Democracy and Industry-varying Liberalization: Evidence from a New Tariff-line Dataset*

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Abstract

Do democracies face more or less political pressures to protect certain industries than non-democracies? How important are a trading partner's political institutions in overcoming time-inconsistency problems? While domestic political institutions and distributional conflicts across disparate industries have long been central to theories of international political economy, few empirical studies examine liberalization trajectories across industries, let alone countries' partner-specific policy differences. We collect 5.2 billion observations of industry-level applied tariff rates that 136 countries differentially apply to their trading partners, incorporating the universe of preferential rates and Generalized System of Preferences (GSP) at the tariff line level. To incorporate the rich structure and volume of our data, we develop a Bayesian multilevel estimator that distinguishes the effects of political institutions across industries and trading partners. We find that pairs of democracies achieve greater tariff reductions in bilateral FTAs than dyads with a democracy and a non-democracy. However, we show that difference between democratic and mixed pairs is due in large part to shallower concessions granted by non-democratic importers vis-á-vis democratic partners, but not vice-versa. We also find evidence for protective demands from agricultural sector that democracies face. Our findings add nuance to the claim that democratic political institutions facilitate unilateral and bilateral trade liberalization.

Key Words: democracy, trade liberalization, international trade, preferential trade agreements, bilateral product-level tariffs, big data, heterogeneous effects, agricultural protection

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1 Introduction

Do democracies and non-democracies differ in the industries that they protect against foreign competition? How important are a trading partner's political institutions in overcoming time-inconsistency problems when countries negotiate bilateral trade agreements? Theories of international political economy predict heterogeneity in trade policy across products and partners, conditioning on the political and economic environments in which countries operate. Governments face disparate protective demands from various political groups (e.g., Hillman, 1984; Rogowski, 1987; Magee, Brock and Young, 1989; Hiscox, 2002; Kim, 2017) while countries with different political institutions evaluate political rents and social welfare differently for each sector (Grossman and Helpman, 1994), resulting in heterogeneous trade policies across products. Moreover, trade policies are also expected to differ across trading partners. The number of Preferential Trade Agreements (PTAs) has grown significantly over the last few decades, creating a complex web of preferential policies across products and partners that most international trade now goes through (Bhagwati, 2008). Again, characteristics of domestic political institutions are important determinants of partner-specific trade liberalization (Mansfield, Milner and Rosendorff, 2000, 2002).

Despite heterogeneity in trade policies across products and exporting partners, researchers typically use high-level, aggregate measures of trade policies when evaluating the relationship between political institutions and trade policies. Specifically, many studies employ Most Favored Nation (MFN) applied tariff rates or non-tariff barriers (NTB) coverage-ratio with respect to import volume averaged across products (e.g., Mansfield and Busch, 1995; Gawande and Hansen, 1999; Milner and Kubota, 2005; Kono, 2006). The resulting *single* number for a given importer-year observation is then used to examine whether democracies have more liberal trade policies than non-democratic nations. Yet theories that predict differences in trade liberalization between democracies and non-democracies often yield rich predictions about sectoral heterogeneity in the effects of political institutions. These theoretical predictions are unfortunately elided by coarse measures of trade policies. Studies that examine the interactive effects of domestic political institutions are also limited. As Mansfield, Milner and Rosendorff (2000) note, measures of bilateral trade barriers across all combinations of country-pairs are notoriously difficult to collect at the product level, and thereby constrain researchers to use bilateral trade volume as a proxy measure for partner-specific trade policy.

We collect over 5.2 billion observations of product-level applied tariff rates that countries differentially apply to their trading partners, incorporating the universe of preferential rates and Generalized System of Preferences (GSP) at the *tariff line* level. We develop a replicable automated

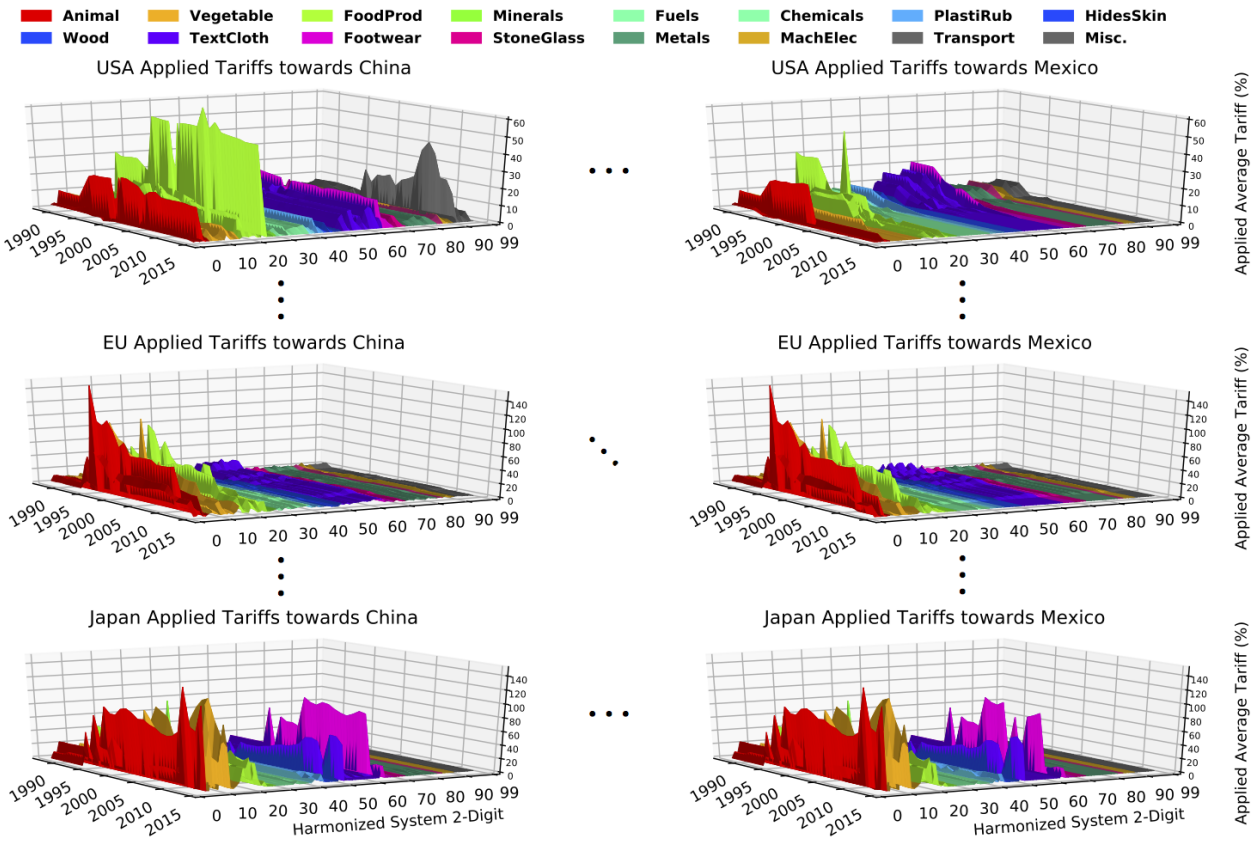

Figure 1: **Variations in Ad-Valorem Applied Tariff Rates across Trading Partners and Industries:** This figure demonstrates how our tariff line data captures both partner-specific and industry-varying trade policies. For a given country and partner, our data distinguishes precise tariff rates on more than 100 highly specific products in various industries (colored within plot) across 30 years. This is identified for any choice of World Trade Organization (WTO) importer (plotted down each column) and exporter (plotted across each row). Note that increases in applied tariff rates are due to the calculation of ad valorem equivalent rates based on the Method for specific tariff rates or actual temporary increases due to "binding overhang" (Pelc, 2013).

pipeline to (1) download massive amounts of tariff data from multiple web data sources, (2) identify the partner-specific tariff rates for each product, and (3) resolve conflicts to ensure data quality when any discrepancies arise. Figure 1 demonstrates the significant variations in trade policy across trading partners and products that we observe from our data. For example, the first row shows that across industries and over time, the MFN tariff rates applied by the U.S. on imports from China (another WTO member) is very different from the preferential rates applied on imports from Mexico (a NAFTA member). It also shows a high variation in each column where different importers impose different rates towards a common exporter (e.g., China). We then combine our product-level trade policy data for each directed dyad with numerous country-, dyad-, and directed dyad-level data

available in the literature, such as measures of political institutions, GATT/WTO membership, and product-level bilateral trade volume. To the best of our knowledge, this is the first database that combines bilateral trade policies and trade volume at the product-level across 136 countries over 30 years.

The main contribution of the paper is to empirically examine the relationship between domestic political institutions of trading partners and their trade policies towards each other. To incorporate the rich structure and volume of our data, we develop a Bayesian multilevel estimator that distinguishes the effects of political institutions across industries and trading partners. We begin our analysis by comparing the MFN trade policies between democracies and non-democratic nations. Consistent with Milner and Kubota (2005), we find that democracies are associated with lower trade tariffs than non-democracies, on average. However, we find a high level of heterogeneity across industries. Specifically, democracies and non-democracies do not differ by much, on average, in terms of tariffs on agricultural products. At the same time, industries such as wood and metal industries tend to get significantly lower tariff rates in democracies compared to non-democracies. Our finding provides evidence for heterogenous effects of democratic political institutions on trade liberalization across industries. In particular, it provides evidence for the agriculture industry's unique status in trade politics, which has been identified by many studies, however with few theoretical connections to domestic political institutions (Anderson et al., 1986; De Gorter and Tsur, 1991; Olper, 1998; Swinnen et al., 2000; Davis, 2003; Thies and Porche, 2007).[1]

Next, we conduct dyadic analysis to examine whether pairs of democracies are more likely to engage in deeper trade liberalization than mixed pairs of democratic and non-democratic trading partners. We consider a total of 85 bilateral free trade agreements that have been signed between 1991 and 2012, and for products in each of 96 Harmonized System (HS) 2-digit industries, compute differences in applied tariff rates prior to and after each agreement. We then compare the difference-in-differences between the two institutional combinations. Consistent with Mansfield, Milner and Rosendorff (2000), we find that pairs of democratic nations tend to undergo deeper trade liberalization than mixed pairs. However, once we decompose the *direction* of trade liberalization, we find that the extent of the association between mutual democracies and trade liberalization, relative to mixed pairs, is conditional on whether the importer or the exporter in the mixed pair is a democracy. We show that a non- democratic importer engages in shallower trade liberalization when negotiating against a democratic exporter, compared to a democratic pair. On the other hand, we find no significant

[1] See Beghin and Kherallah (1994) and Park and Jensen (2007) for notable exceptions.

differences in tariff reductions given by a democratic importer to a non-democratic exporter, compared to a pair of democracies. These results are robust across various industries. Overall, our findings add nuance to the claim that democratic political institutions facilitate unilateral and bilateral trade liberalization.

The rest of the paper is organized as follows. In the next section, we provide a detailed description of our automated dataset compilation pipeline. We show that numerous discrepancies exist between two primary databases that have been widely used in the literature, and detail how we construct a new dataset that resolves these discrepancies. Section 3 presents the empirical findings from the monadic and the dyadic analyses. The final section concludes. The bilateral product-level tariffs database as well as the source codes will be made publicly available through the webpage at `https://tradelab.mit.edu`.

2 New Database: Bilateral Product-level Applied Tariffs

In this section, we describe the challenges involved in collecting large amounts of detailed bilateral tariff rates that countries apply differently to products and trading partners. We discuss the variation in applied tariff rates, our data compilation process, the discrepancies in available data sources, and the ways we organize the data for our empirical analyses.

2.1 Heterogeneity in Applied Tariffs

A vast literature argues that countries with different political institutions will have different incentives to liberalize both unilaterally (e.g., Frieden and Rogowski, 1996; Milner and Kubota, 2005; Kono, 2006) and bilaterally (e.g., Mansfield, Milner and Rosendorff, 2000, 2002). In addition, theories of international political economy predict heterogenous trade policy across various industries and products even for a given country. In a sectoral model of trade politics, Grossman and Helpman (1994) predict that trade policies will differ across industries depending on the intensity of lobbying, import-penetration, and import demand elasticities. Both Ricardo-Viner and Heckscher-Ohlin models also expect that a country might face different political demands for protection across various domestic industries based on its factor endowment or factor mobility (Rogowski, 1987; Hiscox, 2002). Firm-level theory predicts that trade policy may vary significantly across products even within the same industry (Kim, 2017).

Trade policies also differ across partners as illustrated by Figure 1. WTO members face different tariffs when they export goods to other member states because they are permitted to enter regional trade agreements under Article XXIV of GATT, Enabling Clause, and to lower tariffs for the least

developed countries with GSP. That is, the rule of "non-discrimination" does not prevail in practice. For example, the U.S. tariffs on cars (Harmonized Tariff Schedule [HTS] subheading `87039000`) exported by FTA partner South Korea in 2013 is 1.5% whereas it is 2.5% (the MFN rate) if cars originate from other WTO members. Moreover, even the GSP rate can be different across products among GSP beneficiaries for strategic reasons. As Carnegie (2015, pg, 60) finds, Pakistan was *partially* suspended from the U.S. GSP program in 1996 due to its violations of workers' rights. Indeed, we find that the applied rates on gloves (HTS subheading `39262030`) given to Pakistan was 3% (the MFN rate) in 1997 instead of the GSP rate of 0% even though Pakistan remained a GSP beneficiary and still received benefits for many other products. To better analyze such differential trade policies, researchers must use partner-specific tariff line data rather than aggregate tariff measures.

2.2 Challenges in Collecting and Constructing the Bilateral Tariff-line Data

We develop an automated pipeline to create a dataset of bilateral trade policy for each tariff line product and partner. To create our dataset, we begin with two data sources: (1) the WTO Integrated Database (IDB) and (2) UNCTAD Trade Analysis Information System (TRAINS). Both contain applied tariff rates on a variety of products for all WTO countries from at least 1996 (and as early as 1988 for some countries) to 2016 (for some countries). However, there are three challenges that limit the use of the databases by researchers in practice.

First, to download all product-level tariffs, each database requires users to submit numerous queries to the system for each importer-year pair. As shown in **Step 1** in Figure 2, researchers have to specify an importing country and the year of interest more than 2,000 times and download the resulting files separately to their machine, one by one, in order to retrieve the complete dataset. Because the databases are periodically updated as countries report new data to the WTO and UNCTAD, researchers have to repeat the tedious download process to ensure that they use an up to date dataset for empirical analysis. To overcome this difficulty, we develop a web scraper that spawns multiple processors which can log in to each system, submit queries in parallel, and download the entire data, automatically. Our web scraper gathers nearly 40 GB (Gigabytes) of product-level tariff data in a period of 2-3 days, which covers 2,188 importer-year profiles.

Second, even when a researcher can successfully download all product-level tariff data (either automatically or manually), a more difficult challenge remains to identify the correct partner-specific rates. Specifically, both databases only specify the "type" of tariff rates that a given importer applies differently to its partners. For example, we know that from the U.S.-2007 data that the applied rate of "`Free-trade for Singapore`" is 0% and "`Singapore-United States Free Trade`

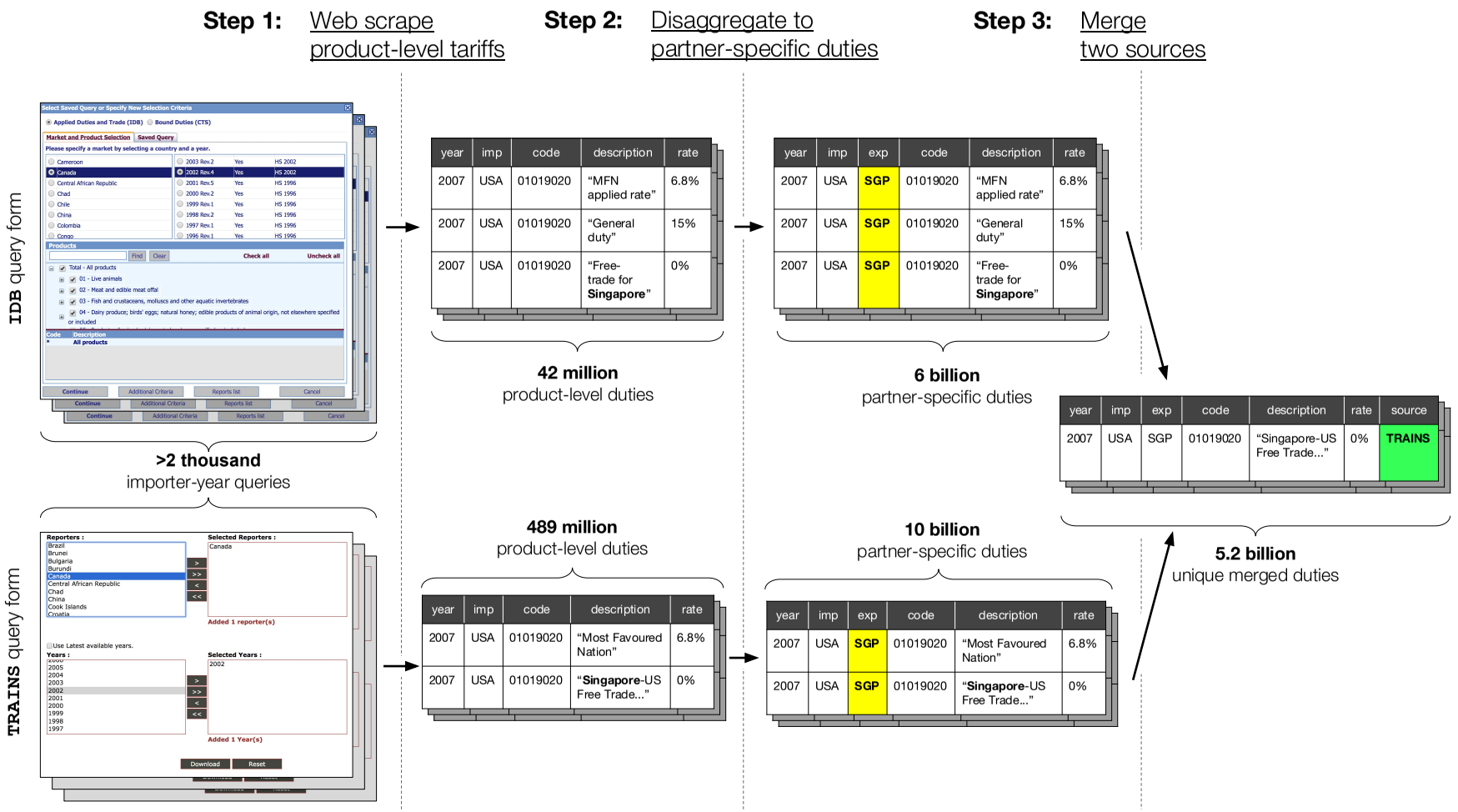

Figure 2: **Tariff-line Dataset Creation:** This figure broadly illustrates the process of creating our industry-level partner-specific tariff dataset. As an example, we show how we produce the United States' 2007 duty on Singaporean exports of `Live horses, asses, mules and hinnies` (HTS subheading `01019020`). First, we scrape tariffs across all available importers and years using the public web forms for IDB and TRAINS respectively. Then, we use the tariff beneficiary description (shown as `type`) to find all tariffs whose beneficiary group includes Singapore. As shown, the two databases produce an MFN duty, a general duty, and a free trade duty as applicable duties. Finally, to select the duty amongst these candidates most likely applied in practice, we use a custom merging algorithm described in A.2. In this case, Singapore enjoys a zero tariff due to a free trade agreement signed in 2003, which undercuts the previous MFN rate.

Issue	Year-Imp-Exp-HS (Product description)	WTO IDB report	UNCTAD TRAINS report (≈ AVE)	Solution(s)	N obs. (%)
Missing Duty	2013-CHN-IND-09041200 (`Crushed or ground Piper pepper`)	8%	none	Use non-missing.	2.35 billion (41.8%)
	1991-JPN-KOR-140490499 (`Vegetable industries`)	none	10%		
Conflicting Rates	1997-AUS-SGP-22082010 (`Grape wine`)	3%	3% + $31.12/L (≈ 127%)	Use ad valorem equivalent (AVE) computed by UNCTAD.	0.40 billion (6.9%)
	2005-IND-CHN-52094910 (`Woven fabrics`)	0%	Rs. 150/kg (≈ 23%)		
	1996-URY-USA-10081090 (`Buckwheat`)	0%	8%	Use lower (preferential) rate.	
	2010-DOM-CRI-08091000 (`Apricots`)	20%	0%		

Table 1: **Solutions to Tariff Data Issues:** This table shows specific disagreements between IDB and TRAINS tariff reports that are resolved by our merging algorithm. In each example, the algorithm selects the report believed to be the most precise applied rate. For instance, for Australia's 1997 tariff on `Grape wine` from Singapore, IDB only reports a 3% ad valorem rate while TRAINS accounts for the additional $31.12 per litre of wine in its ad valorem equivalent (AVE) rate. We provide full details of the merging algorithm in Appendix A.2.

`Agreement (2004)`" is 0% from IDB and TRAINS, respectively. Although it is clear that the rate only applies to Singapore, to code this in the data requires an additional step to link the textual description to the relevant country code for data analysis. A further challenge is that the text description of the duty type may refer to a multilateral trade agreement (e.g. `NAFTA`) or a group of countries (e.g. `G16`). We use a mix of hand-coding from official materials and string matching algorithms with country names and regional trade agreement titles in order to map each unique "type" appearing in the original data to its corresponding set of unique country ISO codes.[2] **Step 2** in Figure 2 illustrates this process.

Finally, there exists a number of discrepancies between the two data sources. Table 1 summarizes various issues that we identify. First, data for 52 importer-years appear only in IDB (but not TRAINS), while data for about 420 importer-years appear only in TRAINS (but not IDB). As a result, we find that at least 2.35 billion observations are missing from one of the databases, and thus make sure to utilize the available data whenever possible. Second, while IDB only reports ad valorem duty rates (e.g. `3.39%`), TRAINS uses a method to estimate ad valorem equivalent (AVE) rates for non-ad valorem specific tariff rates (e.g. `Rs. 150/kg` ≈ `23%`).[3] Third, preferential rates may be

[2]A list of official preference beneficiaries for many tariff measures can be found at `http://wits.worldbank.org/WITS/WITS/Support%20Materials/TrfMeasures.aspx?Page=TfMeasures`.

[3]For a given non-ad valorem tariff tariff, UNCTAD calculates an ad valorem equivalent by estimating the unit value of a product using volume statistics. The type of statistics – either tariff line-level statistics from TRAINS, HS 6-digit statistics from UN Comtrade, or HS 6-digit statistics aggregated across OECD countries – depends on data availability for each product. The unit value is then used to approximate a (%) tariff rate.

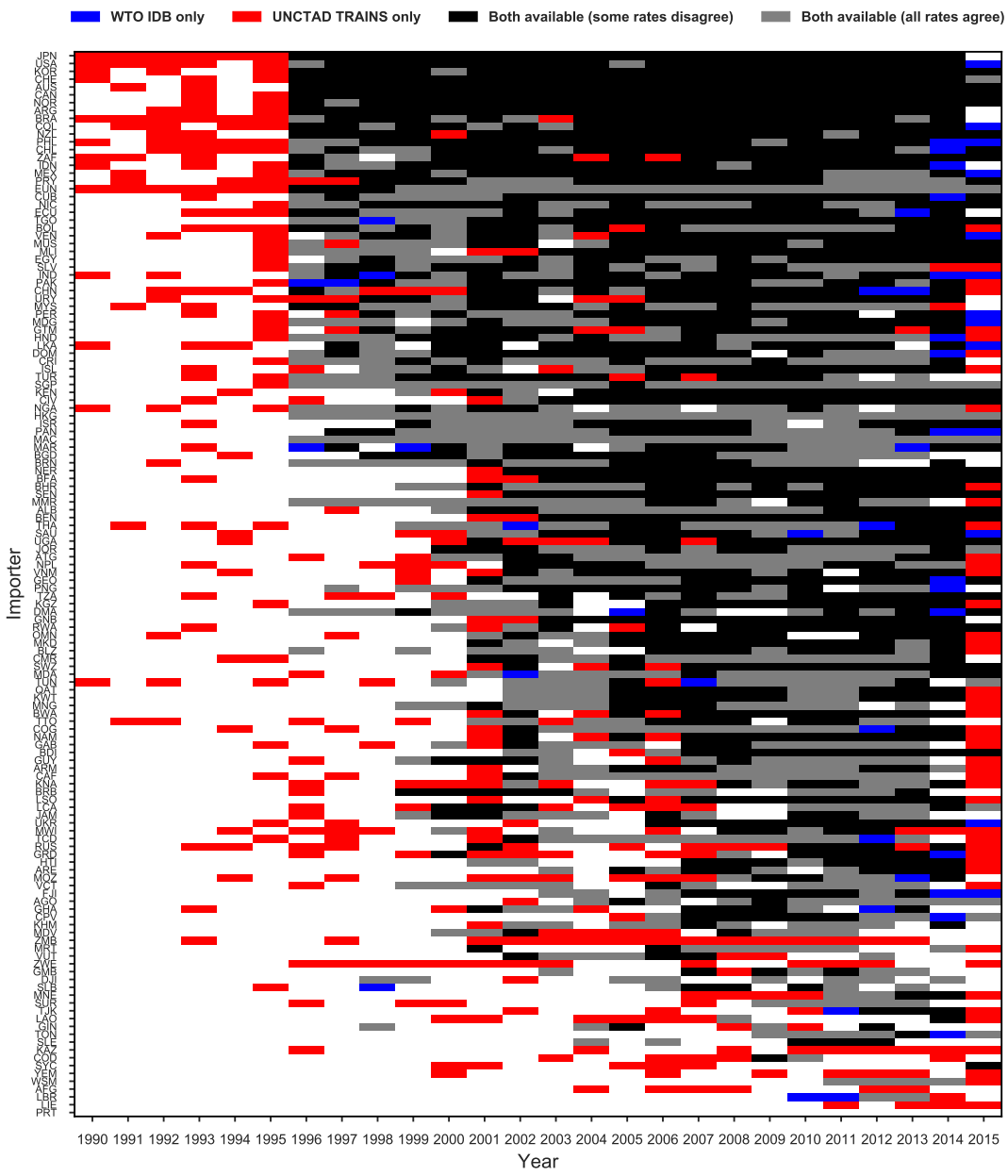

Figure 3: **Data Availability across Importers and Years:** Altogether, we compile 2,188 importer-year tariff profiles from the WTO Integrated Database (IDB) and the UNCTAD Trade Analysis Information System (TRAINS). As illustrated in this figure, only 51% of these observations are available from both sources where the reported duty rates agree. Appendix A.1 explains data collection and processing in detail.

available from only one source. As shown in the last row of Table 1, in this case, we use the lower of the two rates to ensure that our database correctly reflect partner specific preferential rates. This results in over 5.2 billion observations of bilateral trade policy dataset at the product-level.

Figure 3 summarizes the availability of our data for each importer and year. The large number of missing import-year observations from both primary sources (white cells) prevents our dataset

from being fully comprehensive. However, we make several improvements by combining data from the two available sources (red and blue cells) and resolving various discrepancies where the sources may conflict (black cells). In total, Figure 3 shows that we cover 2,188 importer-year tariff profiles, which includes most years for all major participants of global trade since 1995. Using this data, we now turn to the analysis of trade policy across countries with different political institutions.

3 Political Institutions and Trade Policy

In this section, we examine systematic differences in trade policy between countries with different political institutions. Specifically, we document how democracies set import tariffs differently across industries compared to non-democratic nations. We begin by analyzing unilateral trade policies ("monadic" analysis) across countries using MFN applied tariff rates. A robust finding is that democracies have lower tariff rates than non-democracies, on average. However, we find evidence that democracies are as protective as non-democracies for many industries, especially with respect to the agricultural sector. We then utilize our bilateral tariff data to investigate whether pairs of democracies engage in deeper trade liberalization ("dyadic" analysis). Our analysis of 91 bilateral Free Trade Agreements confirms that dyads in which both countries are democracies achieve larger tariff reductions compared to dyads in which only one party is a democracy. However, we find that the difference is due, in large part, to the shallower liberalization by non-democratic importers vis-á-vis democratic partners but not vice-versa.

3.1 Monadic Analysis

Do democratic political institutions facilitate unilateral trade liberalization? Applying the Stolper-Samuelson theorem, Milner and Kubota (2005) argue that democratization empowers the owners of factors with which their country is abundantly endowed, and therefore one should expect that trade liberalization will ensue, reflecting the median-voter's preferences. Using MFN tariff rates averaged across products, they find that democratization in labor-abundant developing countries is associated with lower trade barriers. Others argue that the presence of veto players and high-level of political participation by various interest groups might render democracies more sensitive to protectionist demands (Frieden and Rogowski, 1996). On the other hand, autocracies need to appeal to a narrower segment of society to secure their power, and therefore might be less susceptible to various societal pressures (Acemoglu and Robinson, 2005; Henisz and Mansfield, 2006)

To shed light on this debate, we examine whether trade policy varies between democracies and non-democracies across industries. Our industry-level analysis is motivated by the endogenous tar-

iff literature in which competing economic interests across domestic sectors determine industry-level trade policy (e.g., Mayer, 1984). In fact, the Stolper-Samuelson theorem postulates that the distributional implications of trade liberalization will be asymmetric in capital-abundant and labor-abundant industries, resulting in trade policy heterogeneity across industries. Moreover, as Grossman and Helpman (1994) show, political instituions and political activities of industries will interact with economic heterogeneity. Consequently, the canonical model of trade policy also predicts differences in trade policy across industries.

3.1.1 Methodology

To estimate the industry-varying effects of political institutions on trade policy, we introduce the following hierarchical Tobit model of the observed MFN tariff rate τ_{ith} for importer i, industry h at year t:

$$\begin{aligned} \tau^*_{ith} &= \beta X_{it} + \gamma_h^\top \mathbf{V}_{it} + \delta^\top \mathbf{Z}_{it} + \lambda W_{ith} + \eta_i + \theta_t + \epsilon_{ith} \\ \tau_{ith} &= \begin{cases} \tau^*_{ith} & \text{if } \tau^*_{ith} \geq 0 \\ 0 & \text{otherwise} \end{cases} \end{aligned} \tag{1}$$

where τ^*_{ith} is a latent tariff, which we observe if it is greater than zero, and is censored at zero otherwise. We use a logged value of τ_{ith} to reflect the high-skewness of the data. To facilitate the comparison of our empirical findings against the existing studies, we use a binary measure of democracy whereby X_{it} is unity if importer i's Polity IV score is 6 or above in year t and zero otherwise (e.g. Mansfield, Milner and Rosendorff, 2000; Milner and Kubota, 2005; Persson and Tabellini, 2005). $\mathbf{V}_{it}$ is a set of covariates – democracy (X_{it}), log GDP per capita, and an intercept – for which we estimate industry-varying coefficients. $\mathbf{Z}_{it}$ represents a vector of covariates that have been identified in the literature as confounding factors of political institutions and trade policy: log GDP per capita (PPP basis), log population, an indicator for GATT/WTO membership, log import volume, and an intercept. All covariates are lagged by 1 year.[4] We also include the continuous Balassa index, W_{ith}, in order to control for countries' revealed comparative advantages that vary across industries and time.[5] Finally, η_i and θ_t are importer- and year-varying intercepts respectively, and ϵ_{ith} is idiosyncratic error that

[4]GDP and population figures come from the World Bank Open Data website: `https://data.worldbank.org/`. Trade volume data are sourced from the United Nations Comtrade Database. In the exposition that follows, we use "non-democracy" as a shorthand to describe importer-years with Polity IV scores of less than 6.

[5]The Balassa index of a given industry for a given country is the ratio of the industry's share of the country's total exports, to the industry's share of global exports.

are assumed to be drawn from a Normal distribution:

$$\eta_i \overset{\text{i.i.d.}}{\sim} \mathcal{N}(\mathbf{0}, \Sigma_\eta), \qquad \theta_t \overset{\text{i.i.d.}}{\sim} \mathcal{N}(\mathbf{0}, \Sigma_\theta), \qquad \epsilon_{ith} \overset{\text{i.i.d.}}{\sim} \mathcal{N}(0, \sigma_\epsilon^2). \tag{2}$$

To account for the heterogenous political process across industries, we model the industry-varying effects hierarchically. Specifically, we allow the effects vary across Harmonized System 2-digit industry h (e.g., vegetables vs. fish) but incorporate the complex correlation within a broader sector k (e.g., food sector) that operates differently from other industries (e.g., textile sector).

$$\gamma_h \sim \mathcal{N}(\phi_{k[h]}, \Sigma_\gamma) \tag{3}$$

$$\phi_k \sim \mathcal{N}(\mathbf{0}, \Sigma_\phi) \tag{4}$$

where Harmonized System 2-digit industry h belonging to sector k, is drawn from a multivariate-Normal distribution with a mean vector $\phi_{k[h]}$ and covariance matrix Σ_γ, and ϕ_k is drawn from a multivariate-Normal distribution with mean 0 and covariance matrix Σ_ϕ. This means that the industry-specific coefficients vary based on the sector k to which the industry belongs, which increases the plausibility of the exchangeability assumption for the industry-specific effects.

We estimate the parameters of our model using Hamiltonian Monte Carlo (HMC) method implemented in the Stan program (Carpenter et al., 2016). HMC is an appropriate tool to deal with the complexity of our model in which the high multidimensionality of the parameter space might result in inefficient mixing and severe autocorrelation in the samples from standard Markov Chain Monte Carlo (MCMC) methods (Betancourt, 2017). HMC efficiently explores the parameter space rendering it possible to estimate parameter values with accuracy within a reasonable length of time. We run four separate chains with 2,000 iterations each and verify the convergence using the Gelman-Rubin statistic.[6] We make the entire posterior samples publicly available while focusing on the posterior means and credible intervals of our quantity of interest.

3.1.2 Empirical Results

Our dataset reports MFN tariffs for 73 countries over 26 years (1990 to 2015) across 96 HS 2-digit (HS2) industries. We aggregate MFN tariffs at the industry-level by taking the simple average of MFN tariffs for all products in a given industry. We observe 118,916 MFN rates in total, including 5,639 duty-free (0%) rates. To address missingness in our covariate data, we created multiple imputed datasets using an algorithm for multiple imputation implemented in the Amelia II program (Honaker, King and Blackwell, 2011). We use a different imputed dataset in each of our four HMC chains.

[6] We run the four chains in parallel. Obtaining 2,000 draws from the posterior takes about 3 days of computing time.

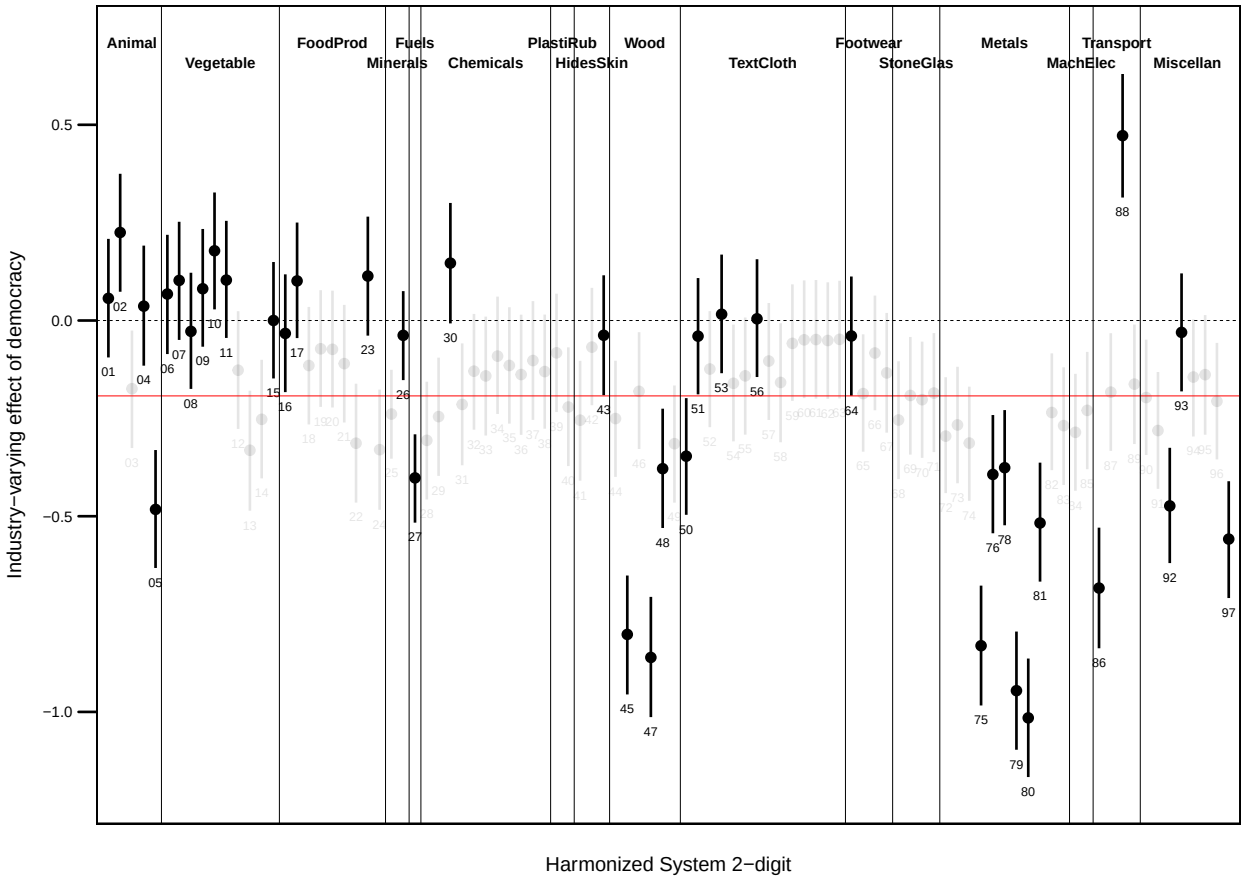

Figure 4: **Effect of Democracy on Log Tariffs:** This plot presents posterior means and 95% credible intervals for the estimated effects of democracy on trade policy for each HS2 industry. Across all industries, MFN tariffs are about 22%($\approx \exp(0.2) - 1$) lower on average for democracies than non-democracies, which corresponds to the solid red horizontal line. However, there exists significant heterogeneity in the effect of democracy across industries. Democracies tend to have relatively higher tariffs over agricultural sectors while metal products get lower tariffs compared to other industries. Industries with black lines have statistically different levels of trade policy than the overall main effect while those with light grey lines are associated trade policy that is similar to it. The two-digit Harmonized System chapter codes are given at the bottom of each line.

Our quantity of interest is the industry-varying effects of democracy on trade policy.[7] The model given in equation (1) decomposes it into two parts: (1) the main effect β and (2) the industry-specific partial effect of democracy $\gamma_h^{\texttt{DEM}}$.[8]

Figure 4 reports the posterior distribution of our quantity of interest: $\beta + \gamma_h^{\texttt{DEM}}$. The mean of the posterior distribution of the main effect of democracy, β, (marked by the red horizontal line) shows that democracies impose about 22%($\approx \exp(0.2) - 1$) lower MFN tariffs across industries on average

[7] Here we use "effect" in the predictive, rather than the causal, sense.

[8] Note that γ_h is a vector of industry varying effects, and we denote the element corresponding to democracy variable X_{it} by $\gamma_h^{\texttt{DEM}}$.

than non-democracies. This finding is consistent with Milner and Kubota (2005) and Chaudoin, Milner and Pang (2015) who find that democratization of developing nations is associated with trade liberalization. We find that this is generally true even when we include a large number of industrialized countries and use a more fine-grained industry-level data since 1990.

It is important to note, however, that the results reveal significant heterogeneity in the effects of democracy *across* industries. The figure highlights (in black) the industries in which the democracy effect is significantly different from the posterior mean of the main effect (β). We also highlight (in light grey) the industries for which the 95% credible intervals of the total effect ($\beta + \gamma_h^{\texttt{DEM}}$) overlap with the main effect. We find that the democracy effects for animal, vegetable, food, wood, and metals products diverge significantly from the main effect, which is mostly pronounced in the first three agricultural industries.

The significant deviation of agricultural trade policy from the overall effect of democratic political institution suggests that democratic political institutions might be susceptible to protectionist demands from the agricultural sector compared to other industries. Economically, agricultural producers are vulnerable to price changes due to inelastic supply of agricultural products in general. Therefore, they are more likely to overcome collective action problems and concentrate their demands for protection. On the other hand, as Anderson et al. (1986) argue, consumers and taxpayers will bear the dispersed costs making it politically viable to provide agricultural protection. This political force might have even more significant effects in representative democracies. In fact, there exists "rural bias" in many democratic countries whereby rural districts are found to be disproportionally overrepresented and the number of "pro-agricultural voters" sharing interests with agricultural sector, for example through extended family, tend to be also large (Mulgan, 1997; Davis, 2003).

To be sure, we do not find strong evidence for the differences between democracies and non-democracies based on the total effects except for Meat products (HS2 `02`) and Cereals (HS2 `10`). Yet, the estimated higher tariff rates, after controlling for various factors such as the size of economy and comparative advantages, consistently suggest that political representation of agricultural sector should be an important theoretical component in the study of political institutions and trade policy (Park and Jensen, 2007).

3.2 Dyadic Analysis

Do interactions of domestic political institutions between trading partners affect the depth of trade liberalization? Mansfield, Milner and Rosendorff (2000) argue that constraints on the chief executive imposed by the legislature, through ratification of trade policy, allow democracies to credibly commit

to liberal trade policy. This is because forward-looking democratic executives expect that protective trade policy will be adopted to reflect the legislature's preferred policy if they fail to agree. Based on this logic, they predict that democratic pairs will have more open trade relations than mixed pairs of democracy and non-democracy.

We make three contributions to the study of the interaction of regime types on trade policy. First, we directly analyze trade policies between country-pairs rather than using a proxy measure that indirectly captures the outcome of interest. In fact, Mansfield, Milner and Rosendorff (2000) use bilateral trade volumes as a proxy for trade policy. Although it is generally true that there exist an inverse relationship between trade volume and trade barriers, many studies suggest that there exist numerous confounding factors through which political institutions may either directly or indirectly affect trade volume other than through countries' trade policies. For example, stable contractural institutions allow countries to trade more even when trade policies that govern the trade relations are held fixed (Nunn, 2007; Levchenko, 2007). By using applied tariffs, our analysis will give more accurate estimates of the relationship between political institutions and the choice of trade policy.

Second, we distinguish the *direction* of trade policy between importing and exporting countries. In fact, a direct test of the hypothesis that pairs of democracies are more likely to engage in liberalization requires researchers to examine the interactive effect in two directions: (1) whether democratic importer is better able to liberalize when its counterpart is a democracy rather than a non-democracy, and (2) whether democratic exporter can achieve freer market access when its negotiating parter (i.e., the importer) is a democracy instead of a non-democracy. That is, if the credible commitment mechanism postulated by Mansfield, Milner and Rosendorff (2000) drives mutual trade liberalization, we should expect to see evidence for both mechanisms.

Finally, we investigate heterogeneity across industries. The findings from the monadic analysis above show that countries might face different political pressures from various interest groups affecting their unilateral incentives to liberalize. Consequently, we expect that bilateral trade negotiation will also be affected by trading partners' heterogeneous political constraints and their interactions across industries. The bilateral tariff data that we introduced in Section 2 enables us to examine the complexity of bilateral trade policy outcomes across industries.

3.2.1 Methodology

We employ a difference-in-differences (DiD) identification strategy. Specifically, we examine the industry-varying interactive effects of political institutions on the degree of trade liberalization as a result of bilateral Free Trade Agreements (FTAs). We compare the differences in the magnitude of

tariffs reduction before and after FTAs between countries with different political institutions. The proposed linear hierarchical model for the change in trade policy before and after FTA between importer i and exporter j is given by,

$$\begin{aligned}\Delta\tau_{ijth} = \alpha + (\beta^{\texttt{IMP}} + \gamma_h^{\texttt{IMP}})X_{it} + (\beta^{\texttt{EXP}} + \gamma_h^{\texttt{EXP}})X_{jt} + (\beta^{\texttt{DYAD}} + \gamma_h^{\texttt{DYAD}})X_{it} \cdot X_{jt} \\ + \delta_0^\top \mathbf{Z}_{it} + \delta_1^\top \mathbf{Z}_{jt} + \delta_2^\top \mathbf{Z}_{ijt} + \lambda W_{ith} + \xi_h + \epsilon_{ijth},\end{aligned} \tag{5}$$

where h again indexes industry. For a FTA between i and j that goes into effect (in force) in year t^*, we compare the degree of tariff reduction between $t^* - L$ and $t^* + F$ where L and F denote the length of lags and leads, respectively. To minimize the extrapolation into the future, we focus on the comparison of tariff rates immediately before and after each trade agreement by setting $L = 1$ and $F = 1$. To simplify the notation, we denote the year prior to FTA by t, i.e., $t = t^* - 1$. Then $\Delta\tau_{ijth}$ represents a change in tariffs (logged) for industry h between year $t^* - 1$ and $t^* + 1$. X_{it} and X_{jt} are unity if the Polity score for importer i and partner j are 6 or above, respectively. $\mathbf{Z}_{it}$ and $\mathbf{Z}_{jt}$ represent covariates for the importer and partner, and include log population and log GDP in year t. $\mathbf{Z}_{ijt}$ represents dyad-level covariates including logged total trade volume between the two countries, log of the partner-specific mean tariff imposed by the importer across all industries, whether at least one of the pair is a major power, whether both parties were GATT/WTO members, as well as logged distance (in kilometers) between the two countries. Additionally, we control for pre-existing tariff levels by including the pre-FTA MFN rates W_{ith} for each industry h. ξ_h is an industry-varying intercept. As in the monadic analysis, we model the prior distribution of industry-varying coefficients $\gamma_h = [\xi_h, \gamma_h^{\texttt{IMP}}, \gamma_h^{\texttt{EXP}}, \gamma_h^{\texttt{DYAD}}]$ to be Normally distributed:

$$\begin{aligned}\gamma_h &\sim \mathcal{N}(\phi_{k[h]}, \Sigma_\gamma) \\ \phi_k &\sim \mathcal{N}(\mathbf{0}, \Sigma_\phi).\end{aligned} \tag{6}$$

The quantity of interest is the difference in the degree of trade liberalization between democratic pairs (i.e., dyads in which both parties are democracies) and mixed dyads (i.e., one party is a democracy and the other is not). Then the conditional expectation of the tariff reduction is

$$\mathbb{E}[\Delta\tau_{ijth} \mid \mathbf{X}, \mathbf{Z}, \beta, \gamma_h, \Theta] = (\beta^{\texttt{IMP}} + \gamma_h^{\texttt{IMP}}) \cdot X_{it} + (\beta^{\texttt{EXP}} + \gamma_h^{\texttt{EXP}}) \cdot X_{jt} + (\beta^{\texttt{DYAD}} + \gamma_h^{\texttt{DYAD}}) \cdot X_{it}X_{jt} + \Theta^\top \mathbf{Z}, \tag{7}$$

where $\mathbf{Z}$ and $\mathbf{\Theta}$ denote all variables and parameters except those related to democracy.

Our formulation allows us to make two direct comparisons. First, we compare a mixed dyad where the *importer* is a democracy to a democratic pair,

$$\mathbb{E}[\Delta\tau_{ijth} \mid X_{it} = 1, X_{jt} = 0] - \mathbb{E}[\Delta\tau_{ijth} \mid X_{it} = 1, X_{jt} = 1] = -(\beta^{\texttt{EXP}} + \gamma_h^{\texttt{EXP}} + \beta^{\texttt{DYAD}} + \gamma_h^{\texttt{DYAD}}) \tag{8}$$

Second, we compare a mixed dyad where the *exporter* is a democracy to a democratic pair,

$$\mathbb{E}[\Delta\tau_{ijth} \mid X_{it} = 0, X_{jt} = 1] - \mathbb{E}[\Delta\tau_{ijth} \mid X_{it} = 1, X_{jt} = 1] = -(\beta^{\texttt{IMP}} + \gamma_h^{\texttt{IMP}} + \beta^{\texttt{DYAD}} + \gamma_h^{\texttt{DYAD}}). \quad (9)$$

3.2.2 Empirical Results

We obtain data on preferential trade agreements from the WTO's Regional Trade Agreements Information System (RTA-IS) database.[9] We focus on bilateral FTAs in which there are only two parties to the agreement, and both parties are sovereign states (as opposed to one or both parties being existing regional trade agreements). We therefore include bilateral FTAs such as the USA-Australia FTA, but exclude multilateral trade agreements such as NAFTA, or bilateral FTAs where at least one party is an existing regional trade agreement, such as the EU-Canada FTA or the EFTA-SACU FTA. Our dataset consists of 91 unique bilateral FTAs. Of these 91 bilateral FTAs, 44 are signed between democratic pairs, 39 are mixed dyads, and 8 are dyads in which both parties are non-democracies. There are 36 unique parties to these 91 FTAs, of which 26 are democracies and 10 are non-democracies. The full list of bilateral FTAs included in our analysis is given in Appendix B.[10]

We begin our dyadic analysis without distinguishing the direction of trade liberalization in order to first make a direct comparison between our analysis and the existing study in the literature. That is, this "undirected" dyadic analysis compares pairs of democracies ($X_{ijt}^{\texttt{PAIR}} = \mathbb{1}\{X_{it} = 1 \text{ and } X_{jt} = 1\}$) against a mixed pair of democracy and non-democracy ($X_{ijt}^{\texttt{MIXED}} = \mathbb{1}\{X_{it} = 1 \text{ or } X_{jt} = 1, \text{ and } X_{it} \cdot X_{jt} \neq 1\}$) using the non-democratic pairs as our reference category. We note that this set-up is same as Mansfield, Milner and Rosendorff (2000) while we consider applied tariffs rather than bilateral trade volume as a measure of trade policy outcome. The left panel in Figure 5 presents the estimated tariff reduction by mixed pairs against that between democratic pairs (the red horizontal line). On average, tariff reductions are $42\%(\approx \exp(0.35) - 1)$ less in mixed dyads compared to democratic pairs. This is consistent with Mansfield, Milner and Rosendorff (2000) who find that democracies are more likely to engage in open trade among themselves than others.

Next, we decompose the direction of trade liberalization among FTA partners. The right panel in Figure 5 reports the posterior mean and 95% credible intervals of the quantities described in equations (8) and (9). First, we examine whether democratic importers are better able to engage in deeper trade liberalization when its counterpart is democracy rather than non-democracy. This

[9] This database is available from `http://rtais.wto.org/`.

[10] As Table 2 shows, 27 of the bilateral FTAs are fairly recent, taking effect on or after 2010. Importers sometimes revise the data they report to the WTO and UNCTAD, and may report changes to tariff schedules with delays. We periodically check the underlying databases for changes, and will update our analysis as the data are refreshed.

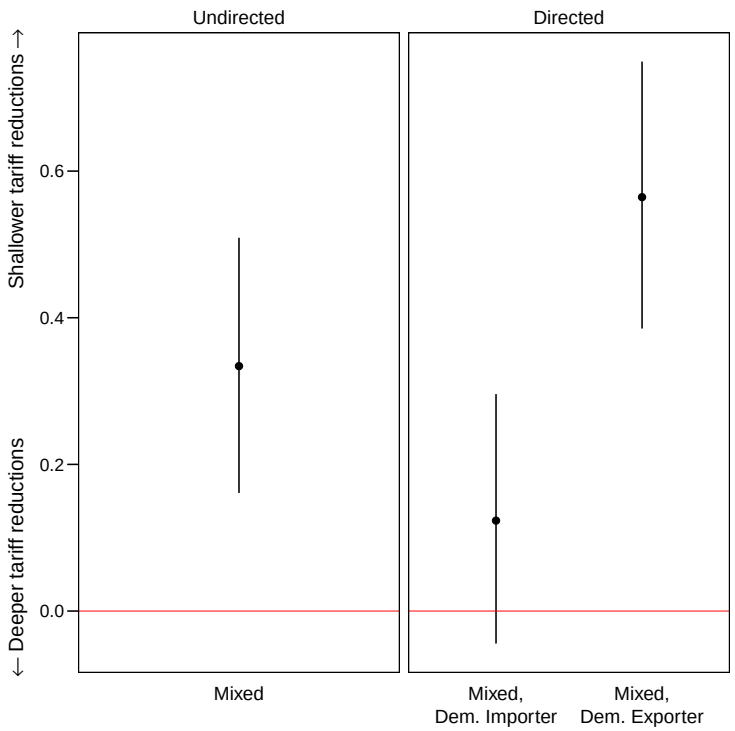

Figure 5: **Differences Against Democratic Pairs:** The left panel shows the difference in tariff reductions between mixed dyads (where one party to the FTA is a democracy and the other is a non-democracy) and democratic pairs. On average, tariff reductions are 0.35 log points less (i.e. shallower) in mixed dyads compared to democratic pairs. The right panel disaggregates mixed dyads into two types: where the importer is the democracy, and where the partner is the democracy. Compared to a democratic pair, a non-democratic importer gives shallower concessions to a democratic partner; however, the degree of tariff reductions is not significantly different when comparing a democratic pair to a mixed pair with a democratic importer.

corresponds to the estimate on the left-hand side ("Mixed, Dem. Importer") in the panel. We find no statistical evidence for this hypothesis. That is, we cannot reject the null that democratic importers give the same amount of tariff concessions to democratic and non-democratic partners alike. Second, we consider whether democratic exporter can achieve better market access when its negotiating parter (i.e., the importer) is democracy instead of non- democracy. As shown in the right-hand side ("Mixed Dem. Exporter") in the panel, we find that the degree of tariff reductions is significantly lower among democracies than when the importing country is non-democratic. In short, the difference in tariff concessions achieved in mixed dyads compared to democratic pairs is driven, to a large degree, by the comparatively shallower tariff concessions given by non-democratic importers to democratic partners, compared to democratic importers.

To explicate the complex bilateral incentives among FTA partners, we examine industry-varying effects of the interaction of political institutions on the depth of trade liberalization. Figure 6 shows

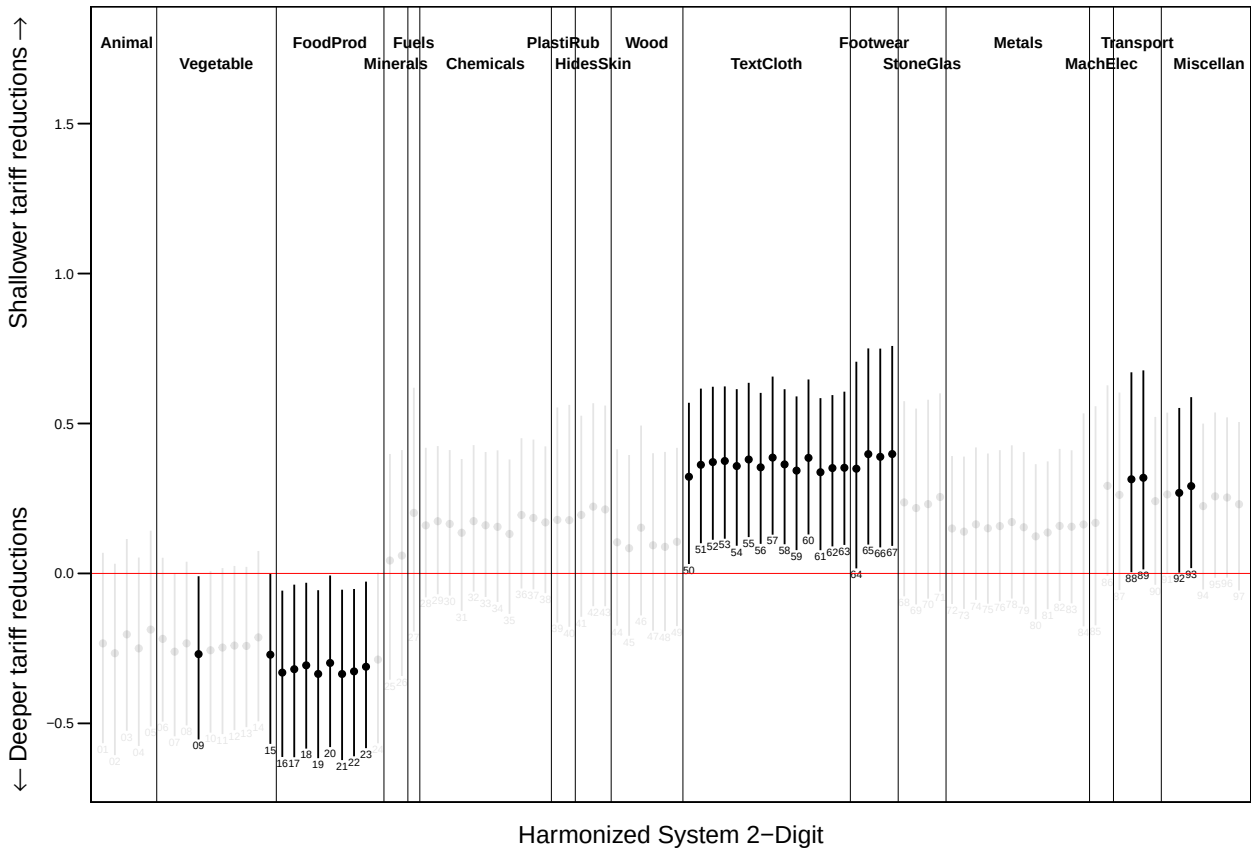

Figure 6: **Mixed Dyad with Democratic Importer Compared to Democratic Pair:** On average, we do not observe differences in tariff reductions between a mixed dyad with a democratic importer and a non-democratic partner, compared to a democratic pair. A democratic importer gives deeper tariff reductions in agricultural products and shallower reductions in textiles when it faces a non-democratic partner, compared to a democratic partner.

whether mixed pairs with democratic importer engage in deeper or shallower liberalization compared to democratic pairs. We find that mixed pairs in effect engage in *deeper* tariff reductions with respect to agricultural industry than democratic pairs. This suggest that democracies not only face protective demands from agricultural sector as shown in our earlier monadic analysis, but also find it difficult to mutually commit to open agriculture market bilaterally. On the other hand, we find that democracies are better able to liberalize textile products compared to mixed pairs.

Finally, we investigate whether mixed pairs with democratic exporter engage in deeper tariff reductions than democratic pairs. Figure 7 shows that democracies (again marked by the red horizontal line) can mutually commit to deeper trade liberalization than mixed pairs across all industries except for agricultural industry. These findings shed important light on the earlier findings given in Figure 5 in which we had only partial evidence for the credible commitment mechanism among democracies. Specifically, we find that democracies might face at least as severe a commitment problem as mixed

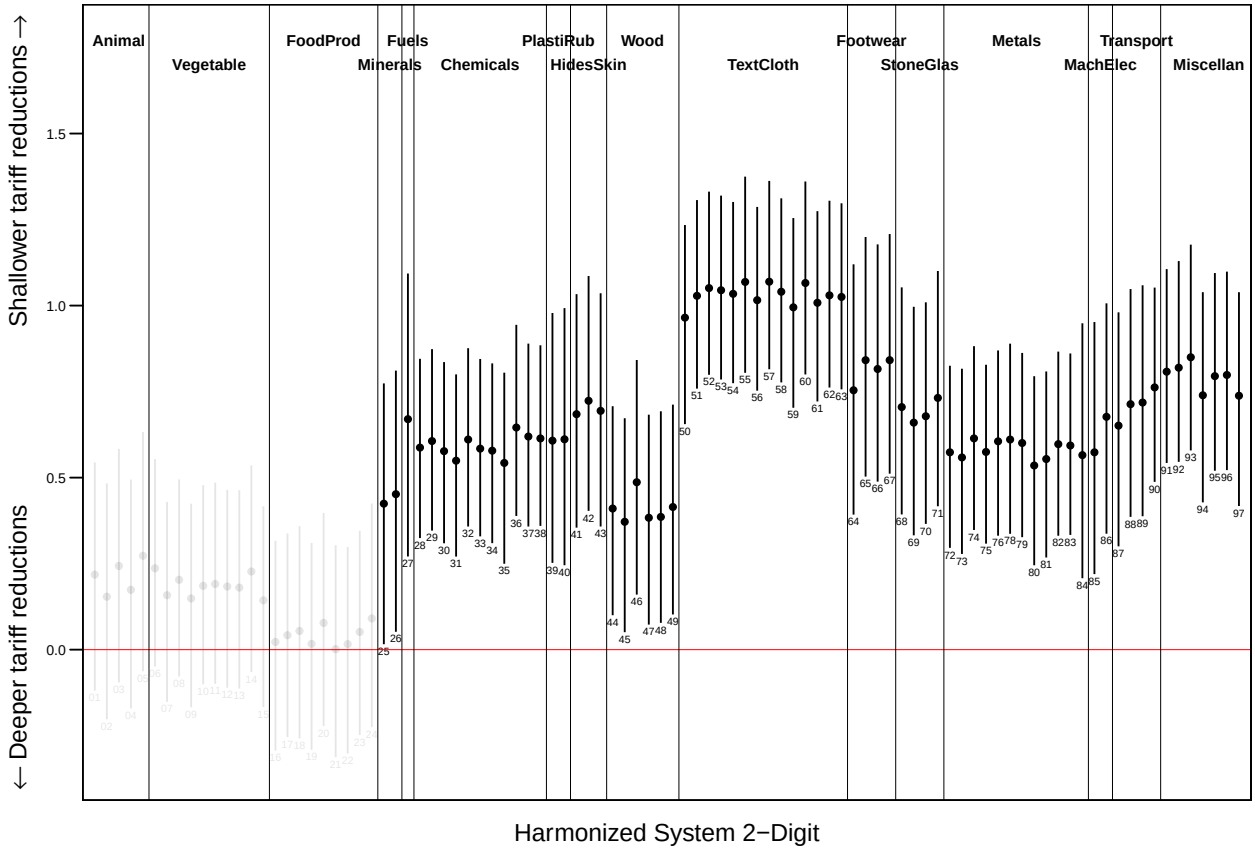

Figure 7: **Mixed Dyad with Democratic Exporter Compared to Democratic Pair:** A non-democratic importer tends to give shallower tariff reductions compared to a democratic importer, when the FTA partner is a democracy. (Equivalently, a democratic importer gives deeper tariff reductions to another democracy, compared to a non-democratic importer.) The difference is most pronounced in textile sectors, and not significantly different from zero in agricultural sectors.

pairs when it comes to their policies toward agricultural industries. In short, both monadic and dyadic analyses given in this section consistently identify the existence of heterogeneous political dynamics related to agricultural protection.

4 Concluding Remarks

In this paper, we present a novel dataset with over 5.2 billion observations of product-level applied tariff rates that countries differentially apply to their trading partners, incorporating the universe of preferential rates and Generalized System of Preferences. To do so, we combine and augment existing datasets available from the WTO and UNCTAD, and resolve conflicting information between these two datasets.

We apply this new data toward examining an enduring question in international political economy: whether there are systematic differences in trade policy between countries with different po-

litical institutions. Consistent with prior work, we find that democracies have lower tariff rates than non-democracies, on average. However, focusing on the average elides significant heterogeneity. We document that democracies are as protective as non-democracies for many industries, and in particular industries in the agricultural sector.

Our data also allows us to track fine-grained temporal changes in product-level trade policy for directed dyads. Our second set of empirical analysis studies bilateral FTAs to examine whether interaction between political institutions at the dyad-level results in differences in the degree of trade liberalization. Our analysis of 91 bilateral FTAs, based on the difference-in-differences design, confirms prior findings that democratic pairs achieve greater tariff reductions than a mixed dyad with a democracy and a non-democracy. We build on this finding by showing that the difference between democratic and mixed pairs is due in large part to shallower concessions granted by non-democratic importers vis-á-vis democratic partners, but not vice-versa.

Our dataset can be combined with industry-level covariates, such as import and export concentration, as well as country-specific industry structures, to further explore linkages between political institutions and industry-level trade policies. In addition, as other scholars have pointed out, there exists significant variation in institutional structures within democracies and non-democracies (Rickard, 2015; Kono, 2015). Differences in the scale and scope of support coalitions that a government needs to assemble are likely to result in different configurations of demands for trade protection. Research into the relationships between political institutions and trade policies continues to be relevant as policymakers around the world re-evaluate the merits of trade liberalization in response to pressures from their constituents, and re-negotiate existing agreements. The question is not so much whether there will be more or less liberalization, but rather which sectors and industries will be most exposed to a review of trade policies. Our dataset usefully contributes to this research agenda.

A Tariff-line Dataset

A.1 Bilateral Tariff Data Collection and Processing

A tariff line is a numeric code that each importer uses to identify a unique product. For a given product, tariff lines can differ from country to country; however, the first six digits of the tariff line are internationally standardized under the Harmonized System.

There are two existing sources of tariff line data: the WTO's Integrated Database (IDB), publicly accessible at the WTO's public Tariff Analysis Online (TAO) facility, and UNCTAD's Trade Analysis Information System (TRAINS), publicly accessible at the World Bank's World Integrated Trade Solution (WITS) website.[11] Together they form a comprehensive collection of ad valorem and non-ad valorem tariff rates across all WTO countries and Harmonized System products from 1988 to the present.

To compile this universe of tariffs, we first web-scrape tariff lines for all available importers and years. An observation in this dataset is a tariff rate imposed in a given year by an importer on a product imported from a country (e.g. Republic of Korea) or a group of countries (e.g. NAFTA, Mercosur, WTO members). Where the tariff affects a group of countries, we identify the members of the group and expand the observation so that each new observation is a dyad with two countries. Finally, for each resulting (year, importer, exporter, tariff line) we compare duties from IDB and TRAINS to select the most likely applied duty using the algorithm detailed in Appendix A.2.

Figure 2 graphically illustrates the data collection, processing, and merging steps in our tariff dataset creation using an example United States tariff line. The next sections detail each of these steps for IDB and TRAINS respectively. To clarify each step, we use a recurring example tariff line: South Africa's (ZAF) 2006 tariff on HS product `2204290` (Wine of fresh grapes, including fortified grapes) from Great Britain (GBR).

A.1.1 WTO IDB Duty Collection and Processing

We perform the following steps to collect and process IDB duties:

> **Step 1. (Web scrape product-level duties)** For each year and importer, we scrape all IDB product-level applied tariffs available through WTO's public Tariff Analysis Online (TAO) facility. Each duty is identified by its year, importer, and Harmonized System product code and contains information on its specific beneficiary group as well as the ad valorem rate applied. E.g.,

Year	Imp.	Code	Description	Type	Rate
2006	ZAF	`22042940`	"MFN applied duty rates"	02	25%
2006	ZAF	`22042940`	"Free-trade area agreement duty rate for the EC"	11	54.75 c/li with a maximum of 18.75%

We acquire two different reported duties for South African imports of wine from European

[11] TAO's URL is `https://tao.wto.org/`, and WITS's URL is `https://wits.worldbank.org/`

Union member countries in 2006. For this particular tariff line, the type 02 corresponds to an MFN applied duty for this tariff line while type 11 corresponds to a Free Trade rate.

Step 2. (Disaggregate duty beneficiaries to countries) Each duty has a type field and description field that uniquely indicates its specific beneficiary which may be a country (e.g. `Preferential rate for Canada`), members of an agreement (e.g. `North-American Free Trade Agreement`), or a group of countries (e.g. `G16`). We use a mix of hand-coding from official materials and string matching with country names and regional trade agreement titles in order to map each duty type appearing in IDB data to its respective set of countries. [12] E.g.,

Year	Imp.	Exp.	Code	Description	Type	Rate
2006	ZAF	GBR	22042940	"MFN applied duty rates"	02	25%
2006	ZAF	GBR	22042940	"Free-trade area agreement duty rate for the EC"	11	54.75 c/li with a maximum of 18.75%

We find that both the MFN and Free Trade duties stipulate Great Britain as a beneficiary.

A.1.2 UNCTAD TRAINS Duty Collection and Processing

Likewise, we perform the following corresponding steps for TRAINS tariffs:

Step 1. (Web scrape product-level duties) For each year, we scrape all TRAINS product-level tariffs available through the WITS web site. E.g.,

Year	Imp.	Code	Description	Type	Rate (≈ AVE)
2006	ZAF	22042940	"Most Favoured Nation duty rate treatment"	22	25%
2006	ZAF	22042940	"Preferential tariff for European Union countries (AA) Association Agreement"	11	54.75 c/li with a maximum of 18.75% (≈ 10.09%)

As when collecting IDB duties, we find two different duties applicable to 2006 South African imports of HS product 22042940 from European Union member countries. Notably, unlike the IDB Free Trade duty, the TRAINS Free Trade duty provides an ad valorem equivalent (`10.09%`) for an otherwise non-ad valorem rate (`54.75 c/li with a maximum of 18.75%`).

Step 2. (Disaggregate duty beneficiaries to countries) Using a combination of a region-to-countries mappings and a type-to-countries mapping, both provided by the World Bank, we expand each beneficiary-level duty to its disaggregated partner-specific duties. E.g.,

[12] We use official preference beneficiaries for many tariff measures from `http://wits.worldbank.org/WITS/WITS/Support%20Materials/TrfMeasures.aspx?Page=TfMeasures`. We map beneficiaries of regional trade agreements from the Regional Trade Agreements Information System (RTA-IS) publicly accessible at `http://rtais.wto.org/`.

Year	Imp.	Exp.	Code	Description	Type	Rate (≈ AVE)
2006	ZAF	GBR	22042940	"Most Favoured Nation duty rate treatment"	22	25%
2006	ZAF	GBR	22042940	"Preferential tariff for European Union countries (AA) Association Agreement"	11	54.75 c/li with a maximum of 18.75% (≈ 10.09%)

Again, we find that both the MFN and Free Trade duties found in TRAINS stipulate Great Britain as a beneficiary.

Performing these procedures, we acquire a total of 10 billion IDB and 6 billion TRAINS product-level partner-specific duties. However, as noted in our example, for each (year, importer, exporter, product) we may have multiple conflicting duties, of which only one is actually applied. In the next section, we describe the merging algorithm used to solve this problem.

A.2 Tariff Merging Algorithm

A given (year, importer, exporter, industry) query may return multiple possible duties from the WTO IDB database and the UNCTAD TRAINS database. In some cases, both sources agree on an ad valorem rate, but TRAINS provides a more informative specific duty rate. In other cases, TRAINS correctly accounts for a compound rate while IDB does not. Moreover, for some years, one source correctly retrieves a newly enforced preferential rate while the other mistakenly reports previous years' Most Favored Nation (MFN) duty rate. Finally, for all non-ad valorem tariffs, TRAINS provides an ad valorem equivalent (AVE) rate using a custom statistical method that allows comparisons to be made between products with ad valorem and non-ad valorem rates. For such tariffs, IDB only provides the original specific rate which is typically less informative for trade researchers.

The goal of the merging algorithm is to account for all of these cases in order to select the single most accurate and informative duty that an importer applies to a industry and partner in a given year. We illustrate how this is done using the previous example of South Africa 2006 tariff on HS product 2204290 from Great Britain In this case, it is clear that South Africa, in practice, applies a partner-specific Free Trade duty rate over a Most Favored Nation duty rate. Our algorithm correctly picks this rate in three steps:

Step 1. (Pick IDB candidate) If all matching IDB duties are ad valorem, pick the duty with the lowest ad valorem rate. If any duties are non-ad valorem, pick the duty with the lowest specific rate. E.g.,

Year	Imp.	Exp.	Code	Description	Type	Rate
2006	ZAF	GBR	22042940	"MFN applied duty rates"	02	25%
2006	ZAF	GBR	22042940	"Free-trade area agreement duty rate for the EC"	11	54.75 c/li with a maximum of 18.75%

In this case, since not all applicable duties are ad valorem, we pick the highlighted Free Trade duty rate, which de facto has the lowest specific rate, over the MFN duty rate.

Step 2. (Pick TRAINS candidate) From all matching TRAINS duties, pick the duty with the lowest ad valorem or AVE rate. If all duties have missing ad valorem and AVE rates, pick the duty with the lowest specific rate. E.g.,

Year	Imp.	Exp.	Code	Description	Type	Rate (≈ AVE)
2006	ZAF	GBR	22042940	"Most Favoured Nation duty rate treatment"	22	25%
2006	ZAF	GBR	22042940	"Preferential tariff for European Union countries (AA) Association Agreement"	11	54.75 c/li with a maximum of 18.75% (≈ 10.09%)

Step 3. (Select between candidates) Given the best IDB and TRAINS candidate duties, if the TRAINS candidate has an AVE rate, select the TRAINS candidate. If not, resolve to the candidate with the lowest ad valorem (AVE or non-AVE) rate. If either a TRAINS or IDB candidate could not be found, select the candidate that is available. E.g.,

Year	Imp.	Exp.	Code	Original Description	Rate	Source
2006	ZAF	GBR	22042940	"Free-trade area agreement duty rate for the EC"	54.75 c/li with a maximum of 18.75%	IDB
2006	ZAF	GBR	22042940	"Preferential tariff for European Union countries (AA) Association Agreement"	54.75 c/li with a maximum of 18.75% (≈ 10.09%)	TRAINS

Both IDB and TRAINS report equivalent preferential rates, however since TRAINS provides an ad valorem equivalent rate which is more useful for direct comparison with other duties, we select the TRAINS candidate as the applied duty for this tariff line.

The result is a unique tariff for each (year, importer, exporter, product) query. In sum, this procedure merges nearly 10 billion IDB duties with 6 billion TRAINS duties to produce 5.2 billion 'resolved' bilateral tariffs.[13]

[13]We implement this procedure as a distributed SQL operation on the Hadoop big data ecosystem. Overall, this operation takes more than 48 hours to run on a 10 node computing cluster (256 GB RAM per node, 24 CPU per node) and the resulting dataset is more than 300 GB in size.

B List of Bilateral FTAs

Table 2: List of Bilateral Free Trade Agreements

Panel A: Non-Democratic Pairs		
Armenia	Ukraine	1996
Azerbaijan	Ukraine	1996
Ukraine	Uzbekistan	1996
Jordan	Singapore	2005
Morocco	Turkey	2006
Egypt	Turkey	2007
China	Singapore	2009
Jordan	Turkey	2011

Panel B: Mixed Pairs		
Georgia	Ukraine	1996
Israel	Turkey	1997
Georgia	Turkmenistan	2000
The former Yugoslav Republic of Macedonia	Turkey	2000
Jordan	United States of America	2001
New Zealand	Singapore	2001
Japan	Singapore	2002
Australia	Singapore	2003
Singapore	United States of America	2004
Australia	Thailand	2005
Republic of Moldova	Ukraine	2005
New Zealand	Thailand	2005
Tunisia	Turkey	2005
Bahrain	United States of America	2006
Chile	China	2006
Japan	Malaysia	2006
Republic of Korea	Singapore	2006
Morocco	United States of America	2006
Panama	Singapore	2006
China	Pakistan	2007
Japan	Thailand	2007
Albania	Turkey	2008
China	New Zealand	2008
Georgia	Turkey	2008
Malaysia	Pakistan	2008
Peru	Singapore	2009
Oman	United States of America	2009
China	Peru	2010
Montenegro	Turkey	2010
Malaysia	New Zealand	2010

Table 2: Continued on next page

Table 2 – *Continued from previous page*

China	Costa Rica	2011
Canada	Jordan	2012
Chile	Malaysia	2012
Australia	Malaysia	2013
Costa Rica	Singapore	2013
Republic of Korea	Turkey	2013
Montenegro	Ukraine	2013
Mauritius	Turkey	2013
Switzerland	China	2014

Panel C: Democratic Pairs

Colombia	Mexico	1995
Canada	Chile	1997
Canada	Israel	1997
Chile	Mexico	1999
Israel	Mexico	2000
Canada	Costa Rica	2002
Chile	Costa Rica	2002
Chile	El Salvador	2002
Panama	El Salvador	2003
Chile	Republic of Korea	2004
Mexico	Uruguay	2004
Chile	United States of America	2004
Australia	United States of America	2005
Japan	Mexico	2005
Sri Lanka	Pakistan	2005
Chile	Japan	2007
Mauritius	Pakistan	2007
Costa Rica	Panama	2008
Indonesia	Japan	2008
Japan	Philippines	2008
Chile	Panama	2008
Australia	Chile	2009
Canada	Peru	2009
Switzerland	Japan	2009
Chile	Colombia	2009
Guatemala	Panama	2009
Honduras	Panama	2009
Nicaragua	Panama	2009
Chile	Peru	2009
Peru	United States of America	2009
Chile	Guatemala	2010
Canada	Colombia	2011
Republic of Korea	Peru	2011
Colombia	United States of America	2012
Japan	Peru	2012

Table 2: Continued on next page

Table 2 – *Continued from previous page*

Republic of Korea	United States of America	2012
Mexico	Peru	2012
Chile	Nicaragua	2012
Panama	Peru	2012
Panama	United States of America	2012
Canada	Panama	2013
Costa Rica	Peru	2013
Australia	Republic of Korea	2014
Canada	Honduras	2014

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