Intra-industry Trade and Trade Liberalization: Evidence from Preferential Tariffs Data[*]

In Song Kim[†]   Weihuang Wong[‡]

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[Work in Progress]

Abstract

Does exchanging similar products within the same industry facilitate trade liberalization? While decades of theoretical research identified forceful political and economic reasons for open trade in the presence of high intra-industry trade, there exists surprisingly little empirical evidence supporting the claim. We contend that the lack of evidence is attributable to the common practice of country-level analysis based on most favored nation (MFN) tariff rates. Specifically, we argue that aggregation bias arises because MFN rates do not differentiate the preferential treatments given to partners with whom a country engages in high intra-industry trade. We construct a large scale database with more than 300 million observations that links partner specific trade volumes to preferential tariffs rates for each HS6 product. We find strong effects of intra-industry trade on trade liberalization. The effect is especially pronounced for industries with high variation in tariffs. We then focus on the free trade agreement between the U.S. and Korea where more than 60% of products are exported (and imported) by both countries. We find that products with higher levels of two-way trade prior to the agreement enjoyed more reduction of tariffs deviating from the baseline MFN rates.

1   Introduction

Both political scientists and economists have long been interested in identifying conditions under which countries can mutually agree upon reducing trade barriers. Intra-industry trade, which involves the exchange of similar products, say Fords for Hyundai cars, has been identified as an explanation for the secular decline in tariffs among industrialized countries. Relative to inter-industry trade, say exchanging cars for textiles, it is politically easier to liberalize because importing foreign goods and services does not completely displace domestic activity and employment (Lipson, 1982; Marvel and Ray, 1987; Milner, 1999). Yet, in their important studies, Gilligan (1997b) and Kono (2009) find that intra-industry trade is *positively* correlated with protection. Kono (2009) argues that "scholars should stop invoking intra-industry trade as an explanation for lower protection among wealthy countries and in advanced manufacturing sectors." These findings contradict the conventional wisdom in the literature, raising an important question about the distributional consequences of increasing intra-industry trade among developed countries.

The objective of this article is to empirically test the effect of intra-industry trade on liberalization, utilizing the variation across directed dyads. This is in contrast to existing studies that have been focused primarily on country-level analysis where uniform trade policy across partners (e.g., most favored nation (MFN) tariff rates) is generally assumed. We find that the levels of intra-industry trade as well as trade policy vary highly across trade partners even for the same product. In fact, 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. For instance, the U.S. currently has trade agreements with 20 countries. It also grants the GSP (Generalized System of Preferences) status to a large number of developing countries. As a consequence, different tariff rates will be applied depending on the origin of imports for any given product. Thus, it is imperative to take into account preferential trade policies in examining the potential effects of intra-industry trade, especially when most international trade now goes through preferential agreements (Bhagwati, 2008).

We construct a new database of dyad-level trade volumes and tariffs across all pairs of countries at the most disaggregated level possible: Harmonized System 6 digits (HS6). For instance, we record trade volumes across all possible combinations of country pairs on a HS6 product 870322

"Spark-ignition Engine of a cylinder capacity exceeding 1,000 cc but not exceeding 1,500 cc." We then combine the volume data with tariffs data, which records differences in tariffs not only across products but also across trading partners.[1] It is worth emphasizing that we use each country's tariff-line, which is the level at which countries actually set distinct tariffs. It is usually more disaggregated than HS6, creating a hierarchical structure in the dataset. Using hierarchical modeling, which partially pools the variation in tariffs across industries, we find strong effects of intra-industry trade on trade liberalization. The effect is especially pronounced for industries with high variation in tariffs.

To be sure, bilateral trade decreases with high trade barriers. As such, one must distinguish to what extent intra-industry trade results in reduction in trade barriers, and not *vice versa*. This is a general problem that any empirical studies of trade policy faces, and addressing the problem of endogeneity is highly difficult unless there exists an exogenous source of variation that does not directly affect trade policy other than its indirect effect through increasing the levels of intra-industry trade. Our database allows us to overcome this important empirical challenge. Specifically, we identify the effect of intra-industry trade on liberalization by focusing on the *changes* introduced by preferential trade agreements with respect to the baseline MFN rates as a function of trade patterns prior to the agreement. The identification relies on the assumption that there is no omitted confounding factor that both affects the levels of intra-industry trade of a given product and its future preferential tariff rates simultaneously. We argue that due to the high uncertainty associated with any trade agreement from the initiation of negotiations to the stages of ratification and implementation, it is reasonable to assume that current trading decisions with a partner are made independently from the expectations about future preferential rates. We find that the U.S. disproportionately reduced its tariffs on products that it exchanged heavily with Korea *prior* to the free trade agreement.

The rest of the paper proceeds as follows. In Section 2, we describe our theoretical argument. In Section 3, we introduce the new database and demonstrate its advantage in testing the theoretical prediction. In Section 4, we first use hierarchical modeling to investigate the industry-varying effects of high intra-industry trade on trade liberalization. We then examine the free trade agreement between the U.S. and Korea by focusing on the degree of preferential tariff reduction as a

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[1] The relational database with more than 300 million observations will be made publicly accessible.

function of previous levels of intra-industry trade. The final section concludes.

2 Political Demands for Trade Liberalization

Scholars of international political economy have long preached the benefits of free international trade, and remain puzzled at the difficulty of achieving it. Much progress has been made. We know, for example, that conflicting political interests (e.g., Hillman, 1984; Rogowski, 1987; Magee *et al.*, 1989; Grossman and Helpman, 1994; Hiscox, 2002), terms-of-trade incentives (e.g., Brander and Spencer, 1985), and incentives to raise revenue (e.g., Stiglitz and Dasgupta, 1977) can all explain the persistence of trade barriers. Yet, we still know relatively little about why some countries are particularly successful in *reducing* tariffs and non-tariff barriers on certain products from the given levels of protection (but see Milner (1988); Gilligan (1997a) for notable exceptions).

Under what condition do countries successfully liberalize? Conventional theories have emphasized the lack of demand for protection with high intra-industry trade as a primary reason why countries can eliminate trade barriers (Lipson, 1982; Milner, 1999). Specifically, when countries exchange similar products, there exists little displacement effect. The usual political demands for protection will not be as pronounced because actors representing scarce factors of production (e.g., unskilled labor in developed countries) will not find themselves being directly hurt by the comparative advantage of foreign countries (e.g., unskilled foreign workers) when both countries exchange goods that intensively use high skilled labor.

This explanation gives a reason for less demand for protection. The new-new trade theory, on the other hand, can account for why government will face more demand for liberalization (e.g., Eaton and Kortum, 2002; Melitz, 2003; Bernard *et al.*, 2007). It emphasizes the role of product differentiation and consumer's taste differences as an important source for gains of trade. That is, intra-industry trade occurs not because of the differences in factor endowments between importers and exporters, but because of consumers' diverse tastes (Krugman, 1979, 1980). It also highlights the heterogeneity of firms who engage in exporting (and importing) differentiated products (Bernard *et al.*, 2005). This lays an important foundation for recent studies which find that productive firms are the main political actors who demand open trade (Osgood, 2012; Kim, 2013).

Such demand for trade liberalization will be particularly pronounced with product differenti-

ation. We argue that producers of differentiated products have the most intense preferences for lowering trade barriers. This is because even a small decrease in trade barriers can be translated into a large profit gain. Specifically, with product differentiation, firms are sheltered from market competition enabling them to capture a large foreign market share with increasing returns to scale *conditional on* them overcoming trade barriers. This intuition can be explained more formally by equation (1). Building upon the new-new trade theory, Chaney (2008) derives a novel gravity equation, and shows that the sensitivity of trade flows to trade barriers depends on whether products are differentiated. In particular, the elasticity, ϵ, of trade between A and B to trade barriers increases with the levels of product differentiation $1/\sigma$, i.e., $\epsilon^{'}(\sigma) < 0$.

$$\text{Export}_{AB} = \frac{f(GDP_A \times GDP_B)}{(\text{Trade Barriers}_{AB})^{\epsilon(\sigma)}} \tag{1}$$

In other words, highly differentiated products (low σ) will magnify the sensitivity of firms towards trade barriers (high ϵ). Thus, firms can benefit a lot more from lower trade barriers especially when the level of product differentiation is high. This is particularly true for productive firms who are on the verge of exporting, and therefore might benefit a lot by start exporting (*extensive margin*). Highly productive firms who are already exporting can still benefit from exporting more. Likewise, domestic firms who are importing these products also demand lower tariffs on them. That is, further trade liberalization will benefit firms who already engage in trade by being able to exchange more goods (*intensive margin*) at cheaper prices. Since intra-industry trade invites political demands for liberalization in *both* countries exchanging similar products, it makes it easier for both parties to credibly commit to liberalization, reciprocally. We argue that an increase in intra-industry trade will encourage these firms to desire further liberalization in hopes of increasing profits at extensive and intensive margins.

HYPOTHESIS 1 *High intra-industry trade is positively associated with trade liberalization*

This logic implies that firms producing differentiated products will be more likely to lobby for trade liberalization. Consequently, we hypothesize that higher intra-industry trade is positively associated with lower trade barriers. To be sure, directly testing this causal chains will require researchers to sequentially establish the effect of intra-industry trade on lobbying, and the effect of lobbying on trade liberalization. Conducting such analysis across all countries, however, is impossible given the limited information on firm-level lobbying, although Kim (2013) provides

evidence for this pattern in the U.S. This paper focuses on testing the association between intra-industry trade and trade liberalization.

3   New Dataset of International Trade

One of the main contributions of this paper is a new dataset that allows researchers to analyze global flows of commodities and dyad-specific tariffs at the same time. To date, researchers have mostly used most favored nation (MFN) tariffs to measure the general level of protection without distinguishing differential treatment across trade partners, e.g., the mean MFN tariffs of the U.S., or MFN tariffs of automobile industry of the U.S. against rest of the world. In theory, this should not be a problem if the norm of "trade without discrimination" prevails. However, in practice, even WTO (World Trade Organization) members face different tariffs because WTO members are permitted to enter regional trade agreements under Article XXIV of GATT, Enabling Clause, and Article V of GATS. Our dataset disaggregates total trade into different product categories, and combines it with the tariffs different partners apply. For example, the U.S. tariffs on cars (87039000) coming from South Korea (the FTA partner) in 2013 is 1.5% whereas it is 2.5% (the MFN rate) if cars originate from other WTO members.[2] The dataset includes trade volume and tariffs of 181 countries for past 25 years, and it accounts for the existence of PTA or GSP benefits. There are two main advantages to the new dataset.

First, it is suitable for analyzing trade policy at the level at which countries actually set tariffs. The tariff-line varies across countries. For instance, South Korea imposes different tariffs across Harmonized System 10 digits (HS10) products: 5% on `Young eels(exceeding 0.3g and not exceeding 50g per unit, for aquaculture)` (HS10: 0301922000), while that on `Sharp toothed eel` (HS10: 0302894000) is 20%. It is worth noting that common practice in the literature, when it comes to analyzing trade policy, has been to aggregate up these product-level tariffs to either the industry-level (e.g., Harmonized System 2 digits, 4 digits or 6 digits), or the country-level, usually in order to match the level of aggregation of other covariates (e.g., Goldberg and Maggi, 1999; Gawande and Bandyopadhyay, 2000). However, Kim (2013) finds that the U.S. sets tariffs differently across very similar products, and this product-level variation points to the

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[2] Although such data is available through the United Nations Comtrade database, World Integrated Trade Solution (WITS) and Tariff Analysis Online facility provided by WTO, the usual download limits imposed by each server, and the difficulty in identifying the PTA relationship across all country pairs greatly constrain researchers' ability to construct a dataset that covers *all* country pairs and products across years.
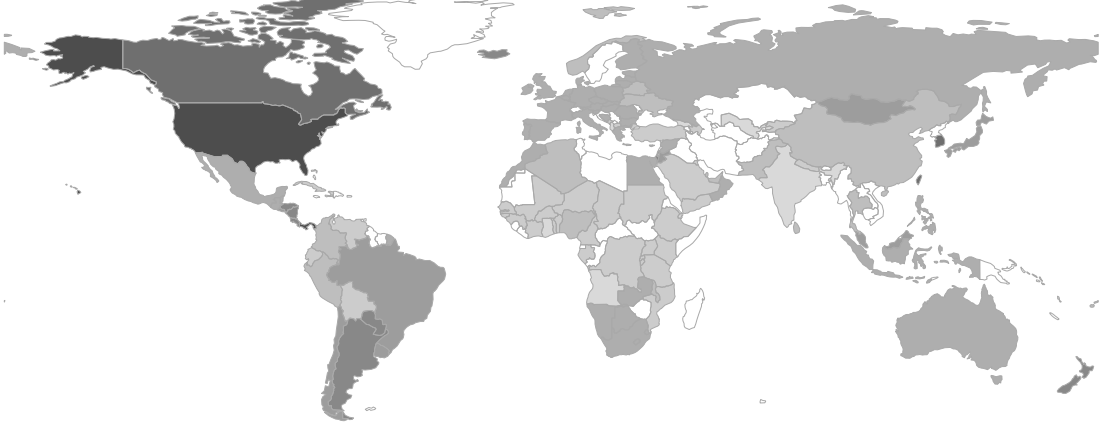
Within Industry Variation in Tariff in 2009

Figure 1: **Within-Industry Variance in Applied Tariff Rates:** This figure shows how countries set tariff differently across similar products as of 2009. Countries with darker shades set tariffs more differently across similar products that belong to the same industry (i.e., high within-industry variance). To measure this, we decomposed the total variance of tariffs (T) into within (W) and between (B) component such that $T = W + B$. Specifically, we calculate each component by $T = \frac{1}{N} \sum_{\text{HS6}} \sum_{i \in \text{HS6}} (\tau_i - \overline{\tau})^2$, $W = \frac{1}{N} \sum_{\text{HS6}} \sum_{i \in \text{HS6}} (\tau_i - \overline{\tau}_{\text{HS6}})^2$, and $B = \frac{1}{N} \sum_{\text{HS6}} N_{\text{HS6}} (\overline{\tau}_{\text{HS6}} - \overline{\tau})^2$ where tariff line products are indexed by i; industry is denoted by 6-digits Harmonized System Chapters (HS6); N and N_{HS6} denote the overall number of products and the products within each industry HS6; τ_i, $\overline{\tau}_{\text{HS6}}$ and $\overline{\tau}$ are the applied tariff rates, the average tariff rates within each industry, and the overall average of tariff rates across all products, respectively.

political dynamics of trade liberalization in the U.S. Indeed, Figure 1 demonstrates that the level varies across the globe, where countries with darker shades set tariffs more differently across similar products than others.[3] Thus, in order to properly measure the effect of intra-industry trade on trade policy, the new database records tariffs at their most disaggregated level.

The second advantage of using the new database is that it takes *directed* dyads and tariff-line products as its main units. Consider product k that country i imports from country j. The tariff rates on the product imposed by country i can vary a lot as a function of country of origin j. Such variation will be especially pronounced when the importer has multiple trade agreements in force with different depth as well as diverse GSP (Generalized System of Preferences) measures. For instance, the U.S. currently has free trade agreements with 20 countries including South Korea, Australia, and Singapore while it grants different tariff levels to a number of developing

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[3] Figure 9 in Appendix 6.2 shows that the degree of within industry variation is remarkably different across industries and countries as well.
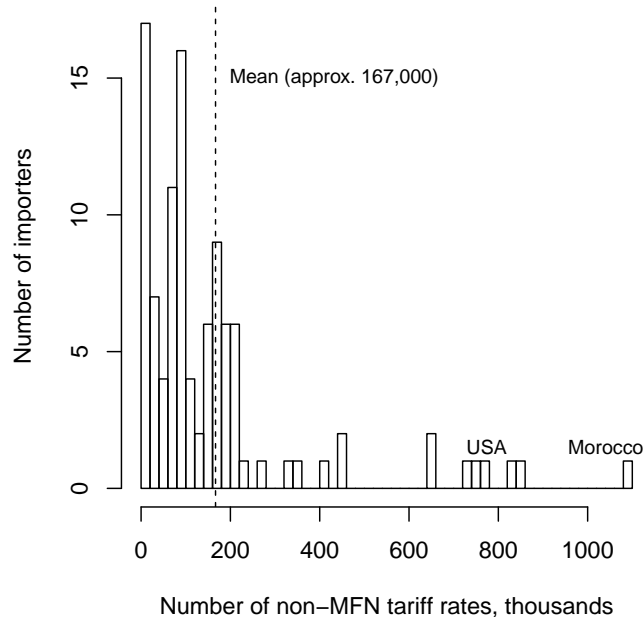
Figure 2: **Distribution of non-MFN dyad-tariff lines by importer:** This figure presents the distribution of non-MFN (i.e. preferential) rates reported per importer in 2012. The mean was around 167,000. Suppose an importer has 4,000 tariff lines with preferential rates. Then, this number implies that on average, 40 of its trading partners enjoy these preferential rates.

countries. This makes the general practice of using MFN (most favored nations) applied tariff rates problematic because doing so might completely miss trade liberalization through PTAs (Preferential Trade Agreements) among countries with high intra-industry trade. In this respect, the dataset presented in this paper correctly measures the tariff policy targeted towards a specific exporter rather than assuming a trade policy that is uniform across all countries. Figure 2 reports the distribution of the number of preferential dyad-tariff lines (summed across all trade partners) reported by importers in 2012. For example, the U.S. extended preferential (non-MFN) rates to 146 trade partners, with each partner benefitting from an average of 5,300 tariff lines at preferential rates, for a total of about 774,000 preferential rates. On average, each importing country reported about 167,000 preferential rates.

Figure 3 illustrates some potential problems that might arise when trade volumes and tariffs are aggregated across different partners. This example is based on trade flows of Canada in one of the textile industries. The two barplots in the far right column under the label of `World` show Canada's total imports/exports of the product from/to the World. Since Canada generally imports and exports large volume of products in the industry, the intra-industry trade measure
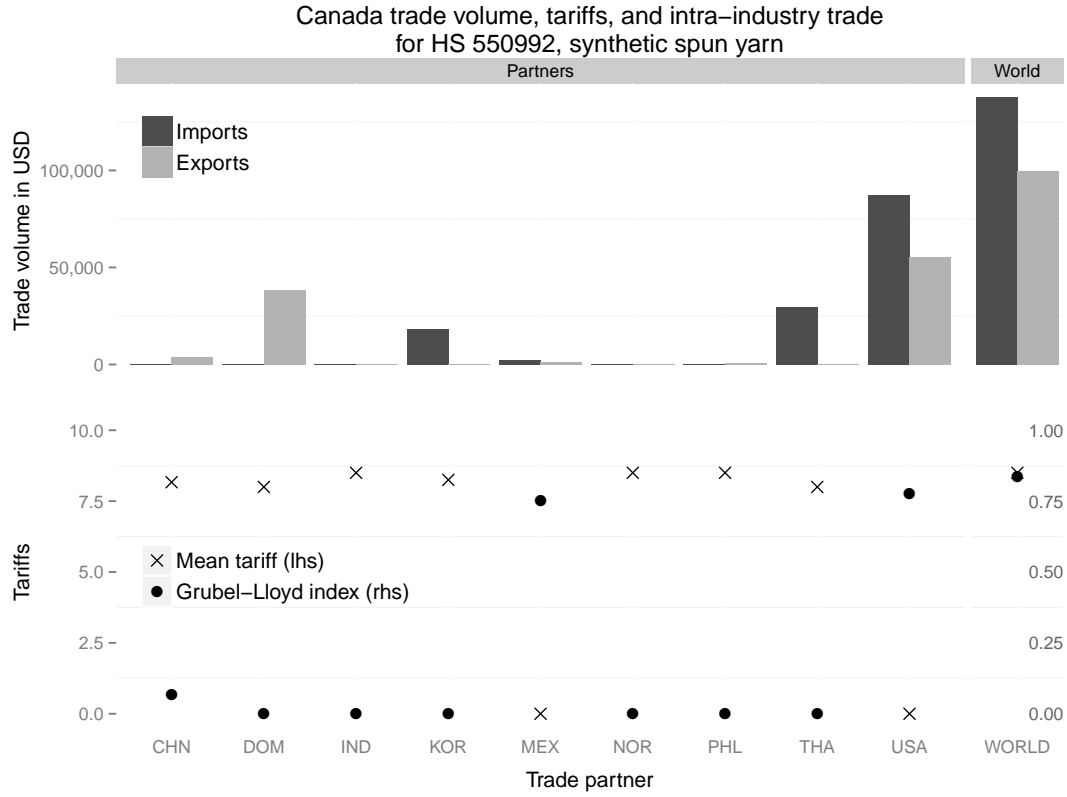
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Figure 3: **Variation in Intra-industry Trade and Tariffs across Partners:** This figure illustrates potential problems associated with using importer-level data (the far right column labeled as World) to examine the effect of intra-industry trade on tariffs. As is clear, one might accidentally find a positive relationship between tariffs and intra-industry trade if aggregated trade volumes and MFN tariffs are used. When the volume is disaggregated across trade partners, and the dyad-level trade policy is correctly incorporated, however, a completely different finding arises. Canada imposes zero tariffs on products within industry HS6 550992 towards USA and Mexico (its NAFTA partners) where the level of intra-industry trade with them is high. Contrarily, MFN tariff rates for other partners (around 8%) is associated with lower level of intra-industry trade. The amount of imports/exports across dyads should add up to the total imports/exports from/to world. Grubel-Lloyd index $(1 - \frac{|import-export|}{import+export})$ is used for measuring intra-industry trade, where it is multiplied by 10 to match the scale of mean tariffs.

will be quite high (≈ 0.8 marked as $\times$).[4] The average MFN tariff rates across products in the industry is around 8% (marked as $\bullet$). Although it captures the general level of protection, it does not distinguish preferential treatments given to different trade partners. This can be problematic, if countries preferentially reduce trade barriers on products for certain partners with high intra-industry trade. In fact, an interesting observation from the Figure is that the degree of intra-industry trade and tariff policies vary across dyads. For example, Mexico and the U.S. (the

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[4] Grubel-Lloyd index achieves 1 as its maximum, when countries import and export the same amount of goods.
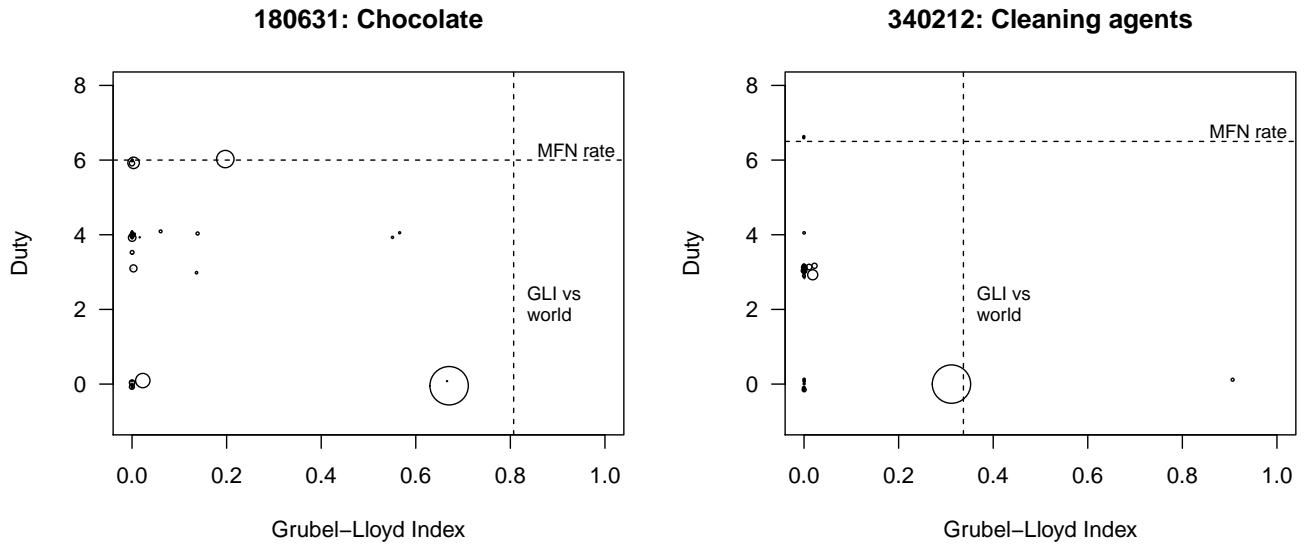
Figure 4: **Comparing MFN and dyad-level intra-industry trade:** This figure illustrates the difference between MFN and partner-specific tariff rates, as well as the difference between world and partner-specific intra-industry trade (GLI). The charts show Canada's import tariffs and GLI in two HS6 products. The sizes of the bubbles correspond to relative differences in the size of total trade volume (imports plus exports) across trade partners.

NAFTA members) get preferential duty-free treatment of that product by Canada. This suggests that one should disaggregate the level of analysis to the dyad-level.

Figure 4 illustrates the same point in more detail. Again, we draw on Canada's import tariffs and trade flows, and plot partner-specific import duties against intra-industry trade, measured by the Grubel-Lloyd index. The plots show that the majority of exporters that trade with Canada in these two products (chocolate and cleaning agents) do not pay the MFN rate; actual applied rates are often much lower, and imports from some countries are duty-free. Furthermore, intra-industry trade at the partner-level is very different from aggregated intra-industry trade. In the two cases we present, despite a high level of aggregated intra-industry trade, indicating two-way trade flows, most of Canada's flows with its trade partners in these products is in fact one way (represented by a GLI value of zero). To reiterate our argument, when trade policy is set at the bilateral or regional level, researchers must take care to use the correct partner-specific rates and partner-specific trade flows in their analysis.

Throughout this paper, we will denote importer, exporter, industry, and year by i, j, h, and t. For instance, average tariffs across products in industry h coming from j to i in year t will be

denoted as τ_{ijht}. We will use the Harmonized System 6 digits (HS6) level as our primary unit of analysis. This is the most disaggregated level at which trade statistics exist across countries. Furthermore, as Kono (2009) pointed out, HS6 is the desired level as too much disaggregation will preclude the notion of intra-industry trade, while product differentiation and substitutability become meaningless with too broad category. When tariff line product k is used, we will denote HS6 industry h corresponding to product k as $h[k]$. Similarly, when further aggregation is needed, we define the variable hierarchically, e.g., HS2[h] for HS2 industry corresponding to HS6 industry h. Finally, all of our analysis include confounding variables ($\mathbf{X} \in \{\mathbf{X}_{ij}, \mathbf{X}_i, \mathbf{X}_j\}$) at the dyadic ($\mathbf{X}_{ij}$) and monadic ($\mathbf{X}_i, \mathbf{X}_j$) level such as distance, colonial relationship, total number of landlocked nation in dyad, GDP per capita, population, level of political particularism, and polity scores.[5] We also include industry level covariates ($\mathbf{Z}_h$) such as volume of total trade, and the level of product differentiation.

4   Empirical Results

In this section, we present our empirical results. We begin by conducting multilevel statistical analysis which partially pools variations from both within and between industries in order to explore industry-varying effects on trade liberalization across the world. We then focus on the free trade agreement between the U.S. and Korea where both countries exchanged a large number of products simultaneously (i.e., two-way trade) prior to the agreement. We examine whether the pre-agreement levels of intra-industry trade have differential effects on the percentage decrease of tariff rates across products from the earlier baseline MFN rates.

4.1   Multilevel Statistical Analysis

We use multilevel models to analyze the association between intra-industry trade and the level of protection. There are several reasons to do so. First, the dataset described in Section 3 creates a natural multilevel structure, where Harmonized System 6 digits (HS6) products can be further embedded in Harmonized System 4 digits (HS4), 2 digits (HS2) industries and so forth. Second, in many situations, researchers are interested in how the effects of intra-industry trade on trade

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[5] Kono (2009) finds that high intra-industry trade leads to protection in countries with high political particularism (the degree to which politicians are responsive to narrow political interests) such as Canada and the U.S.

policy differ across industries. Trade policies are endogenously determined by different political dynamics, making it imperative to analyze the effect separately across industries. Third, the number of products within industry differ across industries and countries since countries set tariffs at different levels of aggregation. This makes sample sizes too small for some industries, which subsequently results in more variable estimates and higher standard errors (Gelman and Hill, 2007). Multilevel analysis is more appropriate because it borrows strength from both within and across industries by partially pooling the variation in data. Taken together, we run the following model with varying slopes on intra-industry trade.

$$\tau_{ijht_2} \mid \mathbf{X}, IIT, \delta, \phi \overset{\text{indep.}}{\sim} \mathcal{N}(\alpha_{HS2[h]} + \beta_{HS2[h]}\text{IIT}_{ijht_1} + \gamma\text{IITmissing}_{ijht_1} + \mathbf{X}_{t_1}^T\delta + \mathbf{Z}_{ht_1}^T, \sigma_\tau^2)$$

$$\alpha_{HS2[h]} \overset{\text{i.i.d.}}{\sim} \mathcal{N}(\alpha, s_\alpha^2),$$

$$\beta_{HS2[h]} \overset{\text{i.i.d.}}{\sim} \mathcal{N}(\beta, s_\beta^2), \tag{2}$$

where $\alpha_{HS2[h]}$ and $\beta_{HS2[h]}$ denotes random intercepts and slopes varying across HS2 industries controlling for unobservable heterogeneity within each industry.

For each analysis, we first divide the dataset into 4 periods: 1996-2000 (period 1), 2001-2005 (period 2), 2006-2010 (period 3), and 2011-2012 (period 4). We then run the model specified in equation (2), where IIT_{ijht_1} denotes the mean level of intra-industry trade from one preceding period (e.g., from 2001 to 2005) and τ_{ijht_2} denotes the mean level of tariffs across the next 5 years (e.g., from 2006-2010).

This choice is made for two reasons. First, the volume of trade is endogenous to the level of trade barriers, and hence using intra-industry trade and tariffs from the same period exacerbates the endogeneity problem. That is, trade should decrease when trade barriers are high. Instead, we assume that international transactions in year t is not affected by the anticipated level of tariffs from year $t + 5$ to $t + 10$. To be sure, this does not completely solve the endogeneity problem if tariff rates do not change, and if there exists an omitted confounder that simultaneously affects both the tariffs and trade flows. We will address this issue more directly in Section 4.2. Second, there is no *a priori* reason why one should use yearly trade data when international transactions can occur at any given time. For instance, firms make both long-term and short-term decisions, and the level of trade should fluctuate daily, monthly, and yearly depending on a myriad of factors such as their inventories. Thus, we use the mean level of trade across multiple years to capture

the general level of intra-industry trade while smoothing out extreme variability.[6]

Our quantity of interest is the effect of intra-industry trade on the future level of tariffs. Following the literature, we use the Grubel-Lloyd index $(1 - \frac{|import-export|}{import+export})$ to measure intra-industry trade, where it achieves the maximum value 1 when countries simultaneously import and export exactly the same amount of goods. Note that this quantity is not defined when there is zero trade, i.e, $import = export = 0$. Unfortunately, the current literature completely excludes these observations. This general practice is based on an implicit assumption that no systemic difference exists between tariffs on products with zero trade and positive trade. Thus, excluding them is equivalent to listwise deleting observations with missing values under the assumption of "missing at random." Since it is unlikely that products with positive and zero trade are subject to similar political dynamics, it is important to explicitly limit our statistical inference to the products with positive trade where intra-industry trade is defined to begin with. Thus, we created an indicator variable IITmissing$_{ijht_1}$ while setting IIT$_{ijht_1}$ value to be zero for those observations with no trade. This allows us to interpret $\beta_{HS2[h]}$ as industry-varying effects of intra-industry trade on liberalization *conditional on* countries exchanging the products within the given industry.

We conduct analyses on three separate datasets based on the four time periods: period 2 on 1, period 3 on 2, and period 4 on 3. This is due to some computational difficulty arising from the large number of observations from each time period (≈ 10 million). We first run fixed and random intercepts model while fixing the slope estimates across all industries, i.e., $\beta_{HS2[h]} = \beta$ for all $HS2[h]$. Within each analysis, we control for importer- exporter- and dyad-level covariates. In order to address the concern of Kono (2009) that there might be heterogeneous effects depending on the levels of political particularism, we also variables for country-level political institutions. Since we run each model separately in each period, both time-varying and time-invariant variables are included. Note that the random effects model relies on the assumption that unobservable industry-level heterogeneity is independent of other independent variables such as country-level and dyad-level covariates. Thus, we conduct a Hausman test after running both industry fixed and random intercepts models. The null hypothesis that both fixed and random effects estimators are consistent cannot be rejected. We find consistently that high intra-industry trade in earlier period is associated with lower tariffs in later periods. The results from HS2 fixed effects and HS6

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[6] Results do not change when different length of aggregation (e.g., 3 years and 7 years average) is used.

varying intercepts models on each period are summarized in Table 1.

	Dependent variable: Log Mean import tariffs, HS6-level					
	OLS			Mixed effects		
	2001-2005	2006-2010	2011-2012	2001-2005	2006-2010	2011-2012
	(1)	(2)	(3)	(4)	(5)	(6)
IIT	−0.069***	−0.037***	−0.067***	−0.105***	−0.063***	−0.110***
	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Missing IIT indicator	−0.013***	−0.033***	−0.085***	0.052***	0.049***	0.003**
	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
Dummy for low particularism (importer)	0.144***	0.283***	0.168***	0.142***	0.278***	0.162***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Dummy for high particularism (importer)	−0.195***	0.114***	0.016***	−0.194***	0.109***	0.014***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Dummy for low particularism (exporter)	−0.020***	−0.029***	−0.054***	−0.020***	−0.029***	−0.053***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Dummy for high particularism (exporter)	0.052***	0.013***	0.013***	0.056***	0.014***	0.016***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Polity2 score (importer)	−0.038***	−0.032***	−0.030***	−0.037***	−0.031***	−0.029***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Polity2 score (exporter)	0.002***	−0.00003	−0.002***	0.002***	0.0002***	−0.001***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Log population (importer)	0.093***	0.022***	0.021***	0.099***	0.029***	0.028***
	(0.0003)	(0.0002)	(0.0003)	(0.0003)	(0.0002)	(0.0003)
Log GDP per capita (importer)	−0.268***	−0.245***	−0.267***	−0.261***	−0.239***	−0.261***
	(0.0004)	(0.0002)	(0.0003)	(0.0003)	(0.0002)	(0.0003)
Log population (exporter)	−0.048***	−0.070***	−0.083***	−0.044***	−0.065***	−0.076***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0002)	(0.0003)
Log GDP per capita (exporter)	0.001***	−0.011***	−0.024***	0.007***	−0.006***	−0.017***
	(0.0003)	(0.0002)	(0.0003)	(0.0003)	(0.0002)	(0.0003)
Log elasticity of substitution	−0.011***	−0.014***	−0.018***	0.039***	0.027***	0.015*
	(0.0004)	(0.0003)	(0.0003)	(0.008)	(0.008)	(0.009)
Log import volume	−0.010***	−0.006***	−0.010***	−0.010***	−0.005***	−0.009***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Constant	2.193***	3.120***	3.318***	2.044***	2.792***	2.801***
	(0.017)	(0.020)	(0.022)	(0.018)	(0.017)	(0.019)
Gravity variables	Yes	Yes	Yes	Yes	Yes	Yes
HS2 fixed effects	Yes	Yes	Yes	No	No	No
HS6-varying random intercepts	No	No	No	Yes	Yes	Yes
N	5635669	9628347	8496272	5635669	9628347	8496272
R²	0.363	0.357	0.355			
Adjusted R²	0.363	0.357	0.355			
F-statistic	27504	45618	40023			
Note:					*p<0.1; **p<0.05; ***p<0.01	

Table 1: **Effects of Intra-industry trade on trade liberalization**: This Table presents results from the OLS (columns 1-3) and mixed effects (columns 4-6) models. This provides strong statistical evidence for positive effect of intra-industry trade on trade liberalization. Standard errors are in parentheses.

To be sure, the negative association between intra-industry trade and protection will not necessarily hold true for all industries. In order to allow for the possibility of heterogeneous effects
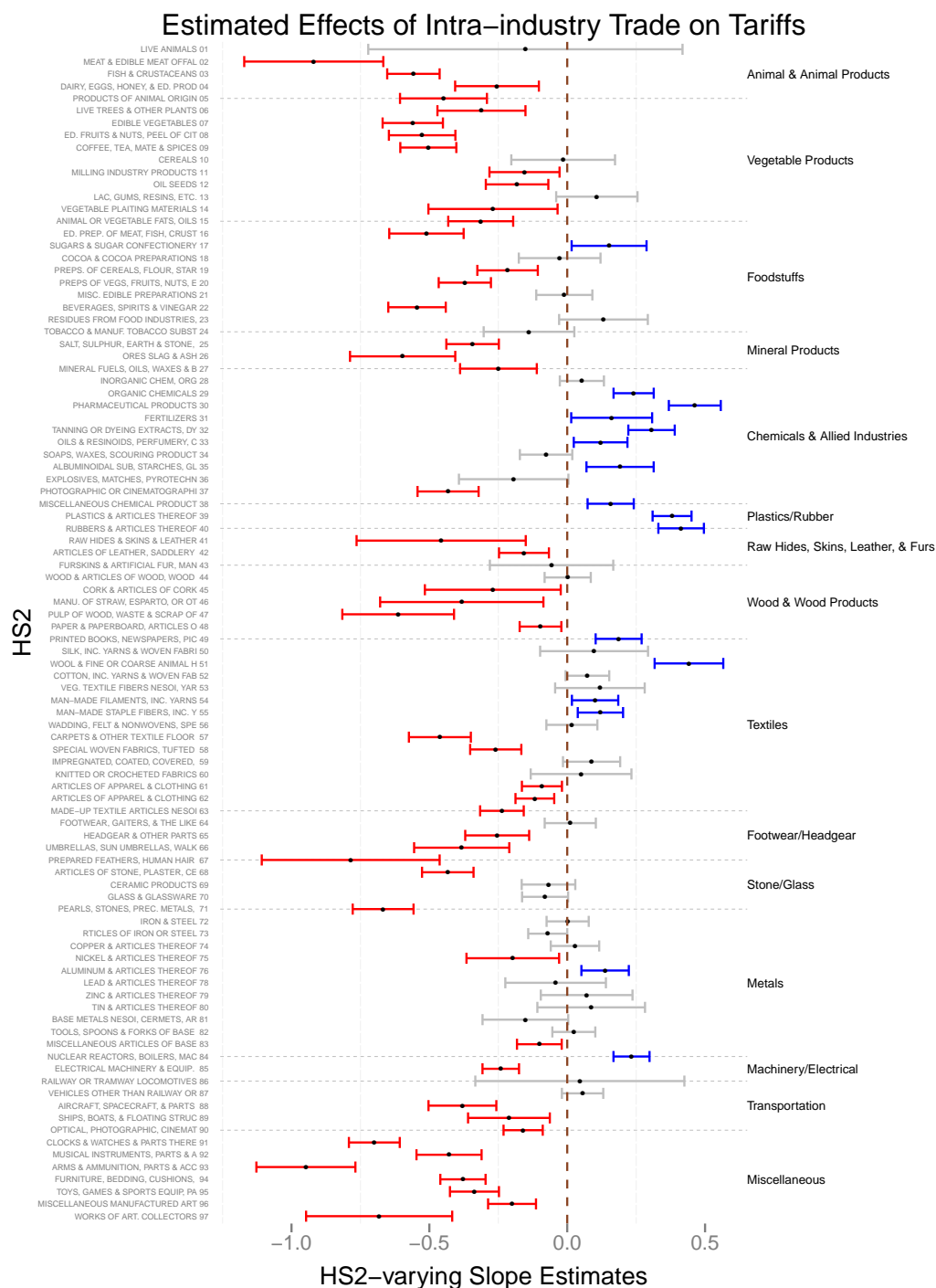
Figure 5: **Industry-varying Effects of Intra-industry on Trade Liberalization:** This figure presents the industry-varying slopes for each HS2 industry. There exist strong evidence for negative effects of intra-industry trade on protection. Positive effects arise when low level of intra-industry trade (one-way trade) is associated with lower tariffs. This is particularly true for intermediate products such as products in chemical industry.

across industries, we then run the varying slopes model specified in equation (2). Figure 5 displays the industry-varying slopes estimates for each HS2 industry from period 3 on period 2.[7] It is clear from the figure that the effect is negative for most industries (red lines). However, we find a cluster of positive estimated effects (blue lines) from the chemical industry. It is also worth noting that high intra-industry trade in textile industry either has no effect on trade policy (grey lines) or does increase the level of protection.

The positive effects can arise from two different reasons. First, it might be that domestic producers, who are exporters by themselves, demand protection on products from foreign countries to secure their domestic market shares. Second, the positive association might result from the fact that high cross-industry trade (one-way trade) is associated with lower tariffs. The latter is consistent with the logic behind comparative advantage in that it is reasonable for countries to eliminate trade barriers on goods that they cannot efficiently produce and thus import to begin with, or they have a comparative advantage and export with little foreign competition. It is also consistent with the prominence of global supply chain in international trade, whereby domestic firms demand trade liberalization on intermediate products (such as chemical products) that they import for producing final goods. To examine what explains the variation in varying-slopes, we order the varying-slopes estimates based on the level of variation in tariffs across products within each industry.

The result is striking. Figure 6 displays varying slopes across HS4 industries.[8] The top panel summaries the distribution of tariffs across all products within each HS4 industry. When the industry-varying slopes are ordered by the variance in tariffs, we find that the positive correlation between intra-industry trade and protection is concentrated on the lower end (blue lines). Note that these industries also generally have low mean tariffs.[9] This corroborates our argument that the level of trade barriers are generally low for products in which countries engage in one-way trade (imports or exports only). We interpret this as evidence of "old-trade theory" force for trade liberalization, which identifies comparative advantage as a source for trade. Note that there exist very little variation in the level of tariffs to be explained across goods where we find the

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[7] This period was chosen because we have fewer observations for trade volume in period 1(especially in 1996-1997), while we only have 2 years (2010-2012) from period 4. Thus, we have complete 5-year data for both trade volumes and tariffs for the two periods. Similar patterns emerge from analyses on other periods.

[8] The result from HS2-varying slopes model is in Appendix 6.2

[9] The mean and variance are positively correlated due to the fact that tariffs are truncated at zero.
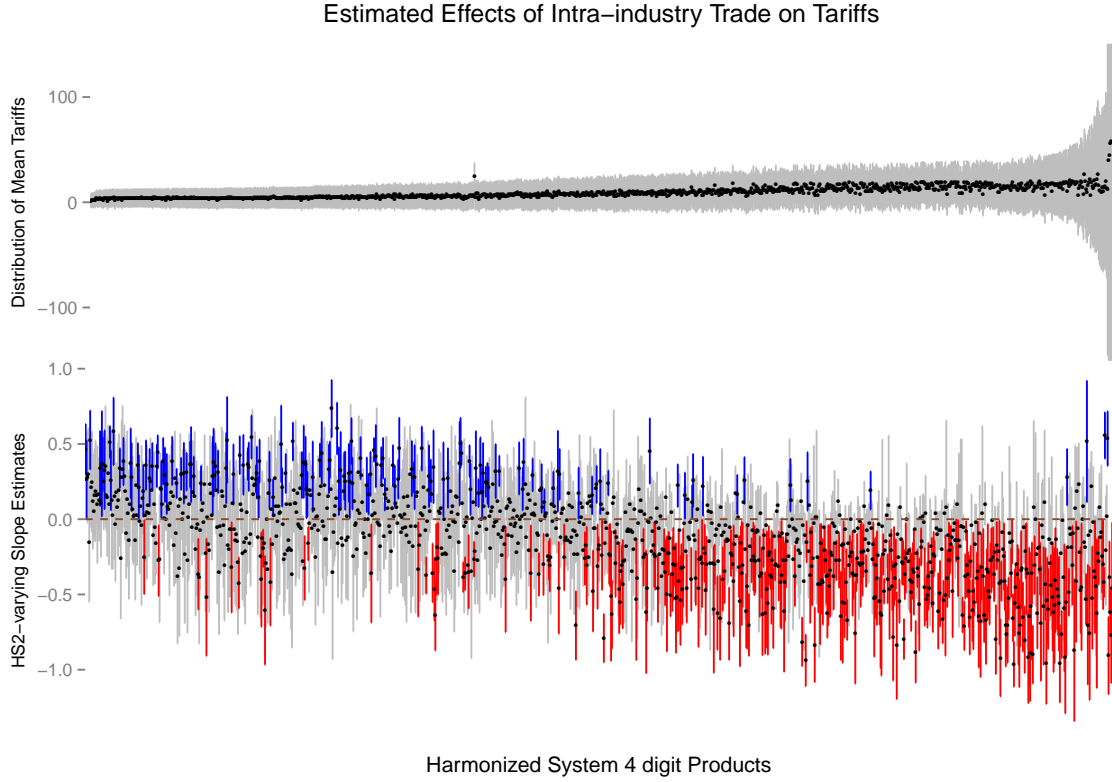
Figure 6: **HS4 Industry-varying Slopes:** This figure shows that the positive effect of intra-industry trade on protection (blue lines) is concentrated in the region with low mean tariffs and variance. When there exist large variation in tariffs, on the other hand, we consistently find that the effect is negative (red lines).

positive effect.

In contrast, when we observe meaningful variation in trade policies, we see strong negative correlation between intra-industry trade and tariffs (red lines). We interpret this as evidence of "new-trade theory" force for trade liberalization, which emphasizes the role or consumer taste differentiation, and firm-level selection into foreign markets.

In sum, this section offers strong empirical evidence for high intra-industry trade on lower trade barriers. It is worth nothing, however, that we do find positive association between intra-industry trade and tariffs. This implies that comparative advantage (one-way trade) still functions as an important driving force for both trade flows and trade policies of many countries. Interestingly, however, such effects are dominated by industries with low overall mean and variance in tariffs. In the following Section, we focus on a preferential trade agreement between two countries whose trade pattern is mostly characterized by two-way intra-industry trade.

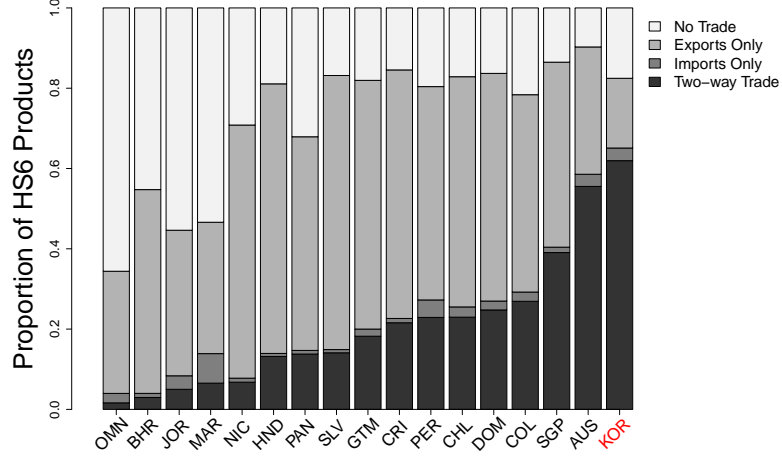## 4.2 Preferential Trade Agreements between the U.S. and Korea

Figure 7: **Composition of Trade Flows Prior to Free Trade Agreements of the U.S.:** This Figure shows that the U.S. and Korea simultaneously exchanged a large proportion of goods prior to the agreement within the same industry (Two-way Trade). Contrarily, the U.S. either primarily exported (Export Only) or did not exchange products at all (No Trade) with most of its partners.

The results from Section 4.1 motivate a closer analysis of trade policy from country pairs who engage mostly in two-way trade. In fact, the scope of new-new trade dynamics on trade liberalization is confined to the cases where a country exports and imports the same product with its partner simultaneously. We also note that tariff rates rarely change over time. This implies that it is likely that τ_{ijht_2} in Equation (2) is in fact same as the tariff rate from t_1 even though we attempted to limit such possibility by widening the size of window between the two subsequent periods. This might introduce endogeneity bias because the levels of intra-industry trade in t_1 itself is certainly determined by τ_{ijht_1}.

In this Section, we directly address the two remaining concerns by limiting our analysis on the free trade agreement between the U.S. and Korea (KORUS FTA). First, the trade between the two countries is primarily driven by intra-industry trade. That is, both countries export (import) similar products to (from) each other rather than one country specializes in exporting a certain product while importing others goods from its partner. Figure 7 demonstrates this fact by comparing the composition of the types of trade flows across 17 free trade agreement partners

of the U.S.[10] Specifically, we consider each HS6 product and calculate the mean trade volumes across three years prior to each FTA agreement. We then categorize each product into 4 separate types based on the direction of trade flows: 1) both the U.S. and its partner export (Two-way trade), 2) only the U.S. imports (Imports Only), 3) only the U.S. exports (Exports Only), and 4) both countries do not trade (No Trade). It shows that the KORUS FTA is distinct from other agreements in that its trade flows prior to the agreement are dominated by two-way trade ($\approx 61.9\%$).[11] This is in stark contrast to other FTAs, where the U.S. either unilaterally exported or did not exchange most of products at all. We argue that the KORUS FTA is a relevant case for examining the effect of intra-industry trade on trade liberalization because dyads such as the U.S. and Oman will simply introduce noise with their lack of intra-industry trade.

Second, analyzing preferential trade agreement allows us to evaluate the effect of intra-industry trade on the *changes* in preferential tariffs from the baseline MFN tariff rates. We first calculate the mean level of imports and exports across three years prior to the agreement (from 2004 to 2006). We then consider the percentage decrease of tariff rates to measure the degrees of tariff cuts across each HS6 industries compared to the baseline MFN tariff rates: i.e., ((MFN rates − Preferential Rates)/MFN rates) × 100. Note that about 37% of HS6 products did not have any changes. These are mostly the products whose MFN tariff rates already reached 0 with no room for further liberalization.[12] This approach directly addresses the concern that trade volumes are determined by the current tariff rates. As it is well known, preferential trade agreements are fraught with uncertainties when it comes to their initiation, negotiation, ratification, and implementation. As a consequence, it is reasonable to assume that decisions on current trade flows (imports and exports) are not driven by clear expectations about future preferential rates for any given product conditional on other observable factors that explain the trading decisions.

Following the new-new trade theory, we control for the levels of product differentiation for each HS6 industry because it is an important determinant of the patterns of two-way trade. We use the measure developed by Rauch (1999), who divides all internationally traded products into

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[10] We excluded the North American Free Trade Agreement (NAFTA) because we have limited information on the volume prior to 1990s.

[11] Out of 5204 HS6 products, the U.S. and Korea engage in two-way trade ro 3224 products.

[12] In fact, majority of HS6 products have some levels of protection. This is because we consider the mean tariff rates across tariff lines (HS8) within each HS6 industry. We also use ad-valorem equivalent tariff rates for the lines with specific tariffs, e.g., 5cents/kg. We note this because this important means of protection tends to be ignored in the literature by being treated as zero tariff rates.

three categories: 1) commodities that are traded on organized exchanges (e.g., oil), 2) goods with "reference prices" (e.g., chemicals), and 3) differentiated products. This measure is based on the idea that homogeneous goods are sold on organized markets while products with some substitutability tend to have reference prices. We also control for the partner-level dependency. Specifically, we calculate the proportion of imports (exports) from a given partner out of total imports (exports) of each HS6 industry. This helps us to control for the partner specific dependency and their sizes. Finally, we control for the volumes to account for the magnitude of trade flows.

Table 2 summarizes the results examining the effect of pre-agreement levels of intra-industry trade on the percentage reduction of the U.S. tariff rates compared to the MFN rates.[13] We also use the levels of preferential tariff rates in Model (5) in order to estimate the effect on the tariff rates themselves as well as the percentage changes. We find that the U.S. liberalizes industries with high intra-industry trade (IIT) disproportionately more than those with one-way trades. In other words, levels of intra-industry trade are positively correlated with the magnitude of tariff reduction. When we use the FTA preferential duty rates as the dependent variable, we have a consistent finding that high intra-industry trade before the agreement is negatively correlated with the tariff rates suggesting more liberalization. We also find that compared to the baseline substitutable products, Differentiated products enjoy greater trade liberalization consistent with the new-new trade theory.

As noted, a large number of products are already liberalized with no further rooms for trade liberalization. Therefore, we implemented a two-stage Heckman like regression in order to address the potential selection effects of the products with some positive levels of protection. The result from this analysis appears in the last column: Model (6). We consistently find that the degree of trade liberalization is systemically driven by the levels of mutual exchanges of goods. To be sure, it might be that the findings are driven by some unique political dynamics of the U.S. or a special relationship between the U.S. and Korea. To address this concern, we replicate the same analysis applied to the FTA between the EU and Korea where both parties exchange more than 77.7% of products bilaterally with each other. We find strong evidence that high pre-agreement levels of intra-industry trade result in deeper trade liberalization. The result is presented in Table 3 in Appendix 6.3.

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[13] The preferential tariff rates of Korea applied to imports from the U.S. are not available yet.

	Dependent variable:					
	Percent Decrease from MFN Rates				FTA duty	Heckman
	OLS				OLS	Selection
	(1)	(2)	(3)	(4)	(5)	(6)
IIT	6.716***	5.598***	4.738**	4.269***	−0.498**	4.586**
	(1.867)	(1.909)	(1.921)	(1.624)	(0.226)	(1.915)
Reference Priced	4.436**	4.807**	4.787**	−3.797*	0.289	6.174***
	(2.074)	(2.069)	(2.065)	(2.125)	(0.296)	(2.106)
Differentiated	14.307***	14.097***	13.719***	−0.163	−0.054	14.474***
	(2.088)	(2.086)	(2.085)	(2.274)	(0.317)	(2.095)
Log Import Volume	−0.618***	−0.426***	−0.883***	−1.017***	0.043**	0.111
	(0.098)	(0.108)	(0.170)	(0.151)	(0.021)	(0.170)
Log Export Volume	−0.696***	−0.867***	−1.010***	−1.284***	0.093***	−0.109
	(0.131)	(0.143)	(0.149)	(0.152)	(0.021)	(0.151)
Proportion from KOR		−32.277***	−26.840***	−19.055***	1.571	−25.978***
		(7.953)	(8.090)	(7.097)	(0.989)	(8.080)
Proportion to KOR		18.714*	20.504*	13.382	−2.794**	22.121**
		(10.550)	(10.540)	(8.928)	(1.245)	(10.518)
Two-way			8.152***	8.523***	−0.620**	8.867***
			(2.349)	(2.052)	(0.286)	(2.353)
Constant	90.181***	90.903***	91.612***	119.202***	−1.256	89.245***
	(2.417)	(2.422)	(2.426)	(9.617)	(1.341)	(2.527)
HS2 Fixed Effect	No	No	No	Yes	Yes	Yes
Observations	2,626	2,626	2,626	2,626	2,626	4,583
R^2	0.052	0.059	0.063	0.390	0.408	
ρ						0.186
Inverse Mills Ratio						4.723***(1.419)

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

Table 2: **Effects of Intra-industry Trade on US Preferential Tariff Rates on Korea's Products:** This table summarizes regression results from the linear regression models of trade liberalization on intra-industry trade. It consistently shows that the U.S. liberalizes products with high intra-industry trade with Korea. Models (1), (2), (3), (4), and (6) use the percentage decrease in preferential tariff rates with respect to the baseline MFN tariff rates as a dependent variable. Model (5) uses the levels FTA tariff duty rates. Model (6) is from a two-step Heckman type Selection model where first stage models the selection into no changes in tariff rates.

5 Concluding Remarks

This study provides compelling evidence of the strong impact of high intra-industry on lower trade barriers. Countries liberalize industries particularly with partners whom they exchange similar products. The evidence suggests that industrialized countries engaging in high levels of intra-industry trade will find it easier to liberalize.

The new dataset that we offer reveals highly detailed information about the cross-country variation in tariffs that countries set differently against their trade partners. By combining trade volumes with partner-specific tariff rates across all internationally traded products, we hope that the database will be useful for testing other important questions in the field of international political economy. For instance, scholars can now directly test whether democracies are successful in reducing trade barriers among themselves by using applied tariff rates rather than using trade volumes as a proxy measure for liberalization (Mansfield *et al.*, 2000). Researchers can also examine political sources for the highly various preferential treatments of the same goods originated from different partners.

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6 Appendix

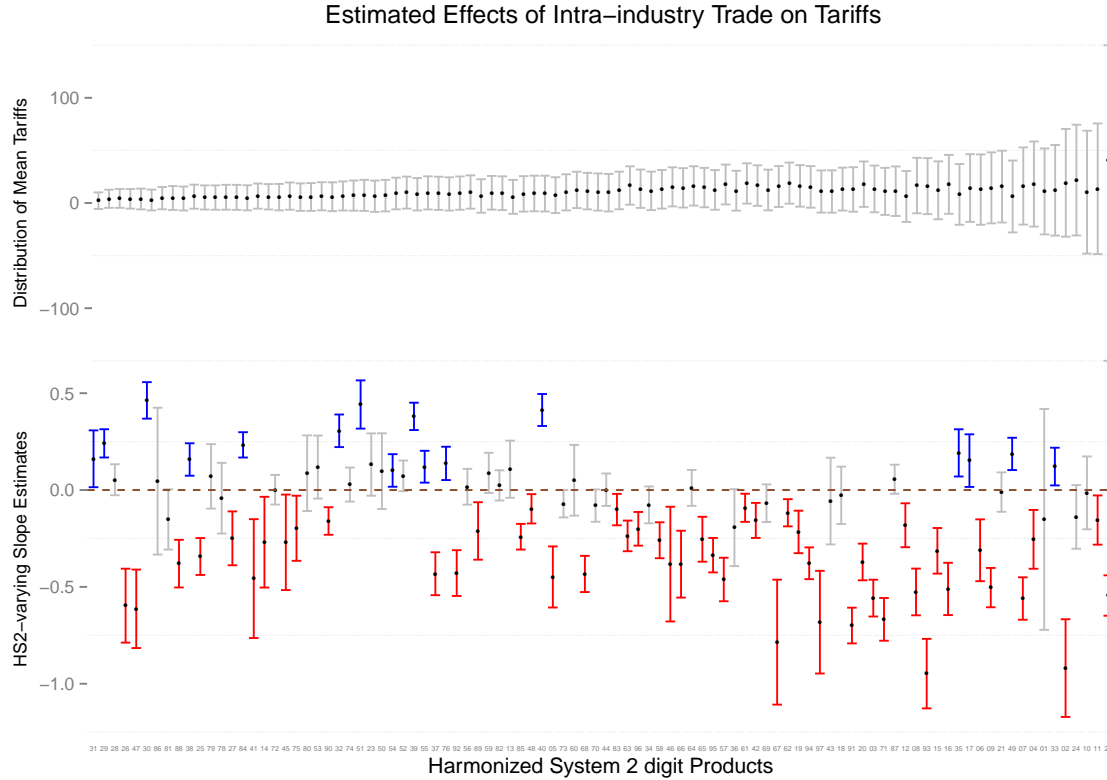## 6.1 Results from Mixed Effects Models

Figure 8: **HS2 Industry-varying Slopes:** This figure shows that the positive effect of intra-industry trade on protection (blue lines) is concentrated in the region with low mean tariffs and variance. When there exist large variation in tariffs, on the other hand, we consistently find that the effect is negative (red lines). This result corresponds to Figure 5.

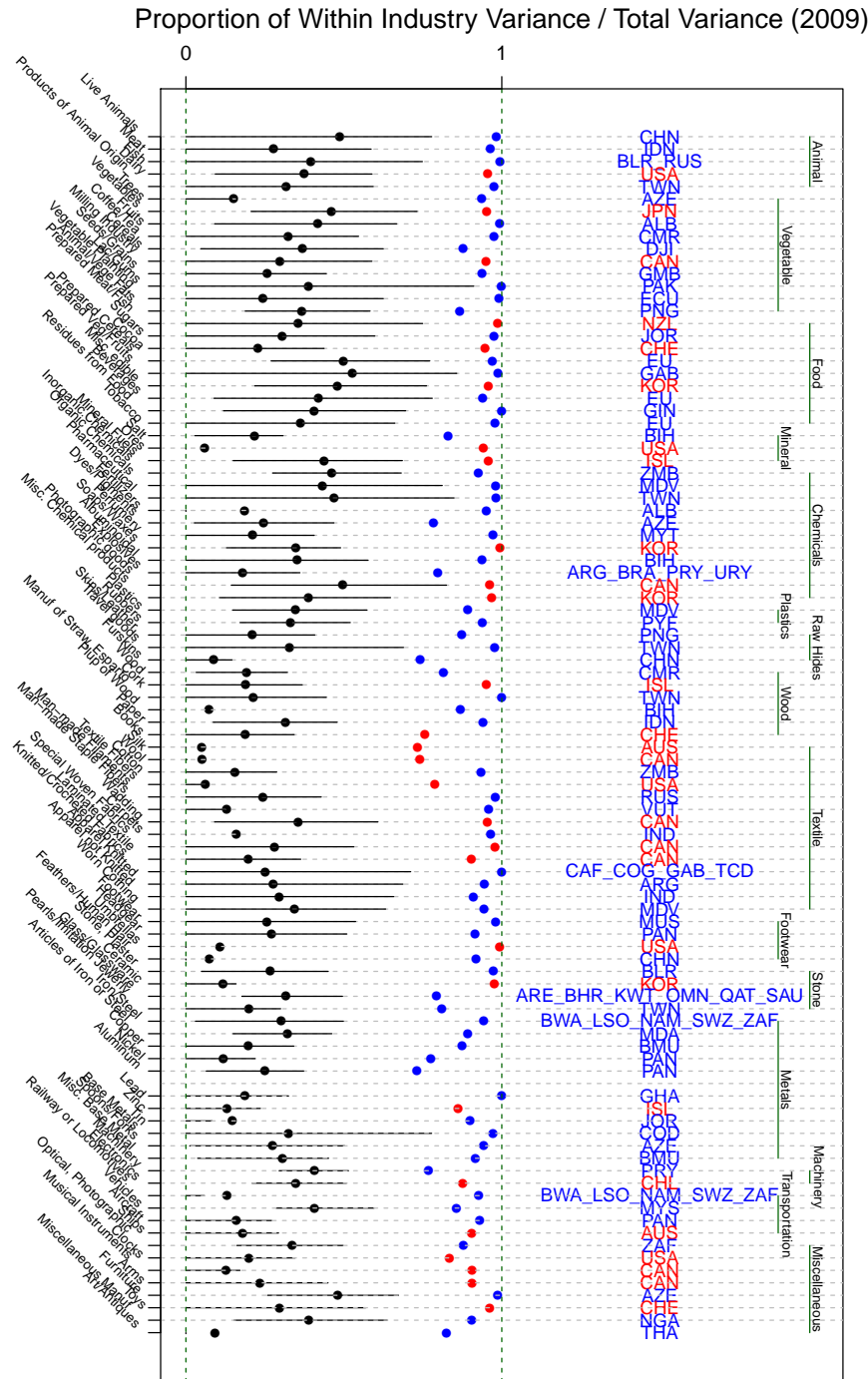## 6.2 Within Industry Variance Across Industries

Figure 9: **Within Industry Variance Across Industries:** This figure shows the distribution of within industry variance across countries. It ranges from zero to one, where one indicates most variation arises within industry. The right part of the figure presents top countries exhibiting highest within-industry variance for a given industry. Countries in red color are the OECD countries. For instance, it shows that developed countries tend to have large within-industry variance in textile industries.

6.3 Preferential Tariff Reduction from the EU-KOR FTA

	Dependent variable:		
	Percent Decrease from MFN Rates		
	(1)	(2)	(3)
IIT	6.815***	6.220***	3.060***
	(1.054)	(1.078)	(0.884)
Reference Priced	1.498	1.529	0.287
	(1.359)	(1.351)	(1.315)
Differentiated	1.003	0.694	0.581
	(1.351)	(1.345)	(1.344)
log(imports + 1)	−0.387***	−0.668***	−0.169**
	(0.073)	(0.105)	(0.068)
log(exports + 1)	0.603***	0.439***	−0.084
	(0.090)	(0.099)	(0.087)
Proportion of Imports from KOR		−9.291*	−20.787***
		(5.430)	(4.443)
Proportion of Exports to KOR		11.831	27.472**
		(16.609)	(13.548)
Two-way		7.742***	
		(1.415)	
Constant	89.187***	88.466***	101.587***
	(1.568)	(1.590)	(7.758)
HS2 FE	No	No	Yes
Observations	3,267	3,267	3,267
R^2	0.026	0.037	0.404
Adjusted R^2	0.024	0.035	0.386
Note:		*p<0.1; **p<0.05; ***p<0.01	

Table 3: **Effects of Intra-industry Trade on EU Preferential Tariff Rates on Korea's Products:** This table summarizes regression results from the linear regression models of trade liberalization on intra-industry trade. There is strong evidence that the EU liberalizes products with high intra-industry trade with Korea.