Innovation, Imitation, and Political Cleavages in International Trade and Patent Protection

Sojun Park*

Abstract

Exporting firms face a range of risks to their assets in global markets, such as intellectual property (IP) theft, yet some exporters demand IP enforcement more than others. Why? This paper illustrates how the threat of new entrants leads to lobbying for entry deterrence by incumbent firms. In equilibrium, companies whose exports are prone to reverse engineering by import-competing firms for their long product lifetime seek stronger patent protection by home government. To test this argument, I measure product cycles using millions of patent citations and analyze lobbying reports filed on US trade agreements for patent protection, signed after the 2001 Doha Round. I find that patent holders who manufacture products with longer product cycles lobbied Congress more to ratify the trade agreements. This tendency becomes more pronounced as the agreements adopt higher standards for patent protection. I also find that the longer product cycle length, the more likely the lobbying reports are to contain keywords representing an increased exposure to imitation, like *counterfeit*. The results suggest that rapidly innovating firms engage less in rent seeking, challenging the dominant view on firms' political connections.

*Ph.D. Candidate, Department of Politics, Princeton University (e-mail: sojunp@princeton.edu). I'm grateful for comments from Helen V. Milner, Kristopher W. Ramsay, Gene M. Grossman, and L. Kamran Bilir.

1 Introduction

Existing research in the politics of international trade identifies various groups of the winners and losers (Rogowski, 1987, 1990; Milner, 1999; Hiscox, 2001, 2002). Commonly, these studies explain how special interest groups engage in political activity to influence the policy making processes. The key motivation for research underlying the existing literature is often rephrased by the logic of collective action problem (Olson, 1965), asking why only some political actors form their coalition successfully and shape trade policies in their favor.

A growing body of research on firms in trade politics also follows the same line of inquiry. Particularly, the existing findings uncover various origins of "the organizational advantage" of some companies (Kim and Osgood, 2019, 408). The sources include firm heterogeneity, where intra-industry trade creates concentrated benefits to a handful of large and productive firms (Bombardini, 2008; Osgood et al., 2017; Osgood, 2017). Bombardini and Trebbi (2012), Osgood (2016), and Kim (2017) also theorize how product differentiation removes the collective action problem, where firms are less worried about their products being substitutes for one another.

Yet, the assumption underlying the existing models of intra-industry trade is not without limitations. In monopolistic competition, which firms become the winners and losers is solely dependent upon their domestic factor market concentration. This rules out the costs of entry into new markets only exporting firms bear or the benefits they enjoy in global markets, such as learning-by-exporting (Amiti and Konings, 2007). Commonly known as import competition, Melitz (2003) also underscores the importance of understanding firm dynamics in trade as it offers "another potentially important channel for the effects of trade." Do the extra costs and benefits of trade openness shape firms' trade policy preference and their political participation in a new way? How do the distributional consequences differ from the conventional wisdom?

In this paper, I argue that there are increasing returns to lobbying for trade liberalization when entering into new markets is risky. In the real world, exporting companies encounter a number of risks to their goods in global markets such as US intellectual property rights theft by Chinese firms. In such cases, I argue exporters who lack economic capacity to manage the risks build more political connections to reduce the hazard, but less otherwise. This tendency becomes more pronounced in the case of trade between the North and the South as the latter often aims to protect and feed their infant industries, such as semi-conductor for China.

I examine firms' heterogeneous political participation in one of the widely known forms of oligopoly: international protection of intellectual property rights. In the world trading system administered by the World Trade Organization (WTO), countries agreed to protect the assets without discrimination under the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS). For its distributional impacts to the Global South, however, WTO members decided to ease enforcement of TRIPS after the 2001 Doha Development Round.

After the pushback from the South in 2001, what remains unclear is how the Global North have led some of their trading partners from the South to enforce more stringent intellectual property protection afterwards. A collection of these higher standards for intellectual property protection than those under TRIPS is known as *TRIPS-plus*. Most US free trade agreements signed after 2001 also contain TRIPS-plus provisions, albeit to varying degrees for patents.

To examine who pushed the boundaries of TRIPS and how they succeeded, I first build a formal model. In this model, the gains and losses from intellectual property protection[1] vary, depending on how much patent holders are threatened by foreign firms who reverse-engineer their proprietary technology. Modeling changing "exposure to the risk of imitation" in intra-industry trade (Grossman and Helpman, 1993, 282), I find that in the equilibrium (Grossman and Helpman, 1994*b*), exporting firms facing higher risks of imitation abroad for their long product lifetime engage more in rent seeking to block the entry of counterfeit products.

To test the theory, I then measure lifecycles of patented exports in manufacturing by using US patent citations, and collect lobbying reports filed to the congress since 2001. Specifically, for each US patent granted after 1975, I check the time lags between its first and last patent

[1]In this paper, I take international protection of intellectual property rights as a case of trade liberalization.

citations, whose average I calculate at each industry and use as a proxy for product life-cycle (Bilir, 2014). I do so by combining various patent datasets at a granular level (Hall, Jaffe, and Trajtenberg, 2001; Arora, Belenzon, and Sheer, 2021). I also collect all lobbying reports filed on US trade agreements signed after 2001 (Kim, 2017, 2018), whose various standards for patent protection I identify by tracing all relevant sections under each of the trade agreements.

I document empirical findings that corroborate the theory. Specifically, using the granular patent-level data, I find that US patent holders who manufacture goods with long life-cycles are more likely to lobby the congress to ratify the US trade agreements on patent protection. To better tease out the key mechanism, I also conduct sub-sample analyses and find that the relation becomes more pronounced under the trade agreements implementing TRIPS-plus. A text analysis also reveals that their lobbying reports are more associated with latent topics whose keywords represent an increased exposure to imitation, such as "counterfeit."

The results contribute to existing literature on political cleavages in international trade in the following ways. First, I endogenize what's often assumed away in the literature where the gains from trade lead to political power (Rogowski, 1987, 1990). To demonstrate when trade liberalization persists, however, it is essential to ask not only who the winners are, but also whether the winners always pursue more political power (Milner, 1988, 1999). Second, I also complement the existing work on firms in trade politics, which links firm heterogeneity and product variety to corporate political activity in trade policy. Focusing on firm dynamics and product cycles, this paper offers a novel explanation on firms' political participation based on the endogenous growth theory in trade (Grossman and Helpman, 1991, 1993, 1994*a*): rapidly innovating firms engage less in lobbying, who are unlikely to be caught up by other competing firms. This framework helps us identify if and when lobbying leads to resource misallocation.

This paper proceeds as follows. After an overview of the literature, I present a new political economy model of intra-industry trade. Next, I delineate my empirical strategy guided by the model and test the empirical implications. Last, I summarize my contribution to the literature.

2 Distributive Politics of International Trade

Who are winners and losers of liberal trade policy? The answer relies on a set of assumptions on market structure and domestic political processes. The latter includes how much political influence the winners can buy on the basis of their gains from trade (Rogowski, 1987, 1990; Frieden and Rogowski, 1996; Alt et al., 1996) and a set of institutional rules by which one's policy preferences are aggregated (Milner and Keohane, 1996; Milner, 1997, 1999).

The neo-classical models of trade define global markets, based on constant returns to scale and perfect competition. Who gains from inter-industry trade relies on the rest of other criteria thereafter. For instance, assuming that factors can cut across industries, the Heckscher-Ohlin model and the Stolper-Samuelson theorem show why low-skilled workers in capital-abundant countries fall victim to open trade. On the other hand, the Ricardo-Viner model adopts the premise that factors cannot move across sectors and identifies the winners and losers of inter-industry trade, using factors attached specifically to import-competing industries.

When North-South trade flourished between the 1960s and the 1980s, both models were empirically proven to be precise, the Heckscher-Ohlin and the Stolper-Samuelson (Scheve and Slaughter, 2001; Mayda and Rodrik, 2005) and the Ricardo-Viner models (Magee et al., 1989; Frieden, 1991). At the same time, Hiscox (2001, 2002) also demonstrated how inter-industry factor mobility could reconcile different projections made, using the neo-classical theories.

When North-North or South-South trade started to grow in the early 1990s, however, new trade theories emerged to explain who the winners and losers are in intra-industry trade. Also known as new trade theory (Krugman, 1979, 1980) and 'new' new trade theory (Melitz, 2003), the models characterize the world economy using increasing returns to scale and monopolistic competition. Product differentiation and firm heterogeneity became decisive factors in this era, also explaining why only some companies off-shore their production facilities (Antràs, 2003; Helpman, Melitz, and Yeaple, 2004).

Empirical evidence on how product- and firm-level characteristics shape firms' trade policy preferences abounds. When goods produced are sufficiently differentiated, for instance, firms serving the same industry need not compete against each other when exporting their products and face confrontation (Osgood, 2016, 2017; Kim, 2017). It is also empirically well documented that the degrees of market concentration, pinned down by the size and productivity of firms, shape their trade policy preference, including FDI, and decide how firms engage in political activity for trade liberalization (Bombardini, 2008; Bombardini and Trebbi, 2012; Weymouth, 2012; Jensen, Quinn, and Weymouth, 2015; Osgood et al., 2017; Osgood, 2018; Kim and Osgood, 2019; Kim et al., 2019).

Based on the micro-foundations, more recent studies in politics ask whether globalization will persist (Mansfield, Milner, and Rudra, 2021), given the distributional consequences of trade at both individual (Jensen, Quinn, and Weymouth, 2017) and firm-levels (Baccini, Pinto, and Weymouth, 2017). In so doing, these studies also illustrate how democracies as an institution are prone to its distributional impact, where the losers become a source of populism and bring democratic backsliding around the world (Milner, 2021; Broz, Frieden, and Weymouth, 2021; Baccini and Weymouth, 2021).

2.1 Trade, Intellectual Property Rights, and the Doha Round

Which individuals or firms do the existing political economy models of trade point out as its winners and losers, whose economic market is nor perfectly neither imperfectly competitive? New and 'new' new trade theories suggest firms who lack productivity to export may fall into the losers of trade within industry. So is the case for oligopolistic markets, such as those of intellectual property rights (Sell, 1995, 2003), where governments confer market exclusivity to inventors of new technologies for a finite duration to reward their efforts for innovation. Thus, it is a handful of firms who own resources to influence governments in their favor that become the winners of globalization (Milner and Yoffie, 1989; Kennard, 2020; Gulotty, 2020).

The distributional consequences of trade under oligopolistic markets raise a political issue when countries agree to enforce protection of those assets but firms in one of the parties lack enough capacity to compete. For intellectual property rights protection, for instance, "patent protection will be stronger in the North" for the discrepancy in market size and productivity (Grossman and Lai, 2004, 1636). Empirical findings suggest that harmonization of intellectual property rights protection increases trade flows among nations (Maskus and Penubarti, 1995), mainly from the North to the South (McCalman, 2001; Chaudhuri, Goldberg, and Jia, 2006).

The asymmetry in the costs and benefits of globalization, such as those of TRIPS, leads one side to imitate technologies invented on the other side (Helpman, 1993), whose incentives to innovate are hamstrung by the spillover effect (Aghion et al., 2001). It has been empirically shown that the incentives for innovation are modest in the South (Sakakibara and Branstetter, 1999; Chen and Puttitanun, 2005). This is due to their lack of other economic capabilities by which intellectual property protection must be backed up (Qian, 2007). As a result, the South are known to boost their engine for growth by combining intellectual property protection with knowledge spillover through FDI (Branstetter, 2006; Branstetter, Fisman, and Foley, 2006).

Unsurprisingly, the distributional impact brought the backlash against globalization in the early 2000s, where the conflict of interest between the North and the South culminated during the 2001 Doha Development Round. During the negotiation, developing countries and LDCs, such as India and Indonesia, criticized "intense economic and political pressure placed upon them by a number of powerful related business interest" and pointed out that the WTO "is not an organization, as is generally perceived, designed just to serve the business interests of big companies" (WTO, 2001, 71, 26). On the other hand, developed countries like the US called other nations' attention to "the normal course of doing business" by their companies (WTO, 2001, 39, 40). Eventually, their discourse led to the Doha Declaration on TRIPS and Public Health, where WTO members recognized the freedom to use a set of options and safeguards under TRIPS for regulation, called *TRIPS Flexibilities* (Correa, 2000; Abbott, 2002, 2005).

3 The Influence of Business

What remains unclear is, despite the pushback from the South after the early 2000s, how the business influence grew even more and the North went the extra mile for trade liberalization after Doha. In specific, developed countries signed bilateral trade agreements with developing nations, where both parties adopted higher standards of patent protection than TRIPS, called *TRIPS-plus*. These measures include extending periods of data protection, associating patent protection with regulatory approvals of drugs and agrochemicals, limiting the scope of TRIPS Flexibilities among many others (Maskus, 2000; Shadlen, 2005; Deere, 2009).

A body of literature describes proliferation of bilateral and regional trade agreements as a "stumbling block" of multilateral trade agreements (Bhagwati, 1991; Limão, 2006). Based on the logic, the North grant preferential market access only when the South "respect intellectual property" under preferential trade agreements (PTA) (Limão, 2007, 839). Considering the domestic politics (Mansfield and Milner, 1997, 1999), however, the analyses leave more puzzles than answers as political leaders of developing nations and LDCs have recipients of drugs and SMEs as their domestic audience. For this reason, the leaders in fact strive to maintain their autonomy over public policies by exploiting ambiguities of public health exception (Park and Konken, 2022) as well as other "policy space" for economic growth in TRIPS (Shadlen, 2005; Gallagher, 2007) rather than making concessions during bilateral trade negotiations.

Historical evidence also suggests that the success of TRIPS-plus cannot be fully analyzed, based on the conventional wisdom. Before the WTO was established in 1995 and TRIPS was included as a part of its multilateral agenda, industrialized countries tried to push forward the frontiers of intellectual property rights protection in the 1970s and 1980s, whose inefficiency in raising the bar led to the Uruguay Round (Deere, 2009). This implies that TRIPS-plus is not so much an example of a successful trade liberalization as a case of its failure, because it may increase the cross-national variation again back into the 1970s and the 1980s.

So how did countries go global after the 2001 Doha Round, in spite of the distributional consequences of trade liberalization in the mid-1990s? In the following subsection, I stress the importance of domestic politics to solve this puzzle. Specifically, I develop a formal model to demonstrate how big companies gain political leverage based on their earlier gains from trade and triumph over small firms in legislative decision making process. Focusing on the cases of patent protection, it illustrates how trade liberalization in the previous era increases the risks of imitation among exporters, who engage more in lobbying to mitigate their risks afterwards. This brings legislation of new trade policies leaning in favor of the winners consecutively.

3.1 Product Cycles and the Returns to Lobbying

The main goals of this section are to delineate (1) conditions under which governments grant market exclusivity to exporting firms at the expense of import-competing firms and (2) when exporting firms engage more in political activities to maintain the status quo. Specifically, I model how the term of patent protection is extended in an open economy, where firms who export patented goods and import-competing firms whose entry into the market is forbidden until the term of patent protection expires schedule political contributions, simultaneously.

In the model, the gains from trade are captured by life-cycles of patented exports,[2] where firms who export goods with long life-cycles become the beneficiaries of trade openness. But instead, they do so at a high risk of reverse engineering by import-competing firms who can also secure more time to imitate their patented technologies and challenge the novelty. Thus, exporters try to block such illegal trade practices by extending the term of patent protection. In this case, if firms succeed in mimicing others' patented technologies early but the term of protection has not expired, then they cannot enter the market by patent laws and sell their counterfeit products (Bilir, 2014). This trade-off leads exporting (import-competing) firms to lobby their government to lengthen (shorten) the term of patent protection in the equilibrium.

[2]Notice that product cycles are distinguished from the term of patent protection enforced by governments. Grossman and Helpman (1991, 1993) show how the risk of imitation in trade gives rise to unique product cycles.

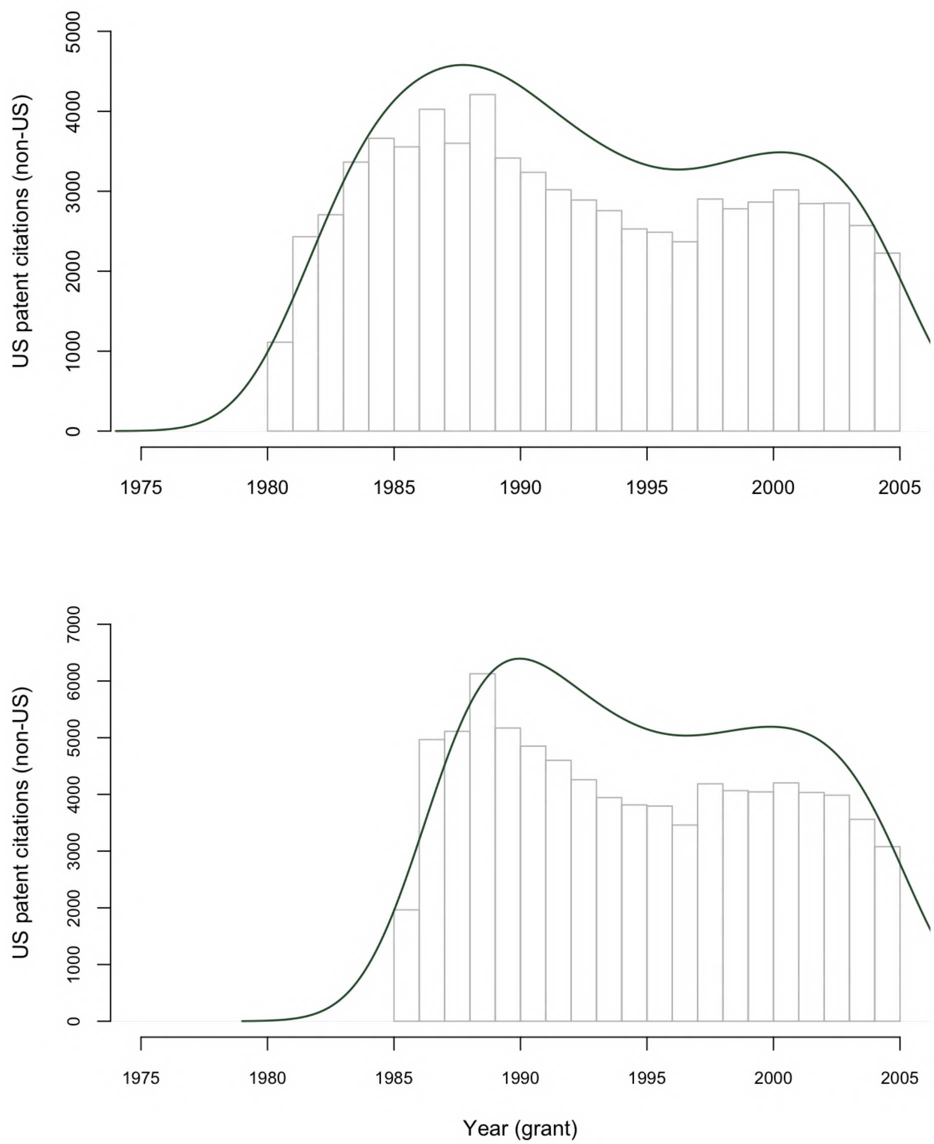

Figure 1: **Forward citations of US patents in manufacturing industry (1980, 1985)** This figure visualizes distribution of US patent citations by non-US firms and individuals in the 1980s. The upper (lower) panel presents distribution of citations of US patents granted in 1980 (1985). Note that the life-cycles of US products patented in the 1980s, like the graphical user interface invented by the Xerox, did not reach their maturity in the early 2000s. Instead, their product life-cycles were extended in the late 1990s, due to their prolonged application to other new products, such as computers and mobile phones.

3.1.1 Players and Payoffs

There are 6 players in this game, government $i \in \{H, F\}$ and firm $j \in \{1, 2, 3, 4\}$, where firms $1, 2$ and $3, 4$ belong to the same industry and produce goods in country H and F, respectively. However, only firms $1, 3$ hold patents indexed by $k \in \{1, 3\}$ and export their goods to other countries. Each government H, F confers market exclusivity to patent holders $1, 3$ for a finite duration ω_H, ω_F. During this period, firm 1 can exclude market entries by import-competing firms 2 and $3, 4$ in country H and F, respectively. Until the term of patent protection expires ($t < \omega_H$), firm 1 gains profit π_1 in both economies, while firms $2, 3, 4$ earn no profit. After the patent expires ($t \geq \omega_H$), firms $1, 2$ gain $\overline{\pi}_1 < \pi_1$ in country H and firms $1, 3, 4$ earn $\tilde{\pi}_1 < \pi_1$ in country F. When the good becomes obsolete in each industry ($t \geq T$), however, it yields no profit. For simplicity, I assume $\pi_1 = \pi_3$, $\overline{\pi}_1 = \overline{\pi}_3$, and $\tilde{\pi}_1 = \tilde{\pi}_3$ so that the same expression holds for firm 3 and its export to country H by symmetry. I also assume $T > \max\{\omega_H, \omega_F\}$ so that the policy choice is driven by not other industry-level attributes but firm-level activities.

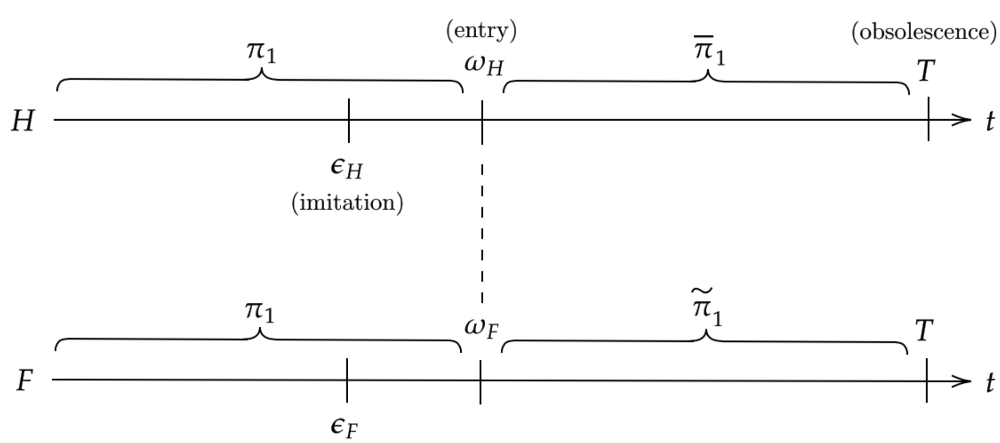

Figure 2: **Patent protection and the risks of imitation in an open economy**

When firms $1, 3$ produce and export their patented goods, competing firms who do not own the patents can reverse engineer their products, imitate their technologies, and challenge their novelty as patents by producing counterfeits (Grossman and Helpman, 1991; Helpman, 1993).

I assume that the piracy taking place in each country $i \in \{H, F\}$ follows independent Poisson process. In each country, the arrival time independently follows $\exp(\lambda_j)$ for $j \in \{2, 3, 4\}$ when firms $2, 3, 4$ mimic firm 1's patented product, and so does copying the good owned by firm 3. Conditioning on times $\overline{\epsilon}_H \geq T, \overline{\epsilon}_F \geq T$ fixed at a time horizon, the success time of imitation ϵ_H, ϵ_F in each region H and F then follows $Unif(0, \overline{\epsilon}_H)$ and $Unif(0, \overline{\epsilon}_F)$, respectively. However, it should be noted that any counterfeit cannot be sold until its patent expires nor can generic brands be introduced promptly after the term expires when the barriers of scientific knowledge are too high. These causes of the delay are captured by $\max\{\omega_i, \epsilon_i\}$ and $\min\{T - \omega_i, T - \epsilon_i\}$, respectively, where exports are also exposed to the risk of imitation by foreign firms and how other government enforces global patent protection, each of which is captured by ϵ_{-i} and ω_{-i}.

$$
\begin{aligned}
\mathbb{E}_{\epsilon_H, \epsilon_F}\big[\pi_1(\omega)\big] &= \pi_1 \cdot \mathbb{E}_{\epsilon_H \leq T}\big[\max\{\omega_H, \epsilon_H\}\big] + \overline{\pi}_1 \cdot \mathbb{E}_{\epsilon_H \leq T}\big[\min\{T - \omega_H, T - \epsilon_H\}\big] \\
&\quad + \pi_1 \cdot \mathbb{E}_{\epsilon_F \leq T}\big[\max\{\omega_F, \epsilon_F\}\big] + \tilde{\pi}_1 \cdot \mathbb{E}_{\epsilon_F \leq T}\big[\min\{T - \omega_F, T - \epsilon_F\}\big] \\
&\quad + 0 \cdot \mathbb{E}_{\epsilon_H \leq T}\big[\max\{\omega_H, \epsilon_H\}\big] + \tilde{\pi}_3 \cdot \mathbb{E}_{\epsilon_H \leq T}\big[\min\{T - \omega_H, T - \epsilon_H\}\big] \\
\mathbb{E}_{\epsilon_H}\big[\pi_2(\omega)\big] &= 0 \cdot \mathbb{E}_{\epsilon_H \leq T}\big[\max\{\omega_H, \epsilon_H\}\big] + \overline{\pi}_1 \cdot \mathbb{E}_{\epsilon_H \leq T}\big[\min\{T - \omega_H, T - \epsilon_H\}\big] \\
&\quad + 0 \cdot \mathbb{E}_{\epsilon_H \leq T}\big[\max\{\omega_H, \epsilon_H\}\big] + \tilde{\pi}_3 \cdot \mathbb{E}_{\epsilon_H \leq T}\big[\min\{T - \omega_H, T - \epsilon_H\}\big]
\end{aligned}
$$

In this game, consumers in each country H and F love invention of new product $k \in \{1, 3\}$ which cannot be substituted. Yet, how much consumers appreciate their new quality depends on their prices, which change as a result of market competition among firms $i \in \{1, 2, 3, 4\}$. I assume $S_1 < \overline{S}_1$ and $S_3 < \tilde{S}_3$, where S_1 represents consumer preferences on patented good $k = 1$ in country H when it is produced by firm 1 only, while $\overline{S}_1$ captures the utility when the same product is also produced by firm 2 after its market entry. Similarly, S_3 denotes the utility of importing $k = 3$ into country H when it is supplied by foreign firm 3, while $\tilde{S}_3$ represents the taste when the product is also produced by domestic firms $1, 2$ at a lower price. For symmetry, I also assume $S_1 = S_3$, $\overline{S}_1 = \overline{S}_3$, and $\tilde{S}_1 = \tilde{S}_3$ so that the same argument holds for country F.

$$\mathbb{E}_{\epsilon_H}\big[S(\omega)\big] = S_1 \cdot \mathbb{E}_{\epsilon_H \le T}\big[\max\{\omega_H, \epsilon_H\}\big] + \overline{S}_1 \cdot \mathbb{E}_{\epsilon_H \le T}\big[\min\{T - \omega_H, T - \epsilon_H\}\big]$$
$$+ S_3 \cdot \mathbb{E}_{\epsilon_H \le T}\big[\max\{\omega_H, \epsilon_H\}\big] + \tilde{S}_3 \cdot \mathbb{E}_{\epsilon_H \le T}\big[\min\{T - \omega_H, T - \epsilon_H\}\big]$$

Government $i \in \{H, F\}$ aggregates its consumer preferences over patented goods $k \in \{1, 3\}$ and its domestic firms' profits of exporting and importing the goods, which vary depending on its policy choice ω_H, ω_F. In so doing, each government also accounts for how much the term of patent protection fosters innovation (Grossman and Lai, 2004). This public policy objective is simplified under $\gamma(\omega) = \gamma\omega$, where $\gamma > 0$ so that the longer the term of patent protection, the more likely it is that firms invest more resources in R&D, bringing more product innovations.

$$W_i(\omega) = \mathbb{E}_{\epsilon \le T}\big[S(\omega)\big] + \sum_j \mathbb{E}_{\epsilon \le T}\big[\pi_j(\omega)\big] + \gamma(\omega)$$

3.1.2 A Sequence of Decision Making

Based on Grossman and Helpman (1994*b*), government $i \in \{H, F\}$ and firm $j \in \{1, 2, 3, 4\}$ play the two-stage game. In the first stage, both governments set the optimal term of patent protection $\omega^* = \omega_H^* = \omega_F^*$ that maximizes the following objective function before they collect political contributions from domestic firms in the next stage. In the following stage, each firm schedules its political contribution simultaneously, where V_j captures attractiveness of the alternatives when lobbying is described as an auction (Bernheim and Whinston, 1986) and determines the truthfulness of firms' political contributions. I also assume $\alpha > 0$ so that the two governments place non-trivial weights on their social welfare (Goldberg and Maggi, 1999).

$$\max_{\omega} \sum_j L_j(\omega) + \alpha \cdot W_i(\omega)$$
$$L_j(\omega; V_j) = \max\Big\{0,\ \mathbb{E}_{\epsilon \le T}\big[\pi_j(\omega)\big] - V_j\Big\}$$

3.1.3 Equilibrium

In this paper, I find a symmetric, subgame-perfect Nash equilibrium $\omega^* = \omega_H^* = \omega_F^*$ by using backward induction. Grossman and Helpman (1994*b*) provide its both sufficient and necessary conditions, which can be rewritten using the following equations. For the symmetry in payoffs, finding the equilibrium can be rephrased as a constrained optimization problem, where the solution ω^* maximizes the objective function of government i, given the contributions made by its exporting and import-competing firms j as constraints.

$$\sum_j \frac{\partial L_j}{\partial \omega}(\omega) + \alpha \cdot \frac{\partial W_i}{\partial \omega}(\omega) = 0,\ \forall i$$

$$\frac{\partial}{\partial \omega}\mathbb{E}_\epsilon\big[\pi_j(\omega)\big] - \frac{\partial L_j}{\partial \omega}(\omega) + \sum_j \frac{\partial L_j}{\partial \omega}(\omega) + \alpha\frac{\partial W_i}{\partial \omega}(\omega) = 0,\ \forall j \text{ given } i$$

In the appendix, I show how to calculate the means of truncated distributions that characterize imitation by import-competing firms in each country H and F. To account for whose imitation succeeds early among import-competing firms, I also illustrate how $\tilde{S}_1, \tilde{\pi}_1$, and $\tilde{\pi}_3$ can be re-written using $\overline{S}_1, \overline{\pi}_1$, and $\overline{\pi}_3$, respectively, later in the appendix.

Proposition 1 *The optimal term of patent protection in international trade.*

$$\omega_H^* = \frac{\alpha\gamma\overline{\epsilon}_H\overline{\epsilon}_F}{(\alpha+1)\big[(\overline{\pi}_1+\overline{\pi}_3)\overline{\epsilon}_F - (\pi_1 - \overline{\pi}_1)(\overline{\epsilon}_H + \overline{\epsilon}_F)\big] + \alpha\overline{\epsilon}_F\big[(\overline{S}_1 - S_1) + (\overline{S}_3 - S_3)\big]}$$

$$\omega_F^* = \frac{\alpha\gamma\overline{\epsilon}_H\overline{\epsilon}_F}{(\alpha+1)\big[(\overline{\pi}_1+\overline{\pi}_3)\overline{\epsilon}_H - (\pi_3 - \overline{\pi}_3)(\overline{\epsilon}_H + \overline{\epsilon}_F)\big] + \alpha\overline{\epsilon}_H\big[(\overline{S}_1 - S_1) + (\overline{S}_3 - S_3)\big]}$$

3.1.4 Comparative Statics

In the equilibrium, it is worth noticing that the term of patent protection ω_H^* varies, depending on the two criteria: the benefits of reverse engineering imports $\overline{\pi}_3$ and protecting exports π_1. Consistent with Grossman and Lai (2004), states in the Global South had less incentives to enforce intellectual property protection before the early 2000s, when their benefits of forcing technology transfer from the Global North outweighed those of protecting their own assets in global markets. However, as developing countries and LDCs became the beneficiaries of trade liberalization after the early 2000s, exporting firms from both the North and the South pushed forward the boundaries of global patent protection to secure their gains from trade openness at the cost of their import-competing firms.

Next, the equilibrium spending in lobbying for global patent protection $L_j^* \equiv L_j(\omega^*)$ relies on sector-specific life-span T of exports and imports, given the trade policies ω^* chosen in the first stage. Notice that in the case of country $i = H$, political contributions made by its exporter $j = 1$ increase as the term of patent protection is extended, because its gains from stronger patent protection are greater than the losses of import-competing firm $j = 2$. This tendency becomes more salient as firms export patented goods with long life-cycles as their exports are exposed to the risk of imitation by their competing firms at both home and host countries. The same illustration holds when firm $j = 3$ competes against firm $j = 4$ in protecting its patented exports in country $i = F$.

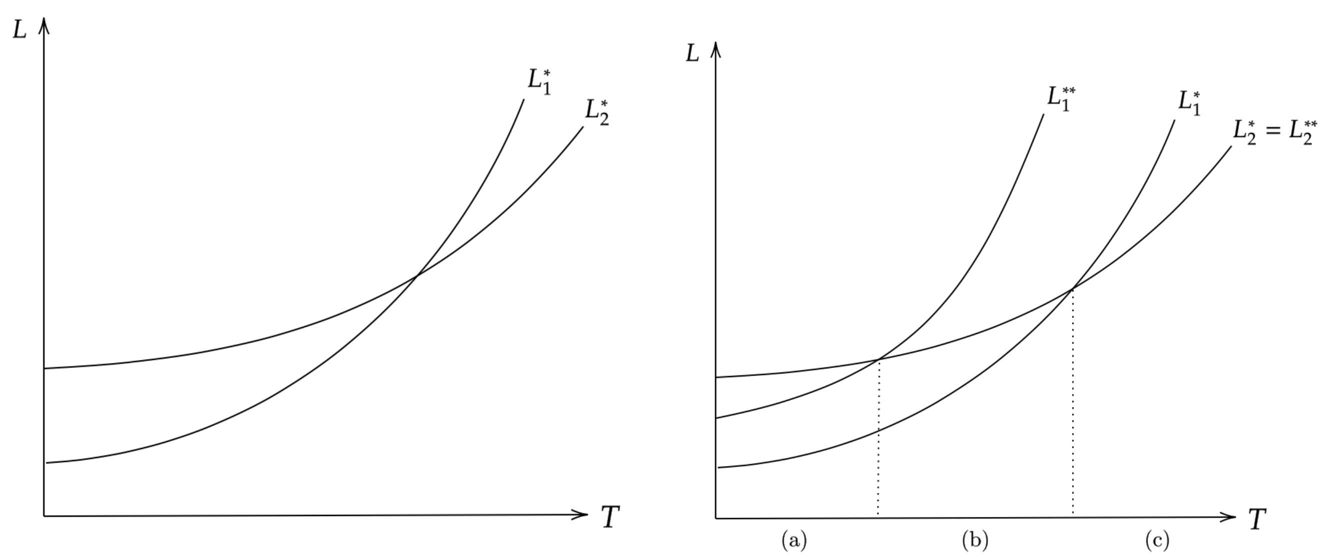

Figure 3: **Truthful Political Contributions: Exporting vs. Import-competing**

Figure 3 summarizes how the lobbying expenditures are adjusted as the parameters π_1, T change, where $\omega^{**} \equiv \omega_H^*(\pi_1') > \omega^* \equiv \omega_H^*(\pi_1)$ for $\pi_1' > \pi_1$. In Figure 3, the gains from trade π_1 accruing from patent ownership determines the intercept and its product life-cycle T defines the slope. The difference in their slopes represents exporting firms' increasing exposure to reverse engineering by import-competing firms in global markets. Exporters whose products exhibit short life-cycles (a) spend less money in lobbying than import-competing firms in both closed and open economies. However, firms who export goods with long life-cycles (b) expend more money on their political activities in an open economy than under a closed economy for their gains from trade. Firms who produce patented products with long life-cycles (c) assign more expenditures in lobbying than those who do not hold patents, as their risks of imitation are already large in a closed economy.

Corollary 1 *The distributional impacts of patent protection in international trade.*

$$\frac{\partial \omega^*}{\partial \pi_1} > 0, \quad \frac{\partial \omega^*}{\partial \overline{\pi}_3} < 0$$

Corollary 2 *Firm-level lobbying for patent protection in international trade.*

$$\frac{\partial L_1^*}{\partial T} > \frac{\partial L_2^*}{\partial T} > 0, \quad \frac{\partial}{\partial \pi_1}\left(\frac{\partial L_1^*}{\partial T}\right) > \frac{\partial}{\partial \pi_1}\left(\frac{\partial L_2^*}{\partial T}\right) = 0$$

3.1.5 Testable Implications

One of the key observable implications of the theory is that the effects of product life-cycle on lobbying are conditional on patent ownership. As in the case of (a), when firms own a small number of patents, the amount of exposure to imitation attributed to their long product life-cycles is likely to be trivial. However, as shown in (b) and (c), when the number of patents owned by each firm increases, so does the risk of imitation, due to the long-term exposure to foreign firms. This tendency is likely to stand out when two governments extend the term of patent protection in international trade agreements as the gains from trade further empower patent holders in their political markets.

Hypothesis 1 *Patent owners who manufacture products with longer life-cycles are more likely to lobby their government to pass international trade agreements on patent protection.*

Hypothesis 2 *The effects of product life-cycle on corporate lobbying are more likely to be significant under international trade agreements on stronger patent protection.*

4 Empirical Analysis

To test the empirical implications directly poses several empirical challenges. First, for our independent variables, patent ownership is challenging to measure. The United States Patent and Trademark Office (USPTO) discloses all patent profiles, most of whose information is not digitized and thus remains not user-friendly. As the National Bureau of Economic Research (NBER) patent data project famously suggests (Hall, Jaffe, and Trajtenberg, 2001), the real obstacle to empirical research on patent is how to keep track of changes in patent ownership when firms reorganize their boundaries through spin-offs, mergers, and acquisitions. This led political scientists to use the degree of concentration of patent ownership at an industry-level instead (Osgood and Feng, 2018) for their research on intellectual property rights up to date.

The remaining challenge for our independent variables is how to operationalize the risk of imitation, using product life-cycles. Product life-cycles can be measured in a number of ways, such as product turnover (Broda and Weinstein, 2010). However, notice that the quantity of interest in this paper is the spillover of scientific know-how embedded in a product, not the product itself. Also, it is the exclusive nature of intellectual property rights that raises the conflict of interest between firms in its diffusion process. Thus, a proxy that captures both of the aspects, intellectual property as scientific knowledge versus assets, should be used for our hypothesis testing.

Last but not least, for our dependent variable, we need to measure provisions on patent protection under international trade agreements at a granular level. The existing studies show how patent policies change across countries and years (Lerner, 2002; Ginarte and Park, 1997;

Park, 2008) but not how they are affected by international trade agreements. Nor do other available datasets on preferential trade agreements provide fine-grained information we need, such as the term of patent protection (Dür, Baccini, and Elsig, 2014; Elsig and Surbeck, 2016). Only recently have some political scientists begun to identify the provisions in sufficient detail yet with a specific focus on pharmaceutical patents (Shadlen, Sampat, and Kapczynski, 2020).

4.1 Data Collection

I overcome these challenges by introducing new patent- and firm-level datasets and creating a new measure of product life-cycle, using the datasets. I also check all patent-related sections under each US trade agreement, signed after the 2001 Doha Round up to 2012. Collecting the information allows me to categorize the US trade agreements, based on their levels of patent protection. Combined with other financial datasets on all publicly-traded US companies from `Compustat` and their lobbying reports filed on each of the trade agreements under `LobbyView` (Kim, 2017, 2018), the final dataset has firm-year by industry as the unit of analysis.

Specifically, information on patent ownership is obtained from Arora, Belenzon, and Sheer (2021). Similar to the NBER patent dataset (Hall, Jaffe, and Trajtenberg, 2001), the authors fully identify changes in patent ownership among publicly-traded US firms investing in R&D. This work is done by matching patent (re)assignee information disclosed by the United States Patent and Trademark Office (USPTO) with other subsidiary data, including SDC, 10-K SEC filing, and other records available in other firm-level datasets, such as `Orbis`. Therefore, the output also captures changes in US patent ownership, attributed to corporate reorganization among publicly as well as privately traded US companies between 1980 and 2015.

Next, product life-cycle is measured, using 45 million patent citations from 1975 to 2010, which covers more than 3.5 million patents granted in the US during this period. Specifically, the empirical strategy proposed by Bilir (2014) is adopted to measure product obsolescence in this paper, where I average patent citation lags across firms within industry. To do so, I follow the guidance provided by the USPTO to match different categories of patents with industrial classifications. While Bilir (2014) uses US patent citations between 1976 and 2006 to calculate the life-cycles using the Standard Industrial Classification (SIC) codes with 3-digits, I update the measurement by using US patent citations between 1975 and 2010 (Bhaven, 2011) and the USPTO concordance file using the North American Industry Classification System (NAICS) with 4-digits. The update allows me to keep track of ongoing innovation up to recent years. In this way, the life-cycle index also becomes compatible with other firm-level attributes that vary significantly across years. In the appendix, I demonstrate reliability of the average citation lag as a proxy for product life-cycle analytically.

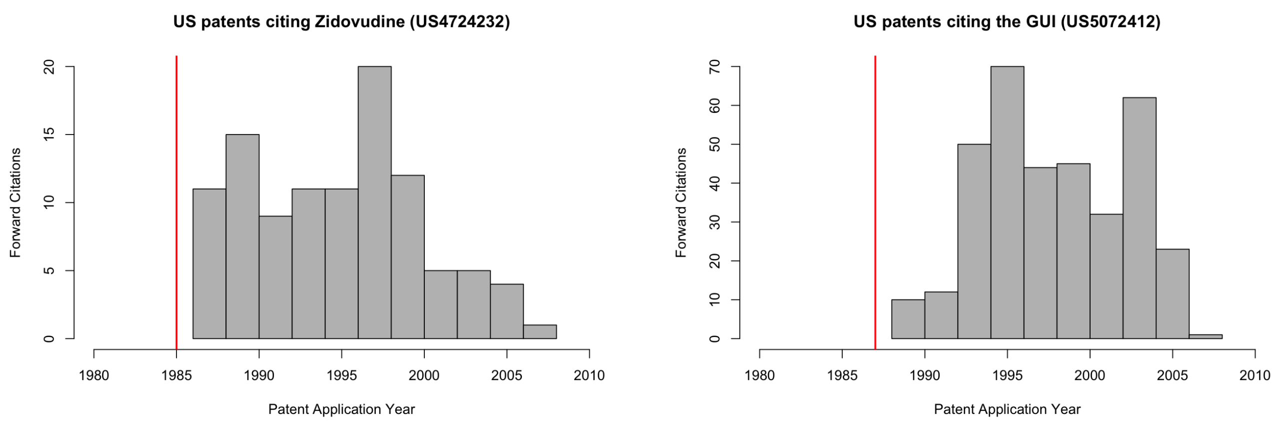

Figure 4: **Examples of patent citation lags: medicine vs. communication device**

Examples of patent citation lags and how they are aggregated at an industrial level are illustrated in Figure 4 and Table 1. As Figure 4 showcases, notice that their distributions are skewed to the right or not, depending on how far the life-cycles are extended. Hence, I use the 75th and other quantiles in my robustness check to measure more precisely how long each technology as proprietary information lasts in practice. Also, it is should be noted in Table 1 that R&D intensive industries, such as computer, semi-conductor, and chemicals, exhibit the shortest product life-cycles. This is most likely so because the more investments in R&D, the more product innovations are achieved, shortening the life-time of other existing products.

NAICS	Description	T
3341	Computer and Peripheral Equipment Manufacturing	9.365
3343	Audio and Video Equipment Manufacturing	9.469
3344	Semiconductor and Other Electronic Component Manufacturing	9.924
3342	Communications Equipment Manufacturing	10.274
3251	Basic Chemical Manufacturing	10.359
3254	Pharmaceutical and Medicine Manufacturing	10.366
3253	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	10.529
3252	Resin, Synthetic Rubber, and Artificial and Synthetic Fibers and Filaments Manufacturing	10.531
3311	Iron and Steel Mills and Ferroalloy Manufacturing	10.795
3361	Motor Vehicle Manufacturing	10.909
3111	Animal Food Manufacturing	10.988
3351	Electric Lighting Equipment Manufacturing	11.008
3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	11.010
3121	Beverage Manufacturing	11.031
3364	Aerospace Product and Parts Manufacturing	11.066
3331	Agriculture, Construction, and Mining Machinery Manufacturing	11.193
...	...	...

Table 1: **Examples of the mean citation lags: shortest vs. intermediate vs. longest**

Lobbying reports filed by all publicly traded US companies in manufacturing industry are downloaded from `LobbyView` database (Kim, 2017, 2018) and used as our dependent variable. In specific, I create an indicator variable that equals 1 if each firm filed any lobbying report on US trade agreements containing patent provisions and signed after the Doha Round, and 0 otherwise. The trade agreements considered for empirical analysis are listed in Figure 5, whose detailed provisions on patent protection I identify manually, based on the criteria established in other earlier works on TRIPS-plus (Maskus, 2000; Correa, 2000; Deere, 2009; Shadlen, 2005; Shadlen, Sampat, and Kapczynski, 2020; Osgood and Feng, 2018). Corporate lobbying reports filed on US congressional bills introduced to ratify the US trade agreements are the subject of our analysis. More details on their patent provisions are illustrated in the appendix.

It is not uncommon that states bargain over a set of policies in their trade negotiation at the same time. Thus, the remaining challenge would be how to flesh out firms' preferences on patent provisions within each trade agreement. To address this issue, not only do I compare lobbying reports filed on US trade agreements with different patent provisions later, but I also sample firms whose industries are patent-intensive[3] from compustat (Osgood and Feng, 2018), based on the report published by the USPTO (ESA, 2012), and add other firm attributes as our control variables. To ensure that I examine US firms' lobbying activities that are targeted at the US trade agreements on patent protection only, listed in Figure 5, I also compare the reports identified in LobbyView with those available in OpenSecret for data sanity check. The final dataset is a large panel of US firms, which covers the profiles between 2003 and 2012.

Negotiating party	Year (signed)	Year (effective)	Bills	Congress	Term of protection	Extension of protection									
						Delays under marketing approval		Violation of test data protection (Pharmaceutical)				Violation of test data protection (Agrochemical)			
						From the date of filing	After a request for examination	Marketing approval (domestic)	Marketing approval (foreign)	New clinical information (domestic)	New clinical information (foreign)	Marketing approval (domestic)	Marketing approval (foreign)	New uses (domestic)	New uses (foreign)
Singapore	2003	2004	HR2739, S1417	108	20 years	4 years	2 years	5 years	5 years	no	no	10 years	10 years	no	no
Chile	2003	2004	HR2738, S1416	108	20 years	5 years	3 years	5 years	no	no	no	10 years	no	no	no
Australia	2004	2005	HR4759, S2610	108	20 years	4 years	2 years	5 years	5 years	3 years	3 years	10 years	10 years	10 years	10 years
Morocco	2004	2006	HR4842, S2677	108	20 years	4 years	2 years	5 years	5 years	3 years	3 years	10 years	10 years	no	no
Dominican Republic - Central America	2004	2006	HR3045, S1307	109	20 years	4 years	2 years	5 years	5 years	no	no	10 years	10 years	no	no
Bahrain	2004	2006	HR4340, S2027	109	20 years	4 years	2 years	5 years	5 years	3 years	3 years	10 years	10 years	10 years	10 years
Oman	2006	2009	HR5684, S3569	109	20 years	4 years	2 years	5 years	5 years	3 years	3 years	10 years	10 years	10 years	10 years
Peru	2006	2009	HR3688, S2113	110	20 years	5 years	3 years	5 years	no	no	no	10 years	no	no	no
Colombia	2006	2012	HR3078, S1641	112	20 years	5 years	3 years	5 years	5 years	no	no	10 years	10 years	no	no
Republic of Korea	2007 (2010)	2012	HR3080, S1642	112	20 years	4 years	3 years	5 years	5 years	3 years	3 years	10 years	10 years	10 years	10 years
Panama	2007	2012	HR3079, S1643	112	20 years	5 years	3 years	5 years	5 years	no	no	10 years	10 years	no	no

Negotiating party	Patentability				Revokation of patent			TRIPS Flexibilities		Enforcement of protection					
											Border measures			Criminal procedures and remedies	
	New uses of products	Plants	Animals	Excludable for moral, health, and safety reasons	Only for the reasons of granting patent	For other misconducts	Not before granting patent	Allowing compulsory licensing	Banning parallel imports	No excuse for resource constraints	Against imports of counterfeits	Against exports and trasiting of counterfeits	Civil and administrative procedures	Beyond willful infringement at a commercial scale	Against trafficking or re-entry of counterfeits
Singapore	no	no	no	no	yes	yes	yes	yes (provisions)	no	yes	yes	yes	yes	yes	no
Chile	no	no	no	no	yes	no	no	not explicit	no	yes	yes	yes	yes	yes	no
Australia	yes	not explicit	not explicit	yes	yes	yes	no	yes (provisions)	yes	no	yes	no	yes	yes	yes
Morocco	yes	yes	yes	no	yes	yes	yes	not explicit	yes	yes	yes	yes	yes	yes	yes
Dominican Republic - Central America	no	yes	yes	no	yes	yes	no	not explicit	no	yes	yes	yes	yes	yes	yes
Bahrain	yes	not explicit	not explicit	yes	yes	yes	yes	yes (provisions)	no	yes	yes	yes	yes	yes	yes
Oman	yes	not explicit	not explicit	yes	yes	yes	yes	not explicit	no	yes	yes	yes	yes	yes	yes
Peru	no	yes	yes	no	yes	yes	no	yes (exceptions)	no	yes	yes	yes	yes	yes	yes
Colombia	no	yes	yes	no	yes	yes	no	yes (exceptions)	no	no	yes	yes	yes	yes	yes
Republic of Korea	yes	not explicit	not explicit	yes	yes	yes	yes	yes (exceptions)	no	no	yes	yes	yes	yes	yes
Panama	no	yes	yes	no	yes	yes	no	yes (exceptions)	no	no	yes	yes	yes	yes	yes

Figure 5: **TRIPS-plus provisions under the US trade agreements (2003−2012)**

[3]A sector is classified as patent-intensive if the ratio of patents to employees is greater than the average across all US industries (Osgood and Feng, 2018). See ESA (2012) for more details.

4.2 Model Specification

To close the gap between the theory and empirical model, I use a multiple logistic regression where I include an interaction between the number of patents owned by each US firm in our sample, $patents_{ijk}$, and the mean citation lag T_j as a proxy for product life-cycle. Notice that $patents_{ijk}$ is log-transformed as the majority of patents are held by a handful of big firms. The life-time of patented technology is also squared for there is no linear term of T_j specified in the equilibrium. Since $T_j > 0$, the significance level would stay the same if we use its linear term instead, yet only the magnitude would change. The model is specified as follows:

$$Lobbied_{ijt} = \alpha + \beta_1 T_j^2 + \beta_2 log(patents_{ijt} + 1) + \beta_3 T_j^2 log(patents_{ijt} + 1) + \delta X_{ijt} + \theta_j + \gamma_t + \epsilon_{ijt}$$

where i, j and t refer to firm, industry, and year, respectively. The key parameter of our theoretical interest is β_3, where $\beta_3 = 0$ in our null hypothesis. To account for other factor that also shapes firms' trade policy preference, such as their size and productivity, a set of control variables X_{ijt} capturing firm heterogeneity, other than patent ownership, is also included.

Industrial- and year-fixed effects θ_j, γ_t are also added to keep the results consistent with the theory, where NAICS 4-digit codes are used for industrial classifications. Specifically, the industry-fixed effects stem from the previous assumption of $T > \max\{\omega_H, \omega_F\}$ in our model, where the term of protection $\omega_H^* = \omega_F^*$ chosen by the governments is sector-invariant but only political contributions made by each firm within industry depend on T_j. Therefore, β_1 attached to T_j^2 in the equation will not be estimated in the model when θ_j is added to control for other unobservable industrial attributes that are beyond the scope of our theory. In a similar vein, the year-fixed effects are added as the theory is not so much about when firms spend money in political activities as about whether they do so. However, because each firm files lobbying reports on the same congressional bill multiple times over a time horizon, I construct a panel data and instead opt to partial out any time-specificity by adding the fixed effect γ_t.

4.3 Results

	Dependent Variable: Lobbied					
	(1)	(2)	(3)	(4)	(5)	(6)
product life-cycle (squared)		0.015***	0.049***			
× patent (stock, thousands)		(0.004)	(0.014)			
product life-cycle (squared)					0.016***	0.040***
× patent (reassign, thousands)					(0.004)	(0.012)
product life-cycle (squared)		0.020**			0.018*	
		(0.012)			(0.012)	
patent (stock, thousands)	0.225**	−1.427***	−4.593***			
	(0.097)	(0.415)	(1.425)			
patent (reassign, thousands)				0.232**	−1.482***	−3.710***
				(0.097)	(0.408)	(1.158)
capital expenditure (log)	0.245	0.403	0.247	0.260	0.457*	0.335
	(0.408)	(0.290)	(0.429)	(0.405)	(0.290)	(0.426)
employees (log)	0.238	−0.056	−0.161	0.217	−0.085	−0.108
	(0.412)	(0.304)	(0.453)	(0.414)	(0.305)	(0.446)
plants and equipments (log)	0.519	0.673**	0.608*	0.517	0.643**	0.522
	(0.455)	(0.309)	(0.468)	(0.454)	(0.311)	(0.467)
revenue (log)	−0.230	−0.203	−0.092	−0.221	−0.200	−0.074
	(0.435)	(0.295)	(0.467)	(0.435)	(0.295)	(0.459)
R&D expenditure (log)	0.343	0.264**	0.159	0.316	0.237*	0.103
	(0.233)	(0.131)	(0.239)	(0.233)	(0.130)	(0.234)
Industry FE	YES	NO	YES	YES	NO	YES
Year FE	YES	YES	YES	YES	YES	YES
Observations	6,175	6,175	6,175	6,175	6,175	6,175
Log Likelihood	-137.335	-346.631	-130.543	-137.150	-345.787	-130.689
Akaike Information Criterion	286.669	709.262	275.085	286.299	707.575	275.379

Note: Robust standard errors are shown in parentheses. *p<0.1; **p<0.05; ***p<0.01

The main results are summarized in Table 2, which are consistent with the theory. In specific, column (1) reaffirms the existing findings that it is mainly large firms, proxied by their size of R&D investments, who engage more in political activities for trade liberalization. The next two columns (2) and (3) highlight another aspect of firm heterogeneity, the number of patents possessed by each company, and demonstrate how the amount of intangible assets owned by individual firms also affects their propensity of political participation to protect the assets in global markets. Column (4) demystifies who among patent owners are more likely to petition home government to protect their intellectual property rights abroad. As the theory suggests, those who manufacture products with long life-cycles face higher risk of imitation by import-competing firms abroad and thus seek more patent protection under their lobbying activities. (5) and (6) show that the results stay the same, when we account for how patent ownership is shifted across the boundaries of publicly-traded US firms as a result of their reorganization, including spin-offs, mergers, and acquisitions.

The reversal of the signs attached to $patent_{ijk}$ and the magnitude of the effects of product life-cycle T_j under (4) and (6) should be interpreted with caution. To begin with, the negative signs of $\hat{\beta}_2$ are mainly ascribed to the fact that the effect of patent ownership is conditional on the life-time of patents, whose proxy T_j was constructed at an industrial-level. It is worthwhile recalling that US patents in manufacturing industry are predominantly possessed by US firms who produce computers, other communication devices, semi-conductors, and pharmaceutical and agrochemical compounds, and these sectors exhibit the shortest life-time in terms of their proprietary technologies under Table 1, due to their high R&D intensity. Therefore, given the negative correlation between concentration of patent ownership $patent_{ijk}$ and the life-cycle T_j across sectors, the negative signs of $\hat{\beta}_2$ should also be flipped when interpreting the marginal effects of $patent_{ijk}$ on corporate lobbying, which are conditional on the values of T_j.

The seemingly small magnitude of $\hat{\beta}_3$ in (4) and (6) can also be understood by following the same chain of reasoning, where firm-level and industry-level covariates $patent_{ijk}, T_j$ are put together in the empirical specification. Thus, the size of the interaction effects in (4) and (6) should be translated into the magnitude at an industrial level. To keep the confusion in their interpretation to a minimum, in the appendix I also construct a firm-level proxy for product cycles. I do so by calculating the mean citation lags by averaging them across patents within the boundary of each firm. Using the new proxy, I find that the results still remain consistent.[4]

[4] As illustrated in Figure 4, the downside of using such a firm-level measurement is that the average citation lag does not remain stable across years in that case.

4.4 Robustness Checks

However, there remain good reasons to be skeptical about the main results presented above. Among the remaining challenges is that a number of other provisions that are irrelevant for patent protection, such as environmental regulation, are also included as a part of the trade agreements. This makes it difficult to isolate lobbying firms' preferences on patent provisions from those on other provisions, despite the fact that our samples are selected from patent-intensive sectors only. Also, after we tease out firms' preferences on those patent provisions, it still remains unclear whether product life-cycles fully capture the risks of imitation exporting firms are facing abroad or represent other underlying factors of firms' trade policy preferences.

	Dependent Variable: Lobbied			
	2003–2008	2005–2008	2011–2012	2011–2012
	(1)	(2)	(3)	(4)
product life-cycle (squared)	0.032*	0.040**	0.060***	0.083***
× patent (stock, thousands)	(0.025)	(0.020)	(0.022)	(0.035)
patent (stock, thousands)	−3.016*	−3.842**	−5.530***	−7.538***
	(2.452)	(1.996)	(2.169)	(3.414)
capital expenditure (log)	0.638	0.923*	−0.912	−1.157
	(0.742)	(0.572)	(0.749)	(1.757)
employees (log)	−0.091	−0.160	0.054	1.322***
	(0.863)	(0.675)	(0.659)	(1.200)
plants and equipments (log)	0.288	0.083	1.294***	2.677***
	(0.795)	(0.627)	(0.726)	(1.981)
revenue (log)	0.063	0.110	−0.032	−0.944
	(0.865)	(0.688)	(0.667)	(1.235)
R&D expenditure (log)	0.303	0.195	0.0004	−1.022*
	(0.426)	(0.328)	(0.367)	(0.634)
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Observations	4,023	3,193	1,291	1,291
Log likelihood	-43.025	-75.593	-47.790	-13.122
Akaike Information Criterion	100.051	165.185	109.580	40.245

Note: Robust standard errors are shown in parentheses. *p<0.1; **p<0.05; ***p<0.01
(1) US-Chile & US-Peru FTAs excluded, (2) US-Peru FTA excluded, (4) US-Panama FTA

Table 2: **The Effect of Product Life-cycle on Lobbying for Global Patent Protection**

To distinguish firms' lobbying activities on patent provisions from non-patent provisions, I conduct sub-sample analyses where I differentiate the US trade agreements, based on their adoption of TRIPS-plus standards. In specific, the US trade agreements are ordered, based on the term of extension in the case of delays in regulatory approval. This is not only because US trade agreements on patent protection are hardly distinguishable in the other dimensions of patent policies (Shadlen, 2005), but because the theory is also about firms' heterogeneous responses to the term of market exclusivity granted by home government in trade. Except for US-Chile and US-Peru free trade agreements (FTA), the term of patent protection extended for the delay gradually increases from 6 to 8 years in total. So does the extension in the case of violation of data protection, whose rule is only applied to companies in applied chemistry and thus considered as a secondary criterion in the sorting.

The results are again summarized in Table 3, where the term of extensions in the case of regulatory delays increases, staring from columns (1) to (4). As the TRIPS-plus standard becomes more stringent, notice that the effects of product life-cycles on corporate lobbying become much more pronounced, and so does their magnitude. Additionally, the indicators for the goodness of fit suggest that the less but more targeted samples are selected from our data, the larger amount of variation in lobbying is captured by our empirical specification.

Also, I test whether product life-cycle operationalizes the risk of imitation accurately and drive the outcomes in a meaningful way, using a text analysis. To do so, I first download all lobbying issues and their contents on trade and intellectual property from `LobbyView`. Then, using structural topic modeling (Roberts et al., 2014), I regress their latent topics on other document-level covariates observed in each lobbying report. These include industries (NAICS, 4-digits) each client belongs to, their average citation lags, and years in which the report was filed. I also control for other lobbying issues for most client firms address multiple issues within the same lobbying report at the same time. Lastly, the number of topics was chosen, based on the residuals, semantic coherence, exclusivity, and congruence of alternatives.

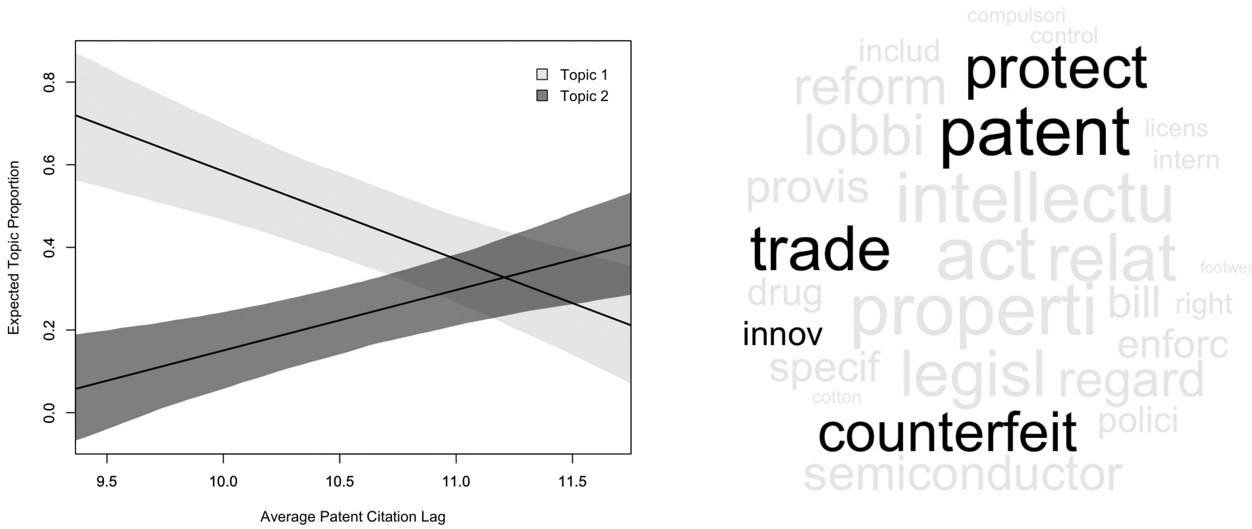

Figure 6: **Expected topic proportions ($K = 4$) and the top keywords (Topic 2)**

The text analysis results are displayed in Figure 6, uncovering the underlying reasons why firms exporting goods with longer life-times engage in lobbying. In Figure 6, I plot the latent topics whose associations with the mean citation lags are statistically significant. Notice that Topic 2 is positively correlated with the life-cycle index, and its keywords include "patent," "protect," "trade," and "counterfeit" among others. Overall, the results provide suggestive, if not compelling, evidence that US companies who produce goods with long life-cycles are more likely to be exposed to illegal trade practices committed by foreign competing firms, leading them to seek more support from home government for protection of their assets exported.

To probe generalizability of my argument more broadly, I conduct additional robustness checks in the appendix. For instance, I examine how the results change as more firms and their lobbying activities from non-patent intensive industries are also included in our sample. I also check whether the results also remain unchanged when the amount of corporate lobbying spending is considered, using the Heckman selection model. Last but not least, I employ other proxies of product life-cycles to test the same hypotheses. These include SIC codes (3-digits), other years in the 1980s used as a benchmark to calculate the mean patent forward citations, and the 75th and the 85th percentiles to account for stability of each index across years.

5 Conclusion

It is well documented in the literature that trade liberalization creates both the winners and losers in intra-industry trade. As to why big and productive companies become the winners, the existing research puts emphasis on *the organizational advantage* of exporting firms, whose economic profits in an open economy are highly concentrated, eliminating the collective action problem (Olson, 1965; Bombardini, 2008; Osgood et al., 2017; Kim and Osgood, 2019). On the other hand, the benefits of protection are much more diffused among producers who are not productive enough to afford the fixed costs, making their voices heard less loudly throughout trade policy-making process. When consumers overseas appreciate a wider range of varieties, large and productive firms' ability to meet such demand adds on to their political advantage (Bombardini and Trebbi, 2012; Osgood, 2016, 2017; Kim, 2017).

This paper provides an alternative perspective on political advantages of exporting firms by shifting the focus from the policy-making process to its outcome. Particularly, I focus on vested interests of incumbent companies and provide a micro-foundation explaining how their economic advantage is translated into political advantage (Rogowski, 1987, 1990). I show how *the incumbency advantage* manifests itself through rent-seeking by developing a formal model of international patent protection. In the model, a patent and its economic lifetime represent incumbent status of each company and the extent to which its market share can be taken by competitors imitating the proprietary technology, respectively. I tested whether the threat of reverse engineering leads to lobbying for patent protection in trade by US patent holders and found empirical evidence consistent with the prediction. The results suggest slowly innovating firms engage more in rent seeking and their political activity leads to misallocation of capitals.

The conflict between innovating and imitating firms in an open economy is grounded in the endogenous growth theory in trade (Grossman and Helpman, 1991; Helpman, 1993). Explaining intra-industry reallocation of profits as a result of "ongoing imitation and innovation in the same industries" in the economy (Grossman and Helpman, 1993, 282), the theory explains how companies who can speed up their innovation to escape from imitation by foreign competitors exhibit short product cycles and trade liberalization "can accelerate innovation and growth in the global economy" (Grossman and Helpman, 1994*a*, 42). In this paper, I theorized and tested the effects on political coalition formation in international trade empirically, where those who cannot accelerate innovation petition home government more to protect their profit overseas. The inefficiency stems from rent-seeking by slowly innovating companies and showcases when political ties reduce firms' continuous efforts to innovate (Akcigit, Baslandze, and Lotti, 2023).

To be sure, this paper is not the first one in the field of international political economy, illustrating how MNCs influence the policy making process to shape foreign policies in their favor (Kim and Milner, 2019). More recent findings on firms in regulatory politics also show how MNCs make use of their profit (Gulotty, 2020) and large firms mobilize their competitive advantages, such as low adjustment costs (Kennard, 2020) and scientific knowledge (Perlman, N.d., 2020), to crowd out other small companies. Building on the existing research, this paper illuminates when big firms seek more political influence to protect their gains from trade and more interestingly, when they do not.

References

Abbott, Frederick M. 2002. "The Doha declaration on the TRIPS agreement and public health: lighting a dark corner at the WTO." *J. Int'l Econ. L.* 5: 469.

Abbott, Frederick M. 2005. "The WTO medicines decision: world pharmaceutical trade and the protection of public health." *American Journal of International Law* 99(2): 317–358.

Aghion, Philippe, Christopher Harris, Peter Howitt, and John Vickers. 2001. "Competition, imitation and growth with step-by-step innovation." *The Review of Economic Studies* 68(3): 467–492.

Akcigit, Ufuk, Salomé Baslandze, and Francesca Lotti. 2023. "Connecting to power: political connections, innovation, and firm dynamics." *Econometrica* 91(2): 529–564.

Alt, James E., Jeffry Frieden, Michael J. Gilligan, Dani Rodrik, and Ronald Rogowski. 1996. "The Political Economy of International Trade: Enduring Puzzles and an Agenda for Inquiry." *Comparative Political Studies* 29(6): 689–717.

Amiti, Mary, and Jozef Konings. 2007. "Trade liberalization, intermediate inputs, and productivity: Evidence from Indonesia." *American Economic Review* 97(5): 1611–1638.

Antràs, Pol. 2003. "Firms, contracts, and trade structure." *The Quarterly Journal of Economics* 118(4): 1375–1418.

Arora, Ashish, Sharon Belenzon, and Lia Sheer. 2021. "Knowledge spillovers and corporate investment in scientific research." *American Economic Review* 111(3): 871–98.

Baccini, Leonardo, and Stephen Weymouth. 2021. "Gone for good: Deindustrialization, white voter backlash, and US presidential voting." *American Political Science Review* 115(2): 550–567.

Baccini, Leonardo, Pablo M Pinto, and Stephen Weymouth. 2017. "The distributional consequences of preferential trade liberalization: Firm-level evidence." *International Organization* 71(2): 373–395.

Bernheim, B Douglas, and Michael D Whinston. 1986. "Menu auctions, resource allocation, and economic influence." *The quarterly journal of economics* 101(1): 1–31.

Bhagwati, Jagdish N. 1991. *The world trading system at risk*. Vol. 1142 Princeton University Press.

Bhaven. 2011. "USPTO Patent and Citation Data.".

Bilir, L Kamran. 2014. "Patent laws, product life-cycle lengths, and multinational activity." *American Economic Review* 104(7): 1979–2013.

Bombardini, Matilde. 2008. "Firm heterogeneity and lobby participation." *Journal of International Economics* 75(2): 329–348.

Bombardini, Matilde, and Francesco Trebbi. 2012. "Competition and political organization: Together or alone in lobbying for trade policy?" *Journal of International Economics* 87(1): 18–26.

Branstetter, Lee. 2006. "Is foreign direct investment a channel of knowledge spillovers? Evidence from Japan's FDI in the United States." *Journal of International economics* 68(2): 325–344.

Branstetter, Lee G, Raymond Fisman, and C Fritz Foley. 2006. "Do stronger intellectual property rights increase international technology transfer? Empirical evidence from US firm-level panel data." *The Quarterly Journal of Economics* 121(1): 321–349.

Broda, Christian, and David E Weinstein. 2010. "Product creation and destruction: Evidence and price implications." *American Economic Review* 100(3): 691–723.

Broz, J Lawrence, Jeffry Frieden, and Stephen Weymouth. 2021. “Populism in place: the economic geography of the globalization backlash.” *International Organization* 75(2): 464–494.

Chaudhuri, Shubham, Pinelopi K Goldberg, and Panle Jia. 2006. “Estimating the effects of global patent protection in pharmaceuticals: a case study of quinolones in India.” *American Economic Review* 96(5): 1477–1514.

Chen, Yongmin, and Thitima Puttitanun. 2005. “Intellectual property rights and innovation in developing countries.” *Journal of development economics* 78(2): 474–493.

Correa, Carlos M. 2000. *Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options*. Zed books.

Deere, Carolyn. 2009. *The implementation game: the TRIPS agreement and the global politics of intellectual property reform in developing countries*. Oxford University Press.

Dür, Andreas, Leonardo Baccini, and Manfred Elsig. 2014. “The design of international trade agreements: Introducing a new dataset.” *The Review of International Organizations* 9(3): 353–375.

Elsig, Manfred, and Jenny Surbeck. 2016. “Intellectual Property Rights and Preferential Trade Agreements: Data, Concepts and Research Avenues.”.

ESA, USPTO. 2012. Intellectual Property and the US Economy: Industries in Focus. US Department of Commerce.

Frieden, Jeffry A. 1991. *Debt, development, and democracy: modern political economy and Latin America, 1965-1985*. Princeton University Press.

Frieden, Jeffry A, and Ronald Rogowski. 1996. “The impact of the international economy on national policies: An analytical overview.” *Internationalization and domestic politics* 15(1).

Gallagher, Kevin P. 2007. "Understanding developing country resistance to the Doha Round." *Review of international political economy* 15(1): 62–85.

Ginarte, Juan C, and Walter G Park. 1997. "Determinants of patent rights: A cross-national study." *Research policy* 26(3): 283–301.

Goldberg, Pinelopi Koujianou, and Giovanni Maggi. 1999. "Protection for sale: An empirical investigation." *American Economic Review* 89(5): 1135–1155.

Grossman, Gene M, and Edwin L-C Lai. 2004. "International protection of intellectual property." *American Economic Review* 94(5): 1635–1653.

Grossman, Gene M, and Elhanan Helpman. 1991. "Quality ladders and product cycles." *The Quarterly Journal of Economics* 106(2): 557–586.

Grossman, Gene M, and Elhanan Helpman. 1993. *Innovation and growth in the global economy.*

Grossman, Gene M, and Elhanan Helpman. 1994*a*. "Endogenous innovation in the theory of growth." *Journal of Economic Perspectives* 8(1): 23–44.

Grossman, Gene M., and Elhanan Helpman. 1994*b*. "Protection for sale." *The American Economic Review* 84(4): 833–850.

Gulotty, Robert. 2020. *Narrowing the Channel: The Politics of Regulatory Protection in International Trade.* University of Chicago Press.

Hall, Bronwyn H, Adam B Jaffe, and Manuel Trajtenberg. 2001. "The NBER patent citation data file: Lessons, insights and methodological tools.".

Helpman, Elhanan. 1993. "Innovation, Imitation, and Intellectual Property Rights." *Econometrica* 61(6): 1247–1280.

Helpman, Elhanan, Marc J Melitz, and Stephen R Yeaple. 2004. "Export versus FDI with heterogeneous firms." *American economic review* 94(1): 300–316.

Hiscox, Michael J. 2001. "Class versus industry cleavages: inter-industry factor mobility and the politics of trade." *International Organization* 55(1): 1–46.

Hiscox, Michael J. 2002. "Commerce, coalitions, and factor mobility: Evidence from congressional votes on trade legislation." *American Political Science Review* 96(3): 593–608.

Jensen, J Bradford, Dennis P Quinn, and Stephen Weymouth. 2015. "The influence of firm global supply chains and foreign currency undervaluations on US trade disputes." *International Organization* 69(4): 913–947.

Jensen, J Bradford, Dennis P Quinn, and Stephen Weymouth. 2017. "Winners and losers in international trade: The effects on US presidential voting." *International Organization* 71(3): 423–457.

Kennard, Amanda. 2020. "The enemy of my enemy: When firms support climate change regulation." *International Organization* 74(2): 187–221.

Kim, In Song. 2017. "Political cleavages within industry: Firm-level lobbying for trade liberalization." *American Political Science Review* 111(1): 1–20.

Kim, In Song. 2018. "Lobbyview: Firm-level lobbying & congressional bills database." *Unpublished manuscript, MIT, Cambridge, MA. http://web. mit. edu/insong/www/pdf/lobbyview. pdf Google Scholar Article Location* .

Kim, In Song, and Helen V Milner. 2019. "Multinational corporations and their influence through lobbying on foreign policy.".

Kim, In Song, and Iain Osgood. 2019. "Firms in trade and trade politics." *Annual Review of Political Science* 22: 399–417.

Kim, In Song, Helen V Milner, Thomas Bernauer, Iain Osgood, Gabriele Spilker, and Dustin

Tingley. 2019. "Firms and global value chains: Identifying firms' multidimensional trade preferences." *International Studies Quarterly* 63(1): 153–167.

Krugman, Paul. 1980. "Scale economies, product differentiation, and the pattern of trade." *The American Economic Review* 70(5): 950–959.

Krugman, Paul R. 1979. "Increasing returns, monopolistic competition, and international trade." *Journal of international Economics* 9(4): 469–479.

Lerner, Josh. 2002. "150 Years of Patent Protection." *The American Economic Review* 92(2): 221–225.

Limão, Nuno. 2006. "Preferential trade agreements as stumbling blocks for multilateral trade liberalization: Evidence for the United States." *American Economic Review* 96(3): 896–914.

Limão, Nuno. 2007. "Are preferential trade agreements with non-trade objectives a stumbling block for multilateral liberalization?" *The Review of Economic Studies* 74(3): 821–855.

Magee, Stephen P, Stephen P Magee, William A Brock, and Leslie Young. 1989. *Black hole tariffs and endogenous policy theory: Political economy in general equilibrium*. Cambridge University Press.

Mansfield, Edward D, and Helen V Milner. 1997. *The political economy of regionalism*. Columbia University Press.

Mansfield, Edward D, and Helen V Milner. 1999. "The new wave of regionalism." *International organization* 53(3): 589–627.

Mansfield, Edward D, Helen V Milner, and Nita Rudra. 2021. "The globalization backlash: Exploring new perspectives." *Comparative Political Studies* 54(13): 2267–2285.

Maskus, Keith E, and Mohan Penubarti. 1995. "How trade-related are intellectual property rights?" *Journal of International economics* 39(3-4): 227–248.

Maskus, Keith Eugene. 2000. *Intellectual property rights in the global economy.* Peterson Institute.

Mayda, Anna Maria, and Dani Rodrik. 2005. "Why are some people (and countries) more protectionist than others?" *European Economic Review* 49(6): 1393–1430.

McCalman, Phillip. 2001. "Reaping what you sow: an empirical analysis of international patent harmonization." *Journal of International Economics* 55(1): 161–186.

Melitz, Marc J. 2003. "The impact of trade on intra-industry reallocations and aggregate industry productivity." *econometrica* 71(6): 1695–1725.

Milner, Helen V. 1988. *Resisting protectionism: Global industries and the politics of international trade.* Princeton University Press.

Milner, Helen V. 1997. *Interests, institutions, and information: Domestic politics and international relations.* Princeton University Press.

Milner, Helen V. 1999. "The political economy of international trade." *Annual review of political science* 2(1): 91–114.

Milner, Helen V. 2021. "Voting for populism in Europe: Globalization, technological change, and the extreme right." *Comparative Political Studies* 54(13): 2286–2320.

Milner, Helen V, and David B Yoffie. 1989. "Between free trade and protectionism: strategic trade policy and a theory of corporate trade demands." *International Organization* 43(2): 239–272.

Milner, Helen V, and Robert O Keohane. 1996. "Internationalization and domestic politics: An introduction." *Internationalization and domestic politics* pp. 3–24.

Olson, Mancur. 1965. *The logic of collective action.* Vol. 124 Harvard University Press.

Osgood, Iain. 2016. "Differentiated products, divided industries: firm preferences over trade liberalization." *Economics & Politics* 28(2): 161–180.

Osgood, Iain. 2017. "The breakdown of industrial opposition to trade: Firms, product variety, and reciprocal liberalization." *World Politics* 69(1): 184–231.

Osgood, Iain. 2018. "Globalizing the supply chain: Firm and industrial support for US trade agreements." *International Organization* 72(2): 455–484.

Osgood, Iain, and Yilang Feng. 2018. "Intellectual property provisions and support for US trade agreements." *The Review of International Organizations* 13(3): 421–455.

Osgood, Iain, Dustin Tingley, Thomas Bernauer, In Song Kim, Helen V Milner, and Gabriele Spilker. 2017. "The charmed life of superstar exporters: Survey evidence on firms and trade policy." *The Journal of Politics* 79(1): 133–152.

Park, Sojun, and Lauren Konken. 2022. "Exploiting Treaty Ambiguity: Public Health Exceptions in the WTO TRIPS Agreement." Working paper.

Park, Walter G. 2008. "International patent protection: 1960–2005." *Research policy* 37(4): 761–766.

Perlman, Rebecca. N.d. "Exerting Influence Through Information: How Private Actors Win Preferential Policies Internationally." . Forthcoming.

Perlman, Rebecca L. 2020. "For safety or profit? How science serves the strategic interests of private actors." *American Journal of Political Science* 64(2): 293–308.

Qian, Yi. 2007. "Do national patent laws stimulate domestic innovation in a global patenting environment? A cross-country analysis of pharmaceutical patent protection, 1978–2002." *The Review of Economics and Statistics* 89(3): 436–453.

Roberts, Margaret E, Brandon M Stewart, Dustin Tingley, Christopher Lucas, Jetson Leder-Luis, Shana Kushner Gadarian, Bethany Albertson, and David G Rand. 2014. "Structural topic models for open-ended survey responses." *American journal of political science* 58(4): 1064–1082.

Rogowski, Ronald. 1987. "Political cleavages and changing exposure to trade." *American Political Science Review* 81(4): 1121–1137.

Rogowski, Ronald. 1990. *Commerce and coalitions: How trade affects domestic political alignments*. Princeton University Press.

Sakakibara, Mariko, and Lee G Branstetter. 1999. "Do stronger patents induce more innovation? Evidence from the 1988 Japanese patent law reforms.".

Scheve, Kenneth F, and Matthew J Slaughter. 2001. "What determines individual trade-policy preferences?" *Journal of International Economics* 54(2): 267–292.

Sell, Susan K. 1995. "Intellectual property protection and antitrust in the developing world: Crisis, coercion, and choice." *International Organization* 49(2): 315–349.

Sell, Susan K. 2003. *Private power, public law: The globalization of intellectual property rights*. Vol. 88 Cambridge University Press.

Shadlen, Kenneth C. 2005. "Exchanging development for market access? Deep integration and industrial policy under multilateral and regional-bilateral trade agreements." *Review of international political economy* 12(5): 750–775.

Shadlen, Kenneth C, Bhaven N Sampat, and Amy Kapczynski. 2020. "Patents, trade and medicines: past, present and future." *Review of International Political Economy* 27(1): 75–97.

Weymouth, Stephen. 2012. "Firm lobbying and influence in developing countries: a multilevel approach." *Business and Politics* 14(4): 1–26.

WTO. 2001. "Minutes of meeting at the TRIPS Council (Special Discussion on Intellectual Property and Access to Medicines)." https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=Q:/IP/C/M31.pdf&Open=True.

Innovation, Imitation, and Political Cleavages in International Trade and Patent Protection
Supplementary Materials

Abstract

This document contains supplementary materials for the manuscript and is organized as follows. Section 1 provides a formal proof of the model presented in the manuscript. Section 2 provides a microfoundation for using the expected mean citation lag as a proxy for product cycles and elaborates the rest of data generating process in detail. Section 3 presents the main results using other control variables, measurements, and empirical models. The final section lists TRIPS-plus provisions included under each of the US trade agreements.

Contents

A Formal Proof

A.1 Truthful Nash Equilibrium

Proposition 1. *The optimal term of international patent protection*

$$\omega_H^* = \frac{\alpha\gamma\bar{\epsilon}_H\bar{\epsilon}_F}{(\alpha+1)\big[(\overline{\pi}_1+\overline{\pi}_3)\bar{\epsilon}_F-(\pi_1-\overline{\pi}_1)(\bar{\epsilon}_H+\bar{\epsilon}_F)\big]+\alpha\bar{\epsilon}_F\big[(\overline{S}_1-S_1)+(\overline{S}_3-S_3)\big]}$$
$$\omega_F^* = \frac{\alpha\gamma\bar{\epsilon}_H\bar{\epsilon}_F}{(\alpha+1)\big[(\overline{\pi}_1+\overline{\pi}_3)\bar{\epsilon}_H-(\pi_3-\overline{\pi}_3)(\bar{\epsilon}_H+\bar{\epsilon}_F)\big]+\alpha\bar{\epsilon}_H\big[(\overline{S}_1-S_1)+(\overline{S}_3-S_3)\big]}$$

Proof. In this paper, product innovation is defined as an improvement of product quality over an infinite horizon (Aghion and Howitt, 1990; Grossman and Helpman, 1991c) rather than an expansion of product variety over time (Romer, 1990; Grossman and Helpman, 1991a).[1] I also assume that industry-specific patent races are constantly taking place over the horizon t. This implies that, after the final product being exported reaches its maturity T, a new product is invented and patented at $t = T$ and the existing one loses its value at $t > T$ (Bilir, 2014).

A.1.1 Market Structure

Market structure changes over time t, depending on when imitation $\epsilon_i \sim Unif(0, \bar{\epsilon}_i)$ arrives in each country and when home government allows entry of counterfeit products into its domestic market ω_i over the horizon. These two features are combined together in the next two terms, $\max\{\omega_i, \epsilon_i\}$ and $\min\{T-\omega_i, T-\epsilon_i\}$. Note that the assumption of $\epsilon_i \leq T \leq \bar{\epsilon}_i$ ensures that, as product life-time T increases ($T \to \bar{\epsilon}_i$), import-competing firms are more likely to succeed in reverse-engineering patented exports before they lose their commercial value or $\mathbb{P}(\epsilon_i \leq T) \uparrow$. I also assume that each copy can be sold within each state but cannot be re-exported to others.

[1] Grossman and Helpman (1991b) combine the two stochastic processes to generalize the interplay between imitation by the South and innovation by the North. For more comprehensive overview of the literature, check Aghion et al. (2014) for endogenous growth and Grossman and Helpman (1994) for international trade.

$$
\begin{aligned}
\mathbb{E}_{\epsilon_i \leq T}\big[\max\{\omega, \epsilon_i\}\big] &= \mathbb{E}_{\epsilon_i \leq T}\big[\omega \cdot \mathbb{1}\{\omega > \epsilon_i\}\big] + \mathbb{E}_{\epsilon_i \leq T}\big[\epsilon_i \cdot \mathbb{1}\{\omega \leq \epsilon_i\}\big] \\
&= \omega \cdot F_{\epsilon_i}(\omega) + \int_{\omega}^{T} \epsilon \cdot f_{\epsilon_i}(\epsilon) d\epsilon \\
&= \omega \cdot \frac{\omega}{\bar{\epsilon}_i} + \int_{\omega}^{T} \epsilon \cdot \frac{1}{\bar{\epsilon}_i} d\epsilon \\
&= \frac{T^2 + \omega^2}{2\bar{\epsilon}_i}
\end{aligned}
$$

$$
\begin{aligned}
\mathbb{E}_{\epsilon_i \leq T}\big[\min\{T-\omega, T-\epsilon_i\}\big] &= \mathbb{E}_{\epsilon_i \leq T}\big[(T-\omega) \cdot \mathbb{1}\{\omega > \epsilon_i\}\big] + \mathbb{E}_{\epsilon_i \leq T}\big[(T-\epsilon_i) \cdot \mathbb{1}\{\omega \leq \epsilon_i\}\big] \\
&= (T-\omega) \cdot F_{\epsilon_i}(\omega) + \int_{\omega}^{T} (T-\epsilon) \cdot f_{\epsilon_i}(\epsilon) d\epsilon \\
&= (T-\omega) \cdot \frac{\omega}{\bar{\epsilon}_i} + \int_{\omega}^{T} (T-\epsilon) \cdot \frac{1}{\bar{\epsilon}_i} d\epsilon \\
&= \frac{T^2 - \omega^2}{2\bar{\epsilon}_i}
\end{aligned}
$$

I simplify intertemporal competition between import-competing firms, using distribution of the minimum of exponential random variables. Specifically, I assume that whoever succeeds in reverse-engineering patented exports for the first time can sell their products but only if their government allows to do so, and the rest of import-competitors stop their on-going efforts to imitate the original product afterwards. By assuming independence among the arrival time Y_j of imitation among import-competing producers j, which follows $\exp(\lambda_j)$ without times $\bar{\epsilon}_H, \bar{\epsilon}_F$ fixed[2] over a time horizon t, I can rewrite $\tilde{S}_1, \tilde{\pi}_1, \tilde{\pi}_3$ as follows. $\tilde{\pi}_1$ captures profits of exporter $j = 1$ when import-competing firms $j = 3, 4$ reverse-engineer its patented product $k = 1$ in country $i = F$ when $\tilde{\pi}_3$ presents those of import-competing firms $j = 1, 2$ when firm $j = 3$ export its patented good $k = 3$ into country $i = H$. The same expression holds for consumer preference $\tilde{S}_3$ and the profits of firms $j = 3, 4$ for the symmetry in pay-offs, which are omitted hereinafter.

[2]The times are fixed to control for the effects of discounting factors on corporate lobbying activity but also construct a proxy of product life-cycle for empirical analysis, which is conducted at a specific moment in time.

$$\tilde{S}_1 = \mathbb{P}(Y_1 < Y_2) \cdot \overline{S}_1 + \mathbb{P}(Y_1 \geq Y_2) \cdot \overline{S}_1 = \left(\frac{\lambda_1}{\lambda_1 + \lambda_2}\right) \cdot \overline{S}_1 + \left(\frac{\lambda_2}{\lambda_1 + \lambda_2}\right) \cdot \overline{S}_1 = \overline{S}_1$$
$$\tilde{\pi}_1 = \mathbb{P}(Y_3 < Y_4) \cdot \overline{\pi}_1 + \mathbb{P}(Y_3 \geq Y_4) \cdot \overline{\pi}_1 = \left(\frac{\lambda_3}{\lambda_3 + \lambda_4}\right) \cdot \overline{\pi}_1 + \left(\frac{\lambda_4}{\lambda_3 + \lambda_4}\right) \cdot \overline{\pi}_1 = \overline{\pi}_1$$
$$\tilde{\pi}_3 = \mathbb{P}(Y_j < Y_{-j}) \cdot \overline{\pi}_1 + \mathbb{P}(Y_j \geq Y_{-j}) \cdot 0 = \left(\frac{\lambda_j}{\lambda_j + \lambda_{-j}}\right)\overline{\pi}_3 = \frac{\overline{\pi}_3}{2} \quad \text{for} \quad j \in \{1, 2\}$$

Then we can rewrite the pay-offs of each producer and those of consumers in country $i = H$ as follows. For the symmetry, we can also characterize the case of country $i = F$ in the same way, which is omitted hereinafter as well.

$$\mathbb{E}_{\epsilon_H, \epsilon_F}\big[\pi_1(\omega)\big] = \pi_1\left(\frac{T^2 + \omega^2}{2\overline{\epsilon}_H}\right) + \overline{\pi}_1\left(\frac{T^2 - \omega^2}{2\overline{\epsilon}_H}\right) + \pi_1\left(\frac{T^2 + \omega^2}{2\overline{\epsilon}_F}\right) + \overline{\pi}_1\left(\frac{T^2 - \omega^2}{2\overline{\epsilon}_F}\right) + \frac{\overline{\pi}_3}{2}\left(\frac{T^2 - \omega^2}{2\overline{\epsilon}_H}\right)$$
$$\mathbb{E}_{\epsilon_H}\big[\pi_2(\omega)\big] = \overline{\pi}_1\left(\frac{T^2 - \omega^2}{2\overline{\epsilon}_H}\right) + \frac{\overline{\pi}_3}{2}\left(\frac{T^2 - \omega^2}{2\overline{\epsilon}_H}\right)$$
$$\mathbb{E}_{\epsilon_H}\big[S(\omega)\big] = S_1\left(\frac{T^2 + \omega^2}{2\overline{\epsilon}_H}\right) + \overline{S}_1\left(\frac{T^2 - \omega^2}{2\overline{\epsilon}_H}\right) + S_3\left(\frac{T^2 + \omega^2}{2\overline{\epsilon}_H}\right) + \overline{S}_3\left(\frac{T^2 - \omega^2}{2\overline{\epsilon}_H}\right)$$

A.1.2 Truthful Political Contributions

I assume that the benchmark utility V_j is not big enough for each company j so that, when all firms schedule their political contributions simultaneously, their bidding amounts in the first-price menu auction (Bernheim and Whinston, 1986) are seen as "truthful" in the eyes of other companies participating in the same auction (Grossman and Helpman, 1992, 840). Note that V_j is a constant, not a function of ω_i.

$$L_j(\omega_i; V_j) = \mathbb{E}_{\epsilon \leq T}\big[\pi_j(\omega_i)\big] - V_j, \qquad \frac{\partial L_j}{\partial \omega_i}(\omega_i) = \frac{\partial}{\partial \omega_i}\mathbb{E}_{\epsilon \leq T}\big[\pi_j(\omega_i)\big]$$

A.1.3 Equilibrium Condition

Using backward induction, I search for a symmetric Truthful Nash Equilibrium (Grossman and Helpman, 1992) with $\omega_i = \omega_{-i} = \omega$ for $i \in \{H, F\}$. In the case of country $i = H$, for instance, the equilibrium condition can be re-expressed as follows.

$$\frac{\partial}{\partial \omega}\mathbb{E}_{\epsilon_H,\epsilon_F}\left[\pi_1(\omega)\right] + \frac{\partial}{\partial \omega}\mathbb{E}_{\epsilon_H}\left[\pi_1(\omega)\right] + \alpha \cdot \frac{\partial W_H}{\partial \omega}(\omega) = 0$$

We can write each term in the equation, based on the previous characterization of market structure and truth political contribution. Substituting each term with the following equations and re-writing the above equation with $\omega = \omega^*$ on its left-hand side and the rest on the right-hand side completes the proof. The same argument holds for country $i = F$ by the symmetry, where firm $j = 3$ holds patent $k = 3$ instead.

$$\frac{\partial}{\partial \omega}\mathbb{E}_{\epsilon_H,\epsilon_F}\left[\pi_1(\omega)\right] = \pi_1\left(\frac{\omega}{\bar{\epsilon}_H}\right) - \overline{\pi}_1\left(\frac{\omega}{\bar{\epsilon}_H}\right) + \pi_1\left(\frac{\omega}{\bar{\epsilon}_F}\right) - \overline{\pi}_1\left(\frac{\omega}{\bar{\epsilon}_F}\right) - \frac{\overline{\pi}_3}{2}\left(\frac{\omega}{\bar{\epsilon}_H}\right)$$

$$\frac{\partial}{\partial \omega}\mathbb{E}_{\epsilon_H}\left[\pi_2(\omega)\right] = -\,\overline{\pi}_1\left(\frac{\omega}{\bar{\epsilon}_H}\right) - \frac{\overline{\pi}_3}{2}\left(\frac{\omega}{\bar{\epsilon}_H}\right)$$

$$\frac{\partial W_H}{\partial \omega}(\omega) = S_1\left(\frac{\omega}{\bar{\epsilon}_H}\right) - \overline{S}_1\left(\frac{\omega}{\bar{\epsilon}_H}\right) + S_3\left(\frac{\omega}{\bar{\epsilon}_H}\right) - \overline{S}_3\left(\frac{\omega}{\bar{\epsilon}_H}\right) + \frac{\partial}{\partial \omega}\mathbb{E}_{\epsilon_H,\epsilon_F}\left[\pi_1(\omega)\right] + \frac{\partial}{\partial \omega}\mathbb{E}_{\epsilon_H}\left[\pi_2(\omega)\right] + \gamma$$

□

A.2 Comparative Statics

Corollary 1. *The distributional consequences of international patent protection in trade.*

$$\frac{\partial \omega^*}{\partial \pi_1} > 0, \quad \frac{\partial \omega^*}{\partial \overline{\pi}_3} < 0$$

Proof.

$$\frac{\partial \omega^*}{\partial \pi_1} = \frac{(\alpha+1)(\overline{\epsilon}_H + \overline{\epsilon}_F)}{\Big[(\alpha+1)\big\{(\overline{\pi}_1 + \overline{\pi}_3)\overline{\epsilon}_F - (\pi_1 - \overline{\pi}_1)(\overline{\epsilon}_H + \overline{\epsilon}_F)\big\} + \alpha\overline{\epsilon}_F\big\{(\overline{S}_1 - S_1) + (\overline{S}_3 - S_3)\big\}\Big]^2} > 0$$

$$\frac{\partial \omega^*}{\partial \overline{\pi}_3} = \frac{-(\alpha+1)\overline{\epsilon}_F}{\Big[(\alpha+1)\big\{(\overline{\pi}_1 + \overline{\pi}_3)\overline{\epsilon}_F - (\pi_1 - \overline{\pi}_1)(\overline{\epsilon}_H + \overline{\epsilon}_F)\big\} + \alpha\overline{\epsilon}_F\big\{(\overline{S}_1 - S_1) + (\overline{S}_3 - S_3)\big\}\Big]^2} < 0$$

□

Corollary 2. *Firm-level lobbying for international patent protection in trade.*

$$\frac{\partial L_1^*}{\partial T} > \frac{\partial L_2^*}{\partial T}, \quad \frac{\partial}{\partial \pi_1}\left(\frac{\partial L_1^*}{\partial T}\right) > \frac{\partial}{\partial \pi_1}\left(\frac{\partial L_2^*}{\partial T}\right)$$

Proof.

$$\frac{\partial L_1^*}{\partial T} = \frac{\partial}{\partial T}\mathbb{E}_{\epsilon_H,\epsilon_F}\big[\pi_1(\omega^*)\big] = \frac{T}{\overline{\epsilon}_H}\left(\pi_1 + \overline{\pi}_1 + \frac{\overline{\pi}_3}{2}\right) + \frac{T}{\overline{\epsilon}_F}\left(\pi_1 + \overline{\pi}_1\right)$$

$$\frac{\partial}{\partial \pi_1}\left(\frac{\partial L_1^*}{\partial T}\right) = \frac{\partial}{\partial \pi_1}\left(\frac{\partial}{\partial T}\mathbb{E}_{\epsilon_H,\epsilon_F}\big[\pi_1(\omega^*)\big]\right) = \frac{T}{\overline{\epsilon}_H} + \frac{T}{\overline{\epsilon}_F} > 0$$

$$\frac{\partial L_2^*}{\partial T} = \frac{\partial}{\partial T}\mathbb{E}_{\epsilon_H}\big[\pi_2(\omega^*)\big] = \frac{T}{\overline{\epsilon}_H}\left(\overline{\pi}_1 + \frac{\overline{\pi}_3}{2}\right)$$

$$\frac{\partial}{\partial \pi_1}\left(\frac{\partial L_2^*}{\partial T}\right) = \frac{\partial}{\partial \pi_1}\left(\frac{\partial}{\partial T}\mathbb{E}_{\epsilon_H}\big[\pi_2(\omega^*)\big]\right) = 0$$

□

B Data Generating Process

B.1 Product Life-cycle

Lemma 1. *The expected mean citation lag is increasing in the unobservable, economic lifetime of product in each industry (Bilir, 2014).*

For a sector-specific product k patented at time $t = 0$ and a new patent l arriving at $t > 0$, assume that until patent k expires, citing the patent brings a value v of preventing future legal disputes between k and l (Caballero and Jaffe, 1993) to companies producing l. In addition, assume that citing the patent also incurs a cost c_{kl} of limiting the chance to explore uncertain legal boundary or technological proximity between k and l (Lemley and Shapiro, 2005; Farrell and Shapiro, 2008) to those producing l. Then the net utility of citing the existing patent can be formalized as follows.

$$V_{kl}(t) \equiv v \cdot \max\{T - t, 0\} - c_{kl}$$

Producers of l cite the existing patent k if and only if $V_{kl}(t) \geq 0$. With the cost of citation being uncertain, the probability of citing the patent at a time t is $\mathbb{P}(V_{kl} \geq 0) = F_c(v(T - t))$ if $0 \leq t \leq T$ and 0 otherwise. For analytical simplicity, let $c_{kl} \sim Unif(-\epsilon, 1 - \epsilon)$ with $vT \leq 1 - \epsilon$ and assume that new patent l arrives at an industry-specific constant Poisson rate of a. Then patent k receives citations with the time-varying arrival rate of $\lambda(t)$ written below.

$$\lambda(t) = \begin{cases} a \cdot v(T - t), & \text{if } 0 \leq t \leq T \\ a \cdot F(0), & \text{if } t > T \end{cases}$$

Let N indicate the total number of patents $k \in \{1, ..., N\}$ granted in each industry, $X_k(t)$ denote the number of citations each patent k receives within industry and $X(t) = \sum_{k=1}^{N} X_k(t)$

represent the total number of citations upto time $t = \overline{T}$. Then, Bilir (2014) shows that the expected mean citation lag $m(\overline{T})$ in each sector monotonically increases in the unobservable, economic lifespan T of products in that industry. More formally,

$$m(\overline{T}) \equiv \mathbb{E}\left[\frac{1}{X(\overline{T})}\sum_{l=1}^{X(\overline{T})} t_l\right] = \beta(T,\overline{T}) \cdot \frac{T}{3} + (1-\beta(T,\overline{T})) \cdot \left(\frac{T+\overline{T}}{2}\right)$$
$$\beta(T,\overline{T}) = \mathbb{E}\Big[X(T)\Big|X(\overline{T}) = n\Big] = \frac{vT^2}{vT^2 + 2\epsilon(\overline{T}-T)} \in [0,1]$$

where $t_1, ..., t_{X(\overline{T})}$ are time lags between cited and citing patents and $\beta(T,\overline{T})$ is the average proportion of citations that occur between $[0,\overline{T}]$ but before T. When constructing $m(\overline{T})$ as a proxy for T using patent citation data, it should be noted that citing patents at $t = t_0$ are also cited by other patents later at $t \geq t_0$. I further assume that patent holders whose scientific knowledge are shared with other patent-filing firms via patent citations are forward-looking, rational actors who make adjustment to their political contribution and R&D investment for product innovation, and that the life-cycle T operates as a steady state over time t.

B.2 Data Sources

US patent citation data from 1975 to 2010 is provided by Bhaven (2011). Patent ownership data is measured at Hall et al. (2001) (1976-2006) as well as Arora et al. (2021) (1980-2015). The concordance files between patent and industrial classification systems, both SIC (3 digits) and NAICS (4 digits), are available in the USPTO website. I use the earliest version for their concordance, i.e., 2001 for SIC and 2008 for NAICS, and apply the same algorithm proposed by Bilir (2014). Instead, I do so by using NAICS and setting $\overline{T} = 33$ to calculate $m(\overline{T})$, where I look at a subset of patents cited between 1975 and 1990 and citing between 1975 and 2008. I also vary the range of patent citations to examine whether the product cycle index remains consistent over time but also use the same index developed by Bilir (2014) using SIC later.

Other firm-level attributes which represent both fixed and variable costs for production are downloaded from `Compustat`. Lobbying activities, including the amounts of money spent and their textual contents, are downloaded from LobbyView (Kim, 2017, 2018). I identify lobbying activities targeted at each of the US trade agreements by using (1) their signatory, (2) the bill trackers, and (3) the years in which each of the trade agreements was ratified. Lastly, I merge the patent ownership data and the life-cycle indices with `Compustat` and `LobbyView` by using their common identifiers, such as `gvkey` and NAICS/SIC codes.

C Robustness Check

C.1 Control Variables

	Dependent Variable: Lobbied					
	(1)	(2)	(3)	(4)	(5)	(6)
product life-cycle (squared)				0.092^{***}	0.050^{***}	0.112^{***}
× patent (stock, thousands)				(0.012)	(0.013)	(0.016)
patent (stock, thousands)				-8.443^{***}	-4.621^{***}	-10.437^{***}
				(1.224)	(1.297)	(1.544)
productivity (L&P, 2003)	0.134^{***}			0.013		
	(0.012)			(0.014)		
gross profit (log)		1.287^{***}			0.725^{***}	
		(0.095)			(0.124)	
investment (log)			0.450^{***}			0.068
			(0.041)			(0.057)
Year FE	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES
Observations	7,663	7,663	7,397	6,175	6,175	5,936
Log Likelihood	−276.372	−151.414	−220.977	−161.810	−135.212	−120.915

Note: Robust standard errors are shown in parentheses. *p<0.1; **p<0.05; ***p<0.01

C.2 Measurement Error

C.2.1 Patent Citation Lag (NAICS, cited between 1975 and 1995)

First, I test robustness of the main results by measuring the expected mean citation lags in various ways. In specific, to test the assumption of product life-cycle as a steady state, I create a new subset of patents cited between 1975 to 1995, instead of 1990, and find that the results remain constant.

Table 1: The 1st Hypothesis

	Dependent Variable: Lobbied					
	(1)	(2)	(3)	(4)	(5)	(6)
product life-cycle (squared)				0.054^{***}		
× patent (stock, thousands)				(0.016)		
product life-cycle (squared)						0.046^{***}
× patent (reassign, thousands)						(0.013)
patent (stock, thousands)		1.226^{***}	0.225^{**}	-3.620^{***}		
		(0.121)	(0.097)	(1.160)		
patent (reassign, thousands)					0.232^{**}	-3.076^{***}
					(0.097)	(0.929)
capital expenditure (log)	0.497^{*}		0.245	0.239	0.260	0.306
	(0.379)		(0.408)	(0.430)	(0.405)	(0.428)
employees (log)	0.361		0.238	−0.077	0.217	−0.046
	(0.402)		(0.412)	(0.435)	(0.414)	(0.434)
plants and equipments (log)	0.383		0.519	0.583	0.517	0.519
	(0.437)		(0.455)	(0.466)	(0.454)	(0.466)
revenue (log)	−0.325		−0.230	−0.110	−0.221	−0.074
	(0.426)		(0.435)	(0.455)	(0.435)	(0.453)
R&D expenditure (log)	0.479^{**}		0.343	0.152	0.316	0.080
	(0.217)		(0.233)	(0.237)	(0.233)	(0.232)
Observations	7,663	6,175	6,175	6,175	6,175	6,175
Log Likelihood	-141.889	-203.602	-137.335	-130.197	-137.150	-129.549

Note: Robust standard errors are shown in parentheses. *p<0.1; **p<0.05; ***p<0.01

Table 2: The 2nd Hypothesis

	Dependent Variable: Lobbied			
	2003–2008	2005–2008	2011–2012	2011–2012
	(1)	(2)	(3)	(4)
product life-cycle (squared)	0.038	0.046**	0.064***	0.092***
× **patent (stock, thousands)**	(0.029)	(0.024)	(0.024)	(0.039)
patent (stock, thousands)	−2.603	−3.140**	−4.136***	−5.840***
	(2.063)	(1.661)	(1.715)	(2.783)
capital expenditure (log)	0.587	0.930*	−0.952*	−1.194
	(0.747)	(0.578)	(0.744)	(1.695)
employees (log)	−0.047	−0.084	0.152	1.393***
	(0.847)	(0.651)	(0.648)	(1.220)
plants and equipments (log)	0.316	0.041	1.274***	2.725***
	(0.802)	(0.631)	(0.714)	(1.940)
revenue (log)	0.019	0.074	0.002	−0.921
	(0.857)	(0.674)	(0.665)	(1.320)
R&D expenditure (log)	0.316	0.208	−0.032	−1.113*
	(0.420)	(0.323)	(0.365)	(0.647)
Observations	4,023	3,193	1,291	1,291
Log Likelihood	−42.858	−75.382	−47.686	−12.966

Note: Robust standard errors are shown in parentheses. *p<0.1; **p<0.05; ***p<0.01
(1) US-Chile & US-Peru FTAs excluded, (2) US-Peru FTA excluded, (4) US-Panama FTA

C.2.2 Patent Citation Lag (SIC, cited between 1975 and 1995)

Following Bilir (2014), I also calculate the expected mean citation lag using the concordance file between the United States Patent Classification (USPC) and SIC (3 digits), instead of NAICS (4 digits). As shown in the following two tables, the main results stay the same.

Table 3: The 1st Hypothesis

	Dependent Variable: Lobbied					
	(1)	(2)	(3)	(4)	(5)	(6)
product life-cycle (squared)				0.039^{***}		
× patent (stock, thousands)				(0.015)		
product life-cycle (squared)						0.036^{***}
× patent (reassign, thousands)						(0.013)
patent (stock, thousands)		0.930^{***}	0.249^{**}	-2.477^{***}		
		(0.111)	(0.107)	(1.081)		
patent (reassign, thousands)					0.273^{**}	-2.304^{***}
					(0.108)	(0.943)
capital expenditure (log)	0.437		0.107	−0.205	0.095	−0.149
	(0.394)		(0.437)	(0.461)	(0.436)	(0.450)
employees (log)	0.199		0.012	0.097	−0.039	0.027
	(0.469)		(0.478)	(0.491)	(0.481)	(0.494)
plants and equipments (log)	0.576^{*}		0.608^{*}	0.833^{**}	0.622^{*}	0.829^{**}
	(0.476)		(0.466)	(0.480)	(0.466)	(0.481)
revenue (log)	−0.190		0.082	0.100	0.102	0.080
	(0.499)		(0.526)	(0.519)	(0.525)	(0.516)
R&D expenditure (log)	0.179		0.054	−0.097	0.033	−0.108
	(0.277)		(0.301)	(0.295)	(0.301)	(0.291)
Observations	5,912	4,768	4,768	4,768	4,778	4,778
Log Likelihood	-102.129	-140.642	-97.259	-93.837	-96.697	-92.743

Note: Robust standard errors are shown in parentheses. *p<0.1; **p<0.05; ***p<0.01

Table 4: The 2nd Hypothesis

	Dependent Variable: Lobbied			
	2003–2008	2005–2008	2011–2012	2011–2012
	(1)	(2)	(3)	(4)
product life-cycle (squared)	0.026*	0.025*	0.044***	0.083**
× patent (stock, thousands)	(0.014)	(0.015)	(0.015)	(0.040)
patent (stock, thousands)	−1.769*	−1.720*	−2.723**	−5.090**
	(1.005)	(1.012)	(1.086)	(2.590)
capital expenditure (log)	0.734	0.710	−1.498***	−4.307*
	(0.505)	(0.488)	(0.469)	(2.327)
employees (log)	−0.369	−0.381	0.674	5.669***
	(0.595)	(0.576)	(0.580)	(1.967)
plants and equipments (log)	0.336	0.470	1.292***	3.486***
	(0.538)	(0.529)	(0.371)	(1.208)
revenue (log)	0.329	0.295	0.582	0.160
	(0.560)	(0.550)	(0.437)	(1.062)
R&D expenditure (log)	0.019	−0.023	−0.379	−2.412***
	(0.365)	(0.347)	(0.300)	(0.620)
Observations	3,151	2,491	971	971
Log Likelihood	−50.024	−54.540	−32.255	−6.113

Note: Robust standard errors are shown in parentheses. *p<0.1; **p<0.05; ***p<0.01
(1) US-Chile FTA excluded, (2) US-Peru FTA excluded, (4) US-Panama FTA

C.2.3 Patent Citation Lag (85%, 75% quantiles)

I also calculate other robust statistics from the distribution of US patent citation, such as 85% and 75% quantiles, and use them as a proxy for product life-cycle as follows. I did so mainly because the distribution of patent citation is often skewed to the right as patent citations are truncated in the last year of our observation. This implies that the expected mean citation lag can also be driven by some of the outliers.

	Dependent Variable: Lobbied			
	(1)	(2)	(3)	(4)
product life-cycle (squared, 85%)	0.023***			
× **patent (stock, thousands)**	(0.007)			
product life-cycle (squared, 85%)		0.021***		
× **patent (reassign, thousands)**		(0.006)		
product life-cycle (squared, 75%)			0.030***	
× **patent (stock, thousands)**			(0.009)	
product life-cycle (squared, 75%)				0.026***
× **patent (reassign, thousands)**				(0.007)
patent (stock, thousands)	−7.196***		−6.501***	
	(2.193)		(1.960)	
patent (reassign, thousands)		−6.510***		−5.610***
		(1.801)		(1.581)
capital expenditure (log)	0.265	0.298	0.234	0.287
	(0.434)	(0.433)	(0.433)	(0.431)
employees (log)	0.075	0.103	0.009	0.042
	(0.412)	(0.416)	(0.421)	(0.423)
plants and equipments (log)	0.514	0.474	0.561	0.507
	(0.468)	(0.468)	(0.467)	(0.467)
revenue (log)	−0.144	−0.088	−0.140	−0.093
	(0.439)	(0.440)	(0.446)	(0.446)
R&D expenditure (log)	0.165	0.078	0.171	0.089
	(0.233)	(0.228)	(0.235)	(0.230)
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Observations	6,175	6,175	6,175	6,175
Log Likelihood	−129.651	−128.170	−129.759	−128.826

Note: Robust standard errors are shown in parentheses. *p<0.1; **p<0.05; ***p<0.01

C.2.4 Firm Heterogeneity: Forward Patent Citation

I also use forward patent citation, that is, the number of citations each firm receives after its patents are granted and their documents are disclosed, as a firm-level proxy for product life-cycles. This is mainly due to the fact that firms within industry also vary significantly in terms of their imitation risks and thus the previous, sector-specific measurement may be imperfect to capture the remaining variation. In the following table, it should be noted that the negative coefficients attached to the amount of patents owned by each firm are no longer statistically significant.

	Dependent Variable: Lobbied				
	(1)	(2)	(3)	(4)	(5)
forward patent citations (mean)			0.244^{***}		
× patent (stock, thousands)			(0.072)		
forward patent citations (mean)					0.225^{***}
× patent (reassign, thousands)					(0.062)
forward patent citations (mean)			0.017^{***}		0.016^{***}
			(0.022)		(0.024)
patent (stock, thousands)		0.225^{**}	−0.105		
		(0.097)	(0.140)		
patent (reassign, thousands)				0.232^{**}	−0.091
				(0.097)	(0.134)
capital expenditure (log)		0.245	0.127	0.260	0.131
		(0.408)	(0.401)	(0.405)	(0.398)
employees (log)	0.326	0.238	0.210	0.217	0.203
	(0.424)	(0.412)	(0.445)	(0.414)	(0.450)
plants and equipments (log)	0.815^{***}	0.519	0.723^{**}	0.517	0.736^{**}
	(0.297)	(0.455)	(0.469)	(0.454)	(0.471)
revenue (log)	−0.275	−0.230	−0.273	−0.221	−0.236
	(0.448)	(0.435)	(0.465)	(0.435)	(0.470)
R&D expenditure (log)	0.506^{**}	0.343	0.359	0.316	0.305
	(0.218)	(0.233)	(0.238)	(0.233)	(0.237)
Year-by-Industry FE	YES	YES	YES	YES	YES
Observations	7,663	6,175	6,106	6,175	6,106
Log Likelihood	-142.741	-137.335	-130.985	-137.150	-130.177

Note: Robust standard errors are shown in parentheses. *p<0.1; **p<0.05; ***p<0.01

C.2.5 Endogeneity: Internal Patent Citation

Despite the fact that sectors may differ in terms of their product life-cycle length (Bilir, 2014) which offers an exogenous source of variation in their risks of imitation (Helpman, 1993), the endogenous growth theory in trade also suggests that product cycles may evolve as a result of trade liberalization, instead of working as its causes (Grossman and Helpman, 1991b, 1994).

To address the issue of endogeneity, I study the effect of marginal cost of imitation. I do so by examining how often each firm cites its own patents, which presents their interdependence for industrial application, and use it as a proxy for their scientific barriers against other firms. When the scientific barriers are too high to imitate, I find that patent owners are less worried about imitation by other competing firms and thus are less likely to lobby for patent protection.

	Dependent Variable: Lobbied		
	(1)	(2)	(3)
internal patent citations (log)			-0.089^{***}
× patent (stock, thousands)			(0.038)
internal patent citations (log)		-0.239^{**}	-0.046
		(0.134)	(0.157)
patent (stock, thousands)	0.225^{**}	0.296^{***}	0.576^{***}
	(0.097)	(0.106)	(0.153)
capital expenditure (log)	0.245	0.221	0.263
	(0.408)	(0.406)	(0.417)
employees (log)	0.238	0.163	0.349
	(0.412)	(0.437)	(0.443)
plants and equipments (log)	0.519	0.525	0.100
	(0.455)	(0.453)	(0.474)
revenue (log)	-0.230	-0.159	0.031
	(0.435)	(0.461)	(0.468)
R&D expenditure (log)	0.343	0.473^{*}	0.490^{*}
	(0.233)	(0.247)	(0.250)
Year FE	YES	YES	YES
Industry FE	YES	YES	YES
Observations	6,175	6,175	6,175
Log Likelihood	-137.335	-135.711	-132.817

Note: Robust standard errors shown in parentheses. *p<0.1; **p<0.05; ***p<0.01

C.2.6 R&D (Patent) Intensity

Lastly, I also create a different subset of firms as the unit of analysis. In particular, I increase the number of firms in my sample by also including those from less R&D intensive sectors and check whether the results stay the same. Note that as more firms are selected from less R&D intensive industries, their lobbying activities as a whole are more likely to target other policies that are irrelevant for patent protection, allowing us to add more noises to our sample.

	Dependent Varialbe: Lobbied			
	85% quantile		50% quantile	
	(1)	(2)	(3)	(4)
product life-cycle (squared)	0.047^{***}		0.015^{**}	
× patent (stock, thousands)	(0.018)		(0.008)	
product life-cycle (squared)		0.032^{***}		0.014^{**}
× patent (reassign, thousands)		(0.014)		(0.007)
patent (stock, thousands)	-4.394^{***}		-1.281^{*}	
	(1.813)		(0.792)	
patent (reassign, thousands)		-2.903^{**}		-1.173^{*}
		(1.392)		(0.738)
capital expenditure (log)	0.150	0.230	0.390	0.482^{*}
	(0.457)	(0.456)	(0.353)	(0.347)
employees (log)	0.041	0.092	−0.406	−0.403
	(0.480)	(0.474)	(0.399)	(0.396)
plants and equipments (log)	0.658	0.575	0.515^{*}	0.420
	(0.486)	(0.486)	(0.390)	(0.381)
revenue (log)	−0.183	−0.155	−0.008	0.005
	(0.487)	(0.480)	(0.423)	(0.419)
R&D expenditure (log)	0.080	0.017	0.358^{*}	0.338^{*}
	(0.245)	(0.239)	(0.213)	(0.212)
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Observations	4,461	4,461	6,888	6,888
Log Likelihood	−114.092	−114.350	−176.013	−176.131

Note: Robust standard errors are shown in parentheses. $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

C.3 Model Specification

C.3.1 Heckman Selection Model

I also use the Heckman selection model to examine how the risks of imitation drive exporting firms to evade imitation by other competing firms throughout their lobbying activity. As Kim (2017, 2018) suggests, using an indicator of whether each firm lobbied on a congressional bill could potentially lead to a biased inference as one misses the information of how much money was also spent to pass the bill. Following the logic, I regressed the amount of money each firm spent to ratify the US trade agreements on the interaction term in the outcome equation and found that the results stay robust to the selection process.

	Lobbied	Amount of Lobbying (millions)
	(1)	(2)
product life-cycle (squared)		0.008^{***}
× patent (stock, thousands)		(0.003)
product life-cycle (squared)	-0.347^{***}	0.009
	(0.129)	(0.006)
patent (stock, thousands)	-2.543^{***}	-0.715^{***}
	(0.820)	(0.271)
capital expenditure (log)	2.537	0.186
	(2.192)	(0.157)
employees (log)	0.850	−0.201
	(2.388)	(0.156)
plants and equipments (log)	−4.157	0.241
	(2.750)	(0.161)
revenue (log)	−1.665	0.099
	(2.719)	(0.162)
R&D expenditure (log)	1.413	0.142^{**}
	(1.148)	(0.070)
Constant	85.553^{*}	-6.752^{***}
	(47.274)	(1.142)
Observations	6,175	
Adjusted R^2	0.301	

Note: Standard errors shown in parentheses. *p<0.1; **p<0.05; ***p<0.01

C.3.2 Keyword-assisted Topic Model

Despite its detailedness, one of the key limitations of using `LobbyView` (Kim, 2018) is that one cannot see whether each client is lobbying for or against a specific bill under lobbying reports. This empirical challenge has led researchers in the field of international political economy to employ various methods, ranging from estimating "the 'direction' of lobbying for each report" by combinding external sources of information (Baccini et al., 2019, 264) to using LDA topic models to check whether there is a keyword representing the mechanism of one's theoretical interest (Kim, 2017). Yet, the latter approach is not without its own limitation, where one can only explore the mechanism but without specifying it before model fitting (Eshima et al., 2020).

To extract information about US firms' lobbying objectives and their connections with the underlying motives more accurately, I use a keyword-assisted topic model proposed by Eshima et al. (2020). In this exercise, I pre-specify the keywords, such as "counterfeit," "theft," and "piracy," all of which represent my substantive interests, the risks of imitation. I also include other keywords, such as "protection," to connect these underlying motives with their position vis-à-vis the US trade agreements on patent protection.

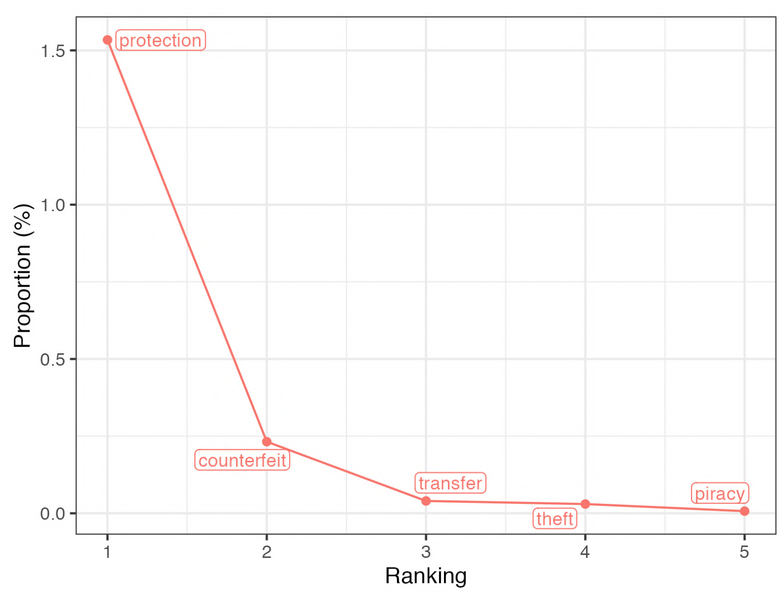

Figure 1: **The Proportion of Keywords: associated with Imitation Risks**

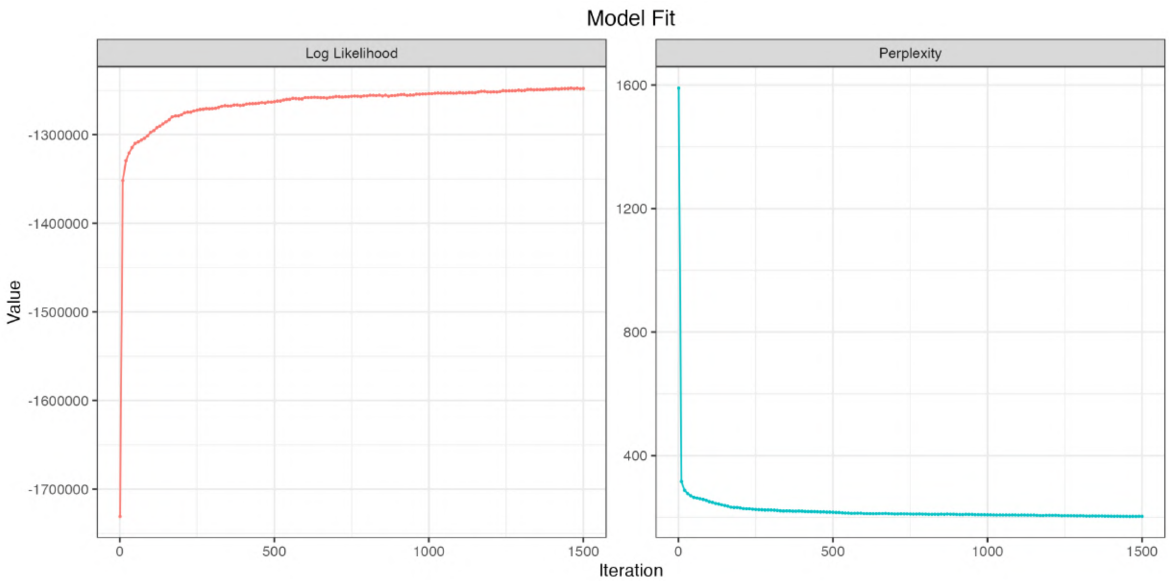

Figure 2: **Goodness of Fit: Keyword-assisted Topic Modeling**

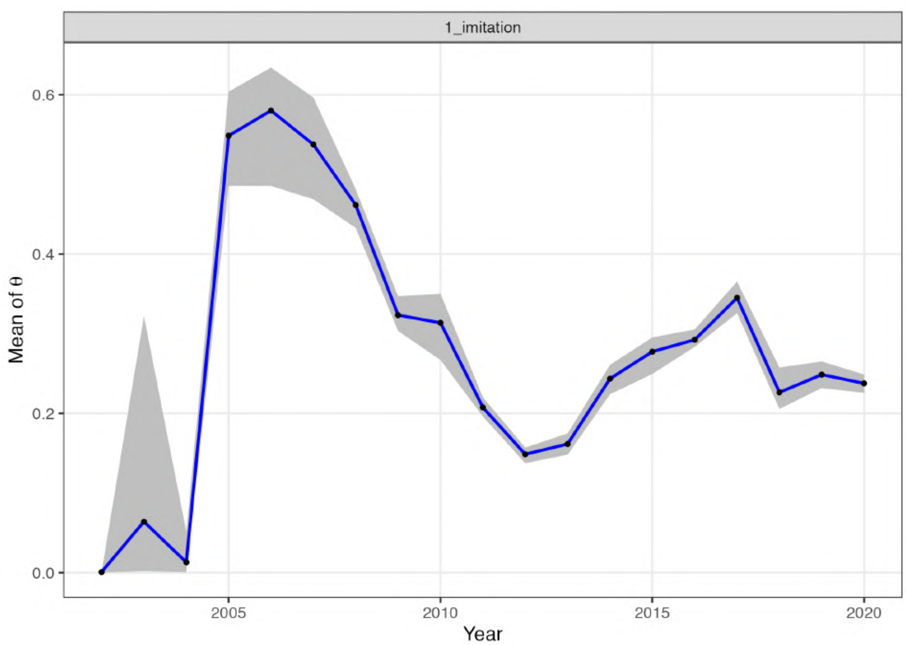

Figure 3: **The Time-trend of Topics: associated with Imitation Risks**

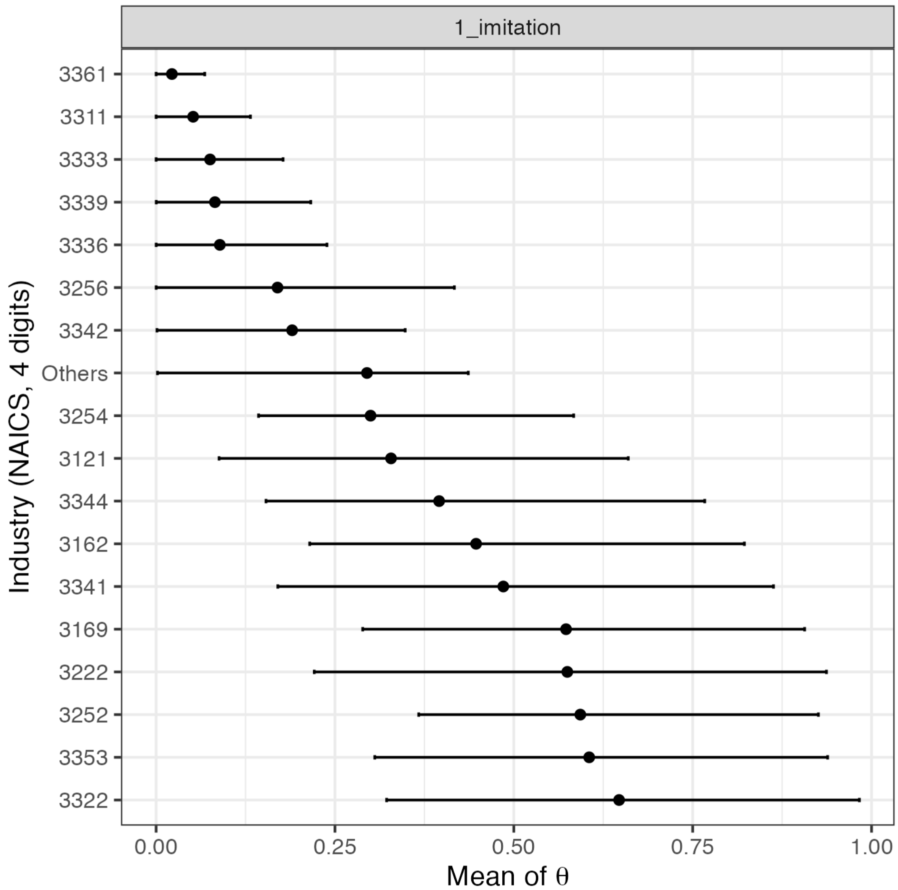

Figure 4: **The Document-topic Distributions across Industry (NAICS)**

Then I check how the topic proportion varies across US manufacturing sector using `keyATM`, whose results are summarized in Figure 4. It shows that US firms who manufacture products with long life-cycles, such as Cutlery and Handtool Manufacturing (3322) and Converted Paper Product Manufacturing (3222), are more likely to state their exposure to the risk of *imitation* as a ground for their lobbying for patent *protection* than other manufacturing sectors whose products exhibit short product life-cycles, such as Communications Equipment Manufacturing (3342) and Motor Vehicle Manufacturing (3361). The main reason why the confidence intervals are larger for those with long product life-cycles is that these industries own a relatively small amount of patents than the others, rendering international patent protection less salient as a political issue among non-patent holders than those serving other manufacturing sectors.

D TRIPS+ in the US Trade Agreements

Free Trade Agreement between the United States and Singapore

Article 16.7, Article 16.8, Article 16.9, Article 16.10

Free Trade Agreement between the United States and Chile

Article 15.5, Article 17.9, Article 17.10, Article 17.11, Article 17.12

Free Trade Agreement between the United States and Australia

Article 17.9, Article 17.10, Article 17.11, Article 17.12

Free Trade Agreement between the United States and Morocco

Article 15.9, Article 15.10, Article 15.11, Article 15.12

Free Trade Agreement between the Dominican Republic, Central America and the United States

Article 15.9, Article 15.10, Article 15.11, Article 15.12

Agreement between the Government of the Kingdom of Bahrain and the Government of the United States of America on the Establishment of a Free Trade Area

Article 14.8, Article 14.9, Article 14.10, Article 14.11

Agreement between the Government of the United States of America and the Government of the Sultanate of Oman on the Establishment of a Free Trade Area

Article 15.8, Article 15.9, Article 15.10

Free Trade Agreement between the United States and Peru

Article 16.9, Article 16.10, Article 16.11, Article 16.12, Article 16.13

The United States-Colombia Trade Promotion Agreement

Article 16.9, Article 16.10, Article 16.11, Article 16.12, Article 16.13

Free Trade Agreement between the Republic of Korea and the United States of America

Article 18.8, Article 18.9, Article 18.10, Article 18.11, Article 18.12

The United States-Panama Trade Promotion Agreement

Article 15.9, Article 15.10, Article 15.11, Article 15.12, Article 15.13

References

Aghion, Philippe, Ufuk Akcigit, and Peter Howitt (2014). What do we learn from schumpeterian growth theory? In *Handbook of economic growth*, Volume 2, pp. 515–563. Elsevier.

Aghion, Philippe and Peter Howitt (1990). A model of growth through creative destruction.

Arora, Ashish, Sharon Belenzon, and Lia Sheer (2021). Knowledge spillovers and corporate investment in scientific research. *American Economic Review 111*(3), 871–98.

Baccini, Leonardo, Iain Osgood, and Stephen Weymouth (2019). The service economy: Us trade coalitions in an era of deindustrialization. *The Review of International Organizations 14*, 261–296.

Bernheim, B Douglas and Michael D Whinston (1986). Menu auctions, resource allocation, and economic influence. *The quarterly journal of economics 101*(1), 1–31.

Bhaven (2011). USPTO Patent and Citation Data.

Bilir, L Kamran (2014). Patent laws, product life-cycle lengths, and multinational activity. *American Economic Review 104*(7), 1979–2013.

Caballero, Ricardo J and Adam B Jaffe (1993). How high are the giants' shoulders: An empirical assessment of knowledge spillovers and creative destruction in a model of economic growth. *NBER macroeconomics annual 8*, 15–74.

Eshima, Shusei, Kosuke Imai, and Tomoya Sasaki (2020). Keyword assisted topic models. *arXiv preprint arXiv:2004.05964*.

Farrell, Joseph and Carl Shapiro (2008). How strong are weak patents? *American Economic Review 98*(4), 1347–1369.

Grossman, Gene M and Elhanan Helpman (1991a). Endogenous product cycles. *The economic journal 101*(408), 1214–1229.

Grossman, Gene M and Elhanan Helpman (1991b). Quality ladders and product cycles. *The Quarterly Journal of Economics 106*(2), 557–586.

Grossman, Gene M and Elhanan Helpman (1991c). Quality ladders in the theory of growth. *The review of economic studies 58*(1), 43–61.

Grossman, Gene M and Elhanan Helpman (1992). Protection for sale.

Grossman, Gene M and Elhanan Helpman (1994). Endogenous innovation in the theory of growth. *Journal of Economic Perspectives 8*(1), 23–44.

Hall, Bronwyn H, Adam B Jaffe, and Manuel Trajtenberg (2001). The nber patent citation data file: Lessons, insights and methodological tools.

Helpman, Elhanan (1993). Innovation, imitation, and intellectual property rights. *Econometrica 61*(6), 1247–1280.

Kim, In Song (2017). Political cleavages within industry: Firm-level lobbying for trade liberalization. *American Political Science Review 111*(1), 1–20.

Kim, In Song (2018). Lobbyview: Firm-level lobbying & congressional bills database. *Unpublished manuscript, MIT, Cambridge, MA. http://web. mit. edu/insong/www/pdf/lobbyview. pdf Google Scholar Article Location*.

Lemley, Mark A and Carl Shapiro (2005). Probabilistic patents. *Journal of Economic Perspectives 19*(2), 75–98.

Romer, Paul M (1990). Endogenous technological change. *Journal of political Economy 98*(5, Part 2), S71–S102.