INTERNATIONAL POLITICAL ECONOMY WITH PRODUCT DIFFERENTIATION: FIRM-LEVEL LOBBYING FOR TRADE LIBERALIZATION

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Abstract

Existing political economy models rely on inter-industry differences such as factor endowment or factor specificity to explain the politics of trade policy-making. However, this dissertation finds that a large proportion of variation in applied tariff rates in fact arises within industry in many countries. This dissertation consists of three essays. In Chapter 1, I offer a theory of trade liberalization that explains how product differentiation in economic markets leads to firm-level lobbying in political markets. I argue that while high product differentiation eliminates the collective action problem exporting firms confront, political objections to product-specific liberalization will decline due to less substitutability and the possibility of serving foreign markets based on the norms of reciprocity. Chapter 2 presents empirical analyses focusing on firm-level lobbying in the U.S. I construct a new dataset on lobbying by all publicly traded manufacturing firms in the U.S. after parsing the 838,588 lobbying reports filed under the Lobbying Disclosure Act of 1995. I find that productive exporting firms are more likely to lobby to reduce tariffs, especially when their products are sufficiently differentiated. I also find that highly differentiated products have lower tariff rates. Finally, Chapter 3 broadens the scope of my analysis to explain the large variation in tariffs across countries. Specifically, I collect 2 billion tariff-line data across 181 countries for past 25 years. I find that countries liberalize industries particularly with partners whom they exchange differentiated products within industry. My dissertation challenges the common focus on industry-level lobbying for protection while emphasizing the role of firms in demanding trade liberalization.
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This dissertation is dedicated to my family:
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\[
T = \frac{1}{N} \sum_{HS6} \sum_{i \in HS6} (\tau_i - \bar{\tau})^2, \quad W = \frac{1}{N} \sum_{HS6} \sum_{i \in HS6} (\tau_i - \bar{\tau}_{HS6})^2, \quad B = \frac{1}{N} \sum_{HS6} N_{HS6} (\bar{\tau}_{HS6} - \bar{\tau})^2
\]

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; \( \tau_i, \bar{\tau}_{HS6} \) and \( \bar{\tau} \) are the applied tariff rates, the average tariff rates within each industry, and the overall average of tariff rates across all products, respectively.
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3.6 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, I consistently find that the effect is negative (red lines). This result corresponds to Figure 3.3.

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Chapter 1

A Theory of Political Cleavages within Industry

1.1 Introduction

What makes trade liberalization possible? This has been a central question in the study of politics of trade policy. Over the last several decades, much progress has been made in understanding how countries can achieve trade liberalization even when they have strong incentives to protect domestic markets\(^1\). We know, for example, that international institutions (Keohane 1984; Bagwell and Staiger 1999), global supply chain (Milner 1987), delegation of negotiation authority to the executives (Bailey et al. 1997), and political motivation (Maggi and Rodríguez-Clare 2007) all

\(^1\) See Bagwell and Staiger (1999) for how the terms-of-trade externality creates an incentive to increase trade barriers. Grossman and Helpman (1994) characterizes the conditions under which governments protect domestic industries even without the terms-of-trade incentives. Guisinger (2013) finds that white Americans are more supportive of trade protection when they are in racially diverse communities because of redistributive concerns.
play a role. However, a vast majority of both theoretical and empirical research on domestic politics of international trade either implicitly or explicitly assumes that the underlying individual trade preferences that drive these forces are shaped by how trade affects their income, which is tied directly to the industry they serve. That is, trade policy preferences of individuals diverge across industry (e.g., Rogowski [1987], Hiscox [2002]).

This paper is motivated by some consistent empirical patterns that I find in the U.S. that contradict the industry-level explanations. First, I find that overall tariff differences occur largely within industries across similar products, the level at which tariffs are actually set. For example, as of 2013, the applied most favoured nation (MFN) tariff rate for Cotton, not carded or combed, having staple length of 28.575 mm or more but under 34.925 mm (HS 52010038) is 31.4 cents/kg ($\approx$ 14%), whereas Cotton, not carded or combed, having a staple length under 19.05 mm (3/4 inch), harsh or rough (HS 52010005) is duty free. The tariff on Flashlights (HS 85131020) is 12.5% while that of Portable electric lamps designed to function by their own source of energy, other than flashlights (HS 85131040) is 3.5%. Second, firms, rather than industry as a whole, individually lobby on trade policies targeting very specific products. This suggests that trade policy preferences of firms in the same industry diverge. Despite these, we know relatively little about how politics affects the distribution of tariffs.

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2 Ad-Valorem Equivalents of non Ad-Valorem Tariffs are calculated based on UNCTAD Method 1, which is “a three-step method for estimating unit values: (1) from tariff line import statistics of the market country available in TRAINS; then (if (1) is not available) (2) from the HS 6-digit import statistics of the market country from UN COMTRADE; then (if (1) and (2) are not available) (3) from the HS 6-digit import statistics of all OECD countries. Once a unit value is estimated, then it is used for all types of rates (MFN, preferential rates, etc)."
across products *within* industry (see Gowa and Kim (2005); Goldstein and Gulotty (2014) for notable exceptions.).

I argue that firm-level lobbying is an important determinant of product-specific liberalization, and in particular, of high within-industry policy variation. To analyze political incentives of firms, I extend the theoretical framework of the new-new trade theory (e.g., Bernard *et al.* 2003; Melitz 2003) to include political interaction between firms and government. In order to allow for within industry heterogeneity, I extend the Grossman and Helpman (1994) model by introducing firm-level differences in their productivity. I show that it is both economically and politically optimal to reduce tariffs on differentiated products (defined as less substitutable goods). My argument differs from the theory of endogenous protection which identifies the conditions under which firms intensify their lobbying activity for *protection* (Hillman 1984; Mayer 1984; Baldwin 1985; Magee *et al.* 1989; Trefler 1993). Although it is well known that governments reduce trade barriers responding to the interests of exporting industries/firms (Schattschneider 1935; Milner 1987; Destler and Odell 1987; Milner and Yoffie 1989; Gilligan 1997b; Hansen and Mitchell 2000), existing studies are unable to predict *which firms* within industry are more or less likely to lobby, *when* they lobby, and *which products* get lower tariffs. That is, few theoretical and empirical studies identify the conditions under which lobbying on product specific liberalization is successful.

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3 Throughout this paper, I use product differentiation and less substitutability interchangeably.
My theory provides the microfoundations of the argument that exporting firms
lobby for free trade (Milner 1988; Gilligan 1997b; Yaşar 2013). Specifically, I focus
on the effects of product differentiation on product-specific trade liberalization by ex-
amining the strategic interaction between firms and government. First, I argue that
product differentiation eliminates the collective action problem exporting firms con-
front because only a small number of firms actually trade specific products on which
governments set tariff. Thus, the firm’s lobbying decision is an endogenous response
to their own cost-benefit calculation rather than a collective problem at the industry
level. Second, product differentiation mitigates domestic firms’ perceived threats of
foreign competition compared to when their products are completely substitutable
by cheaper foreign products. Finally, product differentiation increases the level of
intra-industry trade, which subsequently encourages firms to strategically lobby for
open trade on the basis of the norms of reciprocity.

To estimate the effect of product differentiation on firm level lobbying and trade
liberalization, I construct a firm-level lobbying dataset based on 838,588 lobbying
reports filed under the Lobbying Disclosure Act (LDA) of 1995. For each lobbying
report, I identify the firms lobbying for any trade bills introduced since 1999 (from
106th Congress: both the Senate and the House of Representatives). I then use
financial databases (e.g., Compustat and Orbis) to obtain economic data for those

\footnote{Yaşar (2013) makes an important empirical contribution by showing that exporting firms are
politically influential in trade policy-making based on evidence from 27 Eastern European and
Central Asian countries.}

\footnote{Gilligan (1997b) shows that protection becomes a private good when firms engage in monop-
olicistic competition. He finds that industries with large intra-industry trade tend to request more
protection due to less severe collective action problems. Contrarily, I argue that product differen-
tiation mitigates the threat that import-competing firms face, and thus results in less demand for
protection.}

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firms. I show that productive firms are more likely to lobby on trade policy only when they compete in industries with differentiated products. I also analyze the content of trade bills that have been introduced since 1999 (from 106th to 113th Congress). Consistent with my theory, I find that firms individually lobby to reduce trade barriers on highly specific products. By emphasizing the importance of firm-level political activities and their subsequent effects on trade liberalization, this paper contributes to the empirical literature on the domestic politics of trade policy-making (e.g., Goldberg and Maggi 1999; Gawande and Bandyopadhyay 2000; Scheve and Slaughter 2001; Hainmueller and Hiscox 2006; Mansfield and Mutz 2009; Lü et al. 2012).

The rest of the paper is organized as follows. Section 1.2 highlights the large within industry variation and discusses the limits of existing studies. Section 1.3 theoretically discusses why a high level of product differentiation implies trade liberalization.

1.2 Inconsistencies between Existing IPE Models and Trade Flows

This section undertakes an empirical analysis of tariffs and trade flows of the U.S. at the product level. I find that most of the variation in tariff rates can be explained by differences in tariffs for products within the same industry. This is in contrast to existing theories which generally focus on conflicts of interests across factor owners or industries (e.g., Rogowski 1987; Hiscox 2002). I revisit the validity of two dominant
theories of trade policy formation. I then review the recent development of the new-new trade theory to motivate the study of firm-level political activity.\footnote{This paper focuses on the theoretical implication of the new-new trade theory on firm-level political incentives. There is a large literature on the importance of firms in international political economy (e.g., Milner \citeyear{1988}, Chase \citeyear{2004}, Manger \citeyear{2005}, Broz and Plouffe \citeyear{2010}, Weymouth and Broz \citeyear{2013}). I make no attempt to offer an exhaustive list of the literature.}

1.2.1 Product-level Trade Policy Variation within Industry

With sophisticated global consumer tastes and the development of production technology, international trade has increased not only in volume but also in the variety of goods. There are more than 17,000 internationally traded products on which countries set distinct tariffs and non-tariff barriers.\footnote{For the U.S., there are approximately 9,000 distinct exporting goods (Schedule B) and 17,000 imported products (HTS) used for export/import documentation.} Krugman \citeyear{1980} showed how consumer’s love of variety creates new gains of trade independent from the conventional source of comparative advantage. This paper examines the political implication of high product differentiation in the U.S., a country that is commonly used as a testing ground for endogenous protection literature. Specifically, I compare and contrast the political incentives of firms to identify the conditions under which lobbying on product-specific liberalization is successful.

We now demonstrate that variation of trade policy within industries comprises most of the variation in tariff rates. Thus, I decompose the overall variation in applied tariff rates in each year into a within industry and a between industry component.\footnote{The total variance is decomposed into within and between component such that $T_t = W_t + B_t$. We calculate each component by $T_t = \frac{1}{N_t} \sum_{HS2} \sum_{i \in HS2} (\tau_{it} - \tau_{i,t})^2$, $W_t = \frac{1}{N_i} \sum_{HS2} \sum_{i \in HS2} (\tau_{it} - \tau_{HS2,t})^2$, and $B_t = \frac{1}{N_{HS2,t}} \sum_{HS2} N_{HS2,t} (\tau_{HS2,t} - \tau_t)^2$ where Harmonized System 8 digits level products (HS8) are indexed by $i$ and time by $t$; industry is denoted by 2-digits Harmonized System Chapters (HS2); $N_t$ and $N_{HS2,t}$ denote the overall number of products and the products within each industry HS2; $\tau_{it}$, $\tau_{HS2,t}$, and $\tau_t$ are the applied tariff rates, the average tariff rates within each industry, and the overall average of tariff rates across all products, respectively.}
Figure 1.1: Large Within-Industry Variance in Applied Tariff Rates of the U.S.: This figure demonstrates that a significant proportion (≈ 70%) of the current variance in MFN (Most Favored Nation) tariff rates of the U.S. can be explained by the variation in tariff rates within industries, rather than variation across industries. It also illustrates that most tariff reduction, as a result of Uruguay Round negotiation, occurred across products within industry. This suggests that industry-level analysis is no longer adequate to explain trade policy-making, especially for developed countries like the U.S. Note that mathematically, the within industry variance plus the between industry variance sums up to the total variance.

Figure 1.1 shows that within industry component accounts for most of the total variation in U.S. tariffs. The difference in variation is most noticeable after the Uruguay Round negotiation, which resulted in major tariff reductions. This calls into question the adequacy of relying on industry-level variation to explain trade policy-making in developed countries. To the extent that trade policy is endogenously determined by political dynamics, the pattern observed in the U.S. suggests that firms might differ in their trade policy preferences even within the same industry depending on which

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9 Using different levels of aggregation for industry such as HS4 and HS6 results in essentially the same result: high variation across products within industry.
Table 1.1: Variation in applied most favored nation (MFN) tariff rates: This table illustrates that there exists large variation in MFN applied tariff rates of the U.S. even in the same industry (canned-fruit industry) as of 2013. It also shows that highly differentiated products tend to have lower tariff barriers (the ad-valorem equivalence of 1.5 cent/kg for HS 20089940 is about 1.1% based on the UNCTAD Method 1. See footnote 2 for the method). Applied tariff rates are from WITS (World Integrated Trade Solution).

<table>
<thead>
<tr>
<th>NAICS</th>
<th>HS4</th>
<th>(HS6)</th>
<th>HS8</th>
<th>Description</th>
<th>MFN tariff</th>
</tr>
</thead>
<tbody>
<tr>
<td>3114</td>
<td>2008</td>
<td>20089910</td>
<td>Avocados</td>
<td>10.6 cents/kg</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20089913</td>
<td>Banana pulp</td>
<td>3.4%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20089915</td>
<td>Bananas</td>
<td>0.8%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20089925</td>
<td>Dates</td>
<td>22.4%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20089929</td>
<td>Grapes</td>
<td>7.0%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20089930</td>
<td>Guavas</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20089940</td>
<td>Mangoes</td>
<td>1.5 cent/kg</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20089960</td>
<td>Plums</td>
<td>11.20%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20089980</td>
<td>Pulp of fruit</td>
<td>9.60%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20089990</td>
<td>Fruit, nesi</td>
<td>6.00%</td>
<td></td>
</tr>
</tbody>
</table>

This table illustrates that there exists large variation in MFN applied tariff rates of the U.S. even in the same industry (canned-fruit industry) as of 2013. It also shows that highly differentiated products tend to have lower tariff barriers (the ad-valorem equivalence of 1.5 cent/kg for HS 20089940 is about 1.1% based on the UNCTAD Method 1. See footnote 2 for the method). Applied tariff rates are from WITS (World Integrated Trade Solution).

Indeed, the level of trade barriers differ across fairly similar products in the U.S. Table 1.1 shows the large variation in tariffs across products even within a narrowly defined canned-fruits manufacturing industry.

Explaining this variation is important although researchers have increasingly played down the significance of Most Favored Nation (MFN) applied tariff rates of the U.S., due in large part to its low overall mean (≈ 3.89%). First, countries spend enormous resources on negotiating tariff rates at this level of disaggregation, reflecting diverse domestic and foreign interests in the policy making process. For example, trade representatives of South Korea engaged in lengthy negotiation efforts to reduce current tariff barriers of the U.S. even when both countries already enjoy MFN status as members of the WTO (World Trade Organization). Second, 60% of products are still dutiable (i.e., positive tariffs), and the mean applied MFN

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10 This is starkly different from the pattern observed in developing countries. For example, a same analysis shows that between industry component explains more than 80% of total variation in China. The large between-component in China is consistent with the prediction of industry-level theories, i.e., diverging preferences across industries. This paper focuses on the trade policy-making of industrialized nations.
tariff rate for dutiable products is ($\approx$ 7.27%). According to International Trade Commission, the tariff revenue is estimated to be $31$ billion in FY 2012, which is comparable to the amount that the U.S. spent on foreign aid ($23$ billion) and foreign military assistance ($14$ billion) combined. Finally, tariffs can function as an important foreign policy tool. For example, [Carnegie (2013)] finds that the U.S. used its tariffs to pressure Vietnam to improve its human rights record until it joined the WTO in 2006. As such, a deeper understanding of product specific trade policy making on tariffs is needed.

I argue that the existing theoretical frameworks with their primary focus on inter-industry variation inadequately explain the politics of trade policy making. For example, the U.S. exports and imports each product in Table 1.1 and similar factors of production are used to produce these products. This makes it difficult to determine whether the products belong to an exporting industry or import-competing industry, or whether they are capital or labor intensive goods. Clearly, neither sectoral nor factoral models can explain variations in these tariffs. Below, I provide further evidence of the limits of the existing frameworks in explaining trade policy-making of the U.S. based on some inconsistencies between the theoretical frameworks and actual trade flows of the U.S.
Figure 1.2: Inconsistencies Between Heckscher-Ohlin Model and Actual Trade Flows: This figure shows that the main sources (destinations) of the U.S. imports (exports) are high and medium wage countries. This is in contrast to the Heckscher-Ohlin model, which predicts that most trade flows should be in the shaded region, i.e., from/to medium or low wage countries. Each vertex of the triangles represents countries with different factor prices for labor: high, medium, and low. Each circle represents a HS6 product with the size proportional to the total value of trade. The location of each circle represents the distribution of source/destination country types. For example, a circle at the center of the triangle means that 1/3 of the product is from/to high, medium, and low wage countries at the same time. Each country’s wage level is calculated based on the level of GDP per capita (GDPPC) adjusted by their purchasing power parity: low wage countries have GDPPC levels less than the 20th percentile (≈ $2,000); high wage nations have GDPPC higher than the 70th percentile (≈ $10,000); and medium wage countries are in between. Note that China is responsible for the increasing imports from the medium wage country in recent years. Bilateral trade data is from UN Comtrade. GDPPC data is from Penn World Tables 7.0
1.2.2 Factor-based Model (Heckscher-Ohlin)

The Stolper-Samuelson Theorem predicts political cleavages will arise between owners of different factors of production. Countries endowed with high-skilled labor, for instance, will have class conflict between high-skilled and low-skilled laborers because trade liberalization will have differential effects on their factor prices. Goods will equalize the factor prices across countries through trade, decreasing the wages of low-skilled labor with the imports from a country that is endowed abundantly with the same type of labor (i.e., lower factor prices for low-skilled labor). This perspective has laid an important theoretical foundation for understanding the domestic political cleavages within countries [Rogowski, 1987].

However, Figure 1.2 suggests that the trade pattern of the U.S. is inconsistent with the factor-based theory. Contrary to the factoral theory, which predicts large trade flows from/to middle and low wage countries (shaded region), the imports and exports of the U.S. (a country relatively abundant in high-skilled labor) have been dominated by products from the high and medium wage countries. More importantly, the top panel shows that a large number of products originate in countries with highly different factor prices (circles inside the triangles). This is striking because the Stolper-Samuelson Theorem does not hold if the same product is produced

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11 By using disaggregated industry-level trade data from the U.S. Census Bureau, Pinto and Weymouth [2013] estimated that this industry (NAICS 3114) is one of the most capital-intensive industries.

12 Moreover, the factor-based theories have been also useful in examining the relationship between political institutions and trade policies. In general, democratic countries are hypothesized to have more open trade policies than autocracies since their median voters, whose factor of production tends to reflect the country’s abundant factor, would gain from trade liberalization (e.g., Mansfield et al. [2002], Milner and Kubota [2005]).
by countries with different factor endowments.\footnote{Factor price equalization is found to hold even in the case of more goods than factors \cite{Dixit1980,Feenstra2003}. As such, this theoretical result is implicitly assumed in the literature.} In fact, trade flows should be concentrated only at the bottom two vertices according to the logic of the theorem. The fact that a large number of products are located either inside the triangle or along the northwest edge implies that factor ownership alone cannot explain the patterns of trade liberalization since it is unclear to which direction their factor prices would move.

\subsection*{1.2.3 Sector-based Model (Ricardo-Viner)}

The Ricardo-Viner theory is also limited because sectoral divide between exporting and import-competing industry becomes unclear with high degrees of intra-industry trade. The specific-factors model predicts political cleavages across industries assuming completely immobile factors of production (at least in the short-term). From this perspective, exporting industries generally prefer trade liberalization while import-competing industries seek protection. However, the argument breaks down when intra-industry trade is high.\footnote{I use the following a modified version of the widely used Grubel–Lloyd index: \[1 - \frac{\text{exp} - \text{imp}}{\text{exp} + \text{imp}}.\] Intra-industry trade is highest when the index is equal to zero. As an example, suppose that the total value of trade (import + export) for an industry is 100. Conventionally, researchers have categorized the industry as an exporting (import-competing) industry if "most" of the value 100 is from exports (imports). However, the distinction between exporting versus import-competing industries becomes problematic when countries simultaneously export and import goods (50-50), i.e., there is a large amount of intra-industry trade. The conventional Grubel–Lloyd index is defined as \[1 - \frac{\text{exp} - \text{imp}}{\text{exp} + \text{imp}}.\] The modified version is used to distinguish exports from imports as well as the degree of intra-industry trade, e.g., (100-0) versus (0-100) cases.}

Figure 1.3 shows that the degree of intra-industry trade in U.S. trade has increased significantly across time. The U.S. now imports as much as it exports the products within top 20 exporting industries. It also shows that the level of variation has decreased
Figure 1.3: Inconsistencies Between Ricardo-Viner Model and Actual Trade Flows: The box plots of Grubel–Lloyd index for the top 20 exporting industries of the U.S. for each year underscore that the level of intra-industry trade even within exporting industries has steadily increased over time. The level of intra-industry trade for each manufacturing industry (at SIC 4 digits) is calculated based on a modified version of Grubel–Lloyd index: \( \frac{\text{exp} - \text{imp}}{\text{exp} + \text{imp}} \). The red dotted line (zero) in the vertical axis indicates the highest level of intra-industry trade while the two other extremes (-1 and 1) correspond to the industries with only exports and imports, respectively. The top 20 exporting industries are separately identified by the total value of trade for each year (freight-on-board value for imports).

The results in Figure 1.3 cast doubt on many empirical studies in the field of IPE that dichotomize import-competing versus exporting industries. For instance, Hiscox (2002) measures the trade policy preferences of legislators based on total production in the fixed “10 leading exporting and import-competing industries in each year as a proportion of the state income.” However, the U.S. increasingly imports products even in its top export industries, while it also exports products that import-competing firms produce. Thus, legislators may not prefer a pro-liberalization policy when firms within their state produce a large volume of goods within the top
exporting industries, because those firms may actually be import-competing. Analysis at the firm level is necessary in order to correctly identify the heterogeneous political interests.\textsuperscript{15}

1.2.4 Firm-based Model (New-New Trade Theory)

The high volume of trade between countries with similar factor endowments (intra-industry trade) goes against the predictions of both factor and sector-based theories. To address the inconsistency, new trade theory models were developed to show that increasing returns to scale, imperfect competition, and product differentiation can explain the increasing intra-industry trade \cite{Helpman1985, Krugman1979, Krugman1980}.\textsuperscript{16} First, the access to bigger foreign markets allows firms to take advantage of large-scale production. Consequently, the average cost of production will decline as the output increases when they serve bigger markets (i.e., increasing returns to scale).\textsuperscript{17} For example, both the U.S. and South Korea exchange cars because firms in each country can increase output and enjoy the gain in efficiency by selling their products in both markets. Second, an important technical implication of increasing returns to scale is that trade models can no longer rely on the assumption of perfect competition. This is because firms now have different market power with different

\textsuperscript{15} Leading empirical analysis such as \cite{Goldberg1999} and \cite{Gawande2000} rely on industry level (SIC4) data. They find that industries with high import-penetration lobby more and receive protection.

\textsuperscript{16} \cite{Helpman1985} considers a theoretical framework within which both inter- and intra-industry trade can be analyzed. \cite{Bernard2007b} offer a general equilibrium model that have both firm-level heterogeneity in productivity and different country-level factor abundance.

\textsuperscript{17} Economic theories have examined the effect of increasing returns to scale both \textit{external} and \textit{internal} to the firm \cite{Ethier1982}. This paper focuses on the increasing returns to scale internal to the firm by allowing firm-level productivity differences. Usually, increasing returns to scale arise firms can spread their fixed cost over a larger output. The efficiency gain is greater when firms are more productive with lower marginal cost of production.
average cost charging different prices for similar products, i.e., prices of cars are all different although they should be same under perfect competition. Finally, product differentiation is one of the most important microfoundation of intra-industry trade. Countries exchange similar goods because each market is populated with consumers with different tastes. For example, some people like to drive 3000cc sedans while others prefer pickup trucks. Simply put, consumers “love variety.”

Although successful in explaining the high volume of intra-industry trade, new trade theory is still limited in explaining why some firms are successful in engaging in international trade while others are not. New-new trade theory was developed to explain the vast differences across firms in their levels of trade engagement (e.g., Bernard et al. 2003; Melitz 2003). It predicts that productivity plays a key role in determining firm-level heterogeneity in exporting. Specifically, productive firms, with lower marginal costs of production, can reduce their average cost by serving foreign markets (increasing returns to scale). In addition, their productivity difference will result in different market power whereby more productive firms can charge lower prices on their goods (imperfect competition). In new-new trade theory, each firm produces a differentiated product, which implies that more varieties will be available after trade liberalization (product differentiation). The advent of firm-level micro data has pushed the framework further to empirically examine the significance of firm-level productivity. Now, there exists ample empirical evidence of productivity differences across firms within industry. In particular,

\[\text{See Bernard et al. (2011) for an extension of new-new trade theory to incorporate multiproduct firms.}\]
more productive firms tend to be bigger, pay higher wages to employees, and make larger profits. Moreover, only a very small number of firms engage in international trade. That is, both exporters and importers are rare, and they tend to be productive (Bernard et al., 2007a; Eaton et al., 2011).

I focus on the distributional consequences of the new-new trade theory at the firm-level. Although new-new trade theory can account for economic heterogeneity across firms within industry, its theoretical analysis of market is predicated upon the assumption that trade policy is exogenous to political interaction between firms and government. Moreover, if product differentiation alone is driving policy outcomes, one should expect more variability between industries as products become less and less substitutable as they belong to different industries (Broda and Weinstein, 2006). This is in contrast to the large variation in tariffs within industry as shown in Figure 1.1. I argue that it is firm-level political activities that endogenously determines trade policy outcomes. This paper makes both theoretical and empirical contribution to the fast-growing firm-based research of international trade policy within the framework of the new-new trade theory (Bombardini, 2008; Osgood, 2012; Plouffe, 2012).

19 There is mixed evidence on whether trade liberalization leads to productivity increase (e.g., Clerides et al., 1998; Van Biesebroeck, 2005). Examining this is beyond the scope of this paper.

20 Technically, the elasticity of substitution should be lower as products are more aggregated.

21 Bombardini (2008) is the first that incorporates firm-level heterogeneity into a political economy model. Her study focuses on the structure of protection across sectors rather than products. Osgood (2012) makes an important theoretical contribution to the study of diverging economic preferences across firms. My research is different from his with a focus on political interaction between firms and government.
1.3 Theory

This section shows that firms may have more concentrated political interests regarding trade policy than an industry as a whole when products are sufficiently differentiated. First, I discuss how product differentiation fundamentally changes political incentives of firms. Second, I introduce a formal model to analyze the strategic interaction between firms and government under product differentiation. I find that lobbying by productive exporting firms, accompanied by the absence of objections by firms who only serve the domestic market, can shift trade policies in the direction of open trade especially when products are highly differentiated.

1.3.1 Product Differentiation

Product differentiation decreases exporting firms’ free-riding incentives, while also reducing the potential threat that import-competing firms face from foreign competition. The logic is as follows: 1) The cost of international trade is high; only a small number of productive firms can bear the cost. Thus, the benefits of lobbying for trade liberalization accrue only to the small number of firms that actually produce the differentiated products in question; 2) in contrast, because consumers cannot easily substitute one good for another, firms that only produce goods domestically face less threat to their survival because they can still secure a certain market share with the introduction of foreign products; 3) finally, product differentiation increases the level of intra-industry trade, which subsequently encourages productive firms to strategically lobby for open trade on the basis of the norms of reciprocity. Simply
put, exporting firms see more concentrated benefits while import-competing firms have more dispersed losses with higher levels of product differentiation.

This paper argues that product differentiation increase exporting firms’ influence in the tariff-setting process by directly comparing the incentives between exporting and import-competing firms within the same industry. This is in contrast to the existing literature on the domestic determinants of trade policy which assumes that conflicts of interest divide consumers and producers: free trade leads to gains for consumers and losses for domestic producers. In this regard, it has been generally assumed that import-competing firms are privileged actors in the tariff-setting process because they can more easily solve the collective-action problem that lobbying creates than can consumers. The assumption has been justified by the severe costs of existing market from the perspective of import-competing firms (Hillman, 1984). Product differentiation alters these political dynamics.

**Collective Action Problem Less Free-Riding**

![Figure 1.4: Mitigated Collective Action Problem](image)

Figure 1.4: **Mitigated Collective Action Problem**: This figure illustrates the logic by which product differentiation mitigates collective action problems that firms face. That is, firms have more concentrated interests to influence trade policy. Each square plate represents a product with a distinct tariff rate while each ball corresponds to a firm that produces the product.

First, product differentiation mitigates collective action problems that exporting firms confront. This is because a very small number of productive firms actually
engage in international trade (Olson 1971); 3.1% of all firms in the U.S. export while 2.2 percent of firms import.\textsuperscript{22} It is important to note that exporters tend to be importers as well: more than 50 percent of the firms that import also export and these firms account for about 90 percent of U.S. trade (Bernard \textit{et al.} 2005). Moreover, the legal tariff lines are becoming increasingly fine-grained with high degrees of product differentiation. For instance, the U.S. had about 8,600 unique products with distinct tariff rates in 1989. It now has over 17,000 products at the legal tariff line as of 2011. Tariffs are set at a highly specific product level, and there are very few firms that produce the product in question. As such, productive firms want to reduce trade barriers when they 1) enter the foreign market, 2) import products back to their home country through global production chain, and/or 3) import intermediate goods for production. Figure \ref{fig:1.4} graphically shows the relationship between product differentiation and mitigation of the collective action problem.

Second, with product differentiation, domestic firms are less likely to oppose open trade because consumer's love of variety implies that import-competing firms can still secure some domestic market share. Thus, compared to the case where goods are perfectly substitutable (i.e., not differentiated), whereby cheap foreign products might replace domestic products, firms face relatively less threat of being forced out of the market if goods are less substitutable (differentiated). As a result, firms will not actively lobby for protection unless the costs of lobbying are less than the benefits,\textsuperscript{22}Many firms import intermediate goods for manufacturing or to distribute final goods to the domestic market.
conditional on their likely survival in the face of trade liberalization. Figure 1.5 illustrates this argument.

![Diagram](image)

**Figure 1.5: Reduced Threat Perception of Import-Competing Firms**

This figure graphically compares the levels of perceived threat posed by foreign competition as a function of product differentiation. The left panel shows that when goods are substitutable, domestic firms are threatened by foreign competition. Contrarily, the right panel illustrates that less substitutability implies the possibility of import-competing firms staying in the market under trade liberalization. Increased colorization of balls represents increased product differentiation.

Finally, product differentiation creates a political environment in which firms can strategically use the norms of reciprocity. Specifically, productive firms can pressure their home government to ensure reciprocal tariff reduction in foreign markets. This is because high product differentiation accompanies more intra-industry trade as foreign consumers want different varieties. Therefore, the use of norms of reciprocity will create a feedback loop to reduce trade barriers both at home and abroad as illustrated in Figure 1.6. That is, firms would oppose trade liberalization less in hopes of increasing their foreign market share conditional on reciprocal reduction of foreign trade barriers.

Note that this logic is different from conventional understanding of the norms of reciprocity applied to products across industries, e.g., reducing tariffs on agricultural
Figure 1.6: **Strategic Use of the Norms of Reciprocity:** This figure illustrates the use of norms of reciprocity by domestic producers with product differentiation. When there exists demands for open trade, domestic firms can pressure domestic government to ensure foreign market liberalization. That is, domestic firms will oppose trade liberalization less conditional on reciprocal reduction of barriers abroad.

products in return for liberalizing passenger cars. That is, I argue that there exists political pressures to reciprocally reduce trade barriers on products within the same industry. This accounts for the tariffs reduction on automobile products as an outcome of the U.S.–Korea Free Trade Agreement (FTA). The U.S. car makers have become *in favor of* the FTA contrary to popular belief that they would strongly oppose it. The statement from Sander M. Levin (D-MI) demonstrates that reciprocity played an important role.

“Fortunately, last year, with the support of Members of Congress, including Chairman Camp, the automakers and the United Auto Workers, the Obama Administration negotiated an additional agreement that will provide U.S. automakers with a real opportunity to compete and succeed in the Korean market. With the changes achieved through the additional agreement, the U.S. auto industry (Ford, Chrysler, GM and the UAW) are supporting the U.S.-Korea FTA.”
1.3.2 The Model

The political economy model presented in this section combines an oligopolistic competition model under product differentiation with the Grossman and Helpman (1994) model. First, I show that intra-industry trade increases with product differentiation: some firms export while others compete with foreign firms even within the same industry. I then examine the strategic interaction between firms and government and the role of lobbying in making trade policy. The theory I propose in this section will explain why both domestic and foreign firms should be understood as political agents who can affect trade policy through their strategic interaction with governments.

I analyze the behavior of firms under the following scenario. A representative consumer maximizes the utility function given in equation (1.1).

The utility function incorporates the level of product differentiation in an industry through the parameter $0 \leq \sigma \leq 1$, where lower $\sigma$ implies a higher degree of product differentiation. Consumers “love variety” in that they want to consume a bundle of differentiated products rather than buying only one product, i.e., products are less substitutable.

$$U(q; \sigma, \alpha) = \alpha \sum_i q_i - \frac{1}{2} \left( \sum_i q_i^2 + 2\sigma \sum_i \sum_{j \neq i} q_i q_j \right)$$ (1.1)

subject to

$$\sum_i p_i q_i \leq E$$ (1.2)

This paper considers firms as political actors with different economic capability. For instance, some firms are successful in pushing their governments to be active in eliminating trade barriers abroad, while others fail to initiate an anti-dumping investigation against their foreign competitors. Likewise, some firms are better at convincing legislatures to introduce a trade bill on their behalf, whereas others fail to obtain subsidies in the form of tax-cuts or cheap input costs.

This paper focuses on a partial equilibrium with one industry for the ease of exposition. One can introduce a numeraire good to absorb income effect, and conduct an general equilibrium analysis maintaining the main results. Note that the utility function is a special case of the quasi-linear utility function studied in Melitz and Ottaviano (2008).
where $\alpha$, $p_i$ and $q_i$ denote size of economy, price and quantity of a product $i$, respectively. Maximizing equation (1.1) subject to the standard budget constraint $E$, we obtain the following inverse demand function for product $i$.

$$p_i(q_i, q_j) = \alpha_s - q_i - \sigma \left( \sum_{j \neq i} q_j \right). \quad (1.3)$$

We suppose that there are two states $s \in \{D, F\}$ (domestic and foreign), and four firms: $i \in \{1, 2, 3, 4\}$, where product $i$ is associated with firm $i$\footnote{Considering a more general model with multiple countries and firms is beyond the scope of this paper.}. Firms 1 and 2 are domestic firms and firms 3 and 4 are foreign firms with different marginal cost of production $c_i$ (productivity). Variables that correspond to the foreign market will have an asterisk. I assume that the firms with lower index value (1,3) in each market have lower marginal cost of production: $c_1 < c_2$, $c_3 < c_4$. That is, firms 2 and 4 are not considered to productive. I further assume that only productive firms 1 and 3 can export to the other market\footnote{There exist ample theoretical and empirical justification for this assumption (e.g., Melitz 2003, Bernard and Jensen 2004, Bernard et al. 2005).}. Countries are symmetric in that consumers in each market face the same utility function when consuming product $i$ in a given industry\footnote{One can relax this assumption by explicitly modeling a bargaining step between asymmetric countries. This is beyond the scope of this paper, and I leave it for future research.}.

Firm $i$ maximizes its profit $\Pi_i$ by choosing the quantity in each market as given in equation (1.4). We can then solve the maximization problem to derive the equilibrium.
quantity and corresponding prices of each good. Appendix 1.4.1 contains the results.

\[ \Pi_1 = (p_1 - c_1)q_1 + (p_1^* - c_1 - \tau)q_1^* \]
\[ \Pi_2 = (p_2 - c_2)q_2 \]
\[ \Pi_3 = (p_3 - c_3 - \tau)q_3 + (p_3^* - c_3)q_3^* \]
\[ \Pi_4 = (p_4^* - c_4)q_4^* \] (1.4)

Note that firm 1 and firm 3 face the same tariff \( \tau \) in their respective exporting market. This reflects our assumption of reciprocity in trade negotiations. Although this assumption is made for analytic tractability, it is worth noting that the reciprocal reduction of tariff barriers introduces stronger demand for protection by domestic producers as well. In fact, the results below show that high tariffs are optimal only under some conditions even with the norm of reciprocity. Furthermore, in order to reflect the reality that actual tariff levels between nations are not exactly the same, I introduce an asymmetry between country \( D \) and \( F \) by allowing them to have different choke prices \( \alpha_s \in \{\alpha_D, \alpha_F\} \) (the lowest price at which the quantity demanded of a good is equal to zero) in their respective demand function. To ensure a positive demand, we make a technical assumption that \( \alpha_D \) and \( \alpha_F \) are sufficiently high. In particular, we assume the following.

**Assumption 1 (Positive Demand)**

\[ \alpha_D + \alpha_F > c_1 + c_3 + 2\tau, \quad \alpha_D + \alpha_F > c_2 + c_4 - 2\tau, \]
I first show that increased product differentiation implies a high degree of intra-industry trade. This will lay an important theoretical foundation for understanding the gains of trade independent of comparative advantage or technological difference on which existing political economy models are based. Specifically, it will shed light on who the potential winners and losers from trade are. Intra-industry trade is defined in terms of the quantity of goods that productive firms export to each market, i.e., foreign firm’s export to the domestic market ($q_3$) + domestic firm’s export to the foreign market ($q_1^*$).

**Definition 1 (Intra-industry trade)**

$$IIT(\cdot) := q_3 + q_1^*$$ (1.5)

**Proposition 1 (Intra-industry trade)** Suppose products are sufficiently differentiated such that $0 \leq \sigma < \frac{1}{2}$. Then, intra-industry trade increases as the degree of product differentiation increases.

$$\left. \frac{\partial IIT}{\partial \sigma} \right|_{\sigma < \frac{1}{2}} < 0$$ (1.6)

Proof is in Appendix 1.4.2

The proposition shows that consumers’ love of variety results in a high degree of intra-industry trade. It also highlights the fact that profit maximizing firms will see a big opportunity abroad. That is, it is not only consumers who love variety, but also productive exporting firms who will gain greatly from trade liberalization, particularly when products in an industry are not substitutable with each other. In

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28 A more general result can be achieved with a stronger assumption. It can be shown that \( \frac{\partial IIT}{\partial \sigma} < 0 \) for all \( 0 < \sigma < 1 \) if \( \{3(\alpha_c + \alpha_F) - (2c_1 + c_2 + 2c_3 + c_4)\}/2 < \tau < (c_2 - c_1 + c_4 - c_3)/4 \) and \( \alpha_D + \alpha_F > c_2 + c_4 - 2\tau \).

29 Note that the new-trade theory and new-new trade theory emphasize this mechanism through Dixit-Stiglitz CES utility function (Krugman 1980).
this respect, I argue that the incentives of exporting firms to lobby can be stronger than those of their import-competing counterparts when products are sufficiently differentiated. Although any firm will benefit by having protection at home and open markets abroad, highly productive exporting firms find the latter more attractive due to increasing returns-to-scale. Subsequently, governments, who cannot credibly commit to introducing protective measures when consumers value variety, reduces trade barriers in return. In the following section, I examine the political interaction between firms and government.

1.3.3 Lobbying by Exporters and Trade Liberalization

How can we understand the strategic interaction between firms and governments when firms within the same industry see the benefits from liberalization differently? What if foreign firms can also lobby domestic government? Existing political economy models of trade policy have left these questions unanswered.

Following Grossman and Helpman (1994), I consider the following two stage game. In the first stage, firms simultaneously choose their political contribution schedules, and in the second, government sets policy $\tau$ and collects contribution $L_i(\tau)$ from each firm in the second stage. I consider the lobbying game in the domestic market ($i \in \{1, 2, 3\}$) since similar results will follow in foreign market due to symmetry.

The government values social welfare. Specifically, it tries to increase consumer surplus defined in equation (1.7) and tariff revenue. I assume that the government

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\[\text{Grossman and Helpman (1994)}\] assume that pre-tariff world prices are fixed exogenously. Consequently, foreign firms do not have any incentives to lobby because domestic tariff rate will not affect their profits. As Section 2 shows, foreign firms do lobby.
distributes tariff revenue equally to its population. The revenue is defined as $r(\tau) = \tau q_3$. 

$$s(\tau) = U(\cdot) - \sum_i q_i p_i$$

$$= \alpha_D \sum_i q_i - \frac{1}{2} \left( \sum_i q_i^2 + 2\sigma \sum_i \sum_{j \neq i} q_i q_j \right) - \sum_i q_i p_i \quad \text{(1.7)}$$

The government maximizes the following objective function. Note that $a$ is a weight that the government assigns to welfare relative to political rents.

$$\max_{\tau} \sum_i L_i(\tau) + aW(\tau) \quad \text{(1.8)}$$

where $W(\tau) = \Pi_1(\tau) + \Pi_2(\tau) + s(\tau) + r(\tau)$

The government faces the following trade-off depending on the level of product differentiation. When products are highly substitutable, increasing a tariff protects domestic firms from foreign competition. The demand for protection will be particularly strong if foreign firm 3 is highly productive and charge a much lower price than domestic firms 1 and 2. When consumers value variety, on the other hand, introducing protective measures will decrease consumer surplus. It is important to note that domestic firms will not suffer from foreign competition as much as they would under high substitutability across goods within industry. In fact, productive domestic firm 1 will see a big opportunity from the foreign market since foreign consumers love variety as well. I characterize the optimal tariff of the game with product differentiation.
Proposition 2 (Optimal Tariff) Suppose firms use lobbying schedules that are differentiable around equilibrium tariff rate $\tau^o$. Then, government optimally chooses tariff $\tau^o$ that satisfies,

$$\tau^o = \frac{\zeta \sigma^3 + \eta \sigma^2 + \xi \sigma + \kappa}{10a\sigma^3 + (10 + 21a)\sigma^2 + (16 - 20a)\sigma + 16 - 20a}$$

where

$$\begin{align*}
\zeta &= 4a(c_1 + 2c_2 - 2c_3 - \alpha_D) \\
\eta &= 2(c_2 - c_3 + \alpha_D) - (2 + 7a)c_1 - a(c_2 + 15c_3 - 2c_4 - 15\alpha_D + 2\alpha_F) \\
\xi &= 4[2c_2 + c_4 + a(-2c_1 + 6c_3 + c_4 - 3\alpha_D) - 2\alpha_D - \alpha_F] \\
\kappa &= -8(1 + a)c_1 + 4(-2 + 5a)c_3 - 4(-2 + a)\alpha_D + 8(1 + a)\alpha_F
\end{align*}$$

Proof in Appendix 1.4.3

The Proposition shows the optimal tariff can be expressed as a ratio of two third-order polynomial functions of the level of product differentiation. Although the equation is hard to interpret on its own, an oligopoly game with a finite number of firms has a benefit of giving a closed-form solution as a result of political interaction between firms and the government. Evaluating the equation at $\sigma = 0$ helps understand the intuition. With sufficiently large $a$ (the government values social welfare more than political rents), it is optimal to set a negative tariff. In other words, import-subsidy should be optimal when products are not substitutable with each other.

This result suggests that strong political pressures to open trade would exist when products are differentiated: open-trade-for-sale rather than protection-for-sale occurs.

Figure 1.7 graphically presents the result from Proposition simulating over different

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31 The optimal tariff schedule is continuous at $\sigma = 0$.
32 Note that import-subsidy might be politically unlikely in reality. However, this theoretical result highlights the importance of high product differentiation behind liberalization.
Figure 1.7: **Domestic Firm’s productivity and optimal tariff:** This figure presents a simulation result from Proposition 2 to show that liberal trade policy is optimal when products are sufficiently differentiated. Each line corresponds to the optimal tariff evaluated at four different values of $c_1 \in \{0.1, 0.15, 0.3, 0.5\}$, where domestic firm 1’s productivity increases (lower marginal cost of production) as we move downwards. Note that firm 1 is a domestic firm with productive type. The simulation result also suggests that it is optimal for the government to give import subsidy, and the parameter space corresponding to import-subsidy expands as the productivity of firm 1 increases.

Three general patterns are worth noting in this political game. First, it is optimal to set lower trade barriers when products are sufficiently differentiated. Second, the government should impose only small tariffs (if any) when products are highly differentiated. Furthermore, the range of parameter values of $\sigma$ that requires negative tariff, i.e., import subsidy, increases as the productivity of domestic firm 1 increases. Finally, it is interesting to note that non-monotonicity exists when domestic firm 1 is highly productive.

---

For this simulation I hold other parameters constant at a set of parameter values that fits Assumption 1 on the relative productivity and market size: $c_2 = 0.65$, $c_3 = 0.1$, $c_4 = 0.65$, $\alpha_D = 5$, $\alpha_F = 2$, and $a = 6.5$. We evaluate $\tau^o$ at four distinct values of $c_1$: 0.1, 0.15, 0.3, 0.5 so that it is less than $c_2$. With sufficiently large $a$, similar patterns exist even after setting the parameters at other values.
productive. The inverse U-shape of the optimal tariff schedule suggests that the
government may also want to liberalize when products are highly substitutable and its
domestic firm is very productive. The intuition behind this result is that highly
productive domestic firms can compete with foreign firms by setting much lower prices
and take a larger market share due to the substitutability of goods.

To summarize, lobbying by productive exporters can shift trade policies toward
more open trade. The argument, in brief, presupposes the well known firm-level pro-
ductivity differences: some firms are productive enough to export to foreign markets
while other less productive firms face foreign competition in their own market. The
preferences of each type of firm conflicts with each other since exporters have pref-
erences for a free and fair market access abroad, while import-competing firms want
their government to introduce more protective measures. However, their political
power and incentives to lobby may not be equal. Ample empirical evidence shows
that resource reallocation occurs toward more productive exporting firms (Bernard
et al., 2007a; Eaton et al., 2011). This implies that exporters have more economic
resources to spend on lobbying than import-competitors. On the other hand, the lives
of import-competitors are less threatened with high product differentiation. As such,
product differentiation increases exporting firms’ incentive to lobby while it reduces
that of import-competing firms.

\[34\] Recall that I assume that the norm of reciprocity governs international trade negotiations (Bagwell and Staiger, 1999). That is, domestic exporting firms lobby their government for trade liberalization, which puts indirect pressure on foreign governments to eliminate their trade barriers.
1.4 Appendix

1.4.1 Demand and Price under Oligopoly

• Taking first order conditions of firms’ problem in equation (1.4) gives

\[
q_1 = \frac{1}{2} (\alpha_D - \sigma q_2 - \sigma q_3 - c_1)
\]

\[
q_2 = \frac{1}{2} (\alpha_D - \sigma q_1 - \sigma q_3 - c_2)
\]

\[
q_3 = \frac{1}{2} (\alpha_D - \sigma q_1 - \sigma q_2 - c_3 - \tau)
\]

\[
q_1^* = \frac{1}{2} (\alpha_F - \sigma q_3^* - \sigma q_4^* - c_1 - \tau)
\]

\[
q_3^* = \frac{1}{2} (\alpha_F - \sigma q_1^* - \sigma q_4^* - c_3)
\]

\[
q_4^* = \frac{1}{2} (\alpha_F - \sigma q_1^* - \sigma q_3^* - c_4).
\]

(1.10)

• Solving the above systems of equations gives optimal quantity of each product in respective market.

\[
q_1 = \frac{\alpha_D(2 - \sigma) + \sigma(\tau + c_2 + c_3 - c_1) - 2c_1}{2(2 - \sigma)(1 + \sigma)}
\]

\[
q_2 = \frac{\alpha_D(2 - \sigma) + \sigma(\tau + c_1 + c_3 - c_2) - 2c_2}{2(2 - \sigma)(1 + \sigma)}
\]

\[
q_3 = \frac{\alpha_D(2 - \sigma) + \sigma(c_1 + c_2 - c_3 - \tau) - 2(c_3 + \tau)}{2(2 - \sigma)(1 + \sigma)}
\]

\[
q_1^* = \frac{\alpha_F(2 - \sigma) + \sigma(c_3 + c_4 - c_1 - \tau) - 2(c_1 + \tau)}{2(2 - \sigma)(1 + \sigma)}
\]

\[
q_3^* = \frac{\alpha_F(2 - \sigma) + \sigma(\tau + c_4 + c_1 - c_3) - 2c_3}{2(2 - \sigma)(1 + \sigma)}
\]

\[
q_4^* = \frac{\alpha_F(2 - \sigma) + \sigma(\tau + c_1 + c_3 - c_4) - 2c_4}{2(2 - \sigma)(1 + \sigma)}
\]

(1.11)

31
Finally, combining equations (1.3) and (1.11), we have

\[ p_1 = \frac{\alpha_D(\sigma - 2) + c_1(2\sigma^2 - \sigma - 2) - \sigma(c_2 + c_3 + \tau)}{2(2 - \sigma)(1 + \sigma)} \]
\[ p_2 = \frac{\alpha_D(\sigma - 2) + c_2(2\sigma^2 - \sigma - 2) - \sigma(c_1 + c_3 + \tau)}{2(2 - \sigma)(1 + \sigma)} \]
\[ p_3 = \frac{\alpha_D(2 - \sigma) + c_3(2 + \sigma - 2\sigma^2) + \sigma(c_1 + c_2 + \tau - 2\sigma\tau) + 2\tau}{2(2 - \sigma)(1 + \sigma)} \]
\[ p_1^* = \frac{\alpha_F(2 - \sigma) + c_1(2 + \sigma - 2\sigma^2) + \sigma(c_3 + c_4 + \tau - 2\sigma\tau) + 2\tau}{2(2 - \sigma)(1 + \sigma)} \]
\[ p_3^* = \frac{\alpha_F(\sigma - 2) + c_3(2\sigma^2 - \sigma - 2) - \sigma(c_1 + c_4 + \tau)}{2(2 - \sigma)(1 + \sigma)} \]
\[ p_4^* = \frac{\alpha_F(\sigma - 2) + c_4(2\sigma^2 - \sigma - 2) - \sigma(c_1 + c_3 + \tau)}{2(2 - \sigma)(1 + \sigma)} \]

(1.12)

1.4.2 Proof of Proposition 1

Proof  Intra-industry trade in physical quantity is

\[ IIT(\cdot) = q_3 + q_1^* = \frac{2(c_1 + c_3 + 2\tau) + (\sigma - 2)(\alpha_D + \alpha_F) - \sigma(c_2 + c_4 - 2\tau)}{2(\sigma - 2)(\sigma + 1)} \]
Suppose $0 \leq \sigma_1 < \sigma_2 < \frac{1}{2}$, and let $\chi_1 = (\sigma_1 - 2)(\sigma_1 + 1)$ and $\chi_2 = (\sigma_2 - 2)(\sigma_2 + 1)$.

First, we show that $\chi_2 - \chi_1 < 0$.

$$\chi_2 - \chi_1 = (\sigma_2 - 2)(\sigma_2 + 1) - (\sigma_1 - 2)(\sigma_1 + 1)$$

$$= (\sigma_2 - \sigma_1)(\sigma_2 + \sigma_1) - (\sigma_2 - \sigma_1)$$

$$= (\sigma_2 - \sigma_1)(\sigma_1 + \sigma_2 - 1) < 0 \quad (1.13)$$

Second, we show $\sigma_1 \chi_2 - \sigma_2 \chi_1 > 0$.

$$\sigma_1 \chi_2 - \sigma_2 \chi_1 = \sigma_1(\sigma_2^2 - \sigma_2 - 2) - \sigma_2(\sigma_1^2 - \sigma_1 - 2)$$

$$= \sigma_1\sigma_2(\sigma_2 - \sigma_1) + 2(\sigma_2 - \sigma_1) > 0 \quad (1.14)$$

Finally, it is sufficient to show that $IIT(\cdot)$ is monotonically decreasing for any $\sigma_1$ and $\sigma_2$ such that $0 \leq \sigma_1 < \sigma_2 < \frac{1}{2}$.

$$IIT(\sigma_1) - IIT(\sigma_2)$$

$$= \frac{2(c_1 + c_3 + 2\tau) + (\sigma_1 - 2)(\alpha_D + \alpha_F) - \sigma_1(c_2 + c_4 - 2\tau)}{2(\sigma_1 - 2)(\sigma_1 + 1)}$$

$$- \frac{2(c_1 + c_3 + 2\tau) + (\sigma_2 - 2)(\alpha_D + \alpha_F) - \sigma_2(c_2 + c_4 - 2\tau)}{2(\sigma_2 - 2)(\sigma_2 + 1)}$$

$$= \frac{(\chi_2 - \chi_1)(c_1 + c_3 + 2\tau - \alpha_D - \alpha_F) + (\sigma_1 \chi_2 - \sigma_2 \chi_1)(\alpha_D + \alpha_F - c_2 - c_4 + 2\tau)}{2\chi_1 \chi_2}$$

$$> 0 \quad (1.15)$$

where the last inequality follows from equations (1.13), (1.14), and Assumption 1.

This proves the result. \qed
1.4.3 Proof of Proposition 2

Proof

First, Grossman and Helpman (1994) provide a useful methodology to characterize optimal tariff schedules of our game using the original result from Bernheim and Whinston (1986). Proof for this well-known lemma is omitted.

Lemma 1 (G-H: Equilibrium Tariff Policy) \((\{L^o_i\}, \tau^o)\) is a subgame-perfect Nash equilibrium if and only if

1. \(L^o_i\) is feasible for all \(i\)
2. \(\tau^o\) maximizes \(\sum_i L_i(\tau) + aW(\tau)\)
3. \(\tau^o\) maximizes \(\Pi_i(\tau) - L_i(\tau) + \sum_i L_i(\tau) + aW(\tau)\)
4. \(\forall j\) there exists \(\tau \in \tau\) that maximizes \(\sum_i L_i(\tau) + aW(\tau)\) such that \(L^o_j(\tau) = 0\)

Now, we characterize the optimal tariff schedule. From Condition 2 of Lemma\[1\],

\[
\sum_i \frac{\partial L_i}{\partial \tau}(\tau^o) + a\frac{\partial W}{\partial \tau}(\tau^o) = 0\tag{1.16}
\]

Likewise, the government’s maximization problem from 3 of Lemma\[1\] gives,

\[
\frac{\partial \Pi_i}{\partial \tau}(\tau^o) - \frac{\partial L_i}{\partial \tau}(\tau^o) + \sum_i \frac{\partial L_i}{\partial \tau}(\tau^o) + a\frac{\partial W}{\partial \tau}(\tau^o) = 0\tag{1.17}
\]

\[35\]Here feasibility requires that each firm does not promise nonnegative offers that exceed their revenue
Combining equations (1.16) and (1.17) and summing over \( i \) gives,

\[
\sum_i \frac{\partial \Pi_i}{\partial \tau}(\tau^o) = \sum_i \frac{\partial L_i}{\partial \tau}(\tau^o) \tag{1.18}
\]

Substituting Equation (1.18) to Equation (1.16), we get

\[
\sum_i \frac{\partial \Pi_i}{\partial \tau}(\tau^o) + a\frac{\partial W}{\partial \tau}(\tau^o) = 0 \tag{1.19}
\]

Now, calculate each side of equation (1.19) from the profit functions of each firm and government.

\[
\frac{\partial \Pi_1}{\partial \tau}(\tau^o) = \frac{(\alpha_F - \alpha_D + c_2 - c_4 + 2\tau)\sigma^2 + 2(\alpha_D - c_1 - c_4 + 2\tau)\sigma + 4(c_1 + \tau - \alpha_F)}{2(-2 + \sigma)^2(1 + \sigma)^2} \tag{1.20}
\]

\[
\frac{\partial \Pi_2}{\partial \tau}(\tau^o) = \frac{(c_1 + c_3 - c_2 - \alpha_D + \tau)\sigma^2 - 2(c_2 - \alpha_D)\sigma}{2(-2 + \sigma)^2(1 + \sigma)^2} \tag{1.21}
\]

\[
\frac{\partial \Pi_3}{\partial \tau}(\tau^o) = \frac{(\alpha_D - \alpha_F + c_4 - c_2 + 2\tau)\sigma^2 + 2(c_3 - c_1 - c_2 + 2\tau - \alpha_F)\sigma + 4(c_3 + \tau - \alpha_D)}{2(-2 + \sigma)^2(1 + \sigma)^2} \tag{1.22}
\]

\[
\frac{\partial W}{\partial \tau}(\tau^o) = \frac{(4\alpha_D + 10\tau + 8c_3 - 4c_1 - 8c_2)\sigma^3 + (2\alpha_F - 15\alpha_D + 7c_1 + c_2 + 15c_3 - 2c_4 + 21\tau)\sigma^2}{4(-2 + \sigma)^2(1 + \sigma)^2} + \frac{(3\alpha_D + 2\tau + 6c_3 - c_1 - 5\tau)\sigma}{(-2 + \sigma)^2(1 + \sigma)^2} + \frac{(\alpha_D - 2\alpha_F - 5\tau + 2c_1 - 5c_3)}{(-2 + \sigma)^2(1 + \sigma)^2} \tag{1.23}
\]

Therefore, plugging the results from equations (1.20), (1.21), (1.22), and (1.23) into equation (1.19) and solve for \( \tau^o \) gives the optimal tariff \( \tau^o \).
Chapter 2

Empirical Analysis on Firm-level Lobbying

2.1 Introduction

This Chapter presents the main empirical results that establish the effects of product differentiation on firm-level lobbying and product-level tariffs. My theory predicts that productive exporting firms lobby more when they produce differentiated products. Moreover, the results from Section 1.3 suggest that high product differentiation is associated with high intra-industry trade and lower tariff rates. Section 2.2 describes the data used for the analysis. Section 2.3 examines the conditions under which productive exporting firms are more likely to lobby on trade policy. Section 2.4 shows that a higher degree of intra-industry trade is associated with trade liberalization, which implies political cleavages within industry. Section 2.5 analyzes the substantive contents of lobbying by analyzing the texts of trade bills introduced since
1999. Finally, Section 2.6 examines whether products with a high degree of differentiation have lower tariffs.

2.2 Data

This paper makes an important empirical contribution by constructing an original dataset. First, I construct a firm-level lobbying dataset based on 838,588 lobbying reports that became available under the Lobbying Disclosure Act (LDA) of 1995. Although a number of studies have used the same data (e.g., Ansolabehere et al. 2002; Bombardini and Trebbi 2009; Ludema et al. 2010), only a small part of the original data—in terms of its contents and time frame—has been analyzed due to the large scale and unstructured format of the raw data. More importantly, because there is no unique identifier for firms (other than their names) in lobbying reports, it has been difficult to link firm level political activity with their economic characteristics. This has constrained the use of the data to study the link between lobbying and trade policy outcomes. My data combines the entire lobbying data, scraped with a text-parsing program, with firm level financial data as well as detailed information on legislative bills they have targeted for lobbying. To do so, I manually match each firm

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1 It is not clear how the dataset is constructed for these studies. I parse the original xml files available from [the Senate Office of Public Records (SOPR)]. This allows me to construct a more detailed and accurate dataset than the one available at [the Center for Responsive Politics]. Parsing each lobbying report with a personal computer not only takes enormous time, but also is unviable due to memory limits. I used high performance cluster machines at the TIGRESS High Performance Computing Center at Princeton University to parallelize the parsing program. As of now, the entire dataset can be constructed within five hours. The code and data will be disseminated publicly with the financial support from NSF Grant SES-1264090. An example of a lobbying report can be found in Appendix 2.8.4
who lobbied at least once on trade issues with the firms in multiple finance databases such as Orbis to establish the link between political and economic variables.\(^2\)

The lobbying dataset identifies firm-level political activity and actual lobbying expenditures directly related to trade policy making. To date, empirical studies of political economy models of trade have primarily used the PAC (Political Action Committee) level Federal Election Commission (FEC) campaign contribution dataset (e.g., Goldberg and Maggi, 1999; Gawande and Bandyopadhyay, 2000; Bombardini, 2008). Although campaign contribution certainly reflect general preferences of industry as a whole, this approach relies on a strong assumption that political interests across firms within the industry are more or less homogeneous. Second, the literature relies on an arbitrary assumption about what constitutes a contribution. Given that all sectors make some contributions, the common practice of classifying some sectors as “organized” while others as not based simply on an arbitrary contribution-amount cut-off seems problematic (e.g., Goldberg and Maggi, 1999).

Finally, campaign contributions might conflate highly complex preferences of member firms within each PAC such as that over electoral outcomes, domestic social-political issues, and various economic policies that are distinct from trade policies. In contrast, the lobbying dataset captures each individual firm’s direct, expressed interest in a particular trade policy. Specifically, one can identify firms who lobby on particular trade and tariff bills thanks to Section 5(b)(2)(A) of the Lobbying Disclosure Action of 1995 that requires each report to contain “a list of

\(^2\) Orbis contains more than 99 million global firms including very small private firms. This allows me to match all firms in lobbying report.
Table 2.1: **Final database**: The final database is a panel of annual firm-level lobbying data combined with firms’ financial characteristics and trade policies.

bill numbers” that are targeted to be lobbied[^3]. To be sure, this is not to argue that campaign contributions do not matter at all. In fact, campaign contributions can serve as both substitutes and complements to lobbying. Rather, I argue that existing studies have omitted an important political channel whereby profit-maximizing private corporations utilize *lobbying* in order to buy “access” to legislators to affect specific policies and bills, rather than to make campaign contributions to influence electoral outcomes[^4]. This justifies the use of LDA dataset in studying heterogeneous political behavior of firms that are relevant for affecting trade policy.

I consider trade flows and trade policies at highly refined levels of product categorization. I consider the U.S. tariffs at the 8-digits Harmonized System (HS), which is the actual legal tariff line of the U.S. The degree of intra-industry trade has been

[^3]: Firms are not required to report whether they support or oppose a given bill. I partially overcome this problem by analyze the contents of bills in Section 2.5.

[^4]: Drutman and Hopkins [2013] analyze more than 250,000 internal emails from Enron, and show that the company devoted “minimal attention to campaigns, elections, or fund-raising.” Instead, the firm’s political attention is more on participating in rule-making. The finding provides convincing reasons why LDA data is particularly useful in studying firm-level political activities. Note that, Ansolabehere *et al.* [2002] show that ideologically oriented groups such as labor unions, on the other hand, are more likely to utilize PAC contributions.
calculated at HS6, which is the most refined level possible for the measure given the distinct product categories that the U.S. uses for exported goods (Schedule B) and imported goods (HTS). I also use the Temporary Trade Barriers Database (TTBD) to address the concern that countries increasingly use non-tariff barriers instead of (or in addition to) traditional tariff barriers. All HS8 products which have been subject to at least one anti-dumping case and countervailing duties are included in the analysis.

To verify whether the content of lobbying is consistent with the theoretical predictions, I parse all legislative bills introduced since 1999 (from 106th Congress: both the Senate and the House of Representatives). In particular, I focus on Congressional Research Service (CRS) bill summaries to examine whether firms lobby on differentiated products. I identify all lobbied bills using automated text matches either by bill title or bill number appearing in lobbying reports.

Finally, given that there exist limitations in identifying actual products that each firm produces, I added the most refined industry level variables—NAICS (North American Industry Classification System) 6-digits—into the analysis. This allows me to control for industry level characteristics such as total employment, payment, value added, energy consumption, etc, which have been identified as important determinants of trade policy-making. Table 2.1 describes the original sources of data used in this paper.

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5 Product level imports/exports data at the firm level is confidential. I am currently in the process of applying for getting an access to a number of confidential datasets such as LFTTD and LBD from the U.S. Census Bureau.

6 The entire database is interconnected by SQL (Structured Query Language), and will be available publicly.
2.3 Product Differentiation and Firm-level Lobbying

This section tests the hypothesis that exporters lobby more on trade policy, while import-competing firms lobby less when they produce differentiated products. The highly detailed data on firm-level lobbying activity offers an unique means to analyze which firms lobby under what condition. I find that firm-level productivity is an important determinant of lobbying on trade policy.

I use productivity, measured as value-added per labor, as a proxy measure for firm’s interest in exporting markets\(^7\). My focus on productivity is justified on both theoretical and empirical ground. Theoretically, productivity difference has been an important building block for the new-new trade theory inducing heterogeneous economic interest of firms. The model in Section 1.3 also suggests that productivity differences across firms is important in understanding strategic interacting between firms and governments. Furthermore, there exists ample empirical evidence that productivity difference is critical in determining firm’s ability to export\(^8\). Finally, firms with higher productivity will have stronger interests in foreign market access because of the increasing returns-to-scale. That is, larger profits will be expected

---

\(^7\) Productivity is measured as value-added (total sales less cost of goods sold) per labor.

\(^8\) Each firm trading in the U.S. stock market files FORM 10-K pursuant to Section 13 or 15(d) of the Securities Exchange Act of 1934. In this form, firms report their geographic sales data. I calculated the U.S. sales share based on the most recent data stored in Wharton Research Data Services (WRDS) UNIX secure server. The segment history database is separated into multiple sub-datasets. In order to identify actual geographic sales share, one needs to carefully merge SEG-ANNFUND and SEG-GEO datasets in Compustat. Unfortunately, not every firm reports their geographic sales data, and I found that many multinational firms with foreign presence actually reports that 100% of their sales is from the U.S. I thank Alexis Furuichi and Todd M. Hines for bringing this dataset into my attention.
by having access to a bigger market, and this becomes more attractive when firm’s marginal cost of production is small, i.e., productive.

For my empirical analysis, I consider all publicly trading firms in the U.S. stock market since 1999– a total of 34,048 observations.\textsuperscript{9} I manually match each of these firms with the names of clients who lobbied at least once on either trade or tariff issues based on all lobbying reports filed since 1999. In the LDA dataset, a client is defined as “Any person or entity that employs or retains another person for financial or other compensation to conduct lobbying activities on behalf of the person or entity. An organization employing its own lobbyists is considered its own client for reporting purposes.” Out of 4,089 firms from 235 different industries (SIC 4 digits level), there are 588 firms who have lobbied at least once on trade/tariff issues.\textsuperscript{10}

Figure 2.1 shows that firms are more likely to lobby when they are more productive. It also captures an important variation in firm level lobbying depending on the level of differentiation in the industry in which each firm competes. Specifically, it shows that when products are highly differentiated (first column), productive firms dominate lobbying. This provides a political explanation for lower tariff for differentiated products. In contrast, firms with different levels of productivity lobby at the same rate when they produce substitutable goods. This is consistent with the theory

\textsuperscript{9} Only publicly traded firms are considered because it gives a well-defined population of firms. Otherwise, it is impossible to define a population of all firms as the boundary of firms become increasingly arbitrary with private firms. Moreover, private firms in the U.S. are not legally required to report their financial information, which will further limit the ability to estimate productivity. Despite this restriction, enough variation exists among public firms in terms of their economic and political activities. The time frame was chosen because the LDA dataset is available from 1999.

\textsuperscript{10} I analyze the contents of their lobbying based on the specific legislative bills that have been indicated as being lobbied. Section 5(b)(2)(A) of the Lobbying Disclosure Action of 1995 requires that each report shall contain “a list of bill numbers.”
Figure 2.1: Lobbying and Product Differentiation: This figure shows that firms are more likely to lobby when they are more productive (darker shade means a higher proportion of firms lobbying). It also shows that when products are highly differentiated (first column), productive firms dominate lobbying. Contrarily, when products are substitutable (last column) a larger proportion of firms with different levels of productivity lobby suggesting higher level of political competition. As expected, productive firms are more likely to lobby either when goods are highly differentiated or highly substitutable. This corroborates the result from Proposition 2 and suggest that U.S. firms are in general highly productive as seen from Figure 1.7. Productivity is measured as value-added per labor. Each number inside of each cell represents the total number of firms belonging to each category.

that less productive firms have higher incentives to lobby for protection to prevent them from exiting the market.

To further examine this, I fit a logistic regression of lobbying on firm level characteristics such as employment, sales, and capital expenditure. Domestic producer is a binary variable that is unity when the firm provides goods only domestically. This variable controls for the incentive of import-competing firms. I use three different measures for product differentiation. Differentiated and Homogeneous is the binary measure for product differentiation that is the primary measure used for the
empirical analysis. The original continuous measure for product differentiation ($\sigma$) is estimated by Broda and Weinstein (2006), where smaller value implies larger differentiation. As a robustness check, I also use the Rauch product differentiation index. Rauch (1999) categorizes goods traded on organized exchanges as homogeneous (W), and other goods as differentiated (N). Note that the productivity measure is time invariant and varies across NAICS6 industries that each firm mainly competes. Thus, this measure also controls for industry level unobservable heterogeneity.

Figure 2.2: Productive Firms are More Likely to Lobby when Products are Differentiated: Panel (a) shows that productive firms are more likely to lobby on trade issues when they compete in an industry with highly differentiated products. This is starkly different from the firm-level lobbying behavior in homogeneous industries, where productivity of firms does not explain their lobbying activities. Panel (b) presents the difference, differentiated industry less homogeneous industry, in the probability of lobbying. Note that the difference is negative when productivity of firms are low. Although the effect is relatively small, its statistical significance suggests that less productive firms are more likely to lobby when they produce substitutable goods.

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11 For instance, price per pound of homogeneous chemical products such as Polyoxyethylene Sorbitan Monostearate is quoted weekly in Chemical Marketing Reporter. W, and N is the original index developed by Rauch, where R is used as a baseline category in the analysis. See Rauch (1999) for details.
<table>
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*** p < 0.001, ** p < 0.01, * p < 0.05, p < 0.1

Table 2.2: **Interaction between Product Differentiation and Firm-level Productivity:** Productive firms are more likely to lobby when products are differentiated. This result is robust to having different measures for product differentiation. For example the negative coefficient of the interaction term between productivity and σ is expected because lower value of σ means higher product differentiation.
Table 2.2 summarizes the result. It shows that productive firms are more likely to lobby when their products are differentiated within industry. This result holds consistently across different measures of product differentiation.

Finally, I examine the predicted probability of lobbying simulating over different levels of productivity observed in the data holding other variables at their mean (scalar variables) and median values (categorical variables). Panel (a) of Figure 2.2 shows that productive firms are more likely to lobby on trade issues only when they compete in an industry with highly differentiated products. This is starkly different from the firm level lobbying behavior in homogeneous industries, where the lobbying activity of firm is unrelated to the productivity of those firms. By taking the difference between the two predicted probabilities, it becomes clear that less productive firms are less likely to lobby when they produce differentiated products. This is consistent with the theoretical prediction that product differentiation explains both active lobbying by productive firms and absence of lobbying by less productive firms. Unlike earlier studies, my finding identifies which firm lobbies and when they actively do so (c.f., Milner 1988). That is, productive firms lobby when they produce differentiated products.

2.4 Intra-industry Trade and Trade Liberalization

My theory also predicts that high intra-industry trade is associated with liberal trade policy. This is because of consumers’ love of variety as well as governments’ ability to credibly commit to liberal trade policy as shown in Section 1.3. This section finds that
the variation in trade policy across similar products within industry can be explained by high intra-industry trade.

I use the Grubel–Lloyd measure of intra-industry trade for a product \( i \) at time \( t \)\(^{12}\). I then fit the generalized mixed-effect model given in equation (2.1) in order to identify time-varying effects of intra-industry trade on trade liberalization. I follow the common practice of weighting tariffs by the total value of imports as in Trefler (1993). The unit of analysis is HS6 manufacturing product \( i \)—NAICS6 industry \( j \)—year \( t \). HS6 categorization is chosen because it is the most refined level of product categorization at which import and export codes agree with each other\(^{13}\). Product level controls include total value of imports, number of countries that the U.S. exports and imports the given product. Several industry level (NAICS6) covariates for industry \( j \) such as employment, value-added, total-factor-productivity, payroll, and energy consumption are also included using the information from Bartelsman et al. (2000). This results in a dataset with a multilevel structure whereby each product belongs to an industry. A mixed-effect model is particularly useful to incorporate the variation at the different levels of hierarchy, i.e., HS6 and NAICS (Gelman and Hill 2007). Finally, varying intercepts for each level is included in order to control for the heterogeneity in each product and time.

\(^{12}\) I use this conventional measure rather than the modified Grubel–Lloyd index introduced earlier in Section 1.2.3 because I explicitly control for the import value in the statistical analysis.

\(^{13}\) As noted, the U.S. has two separate coding system for documenting exporting (Schedule B) and importing (HTS) goods. They agree only up to 6 digits. That is, same 8 digits code at Schedule B and HTS does not necessarily refer to identical products. Therefore, the aggregation at the 6 digits level by taking an average appropriately weighted by respective volume of trade is necessary.
\[ \tau_{ijt} \mid \delta_i, \beta_t \overset{\text{indep.}}{\sim} \mathcal{N}(\delta_i + \lambda_t + IIT_{it} \beta_t + Z_{it} \zeta + X_{jt} \gamma, s_\delta^2), \quad (2.1) \]

\[ \delta_i \overset{\text{i.i.d.}}{\sim} \mathcal{N}(\delta, s_\delta^2), \quad \lambda_t \overset{\text{i.i.d.}}{\sim} \mathcal{N}(\lambda, s_\lambda^2), \quad \beta_t \overset{\text{i.i.d.}}{\sim} \mathcal{N}(\beta, s_\beta^2), \]

\[ \zeta = (\zeta_1 \zeta_2 \zeta_3)^\top, \quad \gamma = (\gamma_1 \gamma_2 \gamma_3 \gamma_4 \gamma_5)^\top, \]

\[ Z_{it} = \begin{pmatrix} \text{imp.value}_{it} & \text{n.exp.cty}_{it} & \text{n.imp.cty}_{it} \end{pmatrix}, \]

\[ X_{jt} = \begin{pmatrix} \text{emp}_{jt} & \text{vadd}_{jt} & \text{tfp}_{jt} & \text{pay}_{jt} & \text{eng}_{jt} \end{pmatrix}. \]

Figure 2.3 summarizes the results from two separate models. First, in order to account for the large number of products with zero tariff rate (\( \tau_{ijt} = 0 \)), I estimated a generalized mixed-effect model with binary dependent variable indicating zero tariff rate. Note that there are 17,419 observations at the HS6 category that have zero tariff out of 127,972 from 1999 to 2005. Panel (a) shows a simulation result based on quasi-Bayesian method after fitting the model above. It shows that hypothetically increasing the degree of intra-industry trade from the lowest to the highest has a positive effect on complete elimination of tariff barriers. The effect is statistically significant and steadily increases from late 1990s.

I fit the second-stage time-varying coefficient model conditional on positive tariff rates (\( \tau_{ijt} > 0 \)). I then multiply the estimated coefficients for each year by the probability of having positive tariffs in order to get the estimated effect of IIT on trade liberalization: i.e., \( \mathbb{E}(\tau_{ijt} \mid T_{it}, Z_{it}, X_{jt}) = \mathbb{E}(\tau_{ijt} \mid T_{it}, Z_{it}, X_{jt}, \tau_{ijt} > 0) \cdot \mathbb{P}(\tau_{ijt} > 0) \).\(^{14}\)

\(^{14}\) I included total value of imports and the number of countries that the U.S. export for each product in order to account for the fact that the U.S. does not produce some of the products at all.\(^{15}\) The tariff data for year 1994 is not available in WITS and thus omitted.
Figure 2.3: **Effects of Intra-industry Trade on Trade Liberalization**: Panel (a) shows the effect of changing the level of intra-industry trade from the lowest (Grubel–Lloyd index = 0) to the highest (Grubel–Lloyd index = 1) on the likelihood of the product’s ad-valorem tariff becoming zero. It shows that increasing the degree of intra-industry trade makes it more likely to remove tariff-barriers on each product from late 1990s. The effect is estimated by generalized linear mixed effect model with time varying effect of intra-industry trade. Panel (b) shows that increase in the degree of intra-industry trade, measured by Grubel–Lloyd index, is negatively correlated with the average ad-valorem tariff rate. Note that such effect has disappeared in recent years. This is because tariffs on more than 1/3 of products have been eliminated with little variation in applied tariff rates. Average ad-valorem tariff rate is calculated at the HS6 product level weighted by HS8 digits total values of import. For panel (a), quasi-Bayesian method is applied to the fitted model to simulate the hypothetical change from complete zero intra-industry trade to highest level of intra-industry trade.

0 \mid T_{it}, Z_{it}, X_{it}). As Panel (b) shows, a one-unit increase in the intra-industry trade index is associated with about a 0.2 percentage point decrease in average tariff rate.

Note that the effect is statistically indistinguishable from zero in recent years. This is because a large number of products already have reached their zero-tariff level as Panel (a) shows. In sum, Figure 2.3 shows that a high degree of intra-industry trade is correlated highly with trade liberalization.
2.5 Text Analysis of Trade Bills

So far, I have shown that productive firms are more likely to lobby when they produce differentiated products and that high intra-industry trade is associated with liberal trade policy. However, we still do not know what exactly firms are looking for when they lobby. In fact, this is highly difficult to identify relying solely on lobbying reports. I overcome this problem by establishing direct links between legislative bills and lobbying reports. Specifically, I consider the universe of trade and tariff related bills introduced since 1999 (106th Congress), and search through all lobbying reports one-by-one to determine which bill is lobbied. This section provides evidence of product specific lobbying by firms in favor of reducing trade barriers.

Identifying the universe of trade and tariff bills is not possible given that any bill can be deemed as related to trade: bills on immigration, environment, labor standard, or even defense can be “trade-related” depending on the perspectives of researcher. Searching based on single words also introduces problems given that a word such as “trade” can be used in multiple different contexts, e.g., “trade stocks in finance”. In order to address the first problem, I utilize the Congressional Research Service (CRS) summary of each bill. CRS aims to provide nonpartisan analysis of various policy issues both for the United States Congress and the public. In particular, it offers a detailed summary of all congressional bills. The summary is useful to identify the overarching issue areas related to a given bill with less political/contextual noise on topics than full texts of bills. Second, for all CRS summaries, I employ a tokenized words search in order to identify bills that are directly related to trade policy.
I consider bills that include at least one of the following tokenized terms: trade barrier(s); tariff barrier(s); non-tariff barriers(s); tariff reduction; export subsidy; the U.S. trade representative; world trade organization; most favored nation; rules of origin; generalized system of preferences; free trade agreement; uruguay round. This results in a total of 685 bills. Table 2.3 presents 10 randomly selected bills. Given the list of trade bills, we can search the universe of 838,588 lobbying reports to check if there exist any lobbying activities associated with each bill. Which bills are lobbied? Are lobbied bills systemically different from non-lobbied bills in terms of their context? If so, how can we identify the pattern? By answering these questions, I examine whether the contents of lobbied bills are consistent with the theoretical predictions from Section 1.3.

Using full texts of each bill is problematic because actual texts of bills are endogenous to political process: lobbyists often help draft bills or even write them; legislators insert certain texts to satisfy their constituencies. To remedy this problem, I utilize CRS summary. As noted, CRS offers highly detailed description of each bill from a nonpartisan perspective. Also, it is an independent organization that is outside of lobbying process, which allows researchers to establish a link between the

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16 Adding other terms such as foreign trade usually introduce bills that have already been identified through the other terms, but it adds a large number of non-trade related bills due to the broad context of foreign trade. Including, harmonized tariff schedule significantly increases the size of the trade bills to 7,316. This is mostly from product-specific miscellaneous tariffs bills. However, the current parsing algorithm is not complete to search all of these in lobbying reports. A good example can be seen from Fig 2.7 which shows that the lobbying status of a large number of miscellaneous bills can not be identified if they are reported in a format such as “H.R.4182-4186. The algorithm is currently being improved to accommodate H.R.4183, H.R.4184, H.R.4185 in addition to the two bills that can be searched through regular expressions. Thus, I analyze miscellaneous tariffs bills separately below.

17 The full list of bills will be available through a web-appendix.
Table 2.3: **Trade Bills:** This table lists 10 randomly selected trade bills identified by the tokenized word searching algorithm. It demonstrates that the bills are indeed trade related. The full list of bills will be available through a web-appendix.

 contexts of a given bill to its propensity to be lobbied. Although the text of summary is inevitably affected by the contents of original bill, this is the best available source for deception of each bill created by bipartisan organization.

I first create the list of \( p \) words \( \mathbf{w} \) used in trade related bills.\(^{18}\) I then count \( w_{ij} \), the number of times each word \( j \in \{1, \ldots, p\} \) appears in each bill \( i \): \( w_i = (w_{i1}, \ldots, w_{ip}) \).\(^{19}\) This will create a bill-to-term matrix (number of trade-related bills \( \times p \)) summarizing the distribution of words over trade bills. However, estimating the effect of individual words on lobbying is computationally difficult due to the large dimensionality of \( p \), the number of unique words. To address this problem, I use a variable selection method LASSO (Least Absolute Shrinkage and Selection Operator) to select the list of words that are particularly useful in explaining whether bill \( i \) is lobbied or not \( (y_i) \), while constraining other coefficients to be zero \( (\text{Tibshirani, 1996; Friedman et al., 2010}) \).

As described in equation (2.2), this can be achieved by putting the constraint on the

\[ \sum_{j=1}^{p} \left| \beta_j \right| < \lambda \]

\(^{18}\) For the analysis below, I used words appearing at least 10 bills after stemming them and removing stop words. This results in \( p = 1650 \).

\(^{19}\) Note that most of the entries of \( w_i \) will be zero. For the purpose of prediction, I use frequency since the size of document itself is useful in predicting the occurrence of lobbying. I use proportion of words later in topic modeling.
sum of coefficients $\beta_j$ associated with each word. I use the logistic link to do a LASSO regressing of binary indicator for lobbying on the list of words.

$$\min_{\beta_0, \beta \in \mathbb{R}^{p+1}} \left[ (y_i - \beta_0 - w_i^T \beta)^2 + \lambda \sum_{j=1}^{p} | \beta_j | \right]$$

(2.2)

I use cross-validation to choose $\lambda$ that minimizes out-of-sample prediction error. Specifically, I do 20-fold cross-validation whereby $\lambda$ is chosen to minimize the mean-squared error (MSE) in predicting the occurrence of lobbying. The model is then applied to 5% of randomly chosen bills to predict how likely each bill is going to be lobbied. This process is continued 1000 times to examine whether there exist words in CRS summary that helps predict lobbying. On average, bills that are not lobbied are predicted to be lobbied 35%, whereas bills that are actually lobbied are predicted to be so in almost 80% of the time. The result is graphically presented in Figure 2.10.

Figure 2.4 presents the top 30 words that are found to increase (decrease) the predicted probability of lobbying for each bill. The size of each word is proportional to the absolute size of the coefficient $\beta_j$, where bigger size of the word in the first (second) column implies that a bill with the word are more (less) likely to be lobbied.

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20 I used cross-validated estimates instead of out-of-sample-validated estimates given that my purpose is to identify the words associated with lobbying in the sample. I used the latter to check whether there is over-fitting sample-specific attributes of the observed data. Doing so also gives statistically significant separation. I thank Marc Ratkovic for his insights on applying the method.

21 I did non-parametric statistical test to access the mean difference of predicted probabilities between lobbied and non-lobbied bills. Wilcoxon signed-rank test is used because the truncation of probabilities (between zero and one) makes it hard to make the normality assumption necessary for t-test. The result validates that there is a significant mean difference in cross-validation sample prediction ($p$-value $< 2.2e^{-16}$). Wilcoxon signed-rank test is computed by calculating the following test statistic.

$$W = | \sum_{i=1}^{N_r} \{ \text{sgn}(x_{2,i} - x_{1,i}) \cdot R_i \} |$$

where $R_i$ denotes the rank order of absolute difference between pairs $(x_{2,i} - x_{1,i})$. This test statistic is normally distributed. t-test gives the same result, where $p$-value is $< 2.2e^{-16}$, and 0.232 respectively.
Figure 2.4: **Words with Top 30 Loadings** The size of each word is proportional to the size of loading in the LASSO regression. The bigger the size of a given word in the first (second) column implies that a bill with the word will be more (less) likely to be lobbied.

Having identified the words associated with frequent lobbying, I examine in which context they are actually used. The word “characterist” appears in multiple Reciprocal Market Access Act in 2007, 2009, and 2011. For example, as it is shown in Figure 2.5 Reciprocal Market Access Act of 2011 requires that foreign governments to reduce or eliminate trade and non-tariff barriers with respect to U.S. exports of any product with *same physical characteristics*. 
“Reciprocal Market Access Act of 2011 - Prohibits the President from agreeing to the reduction or elimination of the existing rate of duty on any product in order to carry out a trade agreement entered into between the United States and a foreign country until the President certifies to Congress that: (1) the United States has obtained the reduction or elimination of tariff and nontariff barriers and policies and practices of such foreign country with respect to U.S. exports of any product that has the same physical characteristics and uses as the product for which the President seeks to modify its rate of duty, and (2) any violation of the trade agreement is immediately enforceable by withdrawal of the modification of the existing duty on such foreign product until the United States Trade Representative (USTR) certifies to Congress that the United States has obtained the reduction or elimination of the tariff or nontariff barrier or policy or practice of such foreign government...”

Two important points are in order. First, the word “characteristics” is used in describing specific physical properties of products validating the theoretical connection between product differentiation and the incentives of lobbying. This bill was lobbied by Corning Inc. Based on the texts in the actual lobbying report as seen in Figure 2.6, we know that Corning Inc. is lobbying for reducing the trade barriers on optical fibers.\(^22\) I checked the level of product differentiation ($\sigma$) for this particular product: Optical fibers, optical fiber bundles and cables (HS8 90011000). The measure of $\sigma$ is 1.92 (Broda and Weinstein 2006). Recall that lower value of $\sigma$ implies high differentiation. The mean value of $\sigma$ is 11.14 and the minimum value is 1.10 indicating that optical fiber is a highly differentiated product with different wavelength of light and bandwidths. Second, Corning Inc. lobbied in support of reducing trade barriers on the product both at home and abroad (reciprocally). This corroborates the theoretical prediction that domestic firms might find lobbying for re-

\(^{22}\)As of 2013, the MFN tariff rate for HS8 90011000 is 6.7%.
ducing trade barriers at home optimal since reciprocal treatments of the \textit{same} product abroad will significantly increase their profits due to increasing returns to scale.

Another word that is associated with frequent lobbying is “extends.” This term is used for extending early legislation that promotes trade: e.g., “Trade Act of 2002” (HR3009), “AGOA Acceleration Act of 2004” (S2529), “To extend the Generalized System of Preferences and the Andean Trade Preference Act, and for other purposes” (HR4284). It is also widely used for extending temporary duty-free measures applied to specific products (usually until the end of each Congress). As an example, the top panel of Figure \ref{fig:trade} presents a part of Trade Act of 2002 where “extends” is used. Mattel Inc., a company producing differentiated brands of toys such as Barbie dolls and Fisher-Price, lobbied on this bill.\footnote{Note that dolls are arguably differentiated products: $\sigma$ for \textit{Dolls representing only human beings, whether or not dressed} (HS8 90011000) is 2.55.} Note that lobbying reports are useful not only for determining any occurrence of lobbying but also for identifying firms’ direct interests with respect to product specific trade policy. All other lobbied bills lobbied by Mattel Inc. (H.R.4182-4186, S.2099-2103) are related to suspending duties on highly specific products that directly concern the firm’s interests. Interestingly, the bills were sponsored by Rep. Jane Harman (CA-36) and Sen. Dianne Feinstein (CA) on behalf of Mattel Inc. headquartered in California.

All of these are examples of Miscellaneous Tariff Bills that each Congress passes (except for 107th Congress) to suspend or \textit{extend} the current suspension of duties on hundreds of products. Tariff reductions imply revenue loss. For example, Congressional Budget Office estimated that all tariff reductions and suspensions introduced
“Extends, through December 31, 2006, treatment free of any duties, quantitative restrictions, limitations, or consultation levels to certain apparel articles imported into the United States after assembly in one or more ATPDEA beneficiary countries from U.S. or ATPDEA country products.”

“H.R.3009, Trade Act of 2002. Certain miscellaneous tariff bills to suspend the rates of duty on certain toy-related articles (H.R.4182-4186; S.2099-2103). WTO market access negotiations for non-agricultural products Port and border security measures”

Figure 2.7: (Top) An example of the use of “extends” from the CRS summary of H.R. 3009. (Bottom) Lobbying Report by Mattel Inc. (2002 Midyear) who lobbied on the bill.

in “United States Manufacturing Enhancement Act of 2010” (HR4380) alone will reduce tariff revenue by $298 million in 10 years. This suggests that open-trade-for-sale occurs. If protection-for-sale is the primary political mechanism through which trade policy is determined as a result of lobbying, one should expect that firms would lobby for protecting domestic market from their foreign competitors. Table 2.4 shows, however, that many individual firms lobby for reducing tariff on specific products they are concerned with.

Note that all bills in the table target very specific products, e.g., noise reducing headphones. There were almost 2,000 miscellaneous tariff bills introduced in 112th Congress alone. Ludema et al. (2010) finds that about 79% of the miscellaneous bills introduced between 1999 and 2006 have become law. Given that only a verbal objection is needed to block the bill, however, they argue that “protection for free” occurs. Simply put, protection can be cheaply accomplished by expressing an objection rather than demanding it directly through lobbying. Nevertheless, it is worth noting that most miscellaneous tariff bills have encountered little objection from import-competing firms. This is consistent with the theoretical prediction of
<table>
<thead>
<tr>
<th>Cong.</th>
<th>Bill</th>
<th>Official Title</th>
<th>Firms (Location)</th>
<th>Sponsor (state)</th>
</tr>
</thead>
<tbody>
<tr>
<td>109</td>
<td>S2325</td>
<td>A bill to reduce temporarily the duty on certain audio headphones achieving full-spectrum noise reduction</td>
<td>Bose (MA)</td>
<td>John Kerry (MA)</td>
</tr>
<tr>
<td>111</td>
<td>S2098</td>
<td>A bill to reduce temporarily the duty on certain isotopic separation machinery and apparatus</td>
<td>Louisiana</td>
<td>Jeff Bingaman (NM)</td>
</tr>
<tr>
<td>112</td>
<td>S2334</td>
<td>A bill to reduce temporarily the duty on lithium ion electrical storage batteries</td>
<td>General Motors (MI)</td>
<td>Carl Levin (MI)</td>
</tr>
<tr>
<td>112</td>
<td>HR5557</td>
<td>To reduce temporarily the rate of duty on certain girls’ shorts</td>
<td>Nike (OR)</td>
<td>Earl Blumenauer (OR)</td>
</tr>
<tr>
<td>112</td>
<td>HR4796</td>
<td>To extend the temporary suspension of duty on electromechanical ice shavers</td>
<td>Hamilton Beach (VA)</td>
<td>Bobby Scott (VA)</td>
</tr>
<tr>
<td>112</td>
<td>S2808</td>
<td>A bill to reduce temporarily the duty on golf club driver heads</td>
<td>Reebok (MA)</td>
<td>John Kerry (MA)</td>
</tr>
<tr>
<td>106</td>
<td>HR3704</td>
<td>To amend the Harmonized Tariff Schedule of the United States with respect to certain toys</td>
<td>Mattel Inc (CA)</td>
<td>Xavier Becerra (CA)</td>
</tr>
<tr>
<td>109</td>
<td>S3313</td>
<td>A bill to reduce temporarily the duty certain color monitors video with a display diagonal of 35.56 cm or greater</td>
<td>Honeywell Intl (NJ)</td>
<td>Charles Schumer (NY)</td>
</tr>
</tbody>
</table>

Table 2.4: **Lobby on Miscellaneous Tariff Bills:** This table shows that firms lobby for reducing tariff barriers on specific products. Also, there generally exists a high correlation between firm’s headquarter location and the sponsor state of each bill.

The absence of the demands for protection for differentiated products. Furthermore, firms tend to lobby individually to reduce tariffs on specific products rather than lobbying jointly together at the industry level. This suggests that each individual firm base their lobbying decision on their own cost-benefit analysis rather than lobbying together with other firms which requires them to overcome collective action problems. This is also consistent with the theoretical prediction.

This section finds that there exist political pressures from firms to reduce trade barriers of specific products. A close analysis of trade bills provides evidence that the contents of lobbied bills are consistent with the theoretical predictions from Section 1.3. Certainly, examining words focusing primarily on the sentences where they are used will not give a complete picture of the overarching theme of a given bill. A bill generally covers a large number of issues reflecting diverse political interests and
topics. As such, it might be that one part of a bill is promoting trade while other parts are mainly focusing on introducing protective measures. To remedy this problem, I further my analysis by fitting unsupervised topic models on the texts of CRS summary of each bill. I find that a topic that characterized by a set of words such as certain, duty, treatment, and specific is associated with frequent lobbying suggesting product-specific lobbying. This adds evidence of product-specific lobbying. A detailed description of this analysis is available in Appendix 2.8.3.

2.6 Product Differentiation and Trade Liberalization

This section examines whether tariff policy varies across products with different degrees of substitutability. For the measure of product differentiation ($\sigma$), I use the widely used measure from Broda and Weinstein (2006). They estimate the elasticity-of-substitution for each HS10 product. I take the average of their measure over each HS8 product category $i$ in order to match the unit at the legal tariff line of the U.S. Each HS8 product is then categorized into three distinct levels of product differentiation: low (less than the 33th percentile), medium (between the 33th and 66th percentile), and high (greater than the 66th percentile).
the 66th percentile) and high\textsuperscript{25}.

\begin{equation}
\tau_{ijt} \mid \delta_j, \beta_t \overset{\text{i.i.d.}}{\sim} N(\delta_j + \lambda_t + T_i \beta_t + Z_i \zeta + M_{ijt} \eta + X_{jt} \xi, s^2_{\tau})
\end{equation}

\begin{align*}
\delta_j & \overset{\text{i.i.d.}}{\sim} N(\delta + X_{jt} \gamma, s^2_{\delta}), \\
\lambda_t & \overset{\text{i.i.d.}}{\sim} N(\lambda, s^2_{\lambda}), \\
\beta_t & \overset{\text{i.i.d.}}{\sim} N(\beta, s^2_{\beta}),
\end{align*}

\begin{align*}
\zeta &= (\zeta_1 \zeta_2)\top, \\
\eta &= (\eta_1 \eta_2)\top, \\
\xi &= (\xi_1 \xi_2 \xi_3 \xi_4 \xi_5)\top,
\end{align*}

\begin{align*}
T_i &= \begin{pmatrix} \text{low}_i \text{ high}_i \end{pmatrix}, \\
Z_i &= \begin{pmatrix} \text{AV}_i \text{ CVD}_i \end{pmatrix}, \\
M_{ijt} &= \begin{pmatrix} \text{value}_{ijt} \text{ cty}_{ijt} \end{pmatrix}, \\
X_{jt} &= \begin{pmatrix} \text{emp}_{jt} \text{ vadd}_{jt} \text{ tfp}_{jt} \text{ pay}_{jt} \text{ eng}_{jt} \end{pmatrix},
\end{align*}

To determine if there are any systemic differences in trade policies across products, I run a multilevel model to estimate the average applied MFN tariff rate ($\tau_{ijt}$) differences across products with different levels of differentiation. This model is given in equation (2.3). The unit of analysis is HS8 manufacturing product $i$ in NAICS6 industry $j$ at year $t$. In order to address the concern that non-tariff barriers can function either as substitutes or complements to tariff barriers, I include dummy variables indicating whether a given HS8 product $i$ has ever been subject to an antidumping (AD) or countervailing duties (CVD) investigation using the TTBD database (Bown, 2012). I also control for the value of total imports (value) and the number of exporting nations (cty) for each product. Industry specific effects are modeled hierarchically by assuming that the mean of industry random effects is a function of several industry level (NAICS6) covariates such as employment, value-added, total-factor-productivity, payroll, and energy consumption using the information from Bartelsman\textsuperscript{25}.

\textsuperscript{25} Broda and Weinstein (2006) uses the same strategy in order to address the potential measurement error in estimating the level of product differentiation. Different cut-off decisions do not change the result.
The analysis is based on 92,267 observations (HS8 product $i$—NAICS6 industry $j$—year $t$) from 1990 to 2005 with 7,670 unique manufacturing products and 373 NAICS6 industries.

Figure 2.8: **Lower Tariffs on Differentiated Products:** This figure presents a quasi-Bayesian simulation result based on the prediction of the model. It shows that changing the level of product differentiation from low to high category predicts that the applied MFN tariff rate of the product would decrease by 0.4 percentage point. Note that the time varying effect becomes more or less constant since 1999 which is consistent with the phase-in period after the Uruguay Round.

Figure 2.8 presents a quasi-Bayesian simulation result based on the prediction of the model. It shows that changing the level of product differentiation from low (less than the 33rd percentile) to high (higher than the 66th percentile) category is associated with 0.4 percentage point decrease in the applied MFN tariff rate. This is equivalent to $124 million decrease in tariff revenue.

The result provides empirical evidence that the U.S. had reduced tariff barriers during the course of the Uruguay Round negotiation, especially those of differentiated products holding industry level variation constant. That is, the stark increase in the
within-industry variation in tariffs after the Uruguay Round negotiation shown in Figure 1.1 is attributable to the tariff reduction of differentiated products. This confirms the theoretical prediction. Specifically, the multilateral negotiation provided an opportunity for productive exporting firms to inform the government of their product-specific preferences. As a result, products with high levels of differentiation received larger tariff reduction. It also suggests that counteracting demands for protection by import-competing firms were not as strong as those on products that can be easily substitutable by cheap foreign goods.

2.7 Concluding Remarks

In this paper, I have shown that product differentiation in economic market induces different political incentives among firms within industry. My theory predicts that demand for trade liberalization will increase because high product differentiation eliminates the collective action problem exporting firms confront. On the other hand, political objections by import-competing firms to product-specific liberalization will decline due to less substitutability and the possibility of serving foreign markets based on the norms of reciprocity. With a new dataset on lobbying and trade bills, I show that productive firms actively lobby on trade policy only when they produce differentiated products. I find that goods that cannot be easily substitutable get lower applied tariffs on average.

Of course, the lobbying data cannot be used to directly test the causal mechanisms of this theory. Successfully answering this question is likely to require survey methodologies that directly measure firm-level preferences or exploiting technological
shocks on product differentiation and productivity at the firm-level. I leave for future research this challenging task of investigating how exactly firm-level preferences translate into trade policy outcome.

The existence of political heterogeneity as well as tariffs differences within industry may mean that we need to call into question some of assumptions about what makes trade liberalization possible. A vast majority of research on domestic politics of international trade is based on the assumption that individual trade preferences are shaped by how trade affects their income, which is tied directly to the industry they serve. However, recent research has found that most wage inequality dispersion occurs within occupations and sectors rather than between occupations and sectors (Helpman et al. 2010, 2012). A better understanding of firm’s preferences on trade policy may alter our view on political forces behind trade liberalization.
2.8 Appendix

2.8.1 LASSO regression on CRS summary of Trade Bills

Figure 2.9: cross validation: The left panel shows that \( \log(\lambda) \approx -4 \) is found to minimize the MSE. As shown in the right panel, most coefficients are constrained to be zero around the value of the chosen \( \lambda \).

2.8.2 Measures of Productivity

I measure productivity of firms after taking into account two important biases: \textit{Olley and Pakes (1996)} (O&P hereafter) point out simultaneity and selection biases. To begin, consider the following production function for output \( y \) for firm \( i \) at year \( t \), where \( K, L, M, \) and \( Z \) denotes capital, labor, material, and a vector of control variables, respectively.

\[
y_{it} = \beta_0 + \beta_K K_{it} + \beta_L L_{it} + \beta_M M_{it} + \gamma^T Z_{it} + \epsilon_{it}.
\]  

(2.4)
(a) Cross-validation Sample Prediction  
(b) Placebo Test

Figure 2.10: Predicting the likelihood of Trade Bills Lobbied: Panel (a) presents the result from the LASSO (Least Absolute Shrinkage and Selection Operator) method. It shows that there exists distinct patterns in the frequency of words appearing in the CRS summaries that distinguish bills that are not-lobbied and lobbied. Panel (b) shows the result from a placebo test whereby such distinction disappears by reordering the bill-to-term matrix such that terms that are originally from bill \( m \) becomes as if from bill \( n \neq m \).

\[ \epsilon_{it} = \varphi_{it} + \nu_{it} \]  

(2.5)

First, a simultaneity bias may plague simple OLS regression to estimate productivity. Suppose that firm level productivity \( \varphi_{it} \) is known to each firm, and yet it is unobservable to a researcher. It is reasonable to expect that any profit-maximizing firm will make input choices such as labor\((L)\) and material\((M)\) according to their productivity level. That is, \( L_{it} = f(\varphi_{it}) \) and \( M_{it} = g(\varphi_{it}) \) with some arbitrary function \( f \) and \( g \). It becomes clear that a OLS regression will introduce simultaneity biases due to the correlation between firms’ unobserved productivity level and their input choices. Specifically, the correlation between input choices and productivity are positive, which creates an upward biases to the coefficients for input choices.
O&P also raise the issue of selection bias. Given that each firm makes a choice between exiting or staying in operation, it is important to take into account that firms in the market fundamentally differ from others. In particular, they may be inherently more productive than other firms who have already exited or have not been able to enter at all. Assuming that firm’s future profit is increasing in its capital $K$, therefore, firms with little capital will stay in market only when they are productive enough. This suggests that $\text{Corr}(\varphi_{it}, K_{it})$ is negative, and therefore a simple OLS estimates will underestimate the coefficient of capital.

Following Olley and Pakes (1996), I estimated productivity of each firm in three steps. First, I assume that input choices such as labor and material are affected by productivity $\varphi_{it}$, while the decision on capital is based only on past productivity. I also assume that a proxy variable $i_{it}$ such as investment is strictly increasing in $K_{it}$. These two assumptions imply that one can invert the investment and input choice functions to get the following.

$$
\varphi_{it} = \psi_{it}(i_{it}, K_{it}).
$$

(2.6)

Substituing equation (2.6) into equation (2.4) gives,

$$
y_{it} = \beta_0 + \beta_k K_{it} + \beta_L L_{it} + \beta_M M_{it} + \gamma^T Z_{it} + \psi_{it}(i_{it}, K_{it}) + \nu_{it}
= \beta_0 + \beta_L L_{it} + \beta_M M_{it} + \gamma^T Z_{it} + \Phi_{it}(i_{it}, K_{it}) + \nu_{it}.
$$

(2.7)

26 A detailed discussion of the estimation is quite involved. Interested reader is advised to read the original paper of O&P.
Now, equation (2.7) can be estimated with consistent estimates of \( \beta_L \), \( \beta_m \) and \( \gamma_T \), where \( \Phi(\cdot) \) is estimated with a second order polynomial in investment and capital.

The second step estimates survival probability in order to address the selection issue. That is, I assume that a rational firm chooses to be in the market only when its productivity is high enough\(^\text{27}\) The survival probability is estimated by running a probit model of a binary indicator of being in the market in year \( t \) on \( i_{it-1} \) and \( K_{it-1} \) with their cross products. Denote the predicted probability from the second step by \( \hat{\pi}_{it} \).

The final step fits the following equation to get the consistent estimates of the production function, where \( \xi \) is approximated by a second order polynomial function.

\[
\begin{align*}
y_{it} - \hat{\beta}_L L_{it} - \hat{\beta}_m M_{it} &= \beta_k K_{it} + \gamma_T Z_{it} + \xi(\hat{\Phi}_{it-1} - \beta_k K_{it-1}, \hat{\pi}_{it}) + \varphi_{it} - \varphi_{it-1} + \nu_{it}. 
\end{align*}
\tag{2.8}
\]

Using the estimated coefficient, we get the estimated total factor productivity of each firm by

\[
tfp_{it} = y_{it} - \hat{\beta}_k K_{it} - \hat{\beta}_L L_{it} - \hat{\beta}_m M_{it} - \gamma_T Z_{it}. \tag{2.9}
\]

Table 2.5 compares the results from two production function estimation, where we use net sale for \( y_{it} \), and year and foreign firm indicator as \( Z_{it} \).\(^\text{28}\) As expected, OLS underestimates the coefficient for capital, while it overestimates the effect of labor inputs than the ones based on Olley & Pakes (O&P) method.\(^\text{29}\)

\(^{27}\) The decision to exit is assumed to follow a first-order Markov process.

\(^{28}\) I used STATA’s \texttt{opreg} package to estimate the production function.

\(^{29}\) I get higher estimates for material input. This is due in large part to the lack of data on firm level wages. Currently, I use estimates from Bartelsman \textit{et al.} (2000) for industry level average wages. I define material as “cost of goods” plus “administrative and selling expenses” less “deprecation” less “employment expenses.”

67
Table 2.5: Production function estimation:
The first column summarizes the estimates of production function based on the method proposed by Olley & Pakes (O&P). This corrects the (1) simultaneity and (2) selection biases in firm level input choices and exiting decision. As expected, the coefficient of capital is underestimated in OLS while labor input choice is overestimated. Standard errors are in parenthesis. Note: Standard errors in O&P model are bootstrapped using 250 replications.

**Significant at 1% level.

<table>
<thead>
<tr>
<th>Variable</th>
<th>O&amp;P</th>
<th>OLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>capital</td>
<td>0.092*</td>
<td>0.078*</td>
</tr>
<tr>
<td></td>
<td>(0.028)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>labor</td>
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<td>0.224*</td>
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<tr>
<td></td>
<td>(0.015)</td>
<td>(0.006)</td>
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<td>material</td>
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<td>0.812*</td>
</tr>
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<td></td>
<td>(0.017)</td>
<td>(0.005)</td>
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<tr>
<td>year</td>
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<td>0.000*</td>
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<tr>
<td></td>
<td>(0.020)</td>
<td>(0.010)</td>
</tr>
</tbody>
</table>

N = 23487

Figure 2.11: Productivity on Lobbying:
There exists a positive correlation between productivity of firms and their political contribution. Political contribution at the y-axis is measured by logged total lobbying expenditure by each firm. This is an important finding on firm-level political behavior consistent with the new-new trade theory of heterogeneous firms.

In order to test the validity of the productivity measure used in this paper, I compare how two alternative measures of productivity used in the literature explain the employment level of each manufacturing firm in the U.S. market. Panel (a) of Figure 2.12 is based on a measure defined in equation (2.9), while that of Panel (b) is based on an alternative productivity measure used in the current literature.30 We expect a positive relationship between the employment level and productivity of each firm. In fact, as Bernard et al. (2007a) empirically shows, more productive firms are more likely to export, be bigger, pay higher wages to their employees, and make larger profits. As it clearly shows, the measure correcting for the two biases in Panel (a)

30 I take the productivity measure used in Kuno and Naoi (2012) and Plouffe (2012) because these are only empirical works using firm level productivity in FPE to the best of my knowledge. The measure is defined as $ATFP = \ln \frac{Q}{L} - s \ln \frac{K}{L}$ following Head and Ries (2003), where $Q$ is total revenue, $L$ is number of employees, and $K$ is a proxy for capital. $s$ is arbitrarily set to 1/3.
explains the employment level better than the other measure in Panel (b). Moreover, higher productivity is associated positively with bigger lobbying expenditure as Figure 2.11 shows. The next section will further investigate whether productive exporting firms are in fact more likely to lobby.

(a) Productivity Measure based on O&P
(b) Alternative Productivity Measure

Figure 2.12: Productivity and Employment Level: This figure illustrates the validity of the productivity measure used in this paper. The productivity used in Panel (a) is defined in equation (2.9). The alternative measure in Panel (b) is defined as $\ln(Q/L) - \frac{1}{3}\ln(K/L)$. Note that the recent development of new-new trade theory suggests a strong positive relationship between productivity and employment level. However, the alternative measure used in the literature is unable to explain the employment level of each firm compared to the one in Panel (a).

2.8.3 Topic Models Applied to Trade Bills

I assume that a given bill has a probability distribution over “topics”, where each topic can be characterized as a distribution over words. For example, suppose that there are five topics that generally describe the universe of trade bills: 1) free trade agreement, 2) miscellaneous tariff bill, 3) fast-tract authority for president, 4) appropriations
Figure 2.13: **Distribution over Topics and Lobbying:** This figure summarizes the distribution over 8 trade-related topics for each bill. Lines with darker shade in each column implies that a given bill is highly associated with the given topic. It shows that Topic 2 and Topic 4 are useful in distinguishing lobbied (green) and non-lobbied bills (red).

To the extent that a single bill contains one or more than one of these topics, a bill can be characterized as a probability distribution over these topics, e.g., 70% free trade agreement with 30% protection where the latter reflects the concerns of import-competing industries in the face of free trade agreement. Secondly, a topic is a probability distribution over words because free trade agreement topic might have more frequent use of words such as agreement, tariff, president, import and export, etc than appropriations topic. This will help us characterize each bill in terms of the distribution over topics, which will be subsequently used to link to the occurrence of lobbying.

---

31See [Blei et al. (2003)](http://example.com) for a more formal description of Latent dirichlet allocation topic models used in this section.
Figure 2.14: **Distribution over Words in 8 Topics:** This figure presents top 30 words associated with each of the 8 topics. The size is proportional to the loading sizes of each word.

I fit topic models with 5 to 20 topics. Using the one topic model as a baseline, I chose a model with highest Bayes factor to determine the number of topics. This gives the 8 topic model. Figure 2.13 graphically summarizes the distribution over the 8 topics for each bill categorizing non-lobbied (red & above 400) and lodged bills (green & below 400) separately. I check whether there exists differences between lodged and non-lobbied bills. It shows that both kinds of bills are heavily loaded with Topic 1. This is not surprising in that each bill is trade-related and the first topic concerns general “trade” as a topic. Compared to Topic 1, Topic 2 and Topic 4 jointly separate the occurrence of lobbying better. In other words, bills with more weights on the two topics tend to get lodged more.

---

32 For N topic model $M_N$, Bayes factor is calculated based by computing the following quantity:

$$
\frac{\Pr(D|D_{M_N})}{\Pr(D|D_{M_1})} = \frac{\int \Pr(D|\theta_N, M_N) \Pr(\theta_N|D_{M_N}) \, d\theta_N}{\int \Pr(D|\theta_1, M_1) \Pr(\theta_1|D_{M_1}) \, d\theta_1},
$$

where $D$ is observed data, $\theta$ is model parameters.
Figure 2.14 displays top 30 words associated with each topic. A close examination of Topic 2 and the bills that have the highest loading on the topic suggests that this topic is related to either the fast-track authority bills that grant president an authority to negotiate trade agreements or various bilateral trade agreements themselves, e.g., “United States-Korea Free Trade Agreement Implementation Act” (HR3080). Note that countries negotiate over tariff and non-tariff barriers on highly differentiated products during the course of trade agreements. Topic 4 is related to appropriation bill that authorizes the government to spend money. Most frequent examples include appropriation bills to fund Export-Import Bank of the U.S. and their export financing program to promote U.S. exports abroad, e.g., “Export-Import Bank Reauthorization Act of 2006” (S3938).

To be sure, this is not to argue that all lobbying activities associated with the bills can be considered as pro-trade lobbying. Admittedly, lobbying on liberal trade bills may occur as much to oppose as to support it to be passed. However, the evidence provided in this section strongly suggests that 1) firms are important political actors, 2) they often lobby on specific products, and 3) there exists a pattern that distinguishes between lobbied and non-lobbied trade bills.
2.8.4 An Example of Lobbying Report

LOBBYING REPORT

Lobbying Disclosure Act of 1995 (Section 5)  - All Filers Are Required to Complete This Page

<table>
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<th>1. Registrant Name</th>
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<table>
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3. Principal place of business (if different than line 2)

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4a. Contact Name

<table>
<thead>
<tr>
<th>NANCY BELL</th>
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</thead>
</table>

b. Telephone Number

<table>
<thead>
<tr>
<th>(202) 414-6798</th>
</tr>
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</table>

c. E-mail

<table>
<thead>
<tr>
<th><a href="mailto:neb14@chrysler.com">neb14@chrysler.com</a></th>
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</table>

5. Senate ID# 400460283-12

6. House ID# 408810000

7. Client Name

<table>
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</table>

- Check if client is a state or local government or instrumentality

8. Type of Report

- 2011 Q1 (1/1 - 3/31)
- 2011 Q2 (4/1 - 6/30)
- 2011 Q3 (7/1 - 9/30)
- 2011 Q4 (10/1 - 12/31)

9. Check if this filing amends a previously filed version of this report

10. Check if this is a Termination Report

11. No Lobbying Issue Activity

INCOME OR EXPENSES - YOU MUST complete either Line 12 or Line 13

12. Lobbying

<table>
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<th>EXPENSE</th>
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<td>relating to lobbying activities for this reporting period was:</td>
<td>relating to lobbying activities for this reporting period were:</td>
</tr>
<tr>
<td>Less than $5,000</td>
<td>Less than $5,000</td>
</tr>
<tr>
<td>$5,000 or more</td>
<td>$5,000 or more</td>
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<tr>
<td>$</td>
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</tbody>
</table>

Provide a good faith estimate, rounded to the nearest $10,000, of all lobbying related income from the client (including all payments to the registrant by any other entity for lobbying activities on behalf of the client).

13. Organizations

<table>
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<tr>
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<th>Method C</th>
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</thead>
<tbody>
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<td>Reporting amounts under section 6033(b)(8) of the Internal Revenue Code</td>
<td>Reporting amounts under section 162(e) of the Internal Revenue Code</td>
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</table>

14. Reporting

Check box to indicate expense accounting method. See instructions for description of options.

<table>
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<tr>
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<th>Method B</th>
<th>Method C</th>
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<tbody>
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<td>Reporting amounts under section 6033(b)(8) of the Internal Revenue Code</td>
<td>Reporting amounts under section 162(e) of the Internal Revenue Code</td>
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</tbody>
</table>

15. Reporting

Check box to indicate expense accounting method. See instructions for description of options.

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<th>Method C</th>
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Signature

<table>
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<th>Date 01/20/2012</th>
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</table>

Printed Name and Title

<table>
<thead>
<tr>
<th>Nancy Bell, Senior Manager</th>
</tr>
</thead>
</table>

v6.6.1f

Page 1 of 32
**LOBBYING ACTIVITY.** Select as many codes as necessary to reflect the general issue areas in which the registrant engaged in lobbying on behalf of the client during the reporting period. Using a separate page for each code, provide information as requested. Add additional page(s) as needed.

15. General issue area code: **TRADE (DOMESTIC/FOREIGN)**

16. Specific lobbying issues:

   Free Trade Agreements with South Korea, Panama and Colombia. Trade agreement negotiations on the Trans Pacific Partnership FTA. Possible future FTA with Egypt.

17. House(s) of Congress and Federal agencies: Check if None

   **U.S. SENATE, U.S. HOUSE OF REPRESENTATIVES, U.S. Trade Representative (USTR)**

18. Name of each individual who acted as a lobbyist in this issue area:

<table>
<thead>
<tr>
<th>First Name</th>
<th>Last Name</th>
<th>Suffix</th>
<th>Covered Official Position (if applicable)</th>
<th>New</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jody</td>
<td>Trapasso</td>
<td></td>
<td>Deputy Chief of Staff and LD, Rep. Sue Myrick</td>
<td></td>
</tr>
<tr>
<td>Jordan</td>
<td>Moon</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kristina</td>
<td>Pisanelli</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jennifer</td>
<td>Fox</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

19. Interest of each foreign entity in the specific issues listed on line 16 above: Check if None

   Fiat S.p.A.
   Fiat Automobiles S.p.A.
   Fiat North America LLC

**Printed Name and Title: Nancy Bell, Senior Manager**

Figure 2.15: 4th Quarter Lobbying Report by Chrysler in 2011
Chapter 3

Intra-industry Trade and Trade Liberalization

3.1 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) independently found 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.” Not only do these findings go against the conventional wisdom in the literature, but also they raise an important question about the distributional consequences of increasing intra-industry trade among both developed and developing countries.

In this article, I first develop a theory that explains why high intra-industry invites political demands for trade liberalization. Specifically, I argue that firms who already engage in trade demand further trade liberalization on the very specific products they exchange because they will benefit from lower barriers by trading more goods (intensive margin) at cheaper prices. Such demands will be stronger among firms who produce differentiated products because even a small decrease in trade barriers can be translated into a large profit gain when consumers value variety (Chaney, 2008). It follows that industries with high intra-industry trade will invite persistent demand for liberalization from firms producing differentiated products. Furthermore, the pressure to liberalize will affect both home and foreign governments given the nature of intra-industry trade. This makes governments credibly commit to reducing trade barriers, reciprocally. The central theoretical prediction of my theory is that intra-industry trade will be negatively associated with the degree of trade barriers.

We face two empirical challenges testing the relationship between intra-industry trade and trade policy. First, trade policy is set at the product level between pairs of countries creating a highly complex web of preferential policies across products and partners, whereas existing trade policy data used in the literature generally ignores such complexity. In fact, the number of Preferential Trade Agreements (PTAs) has
grown significantly over the last few decades which results in much variation in one country's trade policy even on the same product across its partners, let alone its trade volume. Thus, It is imperative that one needs to take into account preferential trade policy amongst different pairs of countries in examining potential effects of intra-industry trade, especially when most international trade now goes through preferential agreements (Bhagwati 2008). However, in practice, it requires enormous resources to collect, process, and store the dyad-level data on trade flows as well as preferential policies across all products. Consequently, researchers have primarily focused on country-level analysis where uniform trade policy across partners (e.g., most favored nation (MFN) applied or bound tariff rates) is generally assumed. Second, volume of trade is endogenous to trade policy. Indeed, most models of international trade have been developed to explain trade flows given a particular level of trade barrier. For example, gravity models of trade predicts that trade flows increase as the size of trade partners increase, but decrease with high trade barriers. As such, one must distinguish to what extent intra-industry trade results in deduction in trade barriers, and not vice versa.

To overcome these problems, I first construct a new dataset of dyad-level trade across all pairs of countries at the most disaggregated level possible: Harmonized System 6 digits (HS6). For instance, I 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.” I then combine the volume data with tariffs data, which records differences in tariffs not only across products but also across trade partners. It is worth emphasizing that I 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. I conduct hierarchical analysis which partially pool the variation in tariffs across industries, allowing us to measure industry-varying effect of intra-industry trade on tariffs.

In order to address the reverse causality and endogeneity problem, I conduct instrumental variable analysis. I use the level of product differentiation in the U.S. as an instrument for intra-industry trade in other country pairs. The key idea behind this strategy is that the level of product differentiation in the U.S. encourages high intra-industry trade, and yet it does not directly affect foreign country’s trade policy towards others. As a second instrument, I use the level of intra-industry trade in dyads that are most similar to a given dyad in terms of patterns of trade in order to account for unobservable factors that directly affect intra-industry trade and trade policies. I find that high intra-industry trade results in trade liberalization.

The rest of the paper proceeds as follows. In Section 3.2, I describe my theoretical argument. In Section 3.3, I introduce the new dataset and demonstrate it’s advantage in testing the theoretical prediction. In Section 3.4, I use hierarchical modeling and instrumental variables to investigate the effect of high intra-industry trade on trade liberalization. The final section concludes.

### 3.2 Political Demands for Trade Liberalization

Scholars of international political economy have long been preaching the benefits of free international trade, and puzzled by the difficulty in 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) are all responsible for the prevalence of trade barriers. Yet, we still know relatively little about why some set of countries are particularly successful in reducing tariffs and non-tariff barriers on certain products given the level 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 country) 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. That is, intra-industry trade occurs not because of the differences in factor endowments between importers and exporters, but because of consumer’s diverse tastes (Krugman, 1979, 1980).

This explanation is limited, however, since it implicitly assumes that there always exists demands for trade liberalization. In other words, although the existing theories can explain why there might exist less objection to free trade due to little displacement effect, it is still theoretically unclear how intra-industry trade invites more demand
for trade liberalization. I argue that increase in intra-industry trade will encourage firms, who are already trading goods internationally, to desire further liberalization so that they can increase profits. Domestic firms who are importing these products also demand lower tariffs on these products for the same reason. 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.

Such demand for trade liberalization will be pronounced particularly with product differentiation. I argue that those who produce 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 will be sheltered from market competition, and hence they can capture a large foreign market share with increasing returns to scale as long as they can overcome trade barriers. This intuition can be explained more formally by equation (3.1). Chaney (2008) showed that trade flows are more or less sensitive to trade barriers depending on whether products are differentiated. In particular, the elasticity, $\epsilon$, of trade between A and B to trade barriers decreases with high elasticity of substitution (low product differentiation), i.e., $\epsilon'(\sigma) < 0$.

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

(3.1)

In other words, highly differentiated products (low $\sigma$) will magnify the sensitivity of firms towards trade barriers (high $\epsilon$). Thus, firms can benefit a lot more from lower trade barriers especially when the level of product differentiation is high. Finally,
intra-industry invites political demands for liberalization in both countries who exchange similar products. This makes it easier for both parties to credibly commit to liberalization, reciprocally (Kim, 2013).

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

This logic implies that firms competing in differentiated industry with high intra-industry trade will be more likely to lobby for trade liberalization. Consequently, I hypothesize that high intra-industry trade is positively associated with low trade barriers. To be sure, a direct test of this will involve both 1) testing the effect of intra-industry trade on lobbying, and 2) 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. Thus, this paper focuses on testing the association between intra-industry trade and trade liberalization.

### 3.3 New Dataset of International Trade

One of the main contributions of this paper is to offer a new dataset of international trade that allows researchers to analyze global flow of commodities and dyad specific tariffs at the same time. To date, researchers have mostly used the 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 norms of “trade without discrimination” is ob-
served. However, in practice, even the 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.
My dataset not only disaggregates total imports/exports volume into different prod-
uct categories, it combines the product-level trade volume with the tariffs applied
differently across partners, e.g., tariffs on cars (87039000) coming from South Korea
(the FTA partner) in 2013 is 1.5% whereas it is 2.5% (the MFN rate) when the same
product is originated from other WTO members.  

The dataset covers trade volume
and tariffs of 181 countries for past 25 years, and it accounts for the existence of PTA
or GSP benefits for any given product and dyad. There are two main advantages in
using 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) prod-
ucts: 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 the common practice in the literature,
when it comes to analyzing trade policy, has been that these product-level tariffs are
aggregated up to either industry-level (e.g., Harmonized System 2 digits, 4 digits or

\footnote{Although such data is in theory 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 identify the PTA relationship
across all country pairs greatly constrain researcher’s ability to construct dataset that covers all
country pairs and products across years.}
Within Industry Variation in Tariff in 2009

Figure 3.1: **Within-Industry Variance in Applied Tariff Rates:** This Figure graphically 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, I decomposed the total variance of tariffs ($T$) into within ($W$) and between ($B$) component such that $T = W + B$. Specifically, I calculate each component by $T = \frac{1}{N} \sum_{iHS6} \sum_{i=HS6}^{HS6} (\tau_i - \tau)^2$, $W = \frac{1}{N} \sum_{iHS6} \sum_{i=HS6}^{HS6} (\tau_i - \tau_{HS6})^2$, and $B = \frac{1}{N} \sum_{iHS6} N_{HS6} (\tau_{HS6} - \tau)^2$ 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; $\tau_i$, $\tau_{HS6}$ and $\tau$ are the applied tariff rates, the average tariff rates within each industry, and the overall average of tariff rates across all products, respectively.

6 digits), or 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 explains important political dynamics behind trade liberalization in the U.S. Indeed, Figure 3.3 demonstrates that the same pattern holds across the globe, where countries with darker shades set tariffs more differently across similar products than others.\footnote{Figure 3.7 in Appendix 3.6.2 shows that the degree of within industry variation is remarkably different across industries and countries as well.}

Thus, in order to properly
measure the effect of intra-industry trade on trade policy, the new dataset extends the scope beyond the U.S. by including tariffs data across all countries that we have data either from WITS or Tariff Analysis Online facility provided by WTO. This amounts to having tariff-line data with more than 2 billion observations from 1988.

The second advantage of using the new dataset 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 depending on where it is originated from. Such variation will be especially pronounced when country 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 such as South Korea, Australia, and Singapore while it grants different levels of preferential tariff policy towards a number of developing 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 uniform trade policy towards rest of the world.

It is desired to use the new dataset especially when one wants to estimate the effect of intra-industry trade on liberalization. Figure 3.2 illustrates some potential problems that might arise when one does not disaggregate the trade volume and tariffs across different partners. This example is based on trade flows of Canada in one of the textile industries. Since Canada generally imports and exports large volume of
Figure 3.2: 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) in investigating the effect of intra-industry trade on tariffs. As it is clearly shown, one might accidentally find a positive relationship between tariffs and intra-industry trade if aggregated trade volume and MFN tariffs are used. When the volume is disaggregated across trading 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, the 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 \(1 - \frac{|\text{import}-\text{export}|}{\text{import}+\text{export}}\) is used for measuring intra-industry trade, where it is multiplied by 10 to match the scale of mean tariffs.

This corresponds to the far right two barplots. On the other hand, the average MFN

\[\text{products in the industry, the intra-industry trade measure will be quite high (≈ 0.8)}\]
tariff rates across products in the industry is around 8%. Although it captures the general level of protection, it does not distinguish preferential treatments given to different trading partners. This can be problematic, if countries preferentially reduce trade barriers on products with high intra-industry trade. For example, 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. However, 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 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. Section 3.4 will show that one will find a negative effect of intra-industry trade on tariffs by properly disaggregating the unit of analysis to the dyad-level.

Throughout this paper, I 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 $\tau_{ijht}$. I will use Harmonized System 6 digits (HS6) as my primary unit of analysis. This is the most disaggregated level at which trade statistics are comparable across all 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, I will denote HS6 industry $h$ corresponding to product $k$ as $h[k]$. Similarly, when further aggregation is needed, I define the variable hierarchically, e.g., HS2[h] for HS2 industry
corresponding to HS6 industry $h$. Finally, all of my analysis include confounding variables ($X \in \{X_{ij}, X_i, X_j\}$) at the dyadic ($X_{ij}$) and monadic ($X_i, X_j$) level such as distance, colonial relationship, total number of landlocked nation in dyad, GDP per capita, population, level of political particularism, and polity scores. I also include industry level covariates ($Z_h$) such as volume of total trade, and the level of product differentiation.

3.4 Empirical Results

In this section, I describe my strategies to identify the effect of intra-industry trade on liberalization and present empirical results. I begin by conducting multilevel statistical analysis which partially pools variations from both within and between industries in order to examine industry-varying effects on trade liberalization. I then address the concern of endogeneity of trade volumes to trade policy by employing instrumental variable analysis.

3.4.1 Multilevel Statistical Analysis

I use multilevel models to analyze the association between intra-industry trade and the level of protection. There are several motivations to pursue this strategy. First, the dataset described in Section 3.3 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 policy differ across industries. Trade policies of each industry are endogenously determined by different political dynamics. Thus, it is imperative to analyze the effect sepa-
rately 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 highly variable estimates and higher standard errors (Gelman and Hill 2007). Multi-level analysis is more appropriate because it borrows strength from both within and across industries by partially pooling the variation in data. Taken together, I run the following model with varying slopes on intra-industry trade.

\[
\tau_{ijht2} \mid \mathbf{X}, IIT, \delta, \phi \sim \text{indep. } \mathcal{N}(\alpha_{HS2[h]} + \beta_{HS2[h]} IIT_{ijht1} + \gamma IIT_{missing_{ijht1}} + \mathbf{X}_{t_i}^T \delta + \mathbf{Z}_{ht1}^T, \sigma^2_{\tau})
\]

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

\[
\beta_{HS2[h]} \sim \text{i.i.d. } \mathcal{N}(\beta, s^2_{\beta}),
\]

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, I first divide the dataset into 4 periods: 1996-2000 (period 1), 2001-2005 (period 2), 2006-2010 (period 3), and 2011-2012 (period 4). I then run the model specified in equation (3.2), where \(IIT_{ijht1}\) denotes the mean level of intra-industry trade from one preceding period (e.g., from 2001 to 2005) and \(\tau_{ijht2}\) denotes the mean level of tariffs across the next 5 years (e.g., from 2006-2010). This choice is made for two reasons. First, 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 barrier is high. Instead, I assume that international transaction in year \(t\) is not
affected by the anticipated level of tariffs from year $t+5$ to $t+10$. Second, there is no 
\textit{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 
business decisions, and the level of trade should fluctuate daily, monthly, and yearly 
depending on a myriad of factors such as their inventories. Thus, I use the mean level 
of trade across a number of years to capture the general level of intra-industry trade.\footnote{Results do not change when different length of aggregation (e.g., 3 years and 7 years average) is used.}

Our quantity of interest is the effect of intra-industry trade on the future level 
of tariffs. Following the literature, I use Grubel-Lloyd index \(1 - \frac{|\text{import} - \text{export}|}{\text{import} + \text{export}}\) for 
measuring intra-industry trade, where it achieves the maximum value 1 when coun-
tries simultaneously imports and exports exactly same amount of goods. Note that 
this quantity is not defined when there is no trade, i.e, \(\text{import} = \text{export} = 0\). Unfor-
tunately, the current literature completely excludes these observations. This general 
practice is based on an implicit assumption that there exist no systemic difference 
between tariffs on products with zero trade and positive trade. In other words, ex-
cluding 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 on the products with positive trade where 
intra-industry trade is defined to begin with. Thus, I created an indicator variable 
\(IIT_{\text{missing}}\) while setting \(IIT_{ijht} = 0\) 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.

I 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). I 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, I control for importer- exporter- and dyad-level covariates. 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 the unobservable industry-level heterogeneity is independent of other independent variables such as country-level and dyad-level covariates. Thus, I 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. I 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 varying intercepts models on each period are summarized in Table 3.3 in Appendix 3.6.1.

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 across industries, I then run the varying slopes model specified in equation (3.2). Figure 3.3 displays the industry-varying slopes estimates for each
HS2 industry from period 3 on period 2. It is clear from the figure that the effect is negative for most industries (red lines). However, I find a cluster of positive estimated effects (blue lines) from 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 low intra-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 1) they cannot efficiently produce to begin with and import, or 2) 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, I order the varying-slopes estimates based on the level of variation in tariffs across products within each industry.

---

5 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.

6 The mean and variance are positively correlated due to the fact that tariffs are truncated at zero.
Estimated Effects of Intra−industry Trade on Tariffs

HS2−varying Slope Estimates

Figure 3.3: 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.
Figure 3.4: **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, I consistently find that the effect is negative (red lines).

The result is striking. Figure 3.4 displays varying slopes across HS4 industries.\(^7\) 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, I find that the positive correlation between intra-industry trade and protection is concentrated on the lower end. Note that these industries also generally have low mean tariffs.\(^8\) This corroborates that the level of trade barriers are generally low for products countries engage in one-way trade (imports or exports only). More impor-

---

\(^7\) The result from HS2-varying slopes model is in Appendix 3.6.2

\(^8\) The mean and variance are positively correlated due to the fact that tariffs are truncated at zero.
tantly, there exist little variation in the level of tariffs to be explained across goods where we find the positive effect. In contrast, when we actually observe meaningful variation in trade policies, we see strong negative correlation between intra-industry trade and tariffs.

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. Interestingly, such effects are dominated by industries with low overall mean and variance in tariffs. This implies that countries liberalize when international trade is governed by the force of comparative advantage (one-way trade).

3.4.2 Two-Stage Least Squares Estimation

Intra-industry trade is endogenous to trade policy because lower levels of protection encourage imports, which in turn affects the degree of intra-industry trade.\(^9\) That is, there are potentially some unobservable political and economic factors that affect intra-industry trade and trade policy that might induce biases in our estimates. In Section 3.4.1 I exploited the time gap between the levels of intra-industry trade in earlier years and the tariffs in the later years. In order to further address the problem of intra-industry trade being endogenous to tariffs, I utilize two instrumental variables in this section, which allows us to check the validity of instruments by taking advantage of over-identification.

\(^9\) Note that Grubel-Lloyd index may increase or decrease depending on the value of exports.
First, I use continuous measure of product differentiation based on the data in the U.S. market. [Broda and Weinstein (2006)](https://doi.org/10.1001/jamasn.2006.17.6.1317) (B-W) estimates the degree of elasticity of substitution for each HTS (Harmonized Tariff Schedule of the United States) 10 digits products. It is assumed that the levels of *U.S. consumers’ demand elasticity* are not correlated with domestic determinants of other countries’ trade policy other than its effect through the levels of intra-industry trade. This measure is positively correlated with the degree of intra-industry trade. Intuitively, high product differentiation encourages countries to engage in more intra-industry trade because there are domestic consumers who love foreign varieties. Furthermore, it is worth noting that using the measure is consistent with the modeling assumption of the new-new trade theory as it takes consumers’ love of variety as exogeneously given [Melitz (2003)](https://doi.org/10.1093/restud/70.3.427). In the theory, the level of product differentiation is exogeneously determined by a parameter of consumer utility function (elasticity of substitution). Specifically, products are differentiated if consumers are not willing to substitute one good with other similar products even when prices differ.

As another instrument, I use the average value of sectoral intra-industry trade of other country-pairs whose GDPs per capita are most similar to a given dyad. The idea is that the average degree of intra-industry trade of *other country-pairs* is unlikely to be correlated with unobserved domestic political attributes that directly affect trade policy although it does reflect factor endowments that encourage intra-industry trade. This improves the country-level measure of [Kono (2009)](https://doi.org/10.1016/j.worldpol.2009.01.001) which used the average intra-industry trade of top 10 countries whose GDPs per capital are similar to a given importing country. Using importer as an unit of analysis might be
Figure 3.5: Distribution of Instrumental Variable (IIT3) across Products: This heatmap shows the distribution of our instrumental variable $IIT_{3ijh}$. For given country pairs $i$, $j$, and industry $h$, the variable is created by taking the average level of intra-industry trade in industry $h$ for all countries pairs who are similar in the levels of GDPs per capital excluding all dyads that contain either $i$ and $j$. It shows that $IIT_{3ijh}$ takes low values for rice industry, while high values for manufacturing goods among high income country pairs consistent with the new-new trade theory. The numbers represent the total number of dyads whose GDPs per capita combination matches with the particular cell.

problematic because those top 10 countries will likely include the partners who are directly responsible for the high intra-industry trade to begin with, rendering tariff policy endogenous. Instead, I construct the instrumental variable at the dyad-level as follows. Let’s consider the intra-industry trade of industry $h$ between country $i$ and $j$. I first create three bins based on the tercile (0-33th, 33th-66th, and 66th-100th percentiles) of GDPs per capita across countries\(^\text{10}\). This creates 9 possible combinations of the levels of importer’s and exporter’s GDPs per capita in the data. I then identify which one of the 9 levels the $i$, $j$ pair belongs to, and consider all

\(^{10}\) I used three bins to make sure that enough observations exist for any given bin. Results do not change even when we use 5, 7, 10 cutoff values for determining similar country-pairs. I chose tercile because there will be a large number of empty bins created by finer cutoffs.
country-pairs $m$ and $n$ who are also in the same category while making sure to exclude all dyads if one of the member is either $i$ or $j$, i.e., $m \not\in \{i, j\}$ and $n \not\in \{i, j\}$. I then calculate the average level of intra-industry trade on industry $h$ among all country-pairs $m$ and $n$ and denote it as $IIT_{3,ijh}$.

For the purpose of exposition, I present the average of this measure across all $i$, $j$ pairs weighted by the total volume of trade in industry $h$ in Figure 3.5. The numbers represent the total number of dyads whose GDPs per capita combination matches with the particular cell. As expected, the correlation between our instrumental variable and actual intra-industry trade is highly positive. It is also consistent with theoretical expectations. For instance, trade of Rice (HS6 100630) is mostly governed by factor-endowment of countries where countries endowed abundantly with land are exporting rice while capital abundant countries import. This implies that one should not generally expect much bi-directional trade of rice. As it is shown in the far left panel of Figure 3.5, we do not observe much variation in our instrumental variable. In contrast, it takes generally high values for manufactured products especially among high income country-pairs where GDPs per capital of both importer and exporter are above 67th percentile (the top right part of each panel).

I run the following cross-section analysis with two-stage least squares (TSLS) regression,

$$IIT_{ijh} = \alpha_1 + \alpha_{HS2[h]} + Z_{ijh}^T \xi + X_{ij}^T \gamma_1 + X_i^T \phi_1 + X_j^T \theta_1 + \delta \cdot M_h + \epsilon_{ijh}, \text{ (First Stage)}$$

11 Note that the values used for creating Figure 3.5 are not exactly same as the actual instrumental variable $IIT_{3,ijh}$ used in the empirical analysis. $IIT_{3,ijh}$ is defined for each $i$, $j$, and $h$. By construction, the heat-maps are symmetric.
\[
\tau_{ijh} = \alpha_2 + \alpha_{HS2[h]} + \beta \cdot \hat{IIT}_{ijh} + X_i^T \gamma_2 + X_j^T \phi_2 + X_{ij}^T \theta_2 + \delta \cdot M_h + e_{ijh} \quad \text{(Second Stage)}
\]

where \( \alpha_{HS2[h]} \) denotes industry fixed effects at the Harmonized System 2 digits level.

I also control for both dyad-level and country-level covariates used in most empirical studies based on gravity models. This includes GDPs per capita of importers and exporter, distance between two countries and the levels of democracy. I focus my TSLS analysis on data from 2005 in order to compare my result directly against Kono (2009).

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent variable:</strong></td>
<td><strong>Intra-industry trade</strong></td>
<td><strong>Intra-industry trade</strong></td>
<td><strong>Intra-industry trade</strong></td>
</tr>
<tr>
<td>Broda-Weinstein (B-W)</td>
<td>(-0.37^{***})</td>
<td>(-0.37^{***})</td>
<td>(-0.37^{***})</td>
</tr>
<tr>
<td></td>
<td>((0.04))</td>
<td>((0.04))</td>
<td>((0.04))</td>
</tr>
<tr>
<td>Intra-industry Trade of Similar dyads (IIT3)</td>
<td>6.81^{***}</td>
<td>6.72^{***}</td>
<td>6.72^{***}</td>
</tr>
<tr>
<td></td>
<td>((0.43))</td>
<td>((0.47))</td>
<td>((0.47))</td>
</tr>
<tr>
<td><strong>N</strong></td>
<td>544,225</td>
<td>647,700</td>
<td>538,097</td>
</tr>
<tr>
<td><strong>Adjusted R^2</strong></td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td><strong>F Statistic</strong></td>
<td>69.55^{***}</td>
<td>243.50^{***}</td>
<td>134.57^{***}</td>
</tr>
</tbody>
</table>

*p < .1; **p < .05; ***p < .01

Table 3.1: Strength of Instrumental Variables: This table presents the coefficients of instrumental variables in the first-stage regression. It verifies that high product differentiation (low B-W measure) increases intra-industry trade, and intra-industry trade among similar country-pairs is positively correlated with intra-industry trade. The F-statics are calculated by comparing the first-stage model against the model without instruments.

Table 3.1 presents coefficients of our instrumental variables from three separate first-stage regression analyses. Coefficients for other covariates are omitted. The three TSLS models are based on the following instruments: Broda-Weinstein (B-W) measure of elasticity substitution or the levels of intra-industry trade on industry \( h \) among similar country-pairs \( (IIT3_{ijh}) \), or both. As expected, high levels of product differentiation (lower values of B-W measure) is positively associated with high intra-industry trade. The intra-industry trade among similar country-pairs identified based
on three different levels of importer/export GDPs capita (IIT3) is also positively correlated with intra-industry trade. The F-statistics presented at the bottom of the table indicate that our instruments have desired statistical properties.

One benefit of using more instrumental variables than endogenous variable is that we can indirectly test whether our assumption about the exogeneity of instrumental variables can be justified. This is because our estimate from TSLS is over-identified, and hence we can make statistical comparison across the results from different instrumental variables. Intuitively, one should not expect results to vary too much depending on which instrumental variable is used if both of them satisfy the exogeneity assumption. After running the TSLS regression (Model 3), I conduct J-test by running a regression of residuals from the model on the covariates and instruments. The F-statistics from this regression by comparing against the model without instruments will follow $\chi^2$ with 1 degree of freedom due to the fact that we have one more instrumental variable for over-identification (Sargan, 1958; Newey, 1985). The over-identifying restrictions test statistics reported at the bottom of Table 3.2 shows that we cannot reject the null of exogeneity of the two instrumental variables.

In Table 3.2 I present a series of TSLS estimates. For comparison, the OLS estimates without instrumental variables are also presented. All of the TSLS estimates of intra-industry trade are negative and statistically significant. This provides strong evidence for the effect of high intra-industry trade on trade liberalization. The magnitude of the effect also does not vary between Models 1, 2, and 3 with different instrumental variables. The high TSLS estimates compared to the OSL estimate suggest that trade is indeed endogenous to tariffs. To test this formally, I also present
### Table 3.2: Effects of Intra-industry trade on trade liberalization

This Table presents results from the OLS and TSLS models. Models 1,2,4 are just-identified, while Model 3 is over-identified. This provides strong statistical evidence for positive effect of intra-industry trade on trade liberalization. Standard errors are in parentheses.

<table>
<thead>
<tr>
<th>Dependent variable: Mean import tariffs, HS6-level</th>
<th>Instrumental variables</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OLS</td>
</tr>
<tr>
<td></td>
<td>B-W</td>
</tr>
<tr>
<td></td>
<td>Model 1</td>
</tr>
<tr>
<td>Intra-industry trade</td>
<td>(-0.001^{**})</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
</tr>
<tr>
<td>IT3 × Particularism (importer)</td>
<td>0.149****</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
</tr>
<tr>
<td>Log volume of HS6-level imports</td>
<td>(0.017^{***})</td>
</tr>
<tr>
<td></td>
<td>(0.003)</td>
</tr>
<tr>
<td>Polity2 score (exporter)</td>
<td>(-0.063^{***})</td>
</tr>
<tr>
<td></td>
<td>(0.003)</td>
</tr>
<tr>
<td>Particularism (importer)</td>
<td>(0.107^{***})</td>
</tr>
<tr>
<td></td>
<td>(0.033)</td>
</tr>
<tr>
<td>Particularism (exporter)</td>
<td>(-0.296^{***})</td>
</tr>
<tr>
<td></td>
<td>(0.033)</td>
</tr>
<tr>
<td>Log population (importer)</td>
<td>(-0.055^{***})</td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
</tr>
<tr>
<td>Log GDP per capita (importer)</td>
<td>(-2.721^{***})</td>
</tr>
<tr>
<td></td>
<td>(0.014)</td>
</tr>
<tr>
<td>Log population (exporter)</td>
<td>(-0.153^{***})</td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
</tr>
<tr>
<td>Log GDP per capita (exporter)</td>
<td>(0.094^{***})</td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
</tr>
<tr>
<td>Constant</td>
<td>24.185****</td>
</tr>
<tr>
<td></td>
<td>(0.596)</td>
</tr>
<tr>
<td>Gravity variables</td>
<td>✓</td>
</tr>
<tr>
<td>HS2 fixed effects</td>
<td>✓</td>
</tr>
<tr>
<td>N</td>
<td>655,643</td>
</tr>
</tbody>
</table>

**Diagnostics for IV: test statistics**

- Weak instruments (F-Statistics): 69.55**** 243.50**** 134.57**** 68.96****
- Wu-Hausman: 43.69**** 85.19**** 115.05**** 35.30****
- Overidentifying restrictions (\(\chi^2\) statistics): 1.27

*p < .1; **p < .05; ***p < .01
Wu-Hausman test for endogeneity, which indicates that the difference between the TSLS and OLS estimates is of greater significance. That is, we cannot reject the null of no endogeneity justifying the use of our instrumental variables.

Finally, I include the interaction between intra-industry trade and the level of political particularism to compare my result against Kono (2009). This leads us to having two endogenous variables: intra-industry trade and the interaction term. To bypass this problem, Kono (2009) subsets data based on the level of particularism and subsequently run regressions on each subset. He finds that intra-industry trade is positively correlated with protection in the subset of observations with high particularism. In contrast, I run the TSLS regression with two instrumental variables and two endogenous variables. The result from this “just-identified” model is presented in the Model 4 column in Table 3.2. I find that the estimated effect is even higher, and we do not have any statistical evidence for the interaction effect either.

3.5 Concluding Remarks

The new dataset that I offer reveals highly detailed information about the variation in tariffs that countries set differently against their trade partners. I conduct multilevel analysis to account for the variations across different levels of aggregation, namely tariff-line products and industries. To address the problem of endogeneity of trade flows to trade policy, I utilize instrumental variable analysis. 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

\footnote{In fact, the estimated effects of intra-industry trade are all positive regardless of the levels of particularism, although they are not statistically significant.}
similar products. The evidence suggests that industrialized countries who engage in large degree of intra-industry trade will find it easier to liberalize.
### 3.6 Appendix

#### 3.6.1 Results from Mixed Effects Models

<table>
<thead>
<tr>
<th>Dependent variable: Log Mean import tariffs, HS6-level</th>
<th>OLS</th>
<th>Mixed effects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>IIT</td>
<td>-0.069***</td>
<td>-0.037***</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>Missing IIT indicator</td>
<td>-0.013***</td>
<td>-0.033***</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>Dummy for low particularism (importer)</td>
<td>0.144***</td>
<td>0.283***</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>Dummy for high particularism (importer)</td>
<td>-0.195***</td>
<td>0.114***</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>Dummy for low particularism (exporter)</td>
<td>-0.020***</td>
<td>-0.029***</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>Dummy for high particularism (exporter)</td>
<td>0.052***</td>
<td>0.013***</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>Polity2 score (importer)</td>
<td>-0.038***</td>
<td>-0.032***</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>Polity2 score (exporter)</td>
<td>0.002***</td>
<td>-0.00003</td>
</tr>
<tr>
<td></td>
<td>(0.0001)</td>
<td>(0.0001)</td>
</tr>
<tr>
<td>Log population (importer)</td>
<td>0.093***</td>
<td>0.022***</td>
</tr>
<tr>
<td></td>
<td>(0.0003)</td>
<td>(0.0002)</td>
</tr>
<tr>
<td>Log GDP per capita (importer)</td>
<td>-0.268***</td>
<td>-0.245***</td>
</tr>
<tr>
<td></td>
<td>(0.0004)</td>
<td>(0.0002)</td>
</tr>
<tr>
<td>Log population (exporter)</td>
<td>-0.048***</td>
<td>-0.070***</td>
</tr>
<tr>
<td></td>
<td>(0.0003)</td>
<td>(0.0003)</td>
</tr>
<tr>
<td>Log GDP per capita (exporter)</td>
<td>0.001***</td>
<td>-0.011***</td>
</tr>
<tr>
<td></td>
<td>(0.0003)</td>
<td>(0.0002)</td>
</tr>
<tr>
<td>Log elasticity of substitution</td>
<td>-0.011***</td>
<td>-0.014***</td>
</tr>
<tr>
<td></td>
<td>(0.0004)</td>
<td>(0.0003)</td>
</tr>
<tr>
<td>Log import volume</td>
<td>-0.010***</td>
<td>-0.006***</td>
</tr>
<tr>
<td></td>
<td>(0.0002)</td>
<td>(0.0002)</td>
</tr>
<tr>
<td>Constant</td>
<td>2.193***</td>
<td>3.120***</td>
</tr>
<tr>
<td></td>
<td>(0.017)</td>
<td>(0.020)</td>
</tr>
</tbody>
</table>

**Gravity variables**
- Yes
- No

**HS2 fixed effects**
- Yes
- No

**HS6-varying random intercepts**
- Yes
- No

**N**
- 5635669
- 9628347
- 8496272
- 5635669
- 9628347
- 8496272

**R^2**
- 0.363
- 0.357
- 0.355

**Adjusted R^2**
- 0.363
- 0.357
- 0.355

**F-statistic**
- 27504
- 45618
- 40023

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

Table 3.3: 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.
Figure 3.6: **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, I consistently find that the effect is negative (red lines). This result corresponds to Figure 3.3.
3.6.2 Within Industry Variance Across Industries

Figure 3.7: 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.
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