The Effects of Political Institutions on the Extensive and Intensive Margins of Trade*

In Song Kim† John Londregan‡ Marc Ratkovic§

February 12, 2019

Abstract

We present a model of political networks that integrates both the choice of trade partners (the extensive margin) and trade volumes (the intensive margin). Our model predicts that regimes secure in their survival, including democracies as well as some consolidated authoritarian regimes, will trade more on the extensive margin than vulnerable autocracies, which will block trade in products that would expand interpersonal contact among their citizens. We then apply a two-stage Bayesian LASSO estimator to detailed measures of institutional features and highly disaggregated product-level trade data encompassing 131 countries over a half century. Consistent with our model, we find that (a) political institutions matter for the extensive margin of trade but not for the intensive margin and (b) the effects of political institutions on the extensive margin of trade vary across products, falling most heavily on goods whose marketing involves extensive interpersonal contact.

Key Words: extensive and intensive margins of trade, differentiated products, polity, democracy, international trade, variable selection, machine learning, LASSO

*We thank Avinash Dixit, Nikhar Gaikwad, Benjamin E. Goldsmith, Joanne Gowa, Robert Gulotty, Adeline Lo, Edward Mansfield, Kyle Marquardt, Helen Milner, Walter Mebane, Eliza Riley, and Rachel Wellhausen for helpful comments. We also thank the seminar and conference participants in the International Relations Speaker Series at the University of Texas at Austin, the 2015 Asian Political Methodology Meetings, the International Political Economy Society (IPES), the Midwest Political Science Association, and the V-Dem institue, Gothenburg, Sweden. The editor and the two anonymous reviewers provided helpful comments that have significantly improved this article.

†Associate Professor, Department of Political Science, Massachusetts Institute of Technology, Cambridge, MA, 02139. Email: insong@mit.EDU, URL: http://web.mit.edu/insong/www/

‡Professor of Politics and International Affairs, Woodrow Wilson School, Princeton University, Princeton NJ 08544. Phone: 609-258-4854, Email: jbl@princeton.edu

§Assistant Professor, Department of Politics, Princeton University, Princeton NJ 08544. Phone: 608-658-9665, Email: ratkovic@princeton.edu, URL: http://www.princeton.edu/∼ratkovic

1 Introduction

Countries' engagement with international trade includes both their choice of trading partners—the extensive margin[1]—and the intensity with which they and their trading partners transact—the intensive margin. Any evaluation of the impact of political institutions on trade must consider their effects on both margins. On the extensive margin, democracies are more likely to trade with one another (Bliss and Russett, 1998), and countries with stable domestic property rights and contractual institutions are more likely to trade products with "relation-specific" inputs than other types of products (Levchenko, 2007; Nunn and Trefler, 2014). On the intensive margin, some have argued that legislative constraints allow an executive to make a credible commitment to liberalization and mutual reduction in trade barriers (Mansfield, Milner, and Rosendorff, 2000, 2002), while democracy favors the owners of domestically abundant factors (Milner and Kubota, 2005). In contrast, others argue that the large number of veto players and greater fragmentation of political authority in democracies make them more responsive than autocracies to protectionist demands (Frieden and Rogowski, 1996; Henisz, 2000; Henisz and Mansfield, 2006; Mansfield, Milner, and Pevehouse, 2007), raising tariffs and erecting non-tariff barriers to protect domestic interests (Kono, 2006, 2008; Tavares, 2008).

Yet there are few studies that simultaneously consider both the extensive and intensive margins when evaluating the effects of political institutions on international trade. The "gravity" model of international trade focuses exclusively on bilateral trade volumes, i.e., the intensive margin. Even when the distinction between the extensive and intensive margins is made explicit (Chaney, 2008; Helpman, Melitz, and Rubinstein, 2008; Manova, 2013), a lack of attention to *political* determinants of international trade on the two margins pervades economic models ranging from the "old" to the "new" trade theories (Arkolakis, Costinot, and Rodríguez-Clare, 2012, 98). Indeed, the vast majority of empirical studies of bilateral trade in international political economy examine institutional effects on trade *excluding* country pairs that do not trade (e.g., Mansfield, Milner, and Rosendorff, 2000; Tomz, Goldstein, and Rivers, 2007), a practice that opens the door to selection bias in the analysis of the intensive margin.[2]

[1] Others have defined extensive margin as the number of traded products or the number of firms that trade if researchers conduct country-level analysis. Our definition follows from product-level analysis in line with Broda and Weinstein (2006).

[2] See Dutt, Mihov, and Van Zandt (2013) who find that WTO membership impacts trade "almost exclusively"

A central contribution of this paper is to develop a theoretical framework that encompasses *both* the extensive *and* intensive margins of trade. We incorporate the standard domestic market structure with the CES (constant elasticity of substitution) demand into a game theoretic network model to investigate the dictator's dilemma that autocrats face towards international trade. On the one hand, opening their country to trade generates economic benefits. On the other hand, these pecuniary gains come at a political cost: trade entails increased cross-border interactions and communication among the citizenry (Chaney, 2014), potentially facilitating rebellion (Erickson, 1981; Russett and Oneal, 2000). However, once the connections are made, the dictator seeks to extract the full economic benefit. Hence our model predicts that political calculations will affect the extensive margin of trade but not the intensive margin. It also shows that the government's ambivalence toward trade stems from the threat of being overthrown, and therefore the political influences on extensive margin trade hinge upon regime security rather than on democracy *per se* (Egorov, Guriev, and Sonin, 2009; Hollyer, Rosendorff, and Vreeland, 2011; Lorentzen, 2014; Shadmehr and Bernhardt, 2015). Our theoretical analysis calls for a broader consideration of domestic political externalities of international trade beyond the conventional focus on its distributional consequences (e.g., Rogowski, 1987; Hiscox, 2002). In contrast with models that emphasize the preferences of the mass public driving domestic political considerations, our model draws attention to freedom of association, information flows, and their impact on regime security.

To assess our predictions, we analyze an extensive data set, encompassing fine-grained annual dyad level trade data for 131 countries, covering a time span of 51 years on 450 SITC (Standard International Trade Classification) 4-digit products. Including directed dyads with no trade, we analyze about 390 million observations of product-level trade.[3] Our covariates include standard elements of the canonical "gravity" model of trade, a battery of institutional variables, and component variables of the *Polity IV* measure (Marshall, Gurr, and Jaggers, 2010). We capture the density of the networks inherent to trade in various goods using the tripartite taxonomy developed by Rauch (1999). Furthermore, by working with data disaggregated to the 4-digit product level, we do not rely on the common assumption that demand elasticities and political effects are the same across products, an assumption implicit in the practice of analyzing dyadic trade flows aggregated across all products.

on the extensive margin.

[3]An example of a 4-digit product is SITC 6532: "fabrics, woven, of synthetic staple fibers, containing 85% or more by weight of such fibers (other than chenille fabrics)."

Our estimator encompasses both margins of trade using a sparse Bayesian version of the "type-two Tobit model" (Amemiya, 1984, 3). Our sparse estimator is designed to cope with the high levels of collinearity endemic to empirical studies in international political economy. Indeed, numerous factors that might affect bilateral trade flows are also correlated with political institutions and with each other. A partial list includes economic size (Tinbergen et al., 1962); preferential trading blocks (Frankel, Stein, and Wei, 1997); membership in GATT/WTO (Rose, 2004; Goldstein, Rivers, and Tomz, 2007); other domestic institutions such as contracting institutions (Nunn and Trefler, 2014); security alliances (Gowa, 1989); trade resistance (Anderson, 1979); and multilateral resistance (Anderson and Wincoop, 2003), to say nothing of importer-, exporter-, year-, and even dyad-specific effects. In order to select from a set of highly collinear covariates, our estimator incorporates recent advances in variable selection methods (Ratkovic and Tingley, 2017).

Our empirical analysis yields results consistent with our theory. First, we show that political variables affect the existence of trade at the extensive margin, but do not impact trade flows in the intensive margin. Among the significant political variables here is regime security. Second, we find political variables have a greater impact on products whose trade entails more extensive interpersonal contact. Third, we show that unpacking the widely used portmanteau *Polity IV* measure into its component parts significantly improves the fit of the proposed estimator to the data. This is because only some polity components impact trade. Finally, our analysis also highlights the importance of working with fine-grained product data, as the effects of our explanatory variables show remarkable variation across product categories.

The paper progresses as follows. In the next section, we present our formal model. Section 3 describes our data and methodology. We present our empirical findings in Section 4, and the final section concludes. The bilateral product-level trade dataset, all the estimates for each product, and their posterior distributions will be made publicly available.

2 Modeling Political Institutions and the Margins of Trade

We present a network model that isolates the effects of political institutions on the two margins of trade. Motivated by stylized facts in the literature (Section 2.1), we present a network model relating domestic market structure to political networks (Section 2.2). Finally, we characterize equilibrium behavior on the extensive margin (Section 2.3) and intensive margin (Section 2.4).

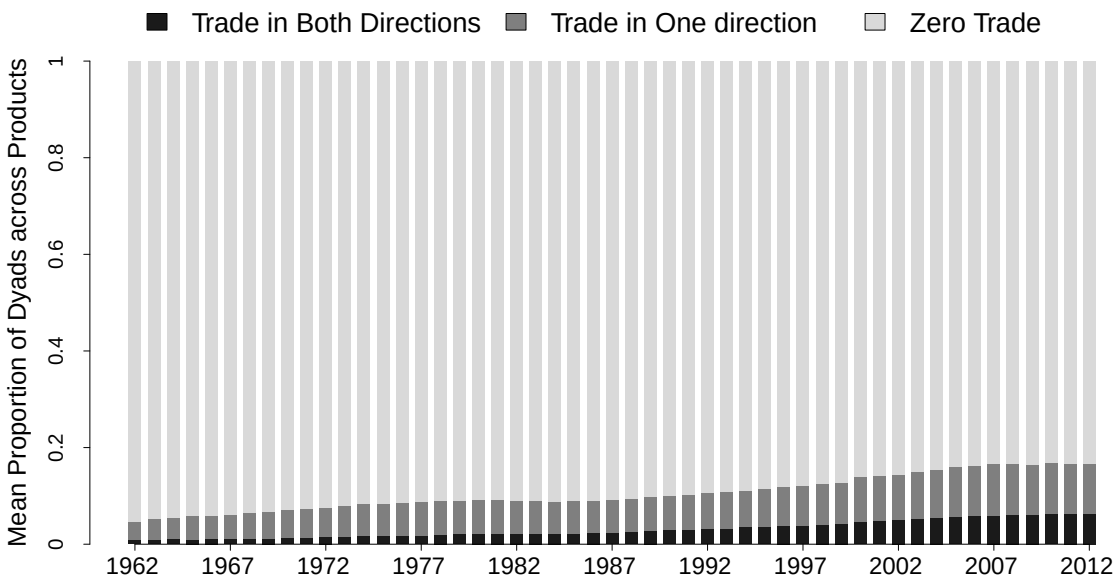


Figure 1: **Distribution of Dyads Based on the Direction of Trades:** This figure demonstrates the prevalence of zero trade across 450 SITC 4-digit products and 131 countries. On average, more than 80% of dyads do not trade for any given product.

2.1 Motivation

Our model is motivated by three consistent empirical findings in the literature. First, the vast majority of countries do not trade in a given product, highlighting the centrality of the extensive margin. Second, among dyads that do trade, there is significant heterogeneity across products. Third, for many goods, networks of interpersonal contacts are crucial to facilitating trade.

A striking feature of the trade data is the prevalence of zero trade flows. More than half of country pairs do not engage in any trade at all (Helpman, Melitz, and Rubinstein, 2008). Among country pairs that do engage in trade, the products that a given pair trades are usually a relatively small subset of products that are traded globally. Figure 1 shows just how prominent zero trade is at the product-level.[4] We group each country pair for a given product into one of three categories: (1) each country exports the product to the other, (2) only one country exports to the other, and (3) neither country in the dyad exports the given product to its partner. Despite the trend of increasing numbers of trading partners, in no year does the fraction of actively trading product-specific dyads exceed 20%. Most dyadic trade that does take place is unidirectional.

Pervasive product-level heterogeneity (Schott, 2004; Eaton, Kortum, and Kramarz, 2011) in

[4]We use the fine-grained SITC 4-digit product level, as described in Section 3.1.

both extensive and intensive margins of trade constitutes a second key feature of the data on international trade. This heterogeneity exists because goods differ in demand elasticities, transportation costs, and the concentration of production and demand. Moreover, the relative simplicity of trade networks in primary products stands in stark contrast with the complex global production networks that characterize commerce in manufactured goods (Antràs, Chor, Fally et al., 2012; Antràs, 2015).

A third key feature of cross border commerce is its dependence on networks of personal contacts (Rauch, 1999; Garmendia, Llano, Minondo et al., 2012). Specifically, networks of informal contacts convey information about trading opportunities, market structure, and previous violations of trade-related contracts—information that makes it possible for producers to overcome trade barriers (Greif, 1989; Greif, Milgrom, and Weingast, 1994; Nunn, 2007). Moreover, the system of informal contacts has various spillover effects, such as transfers of technology and learning through increased interaction (Pavcnik, 2002; Blalock and Gertler, 2004). As noted by Rauch and Trindade (2002, p.116), actors engaged in international trade will serve as "nodes for information exchange."

These information transfers do not take place in a political vacuum. Russett and Oneal (2000) note that trade exposes citizens to the ideas and perspectives of foreign citizens. Moreover, trade networks facilitate direct contact, which is important for the formation of anti-government conspiracies (Erickson, 1981). Metternich, Dorff, Gallop et al. (2013) highlight the importance of network structures in the emergence of violence, while Larson and Lewis (2018) find that rebel groups can re-purpose co-ethnic networks. In other words, foreign trade can have domestic political consequences.

2.2 The Model

Our model encompasses two regime archetypes: an "open" society and an "autocratic" society. In the open society, each individual is free to communicate and exchange with anyone else, whereas in the autocratic society, all communication and trade must pass through the autocrat. The autocrat's power comes at a price: the people he exploits can, at some cost to themselves, rebel against him.

Networks and Insurrection. We begin by illustrating the workings of our model with Figure 2. Communication links are represented by solid lines. The lefthand side depicts an autocracy:

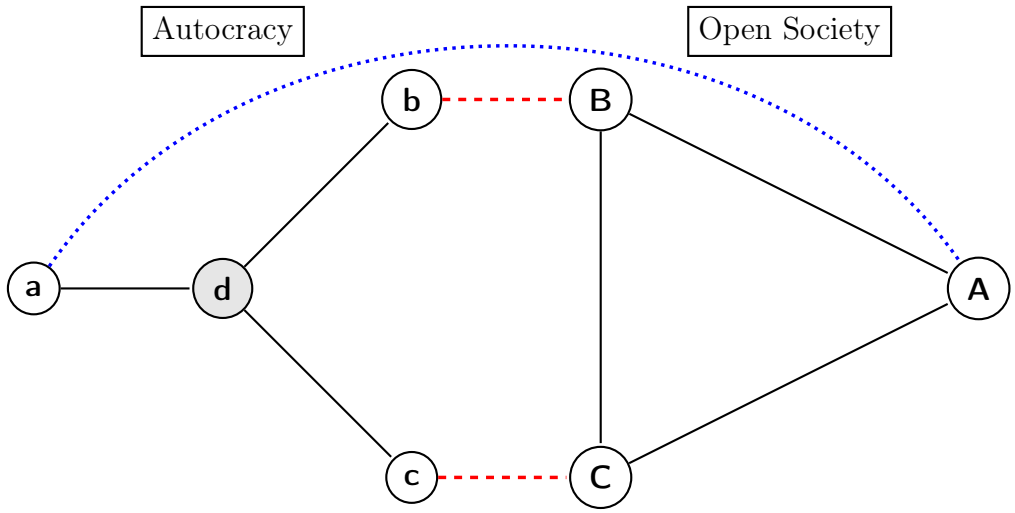


Figure 2: **Political Networks and International Trade.** This figure describes the network structure of our model for an autocracy (left) and an open society (right). In autocratic society, actors (a, b, c) are linked through the autocrat (d), making confidential communication impossible. In contrast, in an open society, citizens (A, B, C) communicate directly with each other. The red dashed line and the blue dotted line represent potential spillover effects of trade between the two nations.

actors are arranged in a star-shaped network structure with the dictator, d, in the middle and the three citizens, a, b, and c, connected to the dictator but disconnected from each other. This shape is intended to capture an autocrat who has inserted himself into society and saturated the environment with spies, informants, and police so that no communication is secure from the possibility of being reported to the authorities. In this setting, potential rebels are unable to communicate confidentially with each other, as the autocrat has effective control of political contacts (e.g., King, Pan, and Roberts, 2013). The righthand side of Figure 2 portrays an open society with three citizens, A, B, and C, each of whom can communicate directly with both of the others without being monitored or interfered with by a third party.

Suppose that a society of n individuals is divided into T components, where all individuals in a particular component are connected by a series of links that exclude the autocrat's node, while no such connection exists between two individuals in distinct components (Jackson, 2010). We index the components by $t \in \{1, ..., T\}$, with a fraction s_t individuals in the tth component. We measure interconnectivity with the parameter θ, which calibrates[5] the extent to which society is

[5]This coincides with the index of concentration propounded by Herfindahl (1950).

interlaced with networks that bypass the autocrat:

$$\theta = \sum_{t=1}^{T} s_t^2. \tag{1}$$

In the extreme, if society is fragmented into a star network, with each individual isolated in her own component, the network has n components, with $s_t = \frac{1}{n}$ each, so that $\theta = \frac{1}{n}$. At the other extreme, if all of society is joined into a single component as in a free society, then $\theta = 1$. Intermediate levels of interconnectivity correspond to indices on the interval $(\frac{1}{n}, 1)$, with higher values corresponding to greater interconnectivity. For the autocracy on the lefthand side of Figure 2, $\theta = \frac{1}{3}$, while for the open society on the right, $\theta = 1$.

Rebels are more effective when they are joined in a shared network, and also when the monitoring technologies (e.g., secret police) are inefficient. We thus model the probability of success in overthrowing the government as given by what we might call the Tullock-Rousseau contest function (Hirschleifer, 1989; Skaperdas, 1996; Rousseau, 1963):

$$\Pr\left(\text{Rebel Success}\right) = \frac{\rho\theta}{1+\rho\theta}, \tag{2}$$

where $\theta > 0$ is the networking measure given in expression (1), while $\rho > 0$ is an inverse measure of the effectiveness of the autocrat's security apparatus. Consulting equation (2), we see that $\Pr\left(\text{Rebel Success}\right)$ is increasing in both θ and ρ.[6]

The logic of our model can be described by Jean-Jacques Rousseau's characterization that in a maximally fragmented society, the effectiveness of rebels "evaporates and is lost as they become spread out like the effect of gunpowder scattered on the ground, that only ignites grain by grain"[7](Rousseau, 1963, Livre 3, Chapitre 8, 70). Alternatively, in a maximally connected society, the tangle of network contacts is dense, and the organizers of a rebellion are free to deliberate "as secure in their rooms as the prince in his council, and the crowd assembles as quickly in the public square as the troops in their barracks"[8] (Livre 3, Chapitre 8, 70). While Rousseau's remarks focused on the effects of population density, he provides an apposite description of the importance of a densely connected network for any insurrection.

[6] $\frac{\partial}{\partial\theta}\Pr\left(\text{Rebel Success}\right) = \frac{\rho}{(1+\rho\theta)^2} > 0$ and $\frac{\partial}{\partial\rho}\Pr\left(\text{Rebel Success}\right) = \frac{\theta}{(1+\rho\theta)^2} > 0$

[7] The original reads, "s'évapore et se perd en s'étendant, comme l'effet de la poudre éparse à terre, et qui ne prend feu que grain à grain." Translation by the authors.

[8] The original reads, "sûrement dans leurs chambres que le prince dans son conseil, et la foule s'assemble aussitôt dans les places que les troupes dans leurs quartiers." Translation by the authors.

Political Spillover Effects of International Trade. A key element of our framework is the impact of trade on the interconnectivity of citizens. Suppose that the autocrat chooses to allow trade with the foreign country and that the trading partner has an open society, with no autocrat of its own.[9] As illustrated by the red dashed lines in Figure 2, when the two countries exchange goods the process of trade puts citizen b in contact with foreign national B, while citizen c is linked to foreign citizen C. The size of the network of potential rebels remains $n = 3$. However, because B and C are linked, there is now a pathway connecting citizens b and c, passing from b to B to C and on to c, a pathway that does not pass through the autocrat at node d. Opening to trade makes the network less legible to the autocrat, allowing citizens b and c to communicate with each other without being "overheard," which causes θ to rise from $\frac{1}{3}$ to $\frac{5}{9}$. This, in turn, increases the probability that a rebellion would succeed if it was attempted.[10]

As we noted above, there exists ample evidence that personal contacts play an important roll in cross border trade. Given the threat posed by trade-induced interpersonal contact, despots' ambivalence toward international commerce is unsurprising. For example, North Korea not only monitored communication between southern managers and northern workers in the (now closed) Kaesong Industrial complex, it also spied on its own workers and their friends (Manyin and Nanto, 2011). Likewise, the former Soviet Union not only restricted international telephone connections, it even limited the publication of telephone directories (Pool, 1983), an economically costly move. To this day, "relationship specific" exports are hamstrung by the Russian Federation's extensive insistence on visas (Kapelko and Volchkova, 2013, 8).

Note that the spillovers in our model bear some resemblance to what Bueno De Mesquita and Downs (2005, 82) call "coordination goods" in that they facilitate contact among individuals. However, coordination goods are "public goods that critically affect the ability of political opponents to coordinate but that have relatively little impact on economic growth," whereas our spillovers

[9] In principle, WTO members cannot pick and choose among trading partners as they are constrained by the rules of "non-discrimination." However, in fact countries routinely employ the targeted use of various tariff and non-tariff barriers to do just that (e.g., Bown, 2011). Furthermore, even within the WTO, negotiators focus on a series of bilateral negotiations based on the "principal supplier rule" on specific products, resulting in a 22,500-page document listing the commitments of each country with its partners on specific goods.

[10] The connection shrinks the number of components t from 3 to 2. Individual a is still isolated in her own component, with $s_{\mathsf{a}} = \frac{1}{3}$, but citizens b and c now share a common component with $s_{\mathsf{bc}} = \frac{2}{3}$, so we now have $\theta = \frac{5}{9}$ if the autocracy opens to trade.

pertain to privately transacted goods whose exclusion from trade would be economically costly.

As we noted in Section 2.1, the political spillover effects may differ in degree depending on the type of products being traded (Rauch, 1999). To illustrate this, we represent the added network density implied by trade in differentiated products with the blue dotted line in Figure 2, which connects citizen a with foreign national A. While a potential rebellion can still draw only on the three individuals a, b, and c, these individuals now form a single component, with each individual able to communicate with any of the others while bypassing the autocrat's node at d, so that $\theta = 1$.[11]

The Market Structure and International Trade. Next, we formally examine the decision to trade (extensive margin) as well as the trade volume conditional on trading (intensive margin) for the case of a small economy[12] (hereafter the "home country") endowed with two goods, $g \in \{D, F\}$. The home country has n citizens, n_D of whom are endowed with one unit of the home country's abundant good D and with no units of good F, while the remaining $n_F = n - n_D$ citizens are endowed with one unit of good F and no units of good D. We use good D as the numeraire good. The heterogeneous endowments of the citizens imply domestic exchange of the two goods even if there is no foreign trade. In the context of a star network, the domestic traders are able to engage in commerce, though they do so under the watchful eye of the autocrat.

Individuals have constant elasticity of substitution (CES) utility of the form commonly employed in the trade literature (e.g., Melitz, 2003):

$$U(q_D, q_F) = \left(q_D^{\frac{\sigma-1}{\sigma}} + q_F^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}, \tag{3}$$

where q_D and q_F denote the consumption of the goods D and F respectively. Note that $\sigma > 1$ is the elasticity of substitution between the two goods.[13]

Consumption will depend on p (the relative price of good F compared to the numeraire good D) and on the value of the individual's endowment I. Under autarky, the domestic price for good

[11] Citizens a and b can communicate using A and B as intermediaries, a can communicate with c with the intermediation of A and C, while b and c are linked through a pathway that accesses nodes B and C.

[12] We use the term "small economy" to mean that the country's volume of trade has a negligible impact on world prices.

[13] Individuals prefer to diversify their consumption for values of σ close to 1 whereas products become better and better substitutes as σ increases.

F will be:[14]

$$p^{\mathsf{autarky}} = \left(\frac{n_F}{n_D}\right)^{-\frac{1}{\sigma}}, \tag{4}$$

whereas if the home country opens to trade the cheaper world price for good F prevails:

$$p^{\mathsf{trade}} < p^{\mathsf{autarky}}. \tag{5}$$

Absent transfers, opening to trade will benefit individuals whose sole endowment consists of a unit of the domestically plentiful good D, while it will hurt their counterparts endowed only with the domestically scarce good F. To keep track of how prices and income affect welfare, it is useful to formulate the "indirect utility function":

$$\psi(p, I) \equiv U\Big(q_D(p, I), q_F(p, I)\Big). \tag{6}$$

Not only do the incomes of individuals vary with the price of good F, so too do aggregate income $I(p)$ and average income $\bar{I}(p)$:

$$I(p) = n_D + n_F \cdot p \quad \text{and} \quad \bar{I}(p) = \frac{n_D + n_F \cdot p}{n_D + n_F}. \tag{7}$$

If the economy opens to trade, the gains from the reduced price of the relatively scarce good are sufficient to allow the winners from trade to compensate the losers, leaving everyone better off under trade than with autarky (see Lemma 2 in the Appendix).

2.3 The Decision to Trade: The Extensive Margin

Now suppose that an autocrat is the one to decide how to allocate resources and whether to trade. The autocrat lives in the shadow of potential rebellion. We use a game to illustrate the process at work.

The sequence of events is as follows. First, the autocrat d decides whether to open or block trade, affecting the extensive margin of trade. If he chooses to trade, the network and price parameters are $(\theta^{\mathsf{trade}}, p^{\mathsf{trade}})$, while if he instead opts for autarky the parameters are $(\theta^{\mathsf{autarky}}, p^{\mathsf{autarky}})$. The ensuing decisions are depicted in Figure 3. At the top node, the autocrat d reallocates citizens' endowments, confiscating all output, then transferring A_i to each individual i. Next, before

[14] See Appendix A1.1 for details.

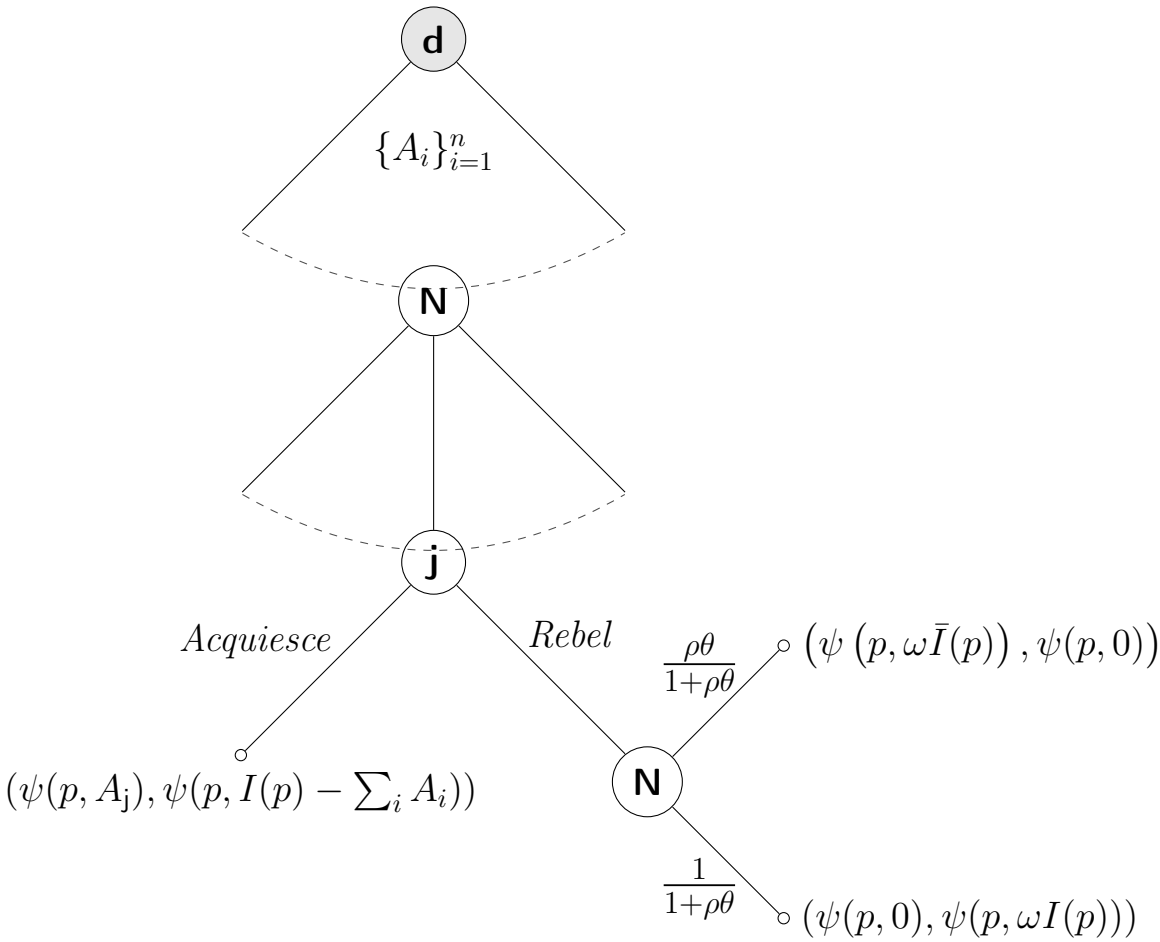
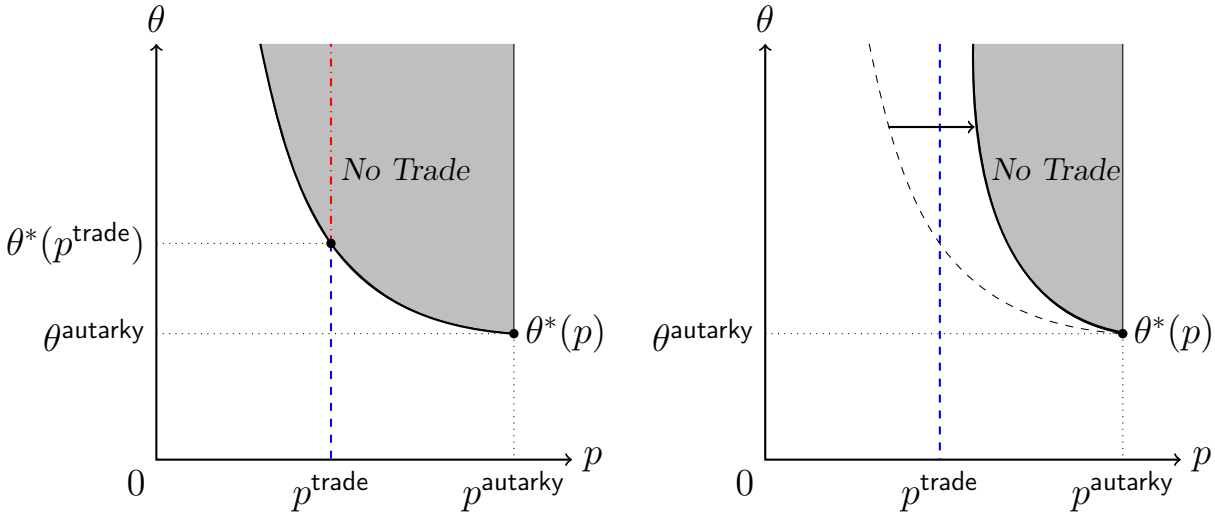


Figure 3: **The Extensive Margin of Trade.** The figure summarizes the subgame in which the autocrat d makes a decision to trade by anticipating its network spillover effects. The payoffs in the terminal nodes are for a representative subject j and the autocrat d, respectively.

the bundles are consumed, "Nature" (N) randomly selects a representative citizen j who has an opportunity to lead a rebellion. This represents the inherent unpredictability of rebellions. If she chooses to "*Acquiesce*" rather than "*Rebel*," she garners the allocation A_{j} already assigned to her by the autocrat before she was selected by nature. This renders her a utility of $\psi(p, A_{\mathsf{j}})$. Other individuals i receive utility of $\psi(p, A_i)$, while the autocrat consumes everything that was not shared with citizens, capturing a utility level of $\psi\big(p, I(p) - \sum_i A_i\big)$. If instead citizen j opts for rebellion, only a fraction $\omega \in [0, \frac{1}{2}]$ of each endowment survives the conflict.[15] With probability $\frac{\rho\theta}{1+\rho\theta}$ the rebellion succeeds (see expression [2]), ousting the autocrat, who gets a payoff of 0, and all citizens share equally in the surviving surplus. Should the rebellion fail, the autocrat seizes all

[15]This condition on ω means the rebellion is very destructive.



(a) Differentiated Product (b) Substitutable Product

Figure 4: **The Expansion of the Extensive Margin of Trade.** This figure illustrates that $\theta^*(p^{\mathsf{trade}})$, the maximum level of network connectivity the dictator would tolerate to trade, is a decreasing function of p^{trade}. The shaded region characterizes the combinations of p and θ for which the dictator opts not to trade. The blue dashed line describes the range of θ for which the dictator accepts trade at a price of p^{trade}, the red line shows those at which he rejects. The right panel illustrates how a decreased level of network spillovers, and the resulting reduction in the probability of rebel success, reduces the size of the "No Trade" region.

available resources, leaving the citizens with nothing.

Anticipating the random outcome of a potential insurrection, the dictator prefers to appease the public rather than risk rebellion. The autocrat brings citizens to the edge of indifference between rebellion and acquiescence by offering everyone the same amount, A^*, equal to the *per capita* income available if the rebellion prevails, weighted by the probability the rebels succeed[16]:

$$A^* = \left(\frac{\rho\theta}{1+\rho\theta}\right)\omega\bar{I}(p). \tag{8}$$

Working backwards through the game, the autocrat will open to trade provided that the extra threat posed by greater network connectivity does not overshadow the additional rents he is able to capture. We formalize this in terms of the maximum extra network connectivity, $\theta^*(p^{\mathsf{trade}})$, the dictator would tolerate to access a price p^{trade} instead of facing the autarkic price of p^{autarky}.[17] The connection between this threshold and p^{trade} is depicted on the lefthand side of Figure 4, where the

[16]See the Appendix for further discussion and a proof.

[17]We leave implicit the dependence of θ^* on $\theta^{\mathsf{autarky}}$, the connectivity faced by the leader with no trade, and on p^{autarky}, the price under autarky.

horizontal axis corresponds to the price for good F that could be accessed by opening to trade, while values for θ, our network parameter, can be found along the vertical axis. At a price of p^{trade} the dashed blue line indicates the values for θ^{trade} that would lead the regime to open to trade at a price of p^{trade}, while the red dashed line corresponds to θ^{trade} levels that would deter the regime from opening. As p^{trade} varies, the solid parabola marked $\theta^*(p)$ traces out the set of θ that would leave the regime indifferent between opening to trade and remaining autarkic. For (p, θ) combinations in the gray shaded region above the curve, the price reduction is not sufficient to tempt the regime to accept the higher θ that trade would entail, whereas below and to the left of the solid line, the regime stands ready to accept the extra θ in exchange for the more favorable price. Notice that as the trade price approaches p^{autarky}, $\theta^*(p^{\mathsf{trade}})$ likewise approaches $\theta^*(p^{\mathsf{autarky}})$. We summarize this with Proposition 1.

Proposition 1 (Regime Security and the Extensive Margin of Trade) *The maximum degree of network spillovers an authoritarian regime will accept in order to trade, $\theta^*(p^{\mathsf{trade}})$, is a decreasing function of p^{trade}.*

Proof is in Appendix A1.3.

As an autocrat becomes more effective at controlling political communication, ρ falls and the locus of equilibrium cutoff values shifts upward, making the regime more amenable to trade. In other words, as the level of network externalities decreases, it is more likely that the autocrat decides to trade. Figure 4 shows this mechanism by contrasting $\theta^*(p^{\mathsf{trade}})$ of a vulnerable autocrat (the parabola in the left panel) with the greater tolerance for connectivity associated with a low value for ρ (the solid parabola in the right panel).

In an open society network, spillovers are politically irrelevant, making all trading possibilities potentially attractive. To be sure, a society that can organize a set of transfers leaving everyone better off as the result of trade might still choose not to trade. However, if an interest group is powerful enough to block trade, it may also enjoy sufficient influence to allow the trade and then compel the winners to compensate.

2.4 Trade Volumes: The Intensive Margin of Trade

Now consider the equilibrium trade volume conditional on trade, *i.e.*, the intensive margin. To compare the demand under autarky and free trade, we express net exports of x_D units of good D as the difference between endowments and demand, and likewise for good F:

$$\Big(x_D\big(p, I(p)\big), x_F\big(p, I(p)\big)\Big) = \Big(n_D - q_D\big(p, I(p)\big), n_F - q_F\big(p, I(p)\big)\Big). \tag{9}$$

Under autarky both of these quantities, are, by definition, equal to zero. If the country opens to trade, the relative price of good F falls to $p^{\mathsf{trade}} < p^{\mathsf{autarky}}$, and the country becomes a net exporter of good D and an importer of good F:

$$x_D\Big(p^{\mathsf{trade}}, I(p^{\mathsf{trade}})\Big) > 0 \quad \text{and} \quad x_F\Big(p^{\mathsf{trade}}, I(p^{\mathsf{trade}})\Big) < 0. \tag{10}$$

Notice that after a country opens to trade, total imports and exports depend on aggregate income, not on how income is distributed among the citizens. In a free society, aggregate income is given by $I^{\mathsf{free}} = I(p^{\mathsf{trade}})$ (see expression [7]), and net exports for each good coincide with those given in expression (10).

Next, consider a country ruled by an autocrat who opts to trade. We have seen the autocrat will appease, so there will be no rebellion, hence aggregate income will be the sum of the $A_i = A^*$ handed out to the citizenry plus the residual endowment of the autocrat:

$$\begin{aligned} I^{\mathsf{autocracy}} &= \sum_{i'} A_{i'} + \big(I(p^{\mathsf{trade}}) - \sum_{i'} A_{i'}\big) \\ &= \sum_{i'} A^* + \big(I(p^{\mathsf{trade}}) - \sum_{i'} A^*\big) \\ &= (n_D + n_F)A^* + \big(I(p^{\mathsf{trade}}) - (n_D + n_F)A^*\big) \\ &= I(p^{\mathsf{trade}}). \end{aligned}$$

Thus, an open society's aggregate income with free trade will be identical to aggregate income in a society ruled by an autocrat who chooses to trade. Consequently, imports and exports will also coincide with those set forth in expression (10) for both regime types, provided of course that they trade at all.[18]

2.5 Empirical Implications of our Theory

Our analysis in Sections 2.3 and 2.4 predicts that regime type matters for the extensive margin of trade:

[18]Technically, this result stems from the homotheticity built into the CES preferences that are the mainstay of trade theory.

Hypothesis 1 *Insecure authoritarian regimes will be more reluctant to engage in any trade at all.*

At the same time, our analysis also implies that regime type does not affect the intensive margin[19]:

Hypothesis 2 *Conditional on trade actually taking place, regime type will not impact the intensive margin.*

We formalize our empirical strategy to evaluate these hypotheses in Section 3.2.

Finally, holding $\theta^*(p^{\mathsf{trade}})$ fixed, the effects of regime type will be mediated by the network externalities associated with each industry, because the success of rebellion depends on the density of political networks. We operationalize these network effects using the taxonomy of goods developed by Rauch (1999) in which differentiated products entail more extensive interpersonal contact, and so greater information spillovers, than do reference priced articles or exchange traded commodities:

Hypothesis 3 *Insecure authoritarian regimes will be more reluctant to trade on the extensive margin in differentiated products than they are to traffic in reference priced and exchange traded goods.*

3 Data and Methods

We assemble an extensive set of trade data, including GATT and WTO membership, along with measures of colonial history and military alliances, merged with the *Polity IV* data decomposed into its constituent variables. We construct a Bayesian statistical estimator that accounts for the joint endogeneity of the extensive and intensive margins of trade and that applies a sparse prior to contend with the collinearity endemic to our extensive roster of explanatory variables.

[19]We thank an anonymous reviewer for pointing out the possibility that politics might matter for the intensive margin in alternative models, for instance, if there were different distributional consequences to trade or if networks expanded proportionately with trade. Exploring the implications of alternative models is an open topic for ongoing research. We test Hypothesis 2 below in Section 4.

3.1 Data

Differences in production technology and consumers' tastes imply that even the typical economic factors in the gravity specification of trade, such as distance and size of the economy, can have differential effects on trade flows across dissimilar products on both margins. For example, distance might matter more for industries with high transportation costs, whereas the consequence of the size of the importing country's market will be magnified for industries with greater increasing returns to scale. Yet most studies of institutional effects on trade implicitly assume homogeneous effects across products by only considering the *total* volume of bilateral trade, aggregating across a diverse set of products (e.g., Rose, 2004; Goldstein, Rivers, and Tomz, 2007).

To minimize compositional bias caused by different countries trading different bundles of goods, we analyze SITC 4-digit product-level trade flows, the most finely disaggregated trade data available that spans our entire 1962-2012 time period.[20] This taxonomy, maintained by the UN, classifies each product based on its market uses, on the materials used in its production, and on the processing phase, adjusting for technological change.

We include countries that have existed as sovereign states during the period, listed in Appendix A6. These nations account for more than 90% of total world trade. Using the concordance table available in the United Nations Statistics Division, we track all 450 unique SITC 4-digit product categories that are comparable across years. This cross-matching addresses the appearance and disappearance of product categories over time, reducing the bias due to the heterogeneity across products in different periods.[21] Finally, we compute the volume of trade for each product, leaving us with a dataset distinguishing imports and exports for each year covering all 450 products and every dyad. Considering all directed dyads, including those without trade to account for the pattern observed in Figure 1, results in $\binom{131}{2} \times 2 \times 450 \times 51 = 390,838,500$ observations for our analysis.

Gravity Variables. We include a canonical list of dyad level "gravity" variables from Rose (2004) and Goldstein, Rivers, and Tomz (2007), including the log of population for each coun-

[20] We used the data extraction API available from the UN Comtrade Database to handle the large automatic download volume. Typically, the size of data amounts to more than 150MB for each year.

[21] We identify 450 SITC 4-digit product categories that exist consistently over time and then map other transient products to each one of them using the concordance table available at `https://unstats.un.org/unsd/trade/classifications/correspondence-tables.asp`

try, (Importer population, Exporter population), and their logged incomes (Importer GDP, Exporter GDP).[22] We also include dyad-level covariates: the logged distance between the members of the dyad (Distance), an indicator for a contiguous land border (Land Border), a common language (Common language), a past colonial relationship (Colony), and a common former colonizer (Common Colony).[23] In order to control for the effects of institutional membership in GATT/WTO, we include indicators for whether both elements of a dyad are formal members of the WTO (Both formal members) or participants (Both participants), for whether only one of the countries in a dyad is a formal WTO member (One formal member), or a WTO participant (One participant), and we code for whether each member of a directed dyad is a non-member participant (e.g., Importer Formal member, Exporter Participant).[24] In addition, we include an indicator for an alliance relationship (Alliance) from the Correlates of War Project (Gibler, 2013), to control for security relations among trading partners (Gowa, 1989). Even though this is not an exhaustive list, these variables capture the key economic forces identified in the literature as affecting bilateral trade.[25]

Unpacking *Polity IV* Our theory suggests that multiple features of regime type will influence a government's receptiveness to trade. Rather than impose a *portmanteau* measure of democracy, such as the *Polity IV* variable POLITY[26], or one of the alternatives (Przeworski, Alvarez, Cheibub et al., 2000; Coppedge and Reinicke, 1991; Bollen, 1993; House, 2014), we separate POLITY into its six constituent components to capture various aspects of political institutions[27]. The first four variables, Competitiveness of Executive Recruitment, Openness of Executive Recruitment, Constraint on Chief Executive, and Competitiveness of Political Participation, possess natural orders of their own, with lower values generally corresponding to more autocratic institutions, while higher scores are

[22]Source: Penn World Tables 7.0.

[23]Some of these variables, such as Common Colony, might reasonably be considered to proxy political institutions, although they are included in "economic" gravity specifications.

[24]The reader will notice that our formal and participant membership variables are perfectly collinear, rather than arbitrarily dropping one, we follow the standard approach for sparse estimators by allowing our LASSO estimator to deal with them.

[25] Oil wealth is often associated with authoritarianism. Appendix A4 shows that our findings are robust to including `% of oil rent per GDP` as an additional covariate in the analysis (Lange, Wodon, and Carey, 2018).

[26]The weights used to aggregate this measure from its component parts exhibit a degree of arbitrariness, see Table A1 in Appendix A5.

[27]We recognize that the POLITY components could themselves be further decomposed into even more finely grained measures, but no consensus has emerged on how this might be done, whereas the profession has accumulated decades of experience with POLITY and its constituent sub-scales.

earned by institutions associated with more open societies.[28] We incorporate two other measures from the *Polity IV* data set: Regulation of Executive Recruitment, a three-point scale measuring the "regularity" of the current leader's accession to power; and Regime Durability, operationalized as the length of time the current regime has endured.[29] We shall see below that these component measures better capture the impact of institutions on trading relationships than does the POLITY measure alone. Moreover, note that while the Regime Durability variable is related to regime stability, it is by no means synonymous with democracy.

3.2 The Methodology: Bayesian Two-Stage Selection Specification

We make several methodological contributions by overcoming three key challenges. First, a proper test of our theory requires a model that integrates both the extensive and intensive margins. Second, our theory relies on claims about regime security rather than a level of "democracy" *per se*. This forces us to consider a broad set of highly-correlated domestic institutional measures, posing a challenge in identifying the relevant subset that drives trade flows. Third, we need a principled way to conduct statistical inference on variables and models across margins. We propose a Bayesian two-stage variable selection random effects method that seamlessly integrates both margins, while drawing our attention to the most relevant predictors. Posterior inference allows us to assess whether political variables affect trade flows at each margin. We next move on to a formal description of the method.

The Covariates and Outcomes We consider two outcomes, one for each margin. On the extensive margin, the binary variable δ_{ijtk} takes on a value of 1 if country i imports good k from country j at time t, else it equals 0. For the intensive margin $\widetilde{Y}_{ijtk}$ is the value of imports of k to i from j at time t. We will work with the more tractable log-transformed outcome $Y_{ijtk} = \log(1 + \widetilde{Y}_{ijtk})$.[30]

We let $\mathbf{x}_{ijtk}$ denote the observed covariates, which we decompose into a vector of gravity variables $\mathbf{x}_{ijtk,G}$, augmented with an intercept, and another consisting of *Polity* variables $\mathbf{x}_{ijtk,P}$:

[28] For more detail on each sub scale, see Marshall, Gurr, and Jaggers (2010)

[29] We exclude the *Polity IV* variable meant to capture the extent to which political participation is "regulated," because it is not a monotonic scale.

[30] Liu (2009) advocates Poisson regression over the Tobit, however the trade flow outcome is virtually continuous and our theory predicts heterogeneous zero-inflation, both of which would confound a Poisson specification. Another alternative, the Poisson pseudo-maximum likelihood estimator (Silva and Tenreyro, 2006), does not differentiate between the two margins.

$\mathbf{x}_{ijtk} = [\mathbf{x}_{ijtk,G}^\top \ : \ \mathbf{x}_{ijtk,P}^\top]^\top$.

Estimating the Extensive Margin We use a probit specification at the extensive margin for each product k, comparing two versions: $\mathcal{E}_k^P$, which includes gravity and political variables, and $\mathcal{E}_k^G$, which is identical with the first, save that it excludes the political variables:

$$\mathcal{E}_k^P : \Pr(\delta_{ijtk} = 1|\cdot) = \Phi(\mathbf{x}_{ijtk,G}^\top \boldsymbol{\beta}_{k,G} + \mathbf{x}_{ijtk,P}^\top \boldsymbol{\beta}_{k,P} + b_{ik} + c_{jk} + d_{tk}) \tag{11}$$

$$\mathcal{E}_k^G : \Pr(\delta_{ijtk} = 1|\cdot) = \Phi(\mathbf{x}_{ijtk,G}^\top \boldsymbol{\beta}_{k,G} + b_{ik} + c_{jk} + d_{tk}) \tag{12}$$

where $\{b_{ik}, c_{jk}, d_{tk}\}$ are importer, exporter, and time random effects, respectively,[31] while $\Phi(z)$ denotes the cumulative distribution function of a standard normal random variable. According to Hypothesis 1, which we test below, $\mathcal{E}_k^P$ should receive more support from the data than $\mathcal{E}_k^G$.

Estimating the Intensive Margin Here we also consider two specifications for each product k: $\mathcal{I}_k^P$, which contains both the gravity and political variables, and $\mathcal{I}_k^G$, with the same structure, save that it excludes the polity variables. For dyads with positive trade flows we have:

$$\mathcal{I}_k^P : Y_{ijtk} = \mathbf{x}_{ijtk,G}^\top \boldsymbol{\gamma}_{k,G} + \mathbf{x}_{ijtk,P}^\top \boldsymbol{\gamma}_{k,P} + f_{ik} + g_{jk} + h_{tk} + \lambda_k m_{ijtk}^P + \epsilon_{ijtk}; \ \ \epsilon_{ijtk} \sim \mathcal{N}(0, \sigma_k^2) \tag{13}$$

$$\mathcal{I}_k^G : Y_{ijtk} = \mathbf{x}_{ijtk,G}^\top \boldsymbol{\gamma}_{k,G} + f_{ik} + g_{jk} + h_{tk} + \lambda_k m_{ijtk}^P + \epsilon_{ijtk}; \ \ \epsilon_{ijtk} \sim \mathcal{N}(0, \sigma_k^2) \tag{14}$$

where $\{f_{ik}, g_{jk}, h_{tk}\}$ are importer, year, and time random effects, respectively. Because we only estimate this specification for dyads that actually trade, our estimator for $\mathcal{I}_k^P$ contains a bias correction factor, known as the "inverse Mills ratio"[32]:

$$E\{\tilde{u}_{ijtk}|\delta_{ijtk} = 1, \mathcal{E}_k^P\} = -\frac{\phi(\mathbf{x}_{ijtk,G}^\top \boldsymbol{\beta}_{k,G} + \mathbf{x}_{ijtk,P}^\top \boldsymbol{\beta}_{k,P} + f_{ik} + g_{jk} + h_{tk})}{\Phi(\mathbf{x}_{ijtk,G}^\top \boldsymbol{\beta}_{k,G} + \mathbf{x}_{ijtk,P}^\top \boldsymbol{\beta}_{k,P} + f_{ik} + g_{jk} + h_{tk})} = m_{ijtk}^P \tag{15}$$

Including m_{ijtk}^P as an additional covariate protects the intensive margin coefficients from selection bias (Heckman, 1979; Olsen, 1980).

Prior Specification. We are conducting a fine-grained analysis not just in terms of data but in terms of our specification. After including gravity variables, the *Polity IV* component variables, and allowing for time-varying effects, we are left with numerous other explanatory variables. In

[31] The random effects account for "multilateral resistance" (Anderson and Wincoop, 2003).

[32] We calculate this expectation using the full extensive margin specification $\mathcal{E}_k^P$.

order to estimate and select from this subset, we turn to recent advances in machine learning developed for fitting high-dimensional linear structures (Ratkovic and Tingley, 2017). We use this variable selection technology in order to estimate parsimonious specifications and select the most relevant explanatory variables.

Our estimator implements a statistical method for "sparse structures," an approach designed for specifications fraught with a large number of correlated explanatory variables, many of which are likely redundant. The estimator is designed to explain the data well in terms of a small subset of the variables. In our case, we estimate numerous coefficients corresponding with political or economic covariates. Without a sparse estimator, using a p-value threshold in a likelihood based context, we would expect to encounter many "false positives"–irrelevant variables that the likelihood based approach would highlight as significant. Our Bayesian approach with a sparse prior, in contrast, sidesteps this inferential problem. The approach we use has been found in other contexts to be both powerful in identifying true effects and effective at not falsely including spurious effects that are in truth equal to zero (see Ratkovic and Tingley, 2017, for extensive simulation evidence and applications). A full, formal description of our estimator appears in Appendix A2.

Assessing the Fit of our Specification The Bayes factor is a summary used to select between competing specifications (Gelman, Carlin, Stern et al., 2014, esp. Sec 7.4, Example 1).[33] We use this criterion to compare $\mathcal{E}_K^P$ and $\mathcal{E}_K^G$.[34] Denoting the observed data for good k as $\mathcal{D}_k$, the Bayes factor assessing the weight of the evidence in favor of specification $\mathcal{E}_K^P$ over specification $\mathcal{E}_K^G$, and hence in favor of Hypothesis 1, is:

$$\mathsf{BF}_k^{\mathcal{E}} = \frac{\Pr(\mathcal{D}_k|\mathcal{E}_K^P)}{\Pr(\mathcal{D}_k|\mathcal{E}_K^G)}. \tag{16}$$

Analogously, we can compare the competing versions of our intensive margin specification to evaluate Hypothesis 2:

$$\mathsf{BF}_k^{\mathcal{I}} = \frac{\Pr(\mathcal{D}_k|\mathcal{I}_K^P)}{\Pr(\mathcal{D}_k|\mathcal{I}_K^G)}. \tag{17}$$

Because we encounter some very large magnitudes, we report logged values of the Bayes factor, so a positive value provides evidence that the version with both gravity and politcal variables receives more support from the data. Ultimately one's posteriors depend on one's priors, but several "rules of thumb" have been suggested; Kass and Raftery (1995, 777) assert that a logged Bayes factor greater than 6 (corresponding to $\mathsf{BF} \approx 20$) implies "strong" evidence, while any value

[33] One might view it as a Bayesian analog to the likelihood ratio test.

[34] See the appendix for further details.

above 10 (corresponding to BF $\approx$ 150) constitutes "very strong" evidence, see also Jeffreys (1998, 18).

4 Empirical Results

We present a large number of coefficients in our model using heat maps. We explain this graphical format in Section 4.1. We then put our apparatus to work in Section 4.2. First, we show that the gravity variables behave as convention would lead us to expect. Second, the extensive margin coefficient estimates for Constraint on Chief Executive and Competitiveness of Political Participation reveal a trade-inhibiting effect for autocracy while Regime Durability promotes trade. Our finding suggests that regime security plays an important role on the extensive margin. In contrast, our estimates on the intensive margin indicate that regime type exercises little influence. Finally, Section 4.3 presents evidence that the intensive margin impact of political institutions is more pronounced in industries that involve greater interpersonal contact.

4.1 Reading the Heat Maps

We have a massive amount of data. We estimate the extensive and intensive margins of trade separately for each of the 450 SITC 4-digit products, generating thousands of parameter estimates and corresponding credible intervals ($13,500 = 450 \times (18+12)$) to report for each margin. Inspired by genomic studies (e.g., Eisen, Spellman, Brown et al., 1998), we display them concisely using a "heat map.

The products are ordered by SITC 4-digit code, with the first-digit industry groupings on the vertical axis and explanatory variables on the horizontal axis. Coefficients with at least 95% posterior mass below zero are represented by narrow blue bands, while coefficients with more than 95% of posterior mass above zero are colored red. The greater the median of the posterior density, the more darkly shaded the color.

To illustrate, Figure 5 portrays our estimated extensive margin coefficients for one variable, the logged distance. On the left-hand side of the panel, each dot represents the median of the posterior density for each product, while the horizontal lines present 95% credible intervals—thanks to the precision of our estimates, many of these intervals are so narrow they coincide with the medians. On the right-hand side, we color code each coefficient (the heat map representation).

This figure shows that the effect of distance varies by product, though greater distance generally

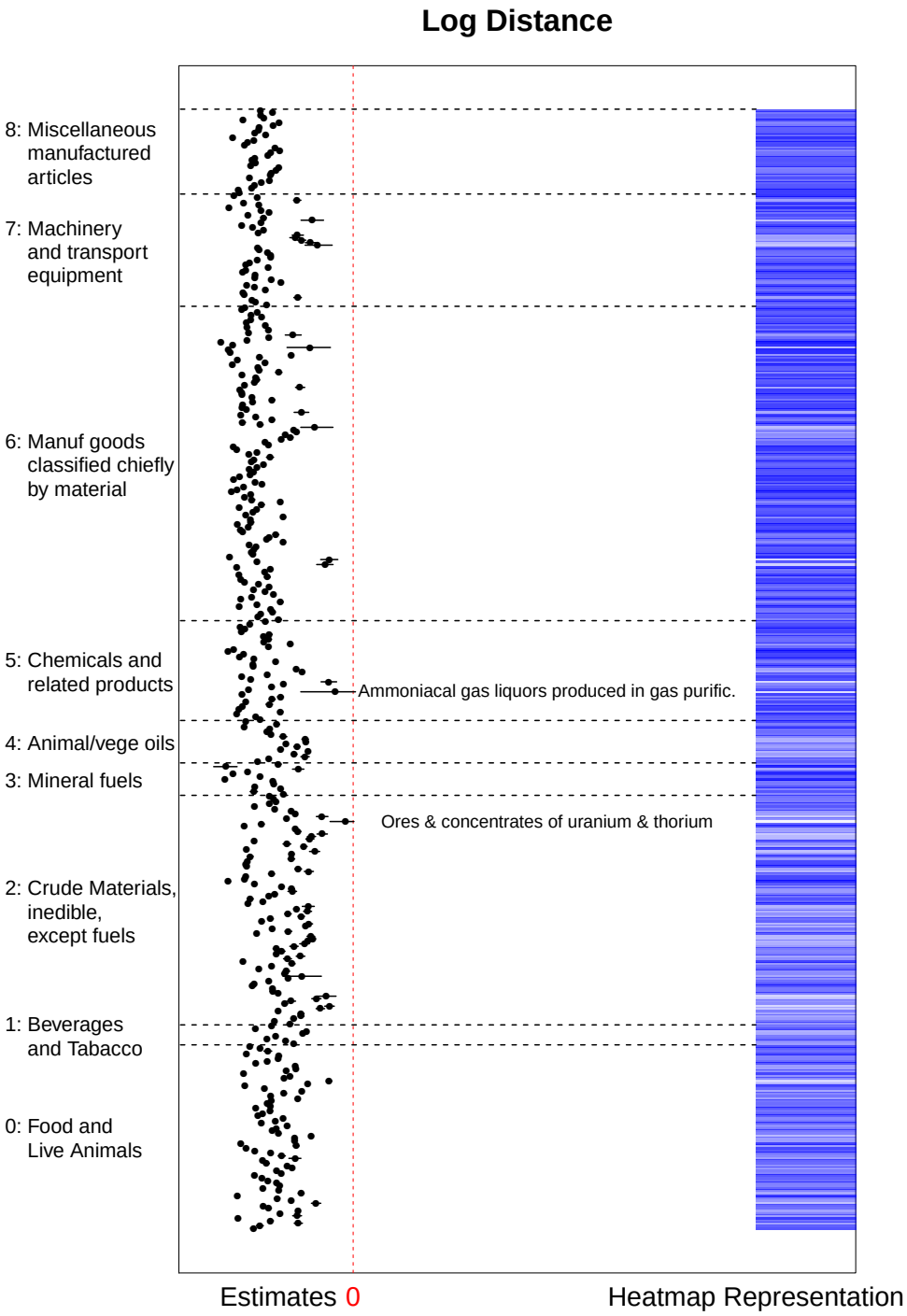


Figure 5: **Effects of Logged Distance on the Extensive Margin of Trade.** Pairs of industries are labeled with the smallest effects of distance on trade. The left side of the panel shows the posterior medians (black circles) with 95% credible intervals. The right-hand side is the heat map representation, which corresponds to the first column in Figure 7.

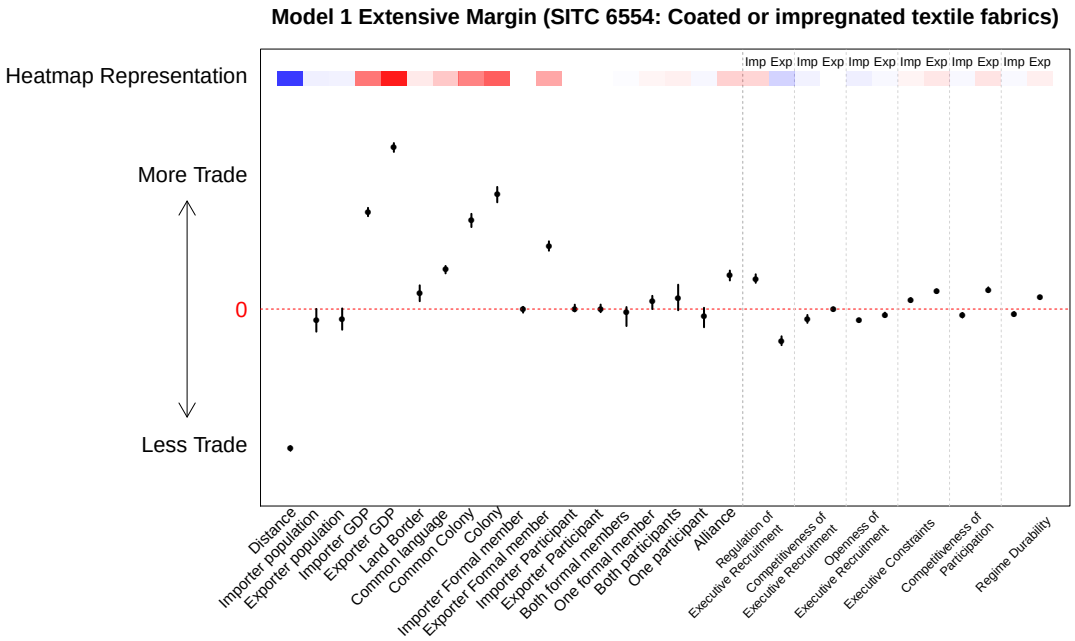


Figure 6: **Effects of Gravity and Polity Variables on Product-Level Trade.** This figure shows the effects of each variable on the extensive margin of trade for a product in the textile industry(SITC 6554). The heat map representation at the top corresponds to a row in Figures 7 and 9.

reduces the likelihood of trade. The lack of red stripes confirms that distance never stimulates trade, though for some industries it appears not to matter. The white shaded band of the heatmap corresponding to "Ores and concentrates of uranium and thorium" (SITC 2860) within the "Crude Materials, inedible, except fuels" industry (SITC 2), indicates that the 95% posterior credible interval contains zero. Likewise, "Ammoniacal gas liquors produced in gas purification" (SITC 5213) corresponds with the figure's other white color band.

Figure 6 zooms in on a row of Figures 7 and 9, displaying the extensive margin coefficients for "Coated or impregnated textile fabrics" (SITC 6554). The 95% credible interval for the exporter GDP coefficient lies well above zero, represented by a dark red band of color, while the posterior mode of the distance coefficient is well below zero, represented by a dark blue streak in the corresponding line of the heat map. The posterior density of the Regulation of Executive Recruitment coefficient for importers is relatively small and positive, thus it is represented on the heat map as a faded pink stripe. The corresponding effect for exporters is small and negative, represented by a washed-out strip of blue color.

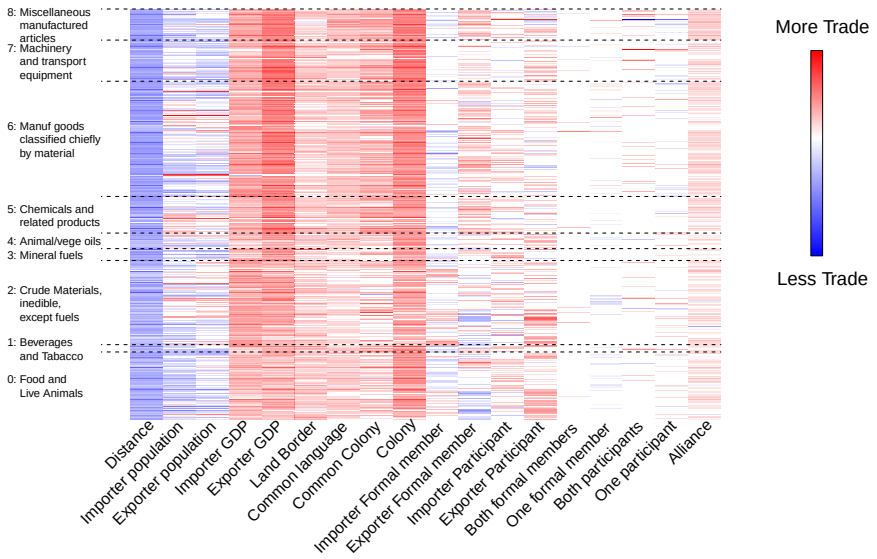


Figure 7: **Extensive Margin (Gravity Variables).** This figure presents our coefficient estimates for the gravity variables on the extensive margin using the heatmap conventions outlined in Section 4.1.

4.2 Parameter Estimates

We first assess the validity of our model by examining the estimates of the gravity models. We then turn to the estimated impact of regime type on trade.

4.2.1 The Gravity Variables

Figures 7 and 8 display heat maps across all products for the coefficients of the gravity variables on the extensive and intensive margins of trade, respectively. Turning first to Figure 7, the standard gravity variables have their expected effects. Distance impedes trade on the extensive margin, while increased income in either the exporting or the importing country is associated with a greater likelihood that two countries trade a given product. A higher GDP for the exporting country is associated with an even higher likelihood of trade in chemicals and manufactures than other products, indicated by the vivid lines in the top segments of the fifth column. The bright red column corresponding with the Colony variable shows that a former colony/colonizer relationship is trade enhancing. More sporadic and attenuated trade enhancing effects are associated with sharing common language or border, being linked by a defensive alliance, or sharing a former colonial power, each of which has been identified in the literature.

Our GATT/WTO variables have mixed effects on the extensive margin, though the exporter

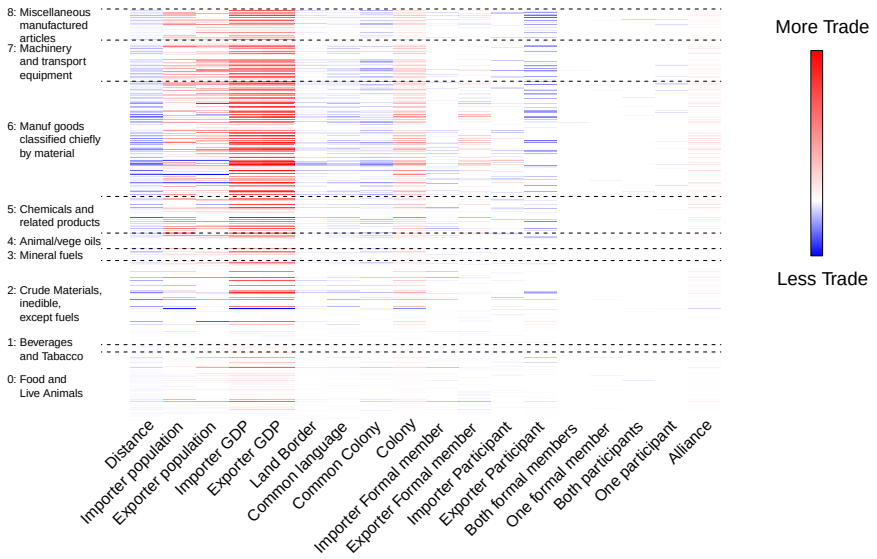


Figure 8: **Intensive Margin (Gravity Variables).** This figure summarizes the estimated effects of "gravity" variables on the intensive margin of trade.

being a formal member appears to encourage trade in chemicals and manufactures. In contrast, the effects of formal membership on exports of primary products appears to be negative, whereas for the same industries, having participant status is strongly export promoting.

Figure 8 presents results on the intensive margin. Higher incomes are trade promoting for both the exporter and the importer, at least for chemicals and manufactures, though the estimated effects are less pronounced than on the extensive margin. Greater distance impedes trade, while one country being the former colony of the other enhances it, but the magnitudes pale, literally in the context of our heat map, by comparison with the corresponding effects of these variables on the extensive margin.

As for the GATT/WTO measures, the Exporter Participant variable sporadically impedes intensive margin trade. This suggests that even industries with low potential trading volumes enter into export trade when a country is a participant. The remaining effects of the intensive margin GATT/WTO variables are severely etiolated. This is consistent with Dutt, Mihov, and Van Zandt (2013, 204) who find that the effect of GATT/WTO is driven "almost exclusively" by the extensive margin.

4.2.2 Institutions Promoting Extensive Margin Trade

We now turn to the effects of our regime type variables on the extensive margin of trade. In accordance with Hypothesis 1, Figure 9 shows that political institutions matter on the extensive

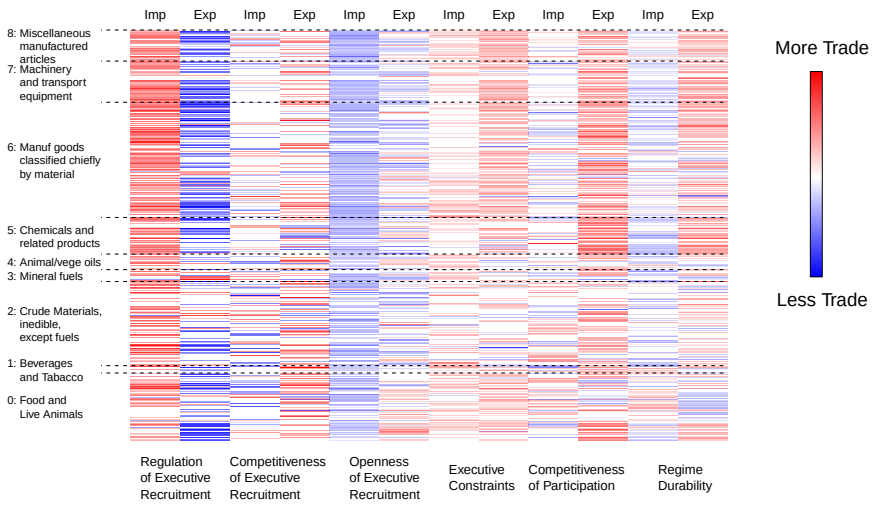


Figure 9: **Extensive Margin (Polity Variables).** This figure depicts the coefficients for POLITY component variables.

margin (indicated by the lack of white space). In particular, the coefficient estimates for Constraint on Chief Executive and Competitiveness of Political Participation are consistent with the idea that autocracy inhibits exports (corresponding to low values for these variables), while Regime Durability emerges as export promoting. In all three cases, the impact of regime type is more pronounced among manufactured products than it is for primary products.[35] This is consistent with Hypothesis 3, which implies a greater impact of regime type on trade in differentiated products. We test Hypothesis 3 formally in Section 4.3. While our theoretical model does not posit a tendency for exports to involve greater network externalities than imports, the empirical results suggest this may be the case.

Beyond the predictions of our theoretical analysis, two fairly similar components of democracy emerge as having opposite effects on imports across product categories: Openness of Executive Recruitment, corresponding to hereditary autocrats rather than constitutional monarchs, inhibits imports, while Regulation of Executive Recruitment, low values of which correspond with coup-prone polities, is associated with an elevated probability of importing and a lower probability of exporting a given product. Most of the countries in our sample appear at the same end of both scales, where the effects of these two variables on imports tend to cancel each other out. What remains is the export inhibiting effect we estimate for the Regulation of Executive Recruitment. This appears to be a byproduct of the economic dislocations caused by coups.

[35] Applying Rauch's "liberal" criterion, about 56% of manufactured products (industry groups 5-8) are differentiated goods, whereas only 19% of industry groups 0-4 are differentiated.

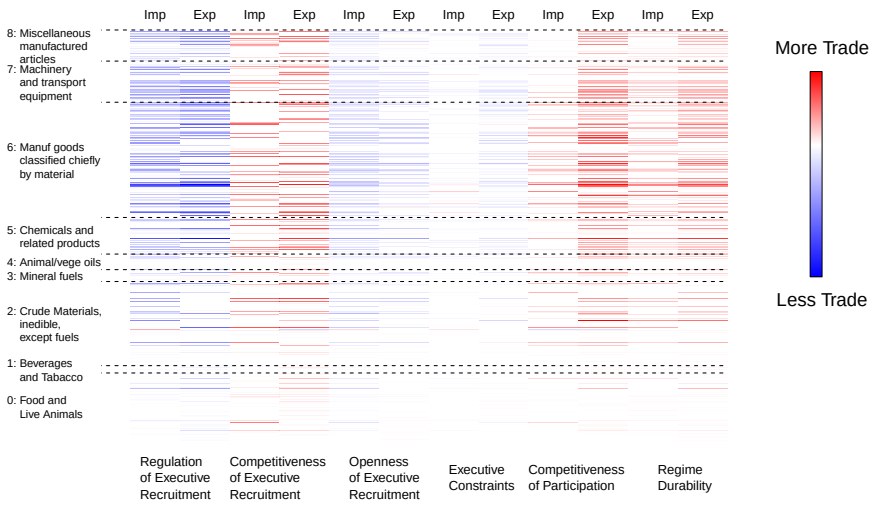


Figure 10: **Intensive Margin (Polity Variables).** This figure summarizes the estimated effects of *Polity IV* variables on the intensive margin of trade with the proposed bias correction. It shows sharply attenuated effects of the variables conditional on the extensive margin of trade. The prevalence of white color suggests that political institutions do not matter for most of agricultural products and crude materials on the intensive margin of trade.

4.2.3 Political Institutions and the Intensive Margin

Next, we turn to the impact of regime type on the intensive margin of trade. Figure 10 shows the estimated parameters on the polity variables. Many more bands in this figure are white than in Figure 9, which indicates that these variables simply do not affect the intensive margin of trade as they do in the extensive margin. This evidence supports Hypothesis 2. The impact of the Constraint on Chief Executive measure disappears almost entirely, while the sporadic and faint red strips corresponding to Competitiveness of Political Participation and Regime Durability are pallid reflections of the corresponding extensive margin coefficients. The executive recruitment coefficients are likewise enfeebled—the faint blue of the remaining Regulation of Executive Recruitment coefficients suggest that perhaps in more stable systems, trade extends to goods with low volumes that would not be traded at all in a coup-prone political environment. Below, we evaluate more formally whether this faded collection of parameters is simply the byproduct of an over-parameterized specification.

To gain insight into the selection effects, Figure 11 presents the results for the estimated parameter on the inverse Mills correction term (this is λ_k in equations (13) and (14)). The vast majority—over 90%—of the credible intervals are negative and exclude 0 (black lines), providing strong evidence that selection impacts trade. Note that almost all of the significant coefficients

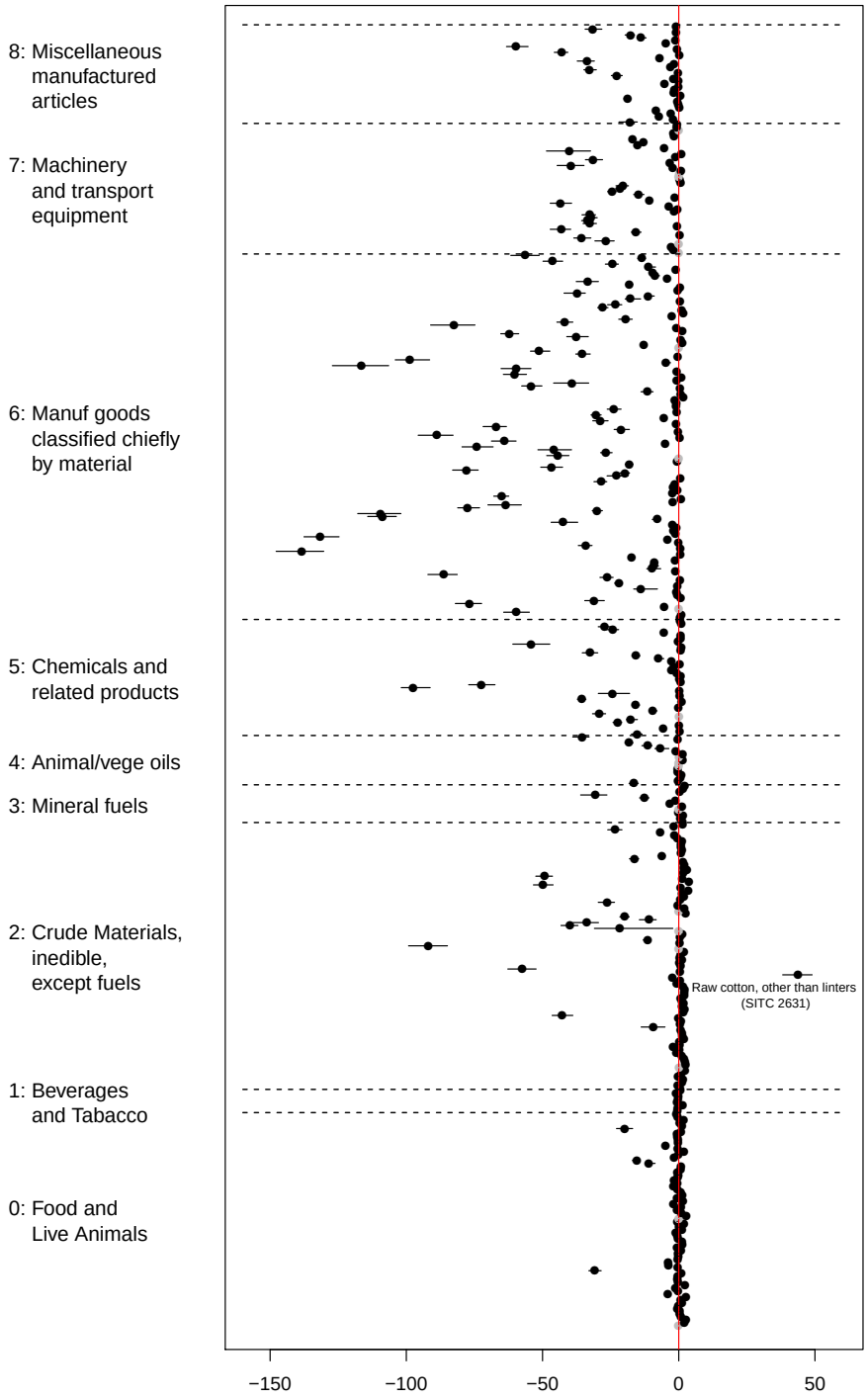


Figure 11: **The Impact of the Inverse Mills Ratio.** This figure displays posterior means and 95% credible intervals for the estimated effects of the inverse mills ratios on the intensive margin of trade. We find statistically significant deviation from zero effect (marked by back horizontal line) for most products. This provides formal evidence of selection due to political institutions in the extensive margin of trade.

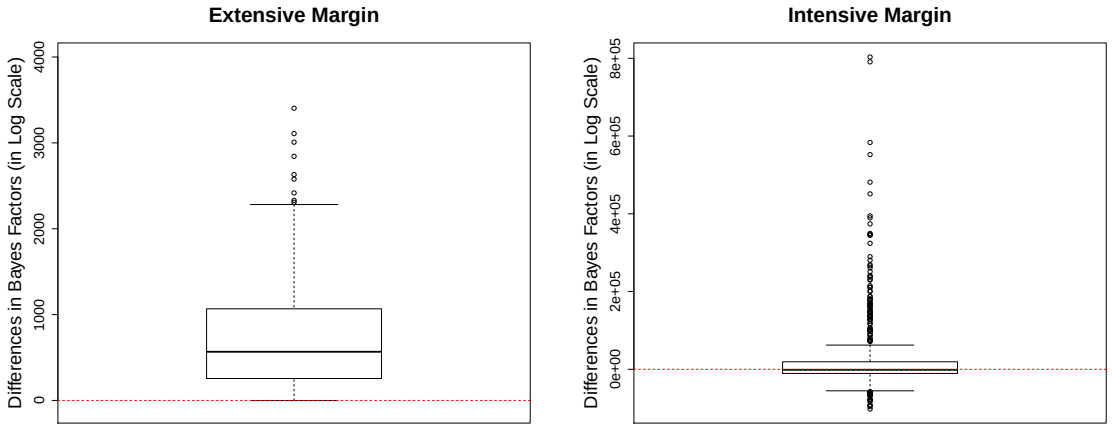


Figure 12: **Institutional Variables Matter for Extensive Margins.** The box-and-whisker plot in each panel shows the distribution of BF_k for each margin as defined in expressions (16) and (17).

are negative. This is in line with the fact that commodities that are actually transacted have above average potential trade volumes relative to the commodities that are not traded.[36] The remaining tenth of cases for which the credible intervals include zero provide little evidence either for or against a selection effect.

4.3 Regime Type, Spillovers, and the Extensive Margin of Trade

The coefficient estimates above indicate that the impact of regime type on trade is concentrated on the extensive margin. More importantly, we see that these effects are heterogenous, with Polity exercising a much more profound effect on some industries than on others. Our theory tells us to expect that these effects will be greater for industries that involve more interpersonal contact, which we operationalize using Rauch's taxonomy. While scanning the heatmaps is useful, we now turn to Bayes Factors to help select among specifications across each model that we estimate for each product as described in Section 3.

Figure 12 presents the Bayes factors comparing our political and gravity-only specifications. The data universally favor the inclusion of the *Polity* variables at the extensive margin, consistent with Hypothesis 1. In contrast, the right panel of Figure 12 fail to provide systematic support for including political institutions on the intensive margin, just as Hypothesis 2 would lead us to expect. The distribution of Bayes factors is centered around and includes zero. This finding suggests that existing studies might overestimate the effect of political institutions on trade volume,

[36] In equation (37) the residual term $\tilde{u}_{ijtk}$ enters with a negative sign, so a large negative value of $\tilde{u}_{ijtk}$ makes the dyad more likely to trade; the negative values are associated with larger intensive margin trade volumes.

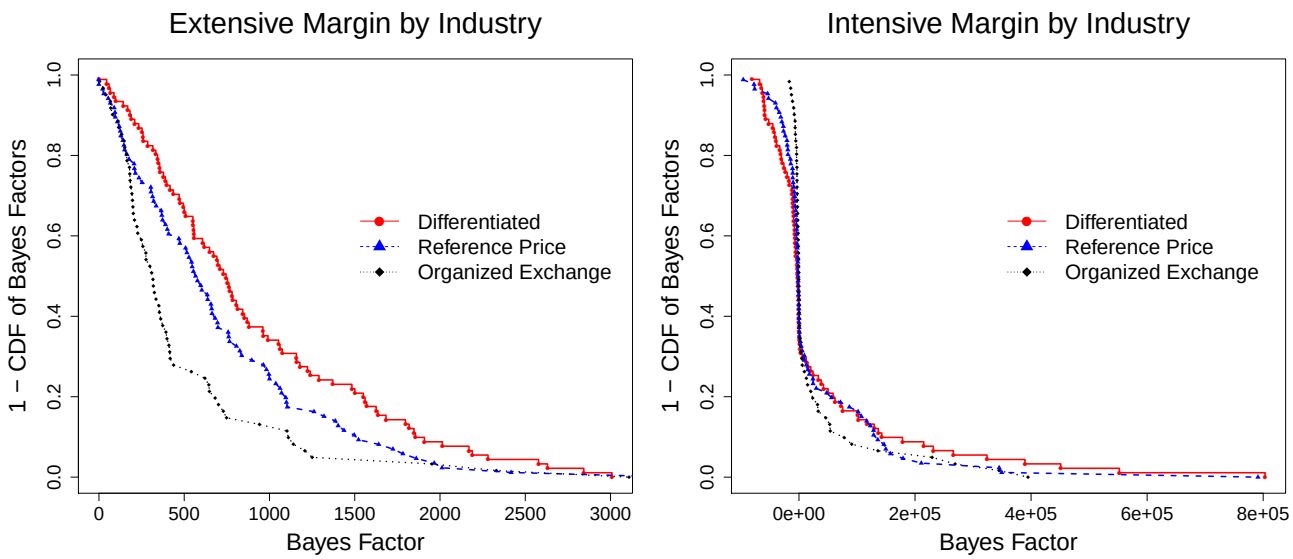


Figure 13: **First-order Stochastic Dominance by Differentiated Products.** The vertical axes report the fraction of observations with Bayes factors at or above the value reported on the horizontal axis. We find that the model with political institutions is particularly favored for differentiated products at the extensive margin of trade.

the intensive margin, by excluding country pairs that do not trade, *i.e.* disregarding the extensive margin of trade (e.g., Mansfield, Milner, and Rosendorff, 2000).

We further assess Hypothesis 3 by comparing the distribution of Bayes factors across all products within the three distinct categories of product differentiation Rauch (1999). Specifically, we examine whether the distribution of Bayes factors for differentiated products *first order stochastically dominates* that of other products with referenced price and goods traded in organized exchanges (Lehmann, 1955; Hanoch and Levy, 1969). Stochastic dominance is often used to compare lotteries (Hadar and Russell, 1969); here we use it to compare the tendency of one class of goods to generate higher Bayes factors in favor of including political variables. This allows us to evaluate our prediction across the entire range of percentiles in the distribution (see Appendix A3 for further exposition of first order stochastic dominance).

Consulting the left panel of Figure 13, the red line, corresponding to the fraction of Bayes factors among the differentiated products that exceed any threshold, lies above the corresponding lines for the other categories. Similarly, the blue line for reference priced goods also exceeds or equals the line for the products traded on organized exchanges. Support for including our political variables in the specification is stronger for industries that involve greater interpersonal contact, and more extensive exchange of information. In contrast, the analogous curves for the intensive

margin show no such tendency, with the interlaced cumulative densities crossing each other at various points. This is consistent with Hypothesis 2, which implies political factors will not affect the intensive margin of trade.

5 Concluding Remarks

We make several contributions. First, we develop a model of political networks that explicitly distinguishes the effects of political institutions on the extensive and intensive margins of trade. Our model focuses on the tendency for trade to facilitate communication amongst the people involved in producing and marketing products across borders. For democracies and consolidated authoritarian regimes, this poses little or no threat, but for vulnerable autocracies this communication can spill over into the political realm by allowing regime opponents better to coordinate their activities. Thus vulnerable regimes block cross border commerce on the extensive margin for products whose network spillovers are high relative to the potential gains from trade that they offer. These spillovers appear to be greatest in differentiated products.

Second, we employ an estimation strategy that simultaneously deals with the selection issue and the substantial collinearity that emerges from analyzing various features of political institutions. Our estimator, based on the recent development of machine learning techniques in variable selection methods (Ratkovic and Tingley, 2017), identifies systemic patterns of international trade using extensive product-level trade data while ensuring compatibility across products over a half century. We merge the trade flows data with a panoply of country- and dyad-level covariates that previous work has identified as affecting bilateral trade. To the best of our knowledge, the size, scope, and level of disaggregation in our dataset expands the empirical frontier for the political economy of trade literature.

Our estimates show that the impact of our political variables falls primarily on the extensive margin. Furthermore, we find that the impact of political institutions varies across industries, with the largest effects manifesting among differentiated products. These are products for which we expect the political spillovers resulting from personal contacts to be more significant, thereby making vulnerable authoritarian regimes more reluctant to trade. Our findings suggest that regime security, rather than democracy *per se*, is particularly relevant to the extensive margin. In fact, the profile that emerges from our empirical analysis of a regime that promotes extensive margin trade does not coincide with democracy. We do find that some *Polity IV* components of

democracy—Competitiveness of Political Participation and Constraint on Chief Executive—promote extensive margin trade, and that they do so primarily for differentiated products. But this is also the case for Regime Durability, which is not a part of the POLITY composite democracy measure. While our theory does not distinguish between the network externalities entailed by exports and imports, our empirical finding is that the impact of all three of the aforementioned variables is concentrated on the extensive margin for exports but not for imports. This is consistent with the idea that an exporter of a differentiated product will need to make extensive contacts in the importing country in order to serve the market, beyond the watchful gaze of the exporting country's secret police.

Our finding that the polity variables affect differentiated products on the extensive margin, while they have little systematic effect on the intensive margin, is consistent with our theory, and highlights the importance of interpersonal contact for the effects of regime type on trade. Generating better measures of networks is a high priority for ongoing investigation.

References

Amemiya, Takeshi. 1984. Tobit Models: A Survey. *Journal of Econometrics* 24 (1-2):3–61.

Anderson, E, James. 1979. A Theoretical Foundation for the Gravity Equation. *The American Economic Review* 69 (1):106–16.

Anderson, James E., and Eric van Wincoop. 2003. Gravity with Gravitas: A Solution to the Border Puzzle. *The American Economic Review* 93 (1):170–92.

Antràs, Pol. 2015. *Global Production: Firms, Contracts, and Trade Structure*. Princeton, NJ: Princeton University Press.

Antràs, Pol, Davin Chor, Thibault Fally, and Russell Hillberry. 2012. Measuring the Upstreamness of Production and Trade Flows. *The American Economic Review* 102 (3):412–416.

Arkolakis, Costas, Arnaud Costinot, and Andrés Rodríguez-Clare. 2012. New Trade Models, Same Old Gains? *The American Economic Review* 102 (1):94–130.

Blalock, Garrick, and Paul J. Gertler. 2004. Learning from Exporting Revisited in a Less Developed Setting. *Journal of Development Economics* 75 (2):397–416.

Bliss, Harry, and Bruce M. Russett. 1998. Democratic Trading Partners: The Liberal Connection, 1962–1989. *Journal of Politics* 60 (4):1126–47.

Bollen, Kenneth. 1993. Liberal Democracy: Validity and Method Factors in Cross-National Measures. *American Journal of Political Science* 37 (4):1207–30.

Bown, Chad P. 2011. Taking Stock of Antidumping, Safeguards and Countervailing Duties, 1990–2009. *The World Economy* 34 (12):1955–98.

Broda, Christian, and David E. Weinstein. 2006. Globalization and the Gains from Variety. *The Quarterly Journal of Economics* 121 (2):pp. 541–85.

Bueno De Mesquita, Bruce, and George W. Downs. 2005. Development and Democracy. *Foreign Affairs* 84 (5):77–86.

Chaney, Thomas. 2008. Distorted Gravity: The Intensive and Extensive Margins. *American Economic Review* 98 (4):1707–21.

———. 2014. The Network Structure of International Trade. *American Economic Review* 104 (11):3600–34.

Coppedge, Michael, and Wolfgang Reinicke. 1991. Measuring Polyarchy. In *On Measuring Democracy: Its Consequences and Comcommitants*, edited by Alex Inkeles. New Brunswick, NJ: Transaction.

Dutt, Pushan, Ilian Mihov, and Timothy Van Zandt. 2013. The Effect of WTO on the Extensive and the Intensive Margins of Trade. *Journal of International Economics* 91 (2):204–19.

Eaton, Jonathan, Samuel Kortum, and Francis Kramarz. 2011. An Anatomy of International Trade: Evidence from French Firms. *Econometrica* 79 (5):1453–98.

Egorov, Georgy, Sergei Guriev, and Konstantin Sonin. 2009. Why Resource-Poor Dictators Allow Freer Media: A Theory and Evidence from Panel Data. *American Political Science Review* 103 (4):645–68.

Eisen, Michael B., Paul T. Spellman, Patrick O. Brown, and David Botstein. 1998. Cluster Analysis and Display of Genome-wide Expression Patterns. *Procedings of the National Academy of Sciences* 95 (25):14,863–8.

Erickson, Kathleen. 1981. Secret Societies and Social Structure. *Social Forces* 60 (1):188–210.

Frankel, Jeffrey A., Ernesto Stein, and Shang-Jin Wei. 1997. *Regional Trading Blocs in the World Economic System*. Peterson Institute.

Frieden, Jeffry A., and Ronald Rogowski. 1996. The Impact of the International Economy on National Policies: An Analytical Overview. In *Internationalization and Domestic Politics*, edited by Robert O. Keohane and Helen V. Milner, chap. 2, 25–47. Cambridge, UK: Cambridge University Press.

Garmendia, Aitor, Carlos Llano, Asier Minondo, and Francisco Requena. 2012. Networks and the Disappearance of the Intranational Home Bias. *Economics Letters* 116 (2):178–82.

Gelman, Andrew, John B. Carlin, Hal S. Stern, and Donald B. Rubin. 2014. *Bayesian Data Analysis*. 3rd ed. Boca Raton, FL: Chapman and Hall/CRC.

Gibler, Douglas M. 2013. Correlates of War Formal Interstate Alliance Dataset, 1816-2012. CQ Press.

Goldstein, Judith L., Douglas Rivers, and Michael Tomz. 2007. Institutions in International Relations: Understanding the Effects of the GATT and the WTO on World Trade. *International Organization* 61 (1):37–67.

Gowa, Joanne. 1989. Bipolarity, Multipolarity, and Free Trade. *American Political Science Review* 83 (4):1245–56.

Greif, Avner. 1989. Reputation and Coalitions in Medieval Trade: Evidence on the Maghribi Traders. *The Journal of Economic History* 49 (4):857–82.

Greif, Avner, Paul Milgrom, and Barry R Weingast. 1994. Coordination, Commitment, and Enforcement: The Case of the Merchant Guild. *Journal of Political Economy* 102 (4):745–76.

Hadar, Josef, and William R. Russell. 1969. Rules for Ordering Uncertain Prospects. *The American Economic Review* 59 (1):25–34.

Hanoch, Giora, and Haim Levy. 1969. The Efficiency Analysis of Choices Involving Risk. *The Review of Economic Studies* 36 (3):335–46.

Heckman, James J. 1979. Sample Selection Bias as a Specification Error. *Econometrica* 47 (1):153–61.

Helpman, Elhanan, Marc Melitz, and Yona Rubinstein. 2008. Estimating Trade Flows: Trading Partners and Trading Volumes. *The Quarterly Journal of Economics* 123 (2):441–87.

Henisz, Witold J. 2000. The Institutional Environment for Economic Growth. *Economics & Politics* 12 (1):1–31.

Henisz, Witold J., and Edward D. Mansfield. 2006. Votes and Vetoes: The Political Determinants of Commercial Openness. *International Studies Quarterly* 50 (1):189–212.

Herfindahl, Orris Clemens. 1950. Concentration in the Steel Industry. Unpublished PhD Dissertation, Columbia University.

Hirschleifer, Jack. 1989. Conflict and Rent-seeking Success Functions: Ratio vs. Difference Models of Relative Success. *Public Choice* 63 (2):101–12.

Hiscox, Michael J. 2002. Commerce, Coalitions, and Factor Mobility: Evidence from Congressional Votes on Trade Legislation. *The American Political Science Review* 96 (3):593–608.

Hollyer, James R., Peter B. Rosendorff, and James Raymond Vreeland. 2011. Democracy and Transparency. *Journal of Politics* 73 (4):1191–1205.

House, Freedom. 2014. *Freedom in the World: 2014*. online document. Available at <https://freedomhouse.org/sites/default/files/Freedom%20in%20the%20World%202014%20Booklet.pdf>.

Jackson, Matthew O. 2010. *Social and Economic Networks*. Princeton, NJ: Princeton University Press.

Jeffreys, Harold. 1998. *The Theory of Probability*. 3rd ed. Oxford, UK: Oxford University Press.

Kapelko, Natalia, and Natalya Volchkova. 2013. Export Costs of Visa Restrictions: Evidence from Russia. SSRN Electronic Journal. Available at <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2243136>.

Kass, Robert E., and Adrian E. Raftery. 1995. Bayes Factors. *Journal of the American Statistical Association* 90 (430):773–95.

King, Gary, Jennifer Pan, and Margaret Roberts. 2013. How Censorship in China Allows Government Criticism but Silences Collective Expression. *American Political Science Review* 107 (2):1–18.

Kono, Daniel Y. 2006. Optimal Obfuscation: Democracy and Trade Policy Transparency. *American Political Science Review* 100 (3):369–84.

Kono, Daniel Yuichi. 2008. Democracy and Trade Discrimination. *Journal of Politics* 70 (4):942–55.

Lange, Glenn-Marie, Quentin Wodon, and Kevin Carey. 2018. *The Changing Wealth of Nations 2018: Building a Sustainable Future*. Washington, D.C.: The World Bank.

Larson, Jennifer, and Janet Lewis. 2018. Rumors, Kinship Networks, and Rebel Group Formation. *International Organization* 72 (4):871–903.

Lehmann, Erich Leo. 1955. Ordered Families of Distributions. *Annals of Mathematical Statistics* 26 (3):339–419.

Levchenko, Andrei A. 2007. Institutional Quality and International Trade. *The Review of Economic Studies* 74 (3):791–819.

Liu, Xuepeng. 2009. GATT/WTO promotes trade strongly: Sample Selection and Model Specification. *Review of international Economics* 17 (3):428–46.

Lorentzen, Peter. 2014. China's Strategic Censorship. *American Journal of Political Science* 58 (2):402–14.

Manova, Kalina. 2013. Credit Constraints, Heterogeneous Firms, and International Trade. *The Review of Economic Studies* 80 (2):711–44.

Mansfield, Edward D., Helen V Milner, and Jon C Pevehouse. 2007. Vetoing Co-operation: The Impact of Veto Players on Preferential Trading Arrangements. *British Journal of Political Science* 37 (3):403–32.

Mansfield, Edward D., Helen V. Milner, and Peter B. Rosendorff. 2000. Free to Trade: Democracies, Autocracies, and International Trade. *The American Political Science Review* 94 (2):305–321.

———. 2002. Why Democracies Cooperate More: Electoral Control and International Trade Agreements. *International Organization* 56 (3):477–513.

Manyin, Mark E., and Dick K. Nanto. 2011. *The Kaesong North-South Korean Industrial Complex.* Collingdale, PA: DIANE Publishing. Congressional Research Service.

Marshall, Monty, Ted R. Gurr, and Keith Jaggers. 2010. Polity IV Project: Political Regime Characteristics and Transitions, 1800-2009. Center for Systemic Peace.

Melitz, Marc J. 2003. The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity. *Econometrica* 71 (6):1695–1725.

Metternich, Nils, Cassy Dorff, Max Gallop, Simon Weschle, and Michael Ward. 2013. Antigovernment Networks in Civil Conflicts: How Network Structures Affect Conflictual Behavior. *American Journal of Political Science* 57 (4):892–911.

Milner, Helen V., and Keiko Kubota. 2005. Why the Move to Free Trade? Democracy and Trade Policy in the Developing Countries. *International Organization* 59 (1):107–43.

Nunn, Nathan. 2007. Relationship-specificity, Incomplete Contracts, and the Pattern of Trade. *The Quarterly Journal of Economics* 122 (2):569–600.

Nunn, Nathan, and Daniel Trefler. 2014. Domestic Institutions as a Source of Comparative Advantage. In *Handbook of International Economics*, chap. 5, 263–315. New York, NY: Elsevier.

Olsen, Randall J. 1980. A Least Square Correction for Selectivity Bias. *Econometrica* 48 (7):1815–20.

Pavcnik, Nina. 2002. Trade Liberalization, Exit, and Productivity Improvements: Evidence from Chilean Plants. *The Review of Economic Studies* 69 (1):245–76.

Pool, Ithiel De Sola. 1983. *Technologies of Freedom.* Cambridge, MA: Belknap.

Przeworski, Adam, Michael E. Alvarez, José Antonio Cheibub, and Fernando Limongi. 2000. *Democracy and Development: Political Institutions and Well-Being in the World.* Cambridge, UK: Cambridge University Press.

Ratkovic, Marc, and Dustin Tingley. 2017. Sparse Estimation and Uncertainty with Application to Subgroup Analysis. *Political Analysis* 25 (1):1–40.

Rauch, James E. 1999. Networks Versus Markets in International Trade. *Journal of International Economics* 48 (1):7–35.

Rauch, James E., and Vitor Trindade. 2002. Ethnic Chinese Networks in International Trade. *Review of Economics and Statistics* 84 (1):116–30.

Rogowski, Ronald. 1987. Political Cleavages and Changing Exposure to Trade. *The American Political Science Review* 81 (4):1121–37.

Rose, Andrew K. 2004. Do We Really Know That the WTO Increases Trade? *The American Economic Review* 94 (1):98–114.

Rousseau, Jean-Jacques. 1963. *Du Contrat Social ou Principes du Droit Politique*. Paris, France: Union Générale d'Éditions.

Russett, Bruce M., and John R. Oneal. 2000. *Triangulating Peace: Democracy, Interdependence, and International Organizations*. New York, NY: W. W. Norton and Company Inc.

Schott, Peter K. 2004. Across-product versus Within-product Specialization in International Trade. *The Quarterly Journal of Economics* 119 (2):647–78.

Shadmehr, Mehdi, and Dan Bernhardt. 2015. State Censorship. *American Economic Journal: Microeconomics* 7 (2):280–307.

Silva, J. M. C. Santos, and Silvana Tenreyro. 2006. The Log of Gravity. *The Review of Economics and Statistics* 88 (4):641–58.

Skaperdas, Stergios. 1996. Contest Success Functions. *Economic Theory* 7 (2):283–90.

Tavares, José. 2008. Trade, Factor Proportions, and Political Rights. *The Review of Economics and Statistics* 90 (1):163–68.

Tinbergen, Jan, et al. 1962. *Shaping the World Economy; Suggestions for an International Economic Policy*. New York, NY: Twentieth Century Fund.

Tomz, Michael, Judith L. Goldstein, and Douglas Rivers. 2007. Do We Really Know That the WTO Increases Trade? Comment. *The American Economic Review* 97 (5):2005–2018.