade indicators, which are the most widely used measure of GVCs. These measures break down the global production process of a product

[4]One of the most common examples of a GVC is how an iPhone is produced.
[5]Table B.1 shows a survey of different measures of GVCs and their data sources.

and calculate the value-added in each stage of production. Hence, these measures capture how much value a country brings to a product and can be good indicators of the spillover effect of GVCs integration on the domestic economy.

The data is obtained from the UNCTAD-Eora Global Value Chain Database (Casella et al., 2019). This database constructs a multi-region input-output table (MRIO) based on national input-output tables or supply/use tables and international trade statistics.[6] The MRIO table allows us to obtain information about the dyad-level value-added trade indicators, including Domestic Value Added (DVA), Foreign Value Added (FVA), and Indirect Value Added exports (DVX). Specifically, DVA in exports is the value-added in exports whose outputs are produced by domestic industries. FVA in exports is the value-added in exports whose outputs are produced by foreign industries, which is also called the backward participation in GVCs. DVX in exports is the value-added that is embodied in the exports of other countries and upstream contributions of DVA of other industries. It is also known as the forward participation in GVCs. This paper uses the sum of FVA and DVX to measure a country's GVCs integration with another country.[7] The unit of analysis is at the dyad-year level.[8]

Figure 5 shows the top 20 dyads with the greatest yearly average GVCs integration, from which we can infer that the level of GVCs integration can be driven by the GDP of the dyad and the geographic distance between the two countries.

4.2 BITs and ISDS Disputes

The BITs data is obtained from the Mapping of IIA Content database from the United Nations Conference on Trade and Development (UNCTAD) website.[9] The dataset provides

[6]Due to data quality issue, the following countries are excluded from the analysis: Belarus, Benin, Burkina Faso, Congo, Eritrea, Ethiopia, Guinea, Guyana, Libya, Moldova, Serbia, Sudan, Yemen, and Zimbabwe.

[7]The results are robust using either FVA or DVX as a measure of GVCs integration.

[8]The GVCs measure is also available at the industry level. However, this paper does not use the more refined information for two reasons. First, the model's prediction about the treaty is at the country level, so the industry-level GVCs measure does not match the theory well. Even though we can construct the disputes at the industry level, there is a huge harmonization problem due to different countries' reporting standards, which is the second reason why a more aggregate measure is a better one.

[9]UNCTAD, Mapping of IIA Content, available at https://investmentpolicy.unctad.org/international-investment-agreements/iia-mapping

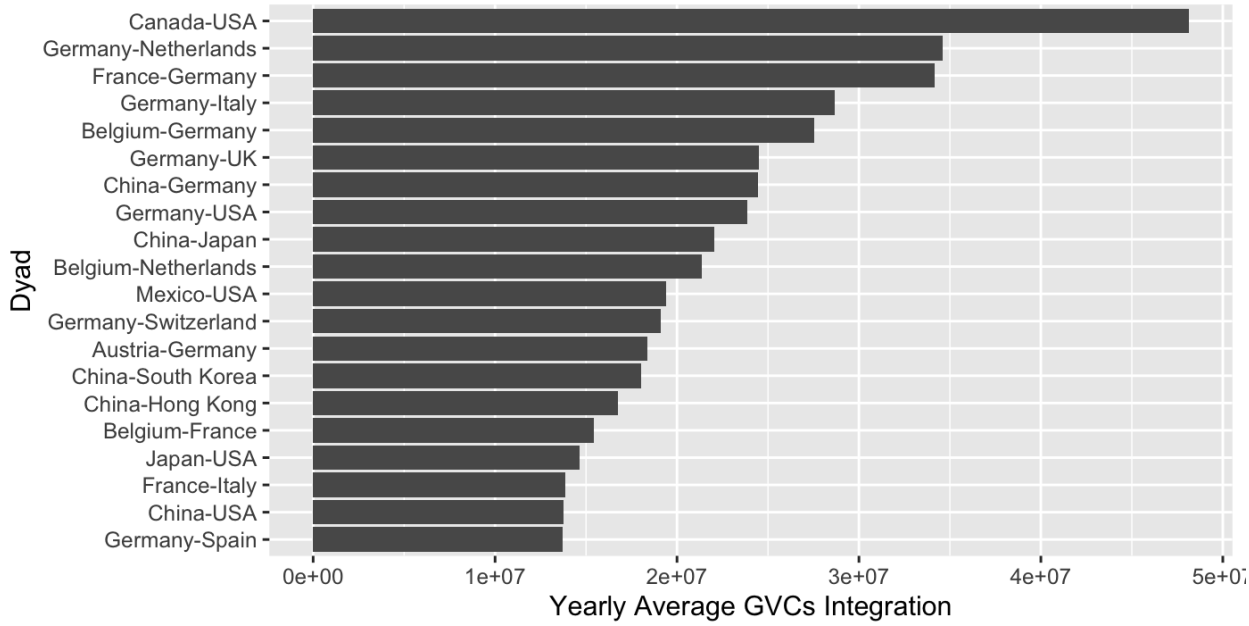

Figure 5: Top 20 Dyads with the Greatest Yearly Average GVCs Integration

detailed information on 2539 BITs, among which 280 have experienced a termination. The type of termination includes expiration (2.9%), replacement by new treaties (33.6%), termination by consent (6.9%), and unilateral termination (56.8%). As all these types reveal that at least one party of the treaty has incentives to discontinue the existing treaties, this paper treats all of them as treaty termination when testing Proposition 2.

Figure 6 shows the top 20 countries with the largest number and share of termination. We can see that Bolivia, Ecuador, India, Indonesia, Italy, Poland, and South Africa all ranked high in both the number and share of BIT termination.

To test which countries are more likely to unilaterally denounce a BIT, I also collected information about the party in a dyad that unilaterally terminates their BITs based on news reports, policy reports, and academic papers.[10] The countries that unilaterally terminate the most are India, Indonesia, Ecuador, Bolivia, South Africa, Italy, Poland, Netherland, and Malta. These are all democratic countries, which is consistent with Proposition 3.

To test Proposition 4 and 5, I obtain data of ISDS disputes from the Investment Dispute

[10]There are four treaties that I did not find information about the terminating party: El Salvador-Nicaragua BIT (1999), France-Israel BIT (1983), Hungary-Israel BIT (1991, Malaysia-Norway BIT (1984). These treaties are terminated from 1995 to 2008, which is relatively early compared to the majority of the termination. They are not included in the analysis given the missing data issue.

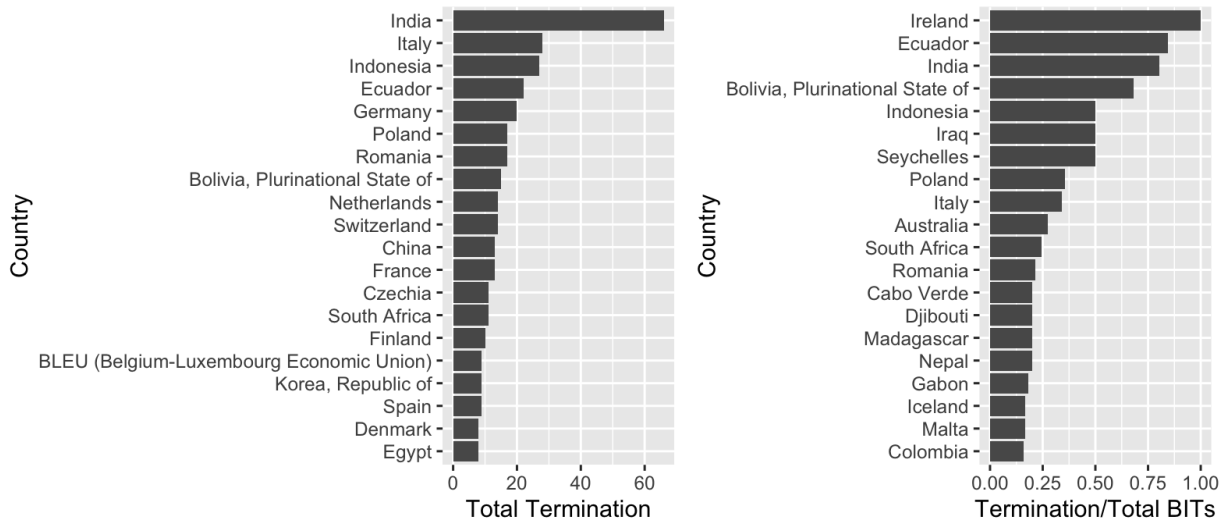

Figure 6: Top 20 Countries with the Largest Number/Share of Termination

Settlement Navigator on the UNCTAD website.[11] To construct the dataset, I use all the dyad-year with a BIT in force as the full sample. Notice that the disputes differentiate between respondent and claimant, so the unit of analysis is at the directed dyad-year level to account for this factor. As 99% of the directed dyad-year has 0 disputes, I create a dummy variable of whether a dispute occurs for a directed dyad in a year to capture the main variation in this variable.

5 Results

5.1 Does GVCs Integration Substitute for BITs?

Given the right-censored nature of the BITs data, this paper uses the Cox proportional hazard model with time-dependent covariates to test how GVCs integration affects BITs termination. To test the substitution relationship between GVCs integration and BITs in Proposition 2, this paper employs a sample of undirected dyad covering years since a BIT is

[11] UNCTAD, Investment Dispute Settlement Navigator, available at https://investmentpolicy.unctad.org/investment-dispute-settlement

in force between the dyad. The regression equation is as follows:

$$h(t|Z_{ij,t-1}) = h_0(t)e^{\beta_1 GVC_{ij,t-1} + Z_{ij,t-1}\Gamma + \theta_i + \lambda_j + \gamma_y}$$

. $h(t|Z_{ij,t-1})$ represents the conditional probability of having a BIT termination at time t, conditional on having survived to time t. e^{β_1} captures the hazard ratio and represents how much more likely a BIT termination will occur given one unit increase in GVCs integration. It should be greater than 1 to lend support for Proposition 2. The key assumption of the Cox proportional hazard model is that hazard rates are proportional across units, which is tested using the Schoenfeld test.[12]

$GVC_{ij,t-1}$ is the dyad-year level measure of GVCs integration between country i and j in time $t-1$ in the logarithmic term. $Z_{ij,t-1}$ is a set of control variables. Following Haftel and Thompson (2018)'s practice, the control variables include gap of GDP per capita between the dyad, gap of the population between the dyad, gap of Polity IV, cumulative disputes of both countries, whether there is a PTA between the dyad, whether any party is a common law country, whether both parties are EU members, and sum of FDI inflows standardized by GDP.[13] θ_i, λ_j, and γ_y capture country i, country j, and year-specific frailty parameters drawn from a Gaussian distribution with mean zero. All the independent variables are lagged for one year to avoid simultaneous bias.

Table 1 shows the results. Column (1) shows the results with a set of basic control variables. Column (2) and (3) add more control variables to the regression. As there is some missing data with the FDI inflow variable, Column (4) replicates the regression in Column (2) using Column (3)'s sample to make sure that the results are not driven by the change in the sample. As we can see, a 100% increase in GVCs integration is correlated with a 21 to 23% increase in the probability of a BIT termination. This is consistent with Proposition 2.

[12]The results of the test are shown in Figure C.1. The frailty terms are not checked in the test.

[13]The data of GDP per capita and population is collected from the World Development Indicators (WDI) of the World Bank (https://datacatalog.worldbank.org/dataset/world-development-indicators). The regime type data is collected from the Center for Systemic Peace (https://www.systemicpeace.org/polityproject.html). The PTA data is collected from Dür et al. (2014). The common law data is collected from LaPorta et al. (2008). The FDI inflow data is from UNCTADstat (https://unctadstat.unctad.org/EN/BulkDownload.html).

Table 1: GVCs Integration and BITs Termination

	Termination of BIT			
	Full sample			Sample in (3)
	(1)	(2)	(3)	(4)
log(1+GVC)	1.232***	1.227***	1.211**	1.216**
	(4.61)	(3.68)	(3.11)	(3.20)
Gap of GDP per capita	1.020	1.036	0.987	0.988
	(0.51)	(0.90)	(-0.29)	(-0.28)
Gap of Population	1.183***	1.264***	1.228**	1.230**
	(2.57)	(3.29)	(2.74)	(2.74)
Gap of Polity IV	0.995	1.005	1.014	1.014
	(-0.36)	(0.36)	(0.83)	(0.82)
Cumulative disputes		0.977	0.988	0.987
		(-0.35)	(-0.19)	(-0.21)
PTA		1.370*	1.555**	1.549**
		(1.82)	(2.28)	(2.26)
Dyad total exports		0.968	0.959	0.958
		(-1.04)	(-1.16)	(-1.18)
Common law		0.940	1.101	1.083
		(-0.24)	(0.35)	(0.29)
Between EU members		2.178**	2.252**	2.220**
		(2.39)	(2.38)	(2.34)
Sum(FDI inflow/GDP)			0.499	
			(-0.65)	
Observations	31,494	31,494	28,584	28,584
Party 1 RE	Y	Y	Y	Y
Party 2 RE	Y	Y	Y	Y
Year RE	Y	Y	Y	Y
AIC	278.41	281.54	257.89	259.34
BIT	254.47	240.49	215.81	220.51

Note: *p<0.1; **p<0.05; ***p<0.01
Coefficients greater than 1 indicate a positive relationship, and vice versa.
Z scores in parentheses.

In terms of the control variables,[14] the gap in population size in the dyad significantly increases the probability of BIT termination. However, difference in regime types does not affect the probability of termination. Interestingly, the results show that cumulative ISDS disputes within the dyad do not increase the probability of termination, which is inconsistent with the finding by Haftel and Thompson (2018). In terms of the PTAs, we can see that trade agreement also increases BITs termination. As both Kim (2021) and Zeng et al. (2021) show that PTAs increase GVCs integration, the positive relationship between the existence of a PTA and BITs termination is consistent with the substitution argument of the paper. The

[14]Given that the results are only correlational, the interpretaion of the coefficients should be taken with a grain of salt.

variable EU members captures a special set of BITs terminations. As is shown in the dispute between the Dutch company *Achmea* and the Slovak Republic, the European Commission realized the incompatibility between the arbitration clause in BITs and the autonomy of EU law and has been urging its member states to terminate their intra-EU BITs voluntarily. The positive coefficient of EU members is consistent with this situation. Lastly, when unilaterlly terminating thier BITs, some states claim that BITs do not increase FDI inflows (Olivet, 2017), suggesting that FDI inflow may reduces the probability of BITs termination. Column (3) in Table 1 controls for the increase in FDI inflows standardized by GDP and find that increase in FDI inflows are not correlated with BITs termination.

5.2 Are Democracies More Likely to Terminate Their BITs?

To examine Proposition 3 about the identity of the country that chooses to terminate their BITs, this section employs a directed dyad-year sample.[15] The regression equation is basically identical to the one in Section 5.1. There are two key differences. First, the event to be examined in this test is whether a country decides to terminate its BIT with the other country in the dyad instead of whether termination occurs between the dyad. To code this variable, I explore the information about the type of BIT termination in the UNCTAD dataset with a supplementary self-collected dataset about the party who unilaterally denounces the treaty. I treat both parties in a dyad that experienced a BIT expiration, replacement by a new treaty, and termination by consent as having the intention to terminate.[16]

Second, instead of focusing on the impact of GVCs integration on BITs termination, I examine the heterogeneous effect of regime type when GVCs integration is high. To provide support for Proposition 3, we should observe a positive coefficient on the interaction between regime type and GVCs integration.

In terms of control variables, since we are interested in the identity of the terminating party, the regression includes a set of variables of state characteristics, including GDP per

[15]This sample doubles the size of the sample in Section 5.1. The key difference is that each party in a dyad has a variable indicating whether it intends to terminate the BIT.

[16]Since the intention to renegotiate is hard to infer, it is unclear how to deal with the case of replacement by a new treaty. I conduct a robust check excluding this category. The result is robust.

capita, total population, cumulative disputes between the dyads, whether a PTA exists between the dyad, whether the state has common law origin, whether the state is an EU member, and FDI inflow standardized by GDP.

Table 2 displays the results. Column (1) shows the results without the interaction term. Column (2) includes the interaction term, from which we can see that the effect of GVCs integration is mostly driven by democracies. Specifically, given the level of GVCs integration, 1 point increase in Polity IV score is correlated with a 5 to 5% increase in the probability of BIT termination. This provides support for Proposition 3.

Table 2: GVCs Integration and Unilateral BITs Termination

	Unilateral Termination of BIT					
	Full sample			Sample in (4)		No EU members
	(1)	(2)	(3)	(4)	(5)	(6)
log(1+GVC)	1.039	0.788	0.837	0.832	0.837	0.688
	t = 0.904	t = -2.548^{**}	z = −1.16	z = −1.11	z = −1.08	z = −1.63
Polity IV	1.339	0.892	0. 775	0.814	0.817	0.799
	t = 7.619^{***}	t = −0.963	z = -1.46	z = −1.09	z = −1.07	z = −0.92
GVC * Polity		1.034	1.036	1.032	1.032	1.050
		t = 3.213^{***}	z= 2.06^{**}	z = 1.68^{*}	z = 1.66^{*}	z = 1.82^{*}
GDP per capita	0.927	0.923	0.995	0.678	0.695	0.563
	t = −1.469	t = −1.560	z = −0.06	z = -2.59^{**}	z = -2.55^{**}	z = -3.34^{***}
Population	2.987	3.035				
	t = 11.848^{***}	t = 11.959^{***}				
Cumulative disputes	0.998	0.991	1.024	1.041	1.041	1.007
	t = −0.046	t = −0.168	z = 0.43	z = 0.74	z = 0.74	z = 0.11
PTA	1.169	1.162	0.986	1.049	1.047	0.847
	t = 0.853	t = 0.822	z = −0.07	z = 0.23	z = 0.23	z= −0.71
Common law	0.362	0.340				
	t = -3.058^{***}	t = -3.242^{***}				
EU members	0.238	0.230				
	t = -4.270^{***}	t = -4.365^{***}				
Sum(FDI inflow/GDP)				0.013		0.069
				z = −0.95		z = −0.45
Country RE	N	N	Y	Y	Y	Y
Year RE	N	N	Y	Y	Y	Y
Observations	63,587	63,587	63,587	60,614	60,614	38,631
R^2	0.006	0.006				
Wald Test	301.430^{***} (df = 8)	312.300^{***} (df = 9)				
AIC			615.39	585.69	585.00	545.23
BIC			592.39	561.39	563.39	522.63

Note: *p<0.1; **p<0.05; ***p<0.01

Coefficients greater than 1 indicate a positive relationship, and vice versa.

The rest columns of Table 2 examine the robustness of the results. Column (3) controls for country and year random effects. Column (4) controls for FDI inflow. Due to the missing value issues in the FDI inflow variable, Column (5) run the same regression as in Column (3) but with the same sample as in Column (4). Lastly, as many BITs termination is due to the termination of intra-EU BITs, the results could be driven by the democratic countries in the EU. Column (6) replicates the regression in Column (5) excluding countries who are EU members. In all these settings, we see that the coefficient estimates of the interaction term between GVC integration and regime type are significantly positive.

5.3 How Does GVCs Integration Affect ISDS Disputes?

To examine how GVCs integration influences ISDS disputes, I construct a dataset of directed dyads with a BIT in force in all years. The OLS regression equation is as follows:

$$Dispute_{ij,t} = \alpha_{ij} + \eta_i + \delta_t + \gamma_i t + \beta_1 GVC_{ij,t-1} + \beta_2 GVC_{ij,t-1} * Polity_{i,t-1} + X_{i,t-1}\Gamma + \epsilon_{ijt}$$

. $Dispute_{ij,t}$ is whether Country i is an ISDS dispute respondent of Country j in year t. $GVC_{ij,t-1}$ is GVCs integration between Country i and j in year $t-1$ in logarithmic term. Its coefficient β_1 should be negative to support Proposition 4. The interaction term between $GVC_{ij,t-1}$ and regime type $Polity_{i,t-1}$ examines Proposition 5. Hence, β_2 should be negative. $X_{i,t-1}$ is a bunch of Country i's characteristics, including GDP per capita, total population, FDI inflow, and number of Country i's BITs.

As GVCs integration increases the intensive margin of the probability of ISDS disputes, it is necessary to control for the FDI inflow from Country j. However, the dyad FDI data may not exist based on my survey of different sources. As a compromise, I use the dyad level trade flow to proxy for GVCs' effect of intensive margin on disputes.[17]

The regression also controls for a bunch of fixed effects and time trends. α_{ij} is the dyad fixed effect, which accounts for time-invariant dyad-specific factors, such as cultural and geographic distance in the dyad. The inclusion of the dyad fixed effect suggests that the

[17]The trade flow data is collected from the UN Comtrade Database (https://comtrade.un.org/data/).

Table 3: GVCs integration and ISDS Disputes

	Whether i is a respondent in a dyad with j					
	(1)	(2)	(3)	(4)	(5)	(6)
GVC	0.004***	0.004***	−0.002	−0.002	−0.002	−0.004*
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Polity IV	−0.0001	0.0003	−0.0001	0.001	−0.0001	
	(0.0004)	(0.001)	(0.0004)	(0.001)	(0.001)	
GVC * Polity IV		−0.00003		−0.0001	−0.00003	−0.00004
		(0.0001)		(0.00005)	(0.00004)	(0.00004)
GDP per capita	0.004	0.003	0.008**	0.007*	−0.015*	
	(0.003)	(0.003)	(0.004)	(0.004)	(0.009)	
Total population	−0.003	−0.003	−0.002	−0.003	−0.032**	
	(0.006)	(0.006)	(0.007)	(0.007)	(0.016)	
FDI inflow	−0.0001	−0.0001	0.00002	0.00001	−0.0001	
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	
log(1+n. of BITs)	0.008***	0.008***	0.009***	0.008***	0.007*	
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	
log(1+dyad trade flow)	−0.00001	−0.00001	−0.0002	−0.0002	−0.00002	−0.0003
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0001)	(0.0002)
Dyad FE	N	N	Y	Y	Y	Y
Respondent FE	Y	Y	Y	Y	Y	N
Year FE	Y	Y	Y	Y	Y	N
Respondent-Year FE	N	N	N	N	N	Y
Respondent-specific time trend	N	N	N	N	Y	Y
Observations	65,865	65,865	65,865	65,865	65,865	65,865
R^2	0.020	0.020	0.081	0.081	0.086	0.128
Adjusted R^2	0.018	0.018	0.051	0.051	0.055	0.059

Note: *p<0.1; **p<0.05; ***p<0.01
Standard errors are clustered at the respondent state level in parentheses.

regression compares the effect of GVCs integration within the dyad. η_i is the respondent fixed effect, which controls for time-invariant respondent characteristics, such as culture and legal origins. δ_t is the year fixed effect. It captures time-specific factors, such as global business cycles. The regression also controls for respondent-year fixed effects to account for time-variant factors in the respondent country, such as regime change. Lastly, $\lambda_i t$ is the country-specific time trend. Given the long time span of the dataset, this term addresses the auto-correlation issue. The standard errors are clustered at the respondent country level.[18]

Table 3 presents the results. Column (1) and (2) examines the effect of GVCs integration

[18]Ideally, the standard errors should be clustered at the dyad level to account for the correlation of the same country in different dyads. However, given the large number of dummies included from different fixed effects, the calculation of dyadic standard errors requires a tremendous computational capacity. With that said, as we can see from the insignificant coefficient estimates in Table 3, how the standard errors are clustered would not substantively change the inference of the results.

and its interaction effect with regime type without controlling for the dyad fixed effect. Column (3) and (4) replicates the regression in Column (1) and (2) including the dyad fixed effect. Column (5) includes the respondent-specific time trend. Lastly, Column (6) adds respondent-year fixed effect.

We can see that the inclusion of the dyad fixed effect dramatically changes the coefficient of GVCs integration. From Column (3), 100% increase in GVCs integration reduces the probability of ISDS disputes by 0.2%, which is of substantive significance given that only 0.8% of the yearly directed dyads has at least one dispute. Column (4) shows that more democratic countries are less likely to be respondents to ISDS disputes. However, neither of the coefficients is statistically significant, which could be due to the zero-inflated nature of this dataset. Despite that, the signs of coefficients of GVCs integration and its interaction with regime type are consistent with Proposition 4 and 5. Therefore, Table 3 provides some weak support for the argument of the paper.

6 Conclusion

What explains the termination of BITs? This paper provides a rationalist explanation to this question: GVCs integration provides an alternative mechanism for states to credibly commit to respect property rights of foreign investors, which renders BITs redundant for states with deep GVCs integration and leads to the termination of BITs. This paper also shows that due to their stronger concern for social welfare, democratic governments are more likely to benefit from the positive spillover effect of GVCs on the domestic economy than autocratic leaders and hence are less likely to impose regulations that harm foreign investors. Such incentive compatibility between democratic government and foreign investors also leads to a higher probability of BITs termination for democracies than autocracies.

The empirical examination supports the argument. First, GVCs integration leads to a higher probability of BITs termination. In addition, when GVCs integration is deep, democracies are more likely to unilaterally denounce BITs than autocracies. This paper also examines how GVCs integration affects ISDS disputes. Despite its statistical insignificance,

the result shows that GVCs integration reduces the probability of being the respondent of an ISDS dispute. Consistent with the model prediction, with deep GVCs integration, democracies are less likely to be respondents of ISDS disputes.

This paper reveals the self-defeating nature of BITs. Created as a property rights protection device, BITs have facilitated the flow of foreign investment into states who desires foreign investment but lacks proper domestic institutions, which gradually builds up GVCs in these states. Once a state's GVCs integration is deep enough, the ISDS mechanism that was once designed to address the incomplete contract nature of BITs only turns out to be costly and redundant, making BITs a suboptimal option for the commitment of property rights protection. In that sense, BITs are destined to be defeated by themselves.

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A Solution to the Model

We start with Step 4: G's choice for the level of regulation r

$$EU_G(r) = \begin{cases} aR(\beta(1-r)K) + B(r) + \lambda q & \text{if } r \leq \tau, k = K \\ (1-\lambda)[aR(\beta(1-r)K) + B(r)] + \lambda[aR(\beta(1-\tau)K) + B(\tau)] + \lambda q & \text{if } r > \tau, k = K \\ aR(0) + B(r) + \lambda q & \text{if } k = 0 \end{cases}$$

FOC w.r.t. r: $-aR'\beta K + B'$, from which we can obtain

$$r^* = \begin{cases} 1 & \text{if } a \leq \dfrac{B'}{R'\beta K} = \tilde{a} \text{ or } k = 0 \\ 0 & \text{if } a > \dfrac{B'}{R'\beta K} \text{ and } k = K \end{cases}$$

Since $a \in [0,1]$, we know that if $\beta \leq \dfrac{B'}{R'K}$, $r^* = 1$. We can discuss the solution in two cases based on the range of β.

A.0.1 Case 1: $\beta \leq \dfrac{B'}{R'K} = \beta^*$

For all G, $r^* = 1$.

For F's investment decision:

$EU_F(k = K|q = 0, \beta \leq \beta^*) = \lambda[W((1-\tau)K) - \kappa K - (1-\tau)K] + (1-\lambda)[-\kappa K]$

$EU_F(k = 0|q = 0, \beta \leq \beta^*) = 0$

$EU_F(k = K|q = 1, \beta \leq \beta^*) = -\kappa K$

$EU_F(k = 0|q = 1, \beta \leq \beta^*) = 0$

$$k^*(q|\beta \leq \beta^*) = \begin{cases} K & \text{if } \lambda \geq \dfrac{\kappa K}{W((1-\tau)K) - (1-\tau)K} = \lambda^*, \text{ and } q = 0 \\ 0 & \text{if } \lambda < \lambda^*, \text{ or } q = 1 \end{cases}$$

Note: Let's assume that $\lambda \geq \lambda^*$, as this is the more interesting case to study.

For G's termination decision:

$$EU_G(q=0, \beta \leq \beta^*) = \lambda[aR(\beta(1-\tau)K) + B(\tau)] + (1-\lambda)[aR(0) + B(1)]$$

$$EU_G(q=1, \beta \leq \beta^*) = aR(0) + B(1) + \lambda$$

$$q^*(a|\beta \leq \beta^*) = \begin{cases} 1 & \text{if } a \leq \dfrac{1 + B(1) - B(\tau)}{R(\beta(1-\tau)K)} \\ 0 & \text{otherwise} \end{cases}$$

Here is the wPBE when GVCs intensity is low $\beta \leq \dfrac{B'}{R'K} = \beta^*$: G's termination decision is

$$q^*(a|\beta \leq \beta^*) = \begin{cases} 1 & \text{if } a \leq \dfrac{1 + B(1) - B(\tau)}{R(\beta(1-\tau)K)} \\ 0 & \text{otherwise} \end{cases}$$

. F's investment decision is

$$k^*(q|\beta \leq \beta^*) = \begin{cases} 0 & \text{if } q = 1 \\ K & \text{if } q = 0 \end{cases}$$

. G sets regulations $r^* = 1$. F's belief about G's type is $a \sim U(d, \dfrac{1 + B(1) - B(\tau)}{R(\beta(1-\tau)K)})$ if $q = 1$ and $d < \dfrac{1 + B(1) - B(\tau)}{R(\beta(1-\tau)K)}$, and $a \sim U(\dfrac{1 + B(1) - B(\tau)}{R(\beta(1-\tau)K)}, 1)$ if $q = 0$

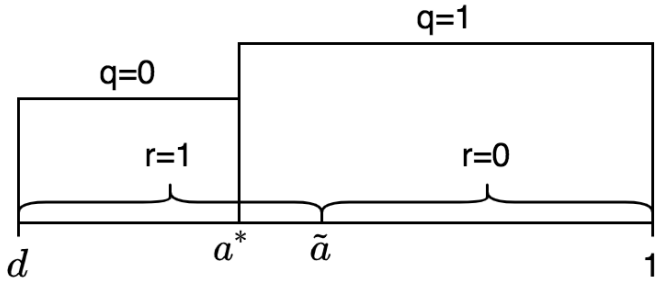
A.0.2 Case 2: $\beta > \dfrac{B'}{R'K}$

Separating Equilibria There are two situations to consider: high type choosing high action and high type choosing low action

Case 1: Consider G's termination strategy $q^*(a|\beta > \beta^*) = \begin{cases} 1 & \text{if } a \geq a^* \\ 0 & \text{if } a < a^* \end{cases}$

Let $\tilde{a} = \dfrac{B'}{R'\beta K}$ be the threshold that G is indifferent between $r = 0$ and $r = 1$.

Case 1.1: Assume that $a^* \leq \tilde{a}$



For F's investment decision:

$$EU_F(k = K|q = 1) = \frac{\tilde{a} - a^*}{1 - a^*}[-\kappa K] + \frac{1 - \tilde{a}}{1 - a^*}[W(K) - \kappa K - K]$$

$$EU_F(k = 0|q = 1) = 0$$

$$EU_F(k = K|q = 0) = -\kappa K < 0$$

$$EU_F(k = 0|q = 0) = 0$$

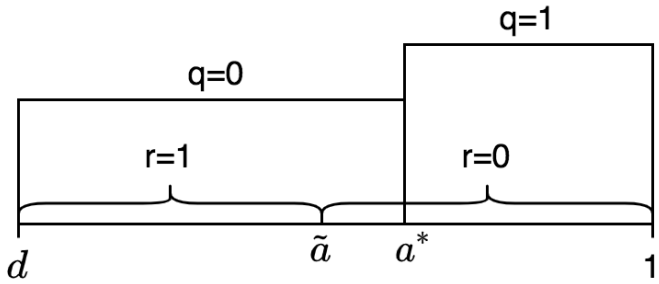
For G's termination decision:

$$EU_G(q = 0|\beta > \beta^*, a < a^*) = aR(0) + B(1)$$

$$EU_G(q = 1|\beta > \beta^*, a^* < a \leq \tilde{a}) = aR(0) + B(1) + \lambda$$

G will not be indifferent at a^*. Contradiction to the cutoff strategy.

Case 1.2: Assume that $a^* > \tilde{a}$



For F's investment decision:

$$EU_F(k = K|q = 1) = W(K) - \kappa K - K > 0$$

$$EU_F(k = 0|q = 1) = 0$$

$$EU_F(k = K|q = 0) = \frac{\tilde{a} - d}{a^* - d}[\lambda(W((1 - \tau)K) - \kappa K - (1 - \tau)K) + (1 - \lambda)(-\kappa K)] +$$

$$\frac{a^* - \tilde{a}}{a^* - d}[W(K) - \kappa K - K] > 0$$

$EU_F(k=0|q=0)=0$

G's investment decision:

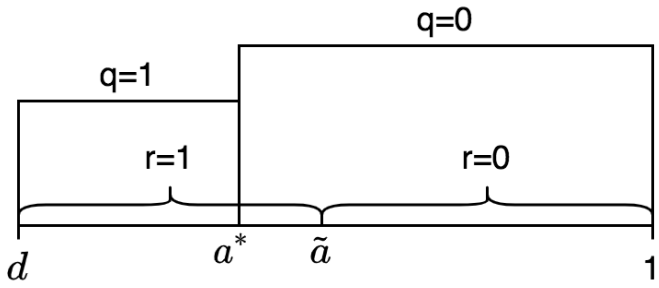
$EU_G(q=1|a>a^*)=aR(\beta K)+B(0)+\lambda$

$EU_G(q=0|\tilde{a}\le a<a^*)=aR(\beta K)+B(0)$

Hence, G chooses $q=1$, suggesting that $k^*(q,d)=K$ and $q^*(a,d|\beta>\beta^*)=1$. This contradicts G's strategy $q^*(a|\beta>\beta^*)=\begin{cases}1 & \text{if } a\ge a^*\\ 0 & \text{if } a<a^*\end{cases}$.

Case 2: Consider G's termination strategy $q^*(a|\beta>\beta^*)=\begin{cases}1 & \text{if } a\le a^*\\ 0 & \text{if } a>a^*\end{cases}$

Case 2.1: Assume that $a^*\le\tilde{a}$



For F's investment decision:

$EU_F(k=K|q=1)=-\kappa K<0$

$EU_F(k=K|q=0)=\frac{\tilde{a}-a^*}{1-a^*}[\lambda(W(1-\tau)K-\kappa K-(1-\tau)K)+(1-\lambda)(-\kappa K)]+\frac{1-\tilde{a}}{1-a^*}[W(K)-\kappa K-K]$

G is indifferent between $q=0$ and $q=1$ when $a=a^*$: $EU_G(q=1|a^*)=EU_G(q=0|a^*)$

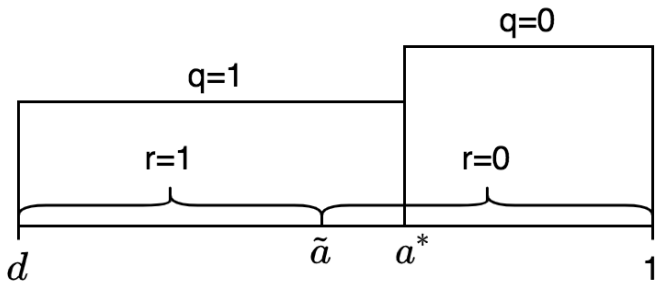
$EU_G(q=1|a<a^*)=aR(0)+B(1)+\lambda$

$EU_G(q=0|a^*<a<\tilde{a})=\lambda[aR(\beta(1-\tau)K)+B(\tau)]+(1-\lambda)[aR(0)+B(1)]$

$a\le\frac{1+B(1)-B(\tau)}{R(\beta(1-\tau)K)}=a^*$

Meanwhile, we need to make sure that $a^* < \tilde{a}$. Using the functional form, $a^* = \frac{1+b(1-\tau)}{m\beta(1-\tau)K}$ and $\tilde{a} = \frac{b}{m\beta K}$, suggesting that $a^* > \tilde{a}$. Contradiction.

Case 2.2: Assume that $a^* > \tilde{a}$



For F's investment decision:

$$EU_F(k = K|q = 1) = \frac{\tilde{a} - d}{a^* - d}(-\kappa K) + \frac{a^* - \tilde{a}}{a^* - d}(W(K) - \kappa K - K)$$
$$EU_F(k = K|q = 0) = W(K) - \kappa K - K$$

For G's termination decision:

$$EU_G(q = 0|a > a^*) = aR(\beta K) + B(0)$$
$$EU_G(q = 1|\tilde{a} \leq a < a^*) = \begin{cases} aR(\beta K) + B(0) + \lambda & \text{if } EU_F(k = K|q = 1) \geq 0 \\ aR(0) + B(1) + \lambda & \text{if } EU_F(k = K|q = 1) < 0 \end{cases}$$

Case a): $EU_F(k = K|q = 1) < 0 \rightarrow d < \tilde{a}(1 - \frac{W(K) - \kappa K - K}{b\kappa K}\lambda) = d^*$

We have $a \leq \frac{\lambda + B(1)}{R(\beta K)} = a^*$.

To make sure that $a^* > \tilde{a}$, we use the functional form of $R(\cdot)$ and $B(\cdot)$ and find that $a^* = \frac{b+\lambda}{m\beta K} > \tilde{a} = \frac{b}{m\beta K}$.

Case b): $EU_F(k = K|q = 1) \geq 0 \rightarrow d \geq \tilde{a}(1 - \frac{W(K) - \kappa K - K}{b\kappa K}\lambda)$

F chooses $k = K$ when $q = 1$. G chooses $q = 1$. This contradicts G's separating strategy

$$q^*(a|\beta > \beta^*) = \begin{cases} 1 & \text{if } a \leq a^* \\ & \\ 0 & \text{if } a > a^* \end{cases}.$$

Therefore, when $d < d^* = \tilde{a}(1 - \frac{W(K) - \kappa K - K}{b\kappa K}\lambda)$, we have $k^*(q|\beta > \beta^*, d < d^*) = \begin{cases} K & \text{if } q = 0 \\ 0 & \text{if } q = 1 \end{cases}$ and $q^*(a|\beta > \beta^*, d < d^*) = \begin{cases} 1 & \text{if } a \leq \frac{\lambda + B(1)}{R(\beta K)} \\ 0 & \text{otherwise} \end{cases}$

Here is the wPBE when GVCs intensity is high $\beta > \frac{B'}{R'K} = \beta^*$: $d < d^* = \tilde{a}(1 - \frac{W(K) - \kappa K - K}{b\kappa K}\lambda)$, G's termination decision is

$$q^*(a|\beta > \beta^*, d < d^*) = \begin{cases} 1 & \text{if } a \leq \frac{\lambda + B(1)}{R(\beta K)} \\ 0 & \text{otherwise} \end{cases}$$

. F's investment decision is

$$k^*(q|\beta > \beta^*, d < d^*) = \begin{cases} K & \text{if } q = 0 \\ 0 & \text{if } q = 1 \end{cases}$$

. G sets regulations

$$r^* = \begin{cases} 1 & \text{if } a \leq \frac{B'}{R'\beta K} \\ 0 & \text{if } a > \frac{B'}{R'\beta K} \end{cases}$$

. F's belief about G's type is $a \sim U(d, \frac{\lambda + B(1)}{R(\beta K)})$ if $q = 1$, and $a \sim U(\frac{\lambda + B(1)}{R(\beta K)}, 1)$ if $q = 0$.

Pooling Equilibria There are two cases to consider: G always terminates and G never terminates.

Case 1: $q^*(a, d|\beta > \beta^*) = 1$ and $k^*(q, d|\beta > \beta^*) = K$

$EU_G(q = 1|\beta > \beta^*) = aR(\beta(1 - r^*)K)) + B(r^*) + \lambda$

$EU_G(q=0|\beta>\beta^*) = aR(\beta(1-r^*)K)) + B(r^*)$

Hence, $EU_G(q=1|\beta>\beta^*) > EU_G(q=0|\beta>\beta^*)$

We need $EU_F(k=K|q=1) > EU_F(k=K|q=0)$.

Case 1.1: $d \leq \tilde{a}$

$$EU_F(k=K|q=1) = \frac{\tilde{a}-d}{1-d}(-\kappa K) + \frac{1-\tilde{a}}{1-d}(W(K)-\kappa K-K) \geq 0$$

$$\rightarrow d \geq \frac{W(K)-K}{\kappa K}\tilde{a} - \frac{W(K)-\kappa K-K}{\kappa K}$$

$$EU_F(k=K|q=0) = \frac{\tilde{a}-d}{1-d}[\lambda(W(1-\tau)K)-\kappa K-(1-\tau)K] + \frac{1-\tilde{a}}{1-d}(W(K)-\kappa K-K) > 0$$

$\rightarrow k^*(q=0) = K$

When $k^*(q)=0$, we have $EU_F(k=K|q=1) < EU_F(k=0|q=1)$.

Case 1.2: $d > \tilde{a}$

$EU_F(k=K|q=1) = W(K)-\kappa K-K > 0$

$EU_F(k=K|q=0) = W(K)-\kappa K-K > 0$

Therefore, to support the pooling equilibrium $q^*(a,d|\beta>\beta^*)=1$, we need $d \geq \frac{W(K)-K}{\kappa K}\tilde{a} - \frac{W(K)-\kappa K-K}{\kappa K}$.

Here is the wPBE: when $d \geq \frac{W(K)-K}{\kappa K}\tilde{a} - \frac{W(K)-\kappa K-K}{\kappa K} = d^{**}$, G's termination decision is

$$q^*(a|\beta>\beta^*, d>d^{**}) = 1$$

. F's investment decision is

$$k^*(q|\beta>\beta^*, d>d^{**}) = K$$

. G sets regulations

$$r^* = \begin{cases} 1 & \text{if } a \leq \dfrac{B'}{R'\beta K} \\ 0 & \text{if } a > \dfrac{B'}{R'\beta K} \end{cases}$$

. F's belief about G's type is $a \sim U(d,1)$.

Case 2: $q^*(a,d|\beta>\beta^*)=1$ and $k^*(q,d|\beta>\beta^*)=\begin{cases}0 & q=1\\ K & q=0\end{cases}$

$EU_G(q=0|\beta>\beta^*,d)=aR(\beta(1-r^*)K)+B(r^*)$

$EU_G(q=1|\beta>\beta^*,d)=aR(0)+B(1)+\lambda$

To make sure that $aR(0)+B(1)+\lambda>aR(\beta(1-r^*)K))+B(r^*)$, we consider two cases.

Case 2.1: $r^*=1\rightarrow a\leq\tilde{a}$

We cannot get a solution that G always choose $q=1$ despite its type.

Case 2.2: $r^*=0\rightarrow a>\tilde{a}$

We cannot get a solution that G always choose $q=1$ despite its type.

No pooling equilibrium is supported in this case.

Case 3: $q^*(a,d|\beta>\beta^*)=0$ and $k^*(q,d|\beta>\beta^*)=\begin{cases}0 & q=1\\ K & q=0\end{cases}$

$EU_G(q=0|\beta>\beta^*,d)=aR(\beta(1-r^*)K)+B(r^*)$

$EU_G(q=1|\beta>\beta^*,d)=aR(0)+B(1)+\lambda$

To make sure that $aR(\beta(1-r^*)K))+B(r^*)\geq aR(0)+B(1)+\lambda$, we need $r^*=0$, suggesting that $a\geq\tilde{a}$. Hence, $d\geq\tilde{a}$.

$EU_F(q=1|\beta>\beta^*,d>\tilde{a})=W(K)-\kappa K-K>0$

$EU_F(q=0|\beta>\beta^*,d>\tilde{a})=W(K)-\kappa K-K>0$

$\rightarrow F$'s strategy $k^*(q,d|\beta>\beta^*)=\begin{cases}0 & q=1\\ K & q=0\end{cases}$ cannot be supported.

Figure A.1 displays the equilibria and their corresponding parameter space on the graph. The pink shade captures the pooling equilibrium, while the blue shade captures the separating equilibrium. The purple shade is the parameter space where both separating and pooling equilibrium can apply.

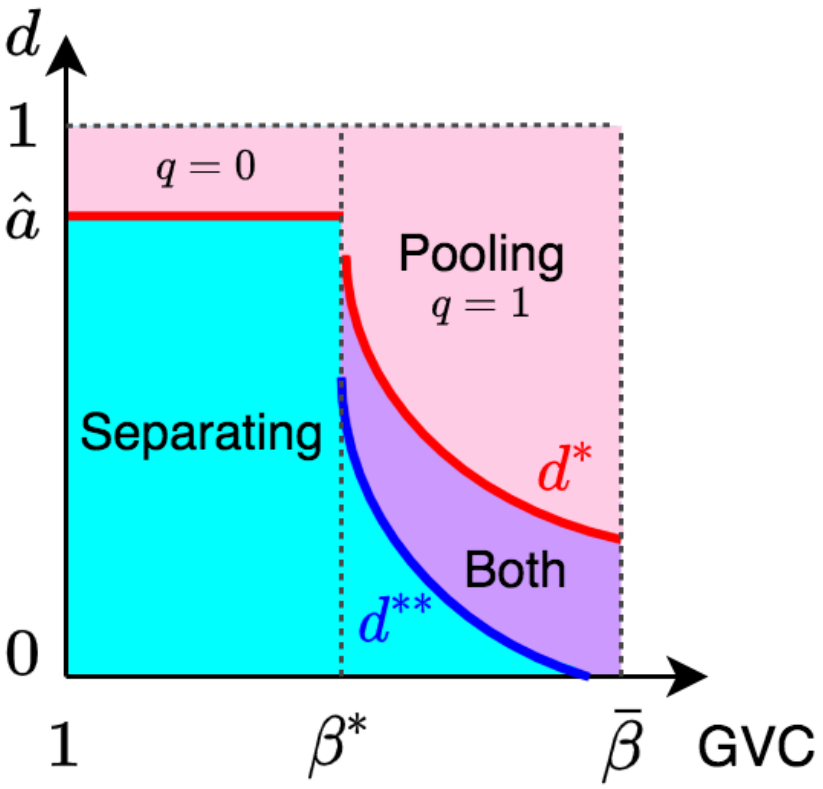


Figure A.1: Equilibria and Parameter Space

B Measuring Global Value Chains

Table B.1: A Summary of GVC Measure and Data Source

Measure	Unit of Analysis	Data Source	Paper
Value Added in Trade: backward, forward	Country dyad	UNCTAD-Eora TiVA	Zeng et al. (2021), Weldzius (2021)
Trade in intermediate goods	Dyad-industry	UN Comtrade	Moehlecke et al. (2019)
Related-party trade	Firm	Activities of US Multinational Enterprises (BEA)	Jensen et al. (2015)
	Industry	Benchmark Input-Output Table (BEA) US Census Bureau: related-party trade	Osgood (2018)

Table 1. Efforts to map GVCs (status as of August 2019)

Project	Institution	Data sources	Countries	Industries	Years	Comments
UNCTAD-Eora GVC Database	UNCTAD/Eora	National Supply-Use and I-O tables, and I-O tables from Eurostat, IDE-JETRO and OECD	189	26-500 depending on the country	1990–2015 (nowcast for 2016, 2017 and 2018)	Meta database drawing together many sources and interpolating missing points to provide broad, consistent coverage
Trade in Value Added (TiVA) dataset	OECD	National I-O tables	64	34	2005–2015 (projections 2016)	Information on all OECD countries, and 27 non-member economies (including all G20 countries)
World Input-Output Database (WIOD): 2016 Release	Consortium of 11 institutions, EU funded	National Supply-Use tables	43	56	2000–2014	Based on official national account statistics; uses end-use classification to allocate flows across partners and countries
Other multi-region input-output databases						
EXIOBASE	EU-based consortium, exiobase.eu	National supply-use tables	44+5	200	1995–2013	Covers 44 countries plus five rest-of-world regions
ADB Multi-Region Input-Output Database (ADB MRIO)	Asian Development Bank	An extension of WIOD which includes 5 additional Asian economies (Bangladesh, Malaysia, Philippines, Thailand and Viet Nam)	45	35	2000, 2005–2008, 2011	The information for the 5 additional Asian countries are estimates methodically produced to assist research and analysis, not official statistics
Global Trade Analysis Project (GTAP)	Purdue University	Contributions from individual researchers and organizations	121 countries plus 20 regions	65	2004, 2007, 2011, 2014	Includes data on areas such as energy volumes, land use, carbon dioxide emissions and international migration.
South American Input-Output table	ECLAC and Institute of Applied Economic Research (IPEA) from Brazil	National I-O tables	10	40	2005	Based on official information from National Accounts

Source: UNCTAD.

Figure 1. Structure of an MRIO Table

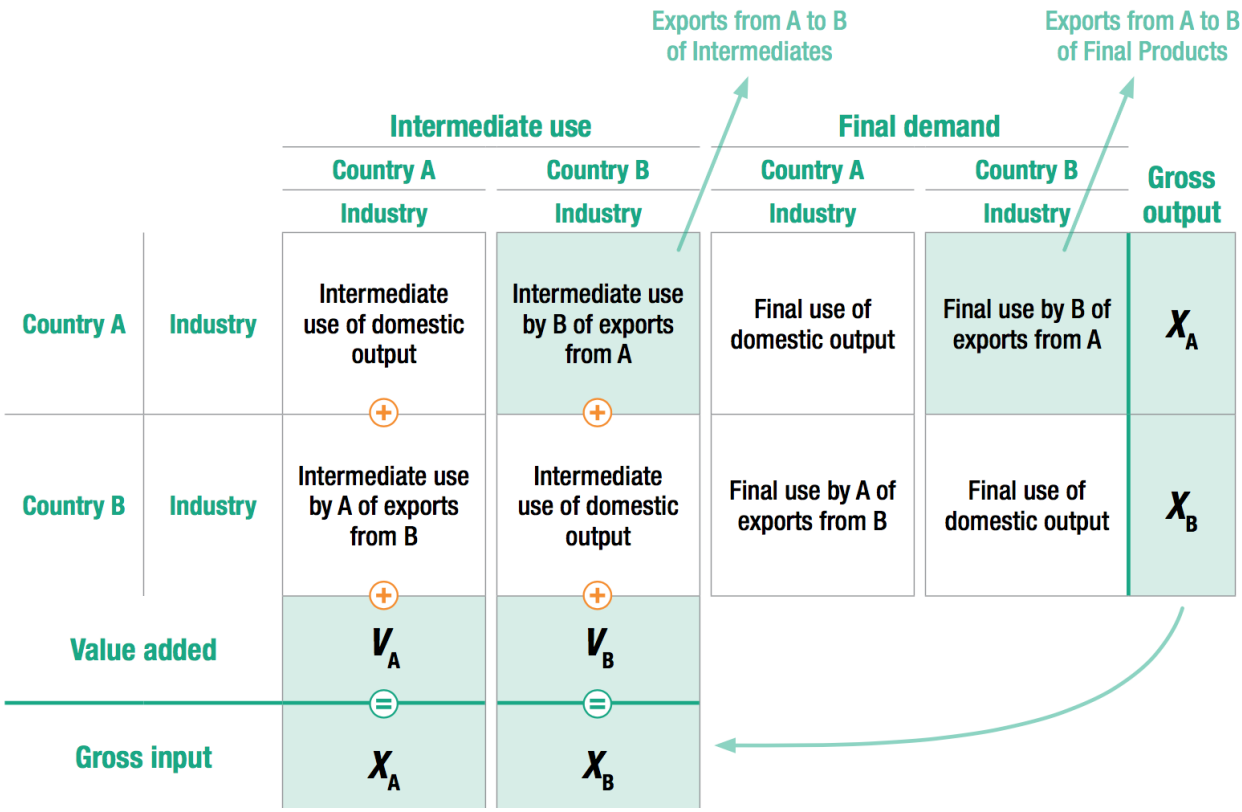


Figure 2. The matrix of the value-added content of trade

		DVA	DVX					
		Country 1	Country 2	Country 3	...	Country K	...	Country N
	Country 1	F^{11}	F^{12}	F^{13}	...	F^{1K}	...	F^{1N}
FVA	Country 2	F^{21}	F^{22}	F^{23}	...	F^{2K}	...	F^{2N}
FVA	Country 3	F^{31}	F^{32}	F^{33}	...	F^{3K}	...	F^{3N}
FVA	...	...	...	...	...	...	...	...
FVA	Country K	F^{K1}	F^{K2}	F^{K3}	...	F^{KK}	...	F^{KN}
FVA	...	...	...	...	...	...	...	...
FVA	Country N	F^{N1}	F^{N2}	F^{N3}	...	F^{NK}	...	F^{NN}

C

Figure C.1: Results for Schonfeld Test