Global regulatory agreements and corporations: does innovation facilitate cooperation?*

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Abstract

This study argues that corporate interests might help accelerate the adoption of formal regulatory agreements at the global level. The most innovative multinational firms within a given industry can profit from global rules that demand the discontinuation of old products and their replacement for newer, more profitable ones. These firms either push for the design of favorable global agreements or at least do not oppose them, either of which can accelerate the adoption of regulatory initiatives at a global scale. First, event-history analyses of the signature and ratification of the three conventions that comprise the global regime for regulation of hazardous chemicals - the Basel (1989), the Rotterdam (1998) and the Stockholm (2001) Conventions - largely corroborate the theory. Results show that the Stockholm Convention had a quicker pace of adoption than the other two, being the agreement that effectively allows firms to profit from product substitution. Moreover, country-level evidence indicates that higher levels of innovativeness in the domestic chemicals' industry are associated with a greater probability of adherence to the regime. Finally, qualitative analysis of American firms' views on the Stockholm Convention indicate that firms with higher levels of innovativeness tend to see the Convention's rules as an opportunity, while those that lag behind overwhemingly frame the Convention as a risk. Overall, global regulation is shown to be a function of firms' characteristics as much as of scientific knowledge and of other political factors. This has profound implications for how governments foster competition and innovation in industries that produce adverse externalities and demand global cooperation.

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1 Introduction

We observe extraordinary variation in the globalization of regulatory agreements. While some rules are promptly agreed upon by governments and quickly spread across countries, other seem to take much longer to do so (Braithwaite and Drahos, 2000; Holzinger, Knill, and Sommerer, 2008). What drives those differences? In this study, I argue that corporate influence is a key factor in explaining why some global regulatory agreements are more quickly and easily adopted across countries than others.

First, I define "regulations" as rules that states enact to either prescribe, proscribe or limit industrial activity that produces negative externalities (Urpelainen, 2010). This definition thus encompasses environmental, health and safety rules, but not taxes, subsidies or standards set to control the activities of banks and other financial institutions, for example. I employ the terms "regulation", "rules" and "regulatory policies" interchangeably. Also, I consider that the adoption of global regulatory agreements is a government act carried out with the purpose of fulfilling the aforementioned goals. The adoption of global regulatory agreements affect firms' activities and, consequently, their interests and behavior. More specifically, this study focuses on formal regulatory agreements, signed and ratified by countries and thus, legally binding according to the tenets of international law.

My overarching argument is based on the notion that there is variation on individual firms' willingness and capabilities to shape global regulation, and in different directions. Such variation is based on how well-positioned firms are to innovate in order to adapt to new regulatory environments and to advocate for the establishment of those. More specifically, I explore variation in firms' interests and capabilities to affect sovereign governments' decisions to adopt welfare-enhancing rules aimed at addressing complex global issues, such as environmental protection and public health. I look at how the preferences and the behavior of firms regarding processes of global regulation can shed light into why we observe so much variation in the timing and in the pace of rules' adoption across countries. Ultimately, I

analyze the conditions under which the innovational capabilities of private businesses help to shape global governance.

I define innovation as the process by which corporations adjust their products and processes in response to changes in their external environment. This definition encompasses firms' overall ability to adapt their outputs and their methods of production in order to adjust to new regulatory rules imposed by governments. Such ability relates to what Christensen (1997) calls sustaining innovation, as opposed to his concept of disruptive innovation. Sustaining innovation improves products and processes for mainstream customers in established markets, so it encompasses a much more predictable process than disruptive innovation. Based on this definition, my overarching argument posits that firms that are better at innovating (that is, in adjusting to new rules adopted by governments) are better positioned to reap more benefits from new regulatory environments, relative to less innovative firms within the same industry. It follows that more innovative firms should benefit not only from innovating but also from pushing for the new rules in question in order to obtain an advantage over their less innovative competitors. This rationale is underpinned by the tradition in the business literature that posits that regulation is mostly a product of firms' demand, acquired and operated on corporations' behalf (Stigler, 1971). I employ the terms innovation and innovativeness interchangeably and, unless noted otherwise, with the concept of sustaining innovation in mind.

Building on these traditions, I go one step further and contend that firms' ability and willingness to support global regulatory initiatives increases the more they can reap benefits from innovation, relative to their less innovative competitors. This is because regulations can increase demand for firms' innovative and more profitable products and processes (Perlman, 2019). Under those conditions, not only adjusting to regulation but actively advocating for it is a profit-maximizing strategy for firms.

These highly innovative firms should then be more likely to actively support regulatory initiatives. Supportive corporate activity should then facilitate the adoption of rules by

governments. The facilitation of rule adoption happens through firms' ability to provide specialized information to governments (Figueiredo, 2002). By lobbying governments both at the domestic and at the international level, highly innovative firms in complex industries provide information that encourage policymakers to move forward with the adoption of regulations those firms are interested in promoting.

The observable implication of such process is that global regulatory initiatives can be accelerated by the means of the information provided by the most innovative firms, especially in industries where innovation is a relevant component of cost structure. In simpler words, innovative firms within a given industry are more likely to lobby governments in support of regulatory initiatives, which then accelerates their adoption process, globally.

This particular section focuses on the chemicals' global regulatory regime, comprised by the Basel (1989), the Rotterdam (1998) and the Stockholm Conventions (2001). These formal, global agreements have been adopted to regulate the production, use, trade and disposal of hazardous chemicals. Specifically, this study aims at validating the hypothesis that the more innovative firms within a given industry have to win from regulatory stringency, the more they support global rules, which in turn accelerates the adoption of such rules. The chemicals regime offers the advantage of holding several attributes constant while allowing to explore variation in their specific goals. While the Stockholm Convention strictly restricts and bans the production and use of several harzadous chemicals, the Rotterdam and the Basel Conventions focus on restrictions that are relatively less appealing to innovative chemicals manufacturers - prior informed consent on trade and guidelines for waste disposal, respectively. That is, the Stockholm Convention is the agreement in the regime that effectively provides innovative firms with the opportunity of restricting older, less profitable products at a global scale and to start marketing newer, more profitable replacements.

To provide support for my argument, I first conduct a comparative analysis of the three agreements in the chemicals' regime to test the observable implication that the Stockholm Convention should display a faster pace of signature and ratification relative to the

other two conventions. To do so, I estimate a series of survival models whose dependent variables are the times to signature and ratification of each of the three agreements in the chemicals regimes. Results support the hypothesis that the Stockholm Convention is the one with the fastest rate of adoption among the three.

Then, I move towards offering evidence at the country-level that supports the idea that the more innovative the chemical industry in a given country is, the greater the likelihood that it will adhere to the conventions in the chemicals' regime. I estimate accelerated-failure (AFT) models where the dependent variable is the time to signature and to ratification in the three conventions. The main explanatory variable is the number of patents each of the 190 countries in the sample have registered in the organic fine chemicals and in the basic chemical materials industries, which are the main two industries that produce the substances regulated by the conventions. Results indicate that a higher number of patents in the aforementioned industry (as a proportion of each country's GDP) is associated with higher likelihoods of signing and ratifying the conventions, in the presence of several covariates.

Finally, I collect American firms' views on the Stockholm Convention to provide firm-level evidence that higher innovativeness is associated with supportive positions towards stringent global rules. Using the EDGAR database provided by the Securities and Exchange Commission (SEC), I look up which firms have mentioned the Stockholm Convention in their filings and whether they indicate it as a risk or as an opportunity for the future of their businesses. Less innovative firms (as collected from BvD Orbis and measured by each company's number of registered patents) overwhemingly depict the Stockholm Convention as a risk, while the leaders in innovation in the industry frame it as an opportunity. This finding also corroborates the latest trends in IPE literature that firm-level heterogeneity holds great promise to explain variation in global phenomena (Kim and Osgood, 2019).

This study (which is part of a book project) is organized as follows. First, I offer a brief literature review of international relations theories that aim at explaining variation in global regulation. Then, I offer my own argument to explain such variation, focused on

the interests and capabilities of the private sector. The sections after that describe the data and methods employed to provide support for my overarching hypothesis. The final section concludes with broader implications for global governance.

2 Literature Review

Several theories aim at explaining why there is variation in the degree to which different aspects of the global economy are formally regulated. Hegemonic stability theory (HST) posits that an hegemon in the international system has both the interest and the capabilities to provide the system with public goods, including regulations (Keohane, 1980; Kindleberger, 1986). Inspired by HST, Drezner (2007) posits that regulatory convergence takes place when there is a concert among great powers and that regimes are strongest when the dominant states in a given issue area converge in their understanding of what the rules should be. The role of firms and other non-state actors in HST and in approaches inspired by it is at most ancillary.

Another tradition analyzes the role of non-materialist explanations in regime creation, as well as the role played by non-state actors. As Green (2013) defines it, under the set of more non-materialist explanations for how rules and regimes come to be, private actors are autonomous and able to influence world politics mostly based on information and discourse, that is, on their informational authority over the topic. For instance, Meyer et al. (1997) argue that the international environmental regime has been produced through a process by which NGOs' discourse led to the negotiation of treaties and organizations, which then facilitated convergence. Relatedly, Haas (1992) sees coordination leading to convergence as an outcome of epistemic communities, whose control over knowledge and information shape the diffusion of ideas that influence behavior and determine coordination.

Several other works have also highlighted the scientific credibility of ideas and their salience as determinants of international regimes (Frank, 1997; Mitchell et al., 2006, e.g.),

but evidence from several case studies show that both firms and governments exert the precautionary principle in a quite political fashion, indicating that scientific soundness alone around regulatory initiatives cannot explain very well why some policies rapidly diffuse at the global level while others do not. Such insights have been corroborated by more contemporary research, which shows that government decisions to push for new regulations and to harmonize them across countries is often science-based, but not detached from economic interests and politics (Levy and Rothenberg, 2002; Perlman, 2018, 2019). That is, actors other than states affect global regulatory processes and ideas do play a role in those, but they are not isolated from materialist interests. If we focus on firms within the broad category of non-state actors, the materialist foundations become even more apparent.

That being said, perhaps the strand of literature that takes business influence on regulatory regimes more seriously is the one that explores private regulation. Private regulations are rules set by private-sector organizations rather than by states. Work in this tradition seeks to explain the conditions under which states delegate regulatory powers to private organizations that then promote regulatory standardization and the distributional consequences of such processes (Bartley, 2007; Büthe and Mattli, 2011). This literature also examines the informational advantage that private actors hold over the often highly technical knowledge required to regulate their activities, which governments tend to lack. For instance, the International Electrotechnical Commission defines itself as a "quasi-governmental" organization as its members are actually national committees or bodies from countries' electrotechnical sectors (Büthe, 2010). It is evident that these national committees or bodies are better equipped to define regulatory standards rather than government officials.

The line of work around private regulation enhances the idea that firms tend to prefer private regulation over standards enacted by states. This plausible hypothesis is directly tested by Malhotra, Monin, and Tomz (2018), who employ an experimental design to show that by adopting voluntary, private standards, firms can successfully dissuade citizens, governments and activists from demanding stiffer public regulations, as long as corporate

participation in these processes is broad enough. Their results suggest that perhaps firms coordinate to set desired levels of voluntary regulation to collectively prevent more stringent public regulation. While convincing, Malhotra, Monin, and Tomz (2018)'s findings leave a puzzle to be answered because we still observe public regulations being adopted by governments. This means that either firms are not always successful in dissuading constituencies from demanding and supporting public regulation, or that some individual firms are particularly interested and successful in promoting formal regulation that attend to their interests. This project focuses on considering the latter.

So far, I have discussed theories that explain variation in global regulatory regimes by means of variation in: the distribution of power in the international system (HST); states' demand for agreements given the constraints imposed by the fundamental characteristics of international politics (as advanced by Keohane, 1982); bargaining among great powers (Drezner, 2007; Kalyanpur and Newman, 2019) and the role of non-state actors in more non-material ways (Haas, 1992, e.g.). In a way, Raustiala (1997) had anticipated those mechanisms: "International regimes develop in three general ways: through coercion, convergence (harmony) or mutual state choice" (p. 482). However, he missed considering the role of non-state actors and the private informational authority they hold over states (Büthe and Mattli, 2011, e.g.). The main gap I identify is that none of those traditions explain heterogeneity across firms within industries in their preferences regarding regulation. Moreover, none of those explain how firm heterogeneity interacts with governments' preferences and capabilities to shape global regulatory agreements.

As reviewed, when it comes to firm participation in regulatory politics, one common and widely accepted assumption is that firms generally oppose regulations and, when they are inevitable, they prefer to direct the locus of regulatory action to private authority, which they can arguably control better (Hafner-Burton, Victor, and Lupu, 2012, p. 95). As I have noted, it could as well be that firms have a general preference for private regulation, but this puts forward the puzzle that, empirically, we observe firms' manifestations and

evidence of attempts of influencing global, state-led agreements, and often in a supportive manner. How can we make sense of such evidence? To be fair, the assumption that firms unrestrictedly oppose government regulation has long been challenged by the literature in industrial organization, which traditionally treats regulation as a strategic tool used by firms (Peltzman, 1976; Stigler, 1971). Such treatment implies that firms can derive benefits from regulation, such as the competitive advantage they get from setting barriers to entry for competitors who have fewer resources to adapt to new regulatory burdens, including at a global scale (Porter, 1990).

Another important aspect of how firms can win from regulation is the idea that large corporations that serve global markets prefer the costs of coordination and harmonization (and even when such harmonization leads to more stringent regulatory standards) to the burden of dealing with a multitude of rules in several countries (Levy and Prakash, 2003; Pollack and Shaffer, 2001, e.g.). It follows from this reasoning that harmonization can be a rational choice for global firms and, as such, that they are likely to be involved with convergence processes on which they have a stake. In other words, firms do not simply react to and interact with the structures of global governance, as they are an integral part of the process through which global governance is shaped (Levy and Newell, 2006).

In the next section, I take the backbone of the literature on private regulation, that is, firms' informational advantage as a starting point for my theory. If firms have an informational advantage, they should be able to credibly and strongly influence state-led global regulatory initiatives. That is, a puzzle remains to be explained: if firms are able to reach their most preferred outcomes from regulation by private means, why do they sometimes try to interfere with fomal regulatory regimes, led by states? In other words, when do firms win from formal regulation and actively try and succeed to facilitate their adoption? The case of the hazardous chemicals' regime offers some insights.

3 Argument

My theory starts with the common assumption that firms are profit-maximizing actors that even though might be concerned about societal welfare, will hardly put that broad goal ahead of profits. Even recent accounts on firms' renovated pledge to attend to societal interests by providing broad stakeholder value in detriment to the traditional and narrow approach to primarily satisfy shareholders (Roundtable, 2019) has been met with skepticism. That is, even if firms have multiple interests and genuinely care about providing some societal benefits, their actions are usually and primarily guided by profit maximization.

The assumption on corporate interest lying primarily in profit maximization has often been accompanied by the conclusion that firms should overall oppose regulation, for they are generally costly and impose constraints on firm activity (Pfeffer and Salancik, 1978; Zhang and Greve, 2016). On the other hand, others have challenged this conclusion and advanced the idea that it is possible for firms to profit from regulation (Porter, 1990), which should lead to some conditions under which firms would actively advocate and demand regulations (Peltzman, 1976; Perlman, 2019; Stigler, 1971). I build my theory on the conditions under which firms will suport formal, global regulatory agreements on such tradition.

Following the profit-maximization assumption and the possibility that firms might win from regulation, the second building block of my theory is that firms are rational actors that are presented with a couple of choices when governments consider to advance with a regulation that affects their activities. That is, at the prospect of regulation, potentially affected firms can choose to: (1) neglect the regulation and pay the costs of non-compliance, which could ultimately drive the firms out of business; (2) actively lobby and/or litigate against the regulation as a means to block or at least delay it for as long as possible; (3) passively comply with the regulation and absorb the costs that stem from it, that is, pay the costs associated with adjusting to the regulation in question but not act to facilitate rule adoption or try to block it; (4) pay the costs associated with adjusting to the regulation in

question and actively endorse its adoption.

I make these considerations under the idea that governments can reasonably enforce the rules they propose. However, I note that if the proposed regulation can be profit-maximizing for an individual firm, the lack of enforcement should not hinder firm support for regulation and compliance with it. As a matter of fact, one of the implications of my theory is that, in the absence of governments' enforcement capabilities, firms that profit from regulation can work precisely as enforcement-enhancement devices[1]. When it comes to global rules that affect industrial activity, the firms that have the capabilities to adjust their products and processes in order to lock-in competitive advantage and thus derive private benefits from the regimes will facilitate both rules adoption and compliance. In that sense, firms are the ultimate locus of compliance with industrial regulations and can enhance governments' capabilities to comply, even if those primarily lack such capabilities.

Now, going back to the options firms are presented with at the prospect of regulatory activity by governments, what affects firms' decision-making processes as rational, profit-maximizing actors? I argue that firms will decide between the four options I have just outlined based on on their position within their industry, relative to their competitors. More specifically, I contend that firms' ability to innovate in order to adjust to new regulatory rules and the extent to which they profit from such adjustment will shape their actions on how to react to government regulation, both at the domestic and at the international level. In a nutshell, the greater the firm's individual capability to innovate is relative to its competitors, the more incentives it has to not only invest in order to adapt to the new regulatory environments but also to actively persuade governments to effectively adopt the rule in question.

[1]This idea is not far from Dai (2007)'s proposed mechanism for how non-state actors help states to comply with international rules. The author argues that even relatively weak international institutions can strengthen non-state actors' capabilities to provide information, which thus helps to enhance compliance with international rules. She focuses on the role played by NGOs as "low-cost monitors" who are invested in enhancing compliance because they are the victims of state non-compliance with international rules. I argue that the role played by firms is not that different.

The idea that there is a relationship between innovativeness and preferences for regulations is not completely new. Considering that R&D is a common proxy for innovativeness, Ozer and Lee (2009) state that several empirical studies show that firms that invest more in R&D also engage in more political activity. For instance, Taylor (1997) argues that firms can employ political strategies in order to obtain advantages that facilitate the spread of new technologies. Contrary to my argument, Alt et al. (1999) claim that firms with higher asset specificity (proxied with higher expenses on R&D investment) also tend to lose more from changes in public policy, so they tend to lobby more in favor of the status quo. The difference is that this paper focuses on subsidies for the oil sector, and not on regulations as defined by this project. More aligned with my outcome of interest, Hart (2003) shows that firms that spend more on R&D also spend more on political strategy in order to secure rents from the government, and that they do so via individual action in order to reap private benefits, even in highly concentrated industries. This line of reasoning relates to the idea that firms need to obtain returns from their R&D investments and thus it makes sense for them to also invest in lobbying in order to secure the best external environment possible to maximize those returns.

There is obviously concern that investing in political activity to secure a favorable regulatory environment can provide a public good to competitors, especially in concentrated industries. But it is precisely firms' investments in innovativeness that enable them to differentiate themselves and maximize private benefits (Barney, 1991). The more firms invest in innovation, the more they can direct their political activity to reap specific private benefits that exclude their competitors (Bernhagen and Mitchell, 2009).

All of these pieces support the idea that investing in innovation and in lobbying activities aimed at securing the most profit-maximizing regulatory framework are actually complements, rather than substitutes. This is because securing the most profit-maximizing regulatory framework is key for individual firms to obtain the best returns from investment in innovation. Implicit in this argument is that such rationale makes sense at the global

level, and especially for large multinational corporations that should then try to influence global regulatory agreements.

Looking at the other outlined alternatives to firms at the prospect of regulation, innovative firms could also choose to simply not develop new products and try to block regulation. However, if the premise is that firms are profit-maximizing agents, this course of action does not make sense for innovative firms because they should profit more from innovating and from reaping quick benefits from it rather than sticking to old, less profitable products. The idea that new technology and innovation allow companies to generate more value from their new products finds support in the literature (Perlman, 2019; Raustiala and Victor, 2004). In other words, if firms have the resources to invest in innovation, not spending those on both innovation and on lobbying in support of regulations is ill-advised because they will be actually forfeiting higher profits for a while.

Relatedly, trying to block regulation alone does not always make sense for firms that compete with the highly innovative firms within a given industry because blocking tends to not be definitive. Furthermore, if the regulation does not come into place quickly, the innovative firm might still have an advantage by shaping up new market trends. The less innovative competitor does not have much option but to try to catch up, at least in the long run. Therefore, the less innovative firm has to invest at least some of its resources in innovativeness. For this firm, though, spending on lobbying means detracting important resources from innovativeness. And if it knows that its innovative peer is spending on lobbying, it should know that it has lower chances of winning. This should be enough for the less innovative competitor to devote resources to research and development in the long run. That is, the less innovative competitors that see innovative competitors investing in new products and in political activity to lock-in rules that benefit the sales of new products should be more passive about regulatory initiatives, and not invest on political activity to either accelerate or block them.

Finally, it would not be sensible for highly innovative firms to simply neglect regulation

and pay the eventual costs of non-compliance. Again, given that they have the resources and the incentives to innovate, forfeiting such competitive advantage is ill-advised because it is not profit-maximizing.

From this argument, it should follow that global regulatory agreements are more prone to arise and to be more quickly adopted, as facilitated by the support of firms who stand to win from regulation and who hold the informational advantage equipped to influence regulatory trends. To put it differently, when we see firms lobbying in favor of regulatory stringency, they should be the leaders in innovativeness within their industry. Figueiredo and Richter (2014) argue that much of lobbying activity is for the status quo. So, whenever we see a firm lobbying against the status quo (that is, for the introduction of a new regulation), it should be the case that it has high stakes in it.

My theory also accounts for why firms do not always choose to promote regulations they would like to through private means, rather than using formal, state-led agreements. My answer is that there are some conditions under which formalizing rules in international agreements might pay off, including after private authority has been established. The flexibility of private authority might be appreciated in the beginning, but once the firm knows it can comply with, it is profit-maximizing for it to institutionalize and thus effectively lock a favorable regulatory framework in.

In a nutshell, the theory developed in this section is a story about how firms' ability to innovate and profit from it can create demand for formal global regulation, thus based on Stigler (1971)'s insight that regulations are often enacted for the benefits of firms. My addition to his argument is that this reasoning should mostly apply to innovative industries when the regulation in question is a rule aimed at either proscribing, prescribing or limiting the production of a product or a process. In less innovative industries, the demand for this type of regulation is unlikely to come from firms. My argument implies that firms can maximize the rents they receive through government policies at the global level whenever those create demand for regulation that maximizes profits from their complex, highly innovative

products. On the other hand, when firms are relatively less innovative, regulation is mostly a costly burden and thus there should not be corporate demand for regulation. If anything, we should observe these firms actively pursuing delaying tactics.

4 Hypotheses and empirical strategy

From the argument, I derive the hypothesis that *(H1:) global regulatory agreements that effectively restrict the production and/or use of certain substances are associated with faster paces of adoption, relative to other kinds of regulatory agreements.* This is because agreements that restrict the production and use of substances offer opportunities to innovative firms to benefit from the introduction of newer, more profitable products.

To test this hypothesis, I analyze the pace of signature and ratification regarding three international regulatory agreements: the Stockholm Convention on Persistent Organic Pollutants, the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade and the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal.

These three agreements establish rules for the production, consumption and disposal of certain hazardous chemicals and their waste. According to Selin (2010), the chemicals regime is one of the oldest environmental regimes and yet it has received relatively scant scholarly attention so far. Because the three aforementioned agreements belong to the same regime, I can hold several attributes across the three constant. As Selin puts, the treaties comprising the regime are "formally independent but functionally dependent" and the relationship among them is nonhierarchical. These characteristics allow participants to try to influence and navigate each of the treaties' provisions strategically.

Crucially for this project, the three agreements have different goals, which is useful to test the claim that agreements that offer opportunities to replace substances are associated with a higher pace of signature and ratification.

Specifically, the Stockholm Convention aims at restricting the production and use of certain persistent organic pollutants (POPs)[2], as established by its Article 3. The Rotterdam Convention focuses on the prior informed consent to international trade of certain hazardous chemicals, according to its Article 6. Finally, the Basel Convention determines rules for disposal of hazardous chemical waste.

Thus, the Stockholm Convention is an agreement that effectively allows firms to profit from stricter rules. The convention requires countries to discontinue the production and the use of a list of substances, opening up the path for newer, less hazardous and potentially more profitable replacements. More importantly, innovative firms that introduce a new product to global markets derive the benefit of holding a patent for several years, which allows for exploring nearly-monopolistic rents. These opportunities offered by the Stockholm Convention contrast with the effects of the introduction of the Rotterdam and the Basel Conventions, which are far more limited in providing business opportunities for chemical producers. And while the Basel Convention might offer opportunities for companies specialized in the disposal of hazardous chemicals, this is a far less complex market, with lower profit rates and with fewer patents.

The idea that the Stockholm Convention should be the agreement associated with higher rates of ratification and compliance in the regime is counterintuitive, since this is the most restrictive agreement. But it is precisely the restrictiveness of the agreement that induces corporate interest in making Stockholm successful. In a nutshell, I contend that firms interested in profiting from the substitution of substances contributed with the acceleration of these global rules. The underlying mechanism that allowed this convergence of forces

[2]According to the Stockholm Convention website, "persistent organic pollutants (POPs) are organic chemical substances, that is, they are carbon-based. They possess a particular combination of physical and chemical properties such that, once released into the environment, they: (i) remain intact for exceptionally long periods of time (many years); (ii) become widely distributed throughout the environment as a result of natural processes involving soil, water and, most notably, air; (iii) accumulate in the fatty tissue of living organisms including humans, and are found at higher concentrations at higher levels in the food chain; and (iv) are toxic to both humans and wildlife". Source: `http://chm.pops.int/theconvention/thepops/tabid/673/default.aspx`

is the global structure of the chemicals' manufacturing industry. According to IBISWorld, one of the leading expert industry market research services in the world, the fertilizers and agricultural chemicals manufacturing industry scores in the upper rankings of relevance of technology. The analysis notes that "access to the latest available and most efficient technology and techniques" is strategic for firms and it points out that the three agreements that compose the chemicals' regime might affect firms' activities. Furthermore, the analysis highlights the concentration of the pesticides industry, in specific: six firms hold 75% of the industry's share. Most of the persistent organic pollutants (POPs) regulated by the Stockholm Convention are used as pesticides. Thus, the characteristics of the Stockholm Convention in comparison to the characteristics of the Rotterdam and Basel Convention imply that the Stockholm Convention should display faster paces of signature and ratification.

The first testable implication as outlined above grasps the more macro consequences of market structures and incentives for regulation for global agreements. I also derive a second observable implication using country as the unit of analysis. Specifically, I hypothesize that *(H2): countries with a higher proportion of registered patents in the industries regulated by the regime should be more likely to adhere to the regime.* To be clear, a similar hypothesis has been evaluated by Marcoux and Urpelainen (2013b), but my test allows for a much larger and diverse sample and it uses a much more specific independent variable. Marcoux and Urpelainen (2013a) employ patents in the biotechnology industry over GDP as their explanatory variable, but this is a very broad category and that might not even capture the patents pertaining the products regulated by the chemicals' convention. This is because biotechnology firms employ living organisms as part of their processes and products - which is not the case of the chemicals' regulated by the Basel, Rotterdam and Stockholm Conventions. Instead, I use patents in the organic fine chemistry and in the basic chemical materials industries, both of which directly comprise the substances regulated by the conventions.

Finally, I derive a third more "microlevel" observable implication and thus more directly related to the mechanism, which is that *(H3): more innovative firms affected by the*

Stockholm Convention are more likely to be supportive of it. I employ BvD Orbis' data on individual firms' registered patents in the industries affected by the Stockholm Convention and qualitatively assess their position towards the chemicals' regime using firm filings in the Securities and Exchange Commission (SEC) in the United States. The fact that the United States has signed but not ratified any of the agreements in the regime means that there are enough datapoints pertaining firm-level activity to explore.

5 Results

5.1 Agreement-level evidence: speeds of signature and ratification

First, to compare the rates of signature and ratification of the Basel, the Rotterdam and the Stockholm Conventions, I estimate six intercept-only survival models, one for the signature and another for the ratification of each agreement. The dependent variable is the number of days it takes for each of the 190 countries in the sample to either sign or ratify the agreement in question. The count starts from the day each convention is adopted - that is, when countries start to be "at risk" of signing and ratifying the agreement [3]. For ratification, the data is censored on November 30th, 2020, the end of the period of analysis.[4]

For the model that estimates the speed of signing onto the agreement, the data is censored on March 22, 1990 for the Basel Convention; September 10, 1999 for the Rotterdam Convention and October 23rd, 2006 for the Stockholm Convention. After each of these dates, all countries acceeded to the agreement. Accession is equivalent to ratification, after the

[3]For the Basel Convention, the date of adoption is March 22nd, 1989. For the Rotterdam Convention, this date is September 10th, 1998. Finally, the Stockholm Convention was adopted on May 23rd, 2001.

[4]Even though countries could and will keep on ratifying the agreements after 2020, survival analysis often demands choosing the end of the period of analysis somewhat arbitrarily. Only two countries (Uzbekistan and Equatorial Guinea) ratified (acceeded) the Stockholm Convention in 2019. The pattern is similar for the Rotterdam Convention (three countries acceeded to it on 2020: Algeria, Barbados and Tuvalu) and for the Basel Convention (one country, Tuvalu). This means that the artificial censoring is not problematic. I choose November 2020 to extend the period of analysis for as long as it is tractable.

treaty is in force - in the case of the Stockholm Convention, the agreement entered into force 90 days after the deposit of the 50th instrument, so the last "opportunity" for a country to sign onto it was on October 2006. Similar rules apply to the other two conventions (90 days after the deposit of the 50th instrument for Rotterdam and 90 days after the deposit of the 20th instrument for Basel). Data on signature and ratification have been extracted from the ECOLEX database [5].

The coefficients that result from these six estimations are akin to comparable average speeds of ratification in terms of unobservable time-invariant covariates. The estimations use the Weibull distribution, whose hazard function increases or decreases monotonically over time. The smaller the coefficient, the faster the rate. As previously noted, I expect the Stockholm Convention to be associated with the smallest coefficient and thus to display the fastest pace of signature and ratification among the three conventions in the chemicals regime. As shown on Tables 1 and 2, results support this expectation for ratification:

Table 1: Survival analysis' results for the ratification of agreements

	Dependent variable: time until ratification of		
	Basel	Rotterdam	Stockholm
	(1)	(2)	(3)
Constant	8.651***	8.354***	7.614***
	(0.079)	(0.061)	(0.060)
Observations	190	190	190
Log Likelihood	−1,495.490	−1,493.408	−1,562.610
Note:			*p<0.1; **p<0.05; ***p<0.01

And also for signature:

[5] www.ecolex.org

Table 2: Survival analysis results for the signature of agreements

	Dependent variable: time until signature of		
	Basel	Rotterdam	Stockholm
	(1)	(2)	(3)
Constant	10.116***	8.449***	5.424***
	(0.787)	(0.536)	(0.292)
Observations	190	190	190
Log Likelihood	−335.047	−428.632	−813.985
Note:			*p<0.1; **p<0.05; ***p<0.01

In the two tables, the smaller the coefficient, the faster the average speed of ratification (Table 1) and of signature (Table 2). As expected, the coefficients for the Stockholm Convention are the smallest. Although the act of signing onto an agreement is a weaker act than the ratification one, one could argue that signatures are a signal of enthusiasm for the treaty. Albeit only suggestive, the evidence presented here is consistent with the argument that global regulatory agreements that offer opportunities for firms to benefit from the substitution of older, less profitable product shown faster paces of adoption.

5.2 Country-level evidence: registered patents and likelihood to sign and ratify agreements

In this subsection, I show results for two pooled accelerated-failure time models (AFT), one for the signature and another for the ratification of the three agreements under the chemicals' regime. AFT models assume that covariates affect the rate of survival by either accelerating or slowing the hazard function down. The dependent variable is the time (counted in days) it takes each country in the sample to either sign or ratify each of the agreements. The starting point is the moment each agreement is open for signature and the ending point is the day each country either signs or ratifies each of the three agreements.

Both models employ the Weibull distribution, adjusted for right-censoring. In both models, the unit of analysis is country-agreement, so there are 570 observations in each (190 countries x 3 agreements). Again, data on signature and ratification have been extracted from ECOLEX.

The main explanatory variable is the number of registered patents in each country in the organic fine chemicals and in the basic chemicals industries, the two industries that include the substances restricted by the chemicals' regime, divided by the GDP in USD bi of each country. This is to allow appropriate comparisons of different economy sizes. I expect that higher proportions of patents over GDP will accelerate the rate of signature and ratification of the three agreements, and thus show a negative sign. Data on registered patents have been extracted from the World Intellectual Property Organization databases [6].

The models also employ several economic and political covariates. Specifically, GDP per capita (measured in constant 2011 USD and adjusted for purchasing power), the value added by the agriculture, forestry, and fishing activities as a % of GDP, the level of democracy (Polity IV) and the degree of fractionalization of the government, which indicates the chance that two random draws will produce legislators from different parties and thus works as a measure of how likely a policy is to pass (as extracted from the Database of Political Institutions). The GDP and valued added by the primary sector variables have been extracted from the World Development Indicators database [7], whereas the political variables were obtained from the World Economics and Politics Dataverse [8]. I also add a dummy variable that takes the value of "1" for when the agreement effectively allows for the replacement of substances and "0" otherwise, which means that the event of signing or ratifying the Stockholm Convention takes the value of "1" while the other two take the value of "0". I cluster standard errors by country.

[6] https://www3.wipo.int/ipstats/

[7] https://databank.worldbank.org/source/world-development-indicators

[8] https://ncgg.princeton.edu/wep/dataverse.html

Resuls are shown on Table 3 and largely corroborate expectations. First, I highlight that the coefficients for *Chemical Patents/GDP (log, lagged)* are statistically significant and substantively important for both the signature and the ratification of the agreements. In both models, the coefficient is negative, which indicates that a higher ratio of patents/GDP accelerate the acts of signature and ratification of the agreements. It is interesting to note that the coefficient for signature is almost 15 times larger than the coefficient for ratification. It could be speculated that this reflects chemical firms' political pressure for governments to join the regime. Ratification is a much more complex act of government than signature. Depending on each country's domestic law, ratification has to go through the lower and the upper houses and be sanctioned by the president, whereas signature is a prerrogative of the Executive. All else equal, one would expect that acts of signature are faster than acts of ratification, but the fact that results show the effects of country-level innovativeness (as measured by *Chemical Patents/GDP (log, lagged)*) accelerating signature much more than accelerating ratification could indicate that corporate pressure is more effective at the signature stage than at the ratification one. This makes sense as ratification entails many more steps and players.

The control variables also largely behave as one would expect. *Democracy* accelerates the signature and ratification of agreements and is statistically significant in both models. *Government Fractionalization* is not statistically significant, but the positive sign of the coefficient would indicate that more fractionalized governments would delay joining the chemicals' regime. Perhaps surprisingly, *GDP PPC (USD, log, lagged)* displays a positive sign, indicating that wealthier countries take longer to sign and ratify agreements, especially if we think of GDP as a rough indicator of state capacity. On the other hand, the coefficients for *% Agriculture Value Added/GDP(lagged)* indicate that the higher the value added of the primary sector to a country's GDP, the longer it takes to sign and ratify the chemicals' regime agreement. This makes sense if we think that the primary sector will have to pay the adjustment costs of replacing pesticides for new substances. Finally, the dummy variable

Table 3: Accelerated Failure Time (AFT) Models for signature and ratification of the three agreements in the chemicals' regime

	Dependent variable:	
	Days to signature	Days to ratification
Chemical Patents/GDP (log, lagged)	-5.299^{***}	
	(1.814)	
Democracy (Polity IV)	-0.323^{*}	
	(0.169)	
Government Fractionalization (DPI)	0.332	
	(2.419)	
GDP PPC (USD, log, lagged)	3.164^{***}	
	(0.802)	
% Agriculture Value Added/GDP (lagged)	0.198^{***}	
	(0.076)	
Agreement allows for substance replacement	-8.123^{***}	
	(0.648)	
Chemical Patents/GDP (log, lagged)		-0.356^{*}
		(0.195)
Democracy (Polity IV)		-0.056^{***}
		(0.016)
Government Fractionalization (DPI)		0.212
		(0.313)
GDP PPC (USD, log, lagged)		0.339^{***}
		(0.111)
% Agriculture Value Added/GDP (lagged)		0.014
		(0.009)
Agreement allows for substance replacement		-0.811^{***}
		(0.093)
Constant	-15.174^{**}	5.396^{***}
	(6.631)	(0.645)
Observations	300	303
Log Likelihood	-821.667	$-2{,}423.789$
χ^2 (df = 6)	161.742^{***}	94.336^{***}

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

associated with the Stockholm Convention (the one that effectively allows chemical firms to profit from substance replacement) displays highly statistically significant and substantively important coefficients. This result again corroborates hypothesis 1.

Overall, these survival models show that innovativeness at the country level is an important predictor of participation in regulatory agreements. I reiterate that the indicator used in *Chemical Patents/GDP (log, lagged)* is as specific as possible: the patents refer to the basic chemical materials and to the organic fine chemical industries, which are the industries that produce the substances regulated by the regime in question. This assuages concerns that the proxy for innovativeness is actually capturing another relationship and increases our confidence that a positive relationship between innovativeness and participation in global regulatory agreements exists. Evidently, this data is still at a higher level of aggregation than what this study's overall argument posits, but since new products and their patents are outputs of private activity, these are relevant results. Nonetheless, I now turn to explore firm-level data to test the argument that more innovative firms are more likely to manifest support for the chemicals' regime.

5.3 Firm-level data: innovativeness and support for regulation

This section discusses results regarding the test of hypothesis 3, which states that more innovative firms affected by the Stockholm Convention should be more likely to support it, relative to their less innovative peers. In order to assess this claim, I looked up the expression *"Stockholm Convention"* in the full text search resource provided by the EDGAR plataform from the Securities and Exchange Comission (SEC) in the United States [9]. The SEC requires that public companies file periodic reports that indicate the firm's status. The filings provide market players with important information that guide their investment decisions. There are several types of forms that firms might need to file to comply with SEC regulations. As I

[9] `https://www.sec.gov/edgar/search/`

do not have any theoretical priors that would lead to the exclusion of any of the form types, I include all filings in my search. The search encompasses the period from January 1st 2001 to January 1st 2020. January 1st, 2001 is the earliest date available in the database, but also coincides with the year of adoption of the Stockholm Convention.

The search returns 216 results, which refer to 37 unique companies. I examine the content of the filings for each result and classify it as either a "risk" or an "opportunity", depending on how each firm describes the potential or actual consequences of the Stockholm Convention to its businesses. For 20 firms, the filings' content regarding the Stockholm Convention is so broad that does not allow any conclusions. However, out of the 17 remaining companies, 7 see the Convention as an opportunity (or to the very least, refer to it as a positive factor), while 10 indicate that the Convention is a risk or a cost to their business. Table 4below brings each of the 17 companies for which one can infer how the Stockholm Convention is framed and the corresponding classification of whether the mention to the convention was posited as a risk or an opportunity to the firm. More importantly, the table brings the number of registered patents for each company's industry and the number of registered patents for each company itself. The number of patents is extracted from the BvD Orbis database and works as a proxy for innovativeness. I restrict the search on the number of patents in the industry for only large and very large firms. This is because all the seventeen firms that came out from the SEC search are either very large or large firms and also because smaller firms are unlikely to hold a substantive number of patents in the analyzed industries.

The analysis of the share of patents that each firm holds in its respective industry is supportive of the study's argument. In general, firms that hold a smaller share of patents in their industry (and thus, are the less innovative players) tend to portray the Stockholm Convention as a risk. This is the case of Momentive Performance Materials, which holds only 0.06% of the patents in the industry of "Manufacturing of plastics in primary form" (NACE REV. 2 Code 2016). The company is rather explicit about the potential costs of the

Table 4: Firms' views on the Stockholm Convention according to SEC filings

Company	Stockholm Convention	NACE REV. 2	Industry's Patents	Firm's Patents	Firm's Patents %
Vale S.A.	opportunity	710	18,703	4,544	24.3%
KMG CHEMICALS	risk	2013	125,087	50	0.04%
Momentive Performance Materials	risk	2016	718,233	3,997	0.6%
DOW CHEMICAL CO	opportunity	2016	718,233	150,187	20.9%
ISRAEL CHEMICALS LTD	risk	2020	123,672	NA	NA
CMC Materials, Inc.	risk	2059	1,070,619	1,615	0.2%
3M CO	opportunity	2391	100,929	94,617	93.7%
APPLE INC	risk	2620	1,067,019	56,347	5.3%
SONIC ENVIRONMENTAL SOLUTIONS INC	opportunity	2894	79,380	21	0.0%
ENEL AMERICAS S.A.	risk	3511	174,614	18	0.0%
ENERGY CO OF MINAS GERAIS	risk	3511	174,614	59	0.0%
KOREA ELECTRIC POWER CORP	opportunity	3511	174,614	18,322	10.5%
Jumia Technologies AG	risk	4675	NA	88,162	NA
Banco Santander (Brasil) S.A.	opportunity	6419	424,202	NA	NA
NXP B.V.	risk	7010	1,898,008	27,550	1.45%
ALBEMARLE CORP	risk	8299		NA	NA
Ternium S.A.	opportunity	2410	391,370	377	0.1%

Stockholm Convention on its business. In its 10-K form[10] filed for the fiscal year ended in December 31st, 2017, the company states:

"Finally, in March 2016 and March 2017, the European Union Directorate General for Environment ("DG Environment") proposed to the European Commission that D4 be nominated as a persistent organic pollutant pursuant to the Stockholm Convention on Persistent Organic Pollutants (the "Stockholm Convention"). This proposal was not acted upon by the European Commission, but continues to be evaluated by the DG Environment. The Stockholm Convention is an international treaty aimed at eliminating or minimizing the release of organic chemicals that are toxic, resistant to degradation in the environment, and transported and deposited far from the point of release. We and other silicone industry members have entered into a consent order with the USEPA to conduct certain studies to obtain relevant data, the results of which were submitted to the USEPA in September 2017. ***Regulation of our products containing such substances by the European Union, Canada, the United States or parties to the Stockholm Convention would likely reduce our sales within the respective jurisdiction and possibly in other geographic areas as well. These reductions in sales could be material depending upon the extent***

[10]10-K forms are required forms that firms file annualy on their financial performance.

of any such additional regulations."[11].

For comparison, Dow Chemical Co, which is in the same industry as Momentive Performance Materials but holds 20.9% of the industry's patents, displays a much more positive view on the Stockholm Convention. According to the firm's DEF 14A filing[12] from 2003:

"The Stockholm Convention on Persistent Organic Pollutants ("POPs"), ***which is referenced in the proposal and which Dow supports****, does not require any phase-out of current Dow products. Rather, as to such products, it addresses measures to reduce or eliminate releases from unintentional production."*

This evidence from SEC filings is consistent with Clapp (2003)'s work, which shows that the substances initially banned by the Stockholm Convention were all products whose patents had long expired. I extend Clapp (2003)'s work to comprise all the substances that had been added to the Convention after the initial twelve products known as the "dirty dozen". The new information further supports that substances are listed after original patents expire and two of the major markets for POPs restrict or indicate an intention to restrict the substance in question. It merits saying that parties to the Convention agree to a process by which new substances can be reviewed and added to the convention's annexes, if they meed certain criteria associated with persistence in the environment and transboundary threats. So, to assess the observable implication that the listing of a substance to the Annexes A and B of the Stockholm Convention is associated with the expiration of patents, their production phase out and thus with the decline of nearly-monopolistic rents for major manufacturers, I compiled information from several sources [13] concerning the manufacturing, regulatory and

[11]The bold passage is not in the original and it was added for emphasis.

[12]SEC Form DEF 14A is a form that firms need to file when a shareholder vote is required.

[13]A list of sources and references is available upon request

patent status of each listed substance. The information is summarized on Table 5.

Table 5: Substances listed under the Stockholm Convention

Substance	Patented	Expired	Restricted U.S.	Banned U.S.	Restricted EU	Banned EU	Listed	Annex
Aldrin	1950	1967	1969	1987	1981	2004	2004	A
Chlordane	1945	1962	1978	1988	1981	2004	2004	A
DDT	1943	1960	1972	1989	1981	2004	2004	B
Dieldrin	1950	1967	1969	1987	1981	2004	2004	A
Endrin	1950	1967	1979	1984	1991	2004	2004	A
Heptachlor	1952	1969	1978	2000	1981	2004	2004	A
Hexachlorobenzene	1957	1974	1966	1985	1981	1981	2004	A*
Mirex	1946	1963	1977	1989	NA	2004	2004	A
Polychlorinated biphenyls	1930	1947	1978	1979	NA	1987	2004	A*
Toxaphene	1947	1964	1982	1990	1984	2004	2004	A
Hexachlorocyclohexane	1940	1957	1976	1976	1981	2004	2009	A
Chlordecone	1958	1975	1975	1975	1981	2004	2009	A
Hexabromobiphenyl	1970	1987	1976	1976	NA	2004	2009	A
Hexa, hepta and octa bromodiphenyl ether	NA	NA	NA	NA	NA	NA	2009	A
Lindane	1939	1956	1983	2006	NA	2003	2009	A
Pentachlorobenzene	1930	1947	1980	Not yet	NA	2002	2009	A*
Tetra and pentabromodiphenyl ether	NA	NA	2007	Not yet	NA	2020	2009	A
Technical endosulfan	1950	1970	NA	2010	NA	2006	2011	A
Hexabromocyclododecane	1987	2008	Not yet	Not yet	NA	2016	2013	A
Hexachlorobutadiene	1940	1957	Not yet	Not yet	NA	NA	2015	A*
Penthachlorophenol	1938	1955	1980	Not yet	NA	NA	2015	A
Polychlorinated Naphtalenes	1910	NA	1986	NA	NA	NA	2015	A
Decabromodiphenylether	1980	2000	2007	Not yet	2007	2019	2017	A
Short-chain chlorinated paraffins (SCCPs)	1930	NA	2016	Not yet	2004	Not yet	2017	A
Dicofol	1957	1974	1986	Not yet	NA	NA	2019	A
Perfluorooctane sulfonic acid	NA	NA	2020	Not yet	NA	2009	2019	B
Dechlorane Plus	1960	1980	Not yet	Not yet	Not yet	Not yet	Under review	

Of the initially banned substances (shown in italics), it is easy to see that all had been already restricted or banned in the United States long before the Convention had been adopted. A similar pattern is observed for the European Union, although most restrictions came later on in Europe relative to the United States and full bans were actually adopted in compliance to the Convention, as the 2004 European bans for the initially listed substances indicate[14]. Moreover, several of the initially listed substances had been voluntarily phased out by major American and European producers, in a market where only one or two corporations manufactured these chemicals. For instance, Shell was the original patent holder and sole manufacturer of Aldrin, Dieldrin and Endrin. The patents expired in the late 60s and production in the United States ended in 1974 [15]. Of course, this has not prevented these substances from being manufactured in other parts of the world. But it is important to note that Shell used to benefit from a nearly-monopolistic control of the market for these

[14]According to the Regulation (EC) No 850/2004 of the European Parliament and of the Council of 29 April 2004 on persistent organic pollutants and amending Directive 79/117/EEC

[15]According to the U.S. Agency for Toxic Substances and Disease Registry - `https://www.atsdr.cdc.gov/toxprofiles/tp1-c5.pdf`.

substances and after the early 70s, these benefits ceased. The fact that Aldrin, Dieldrin and Endrin and the other initially listed POPs all seem to conform to these same pattern - nearly-monopolistic production, expired patents and voluntary phase outs - indicates that the listing of substances is also an artifact of how major producers are affected by regulations.

Out of the newly listed substances, there is a first "batch" that joins the annexes of the Convention on 2009. These substances follow a similar pattern of those listed on 2004 so it is not possible to assert that market characteristics played a major role in determining which substances fell on the first batch and which fell on the second.

However, when we look at the substances listed between 2011 and 2019, new patterns emerge. In the United States, a few substances had been domestically restricted or banned - specifically, alpha and beta hexachlorocychlohexane, chlordecone, hexabromobiphenyl, lindane and endosulfan (this last one was banned very close to the listing year itself). In Europe, we see that some of these substances are banned very closely to the years of listing to the Convention.

More generally, we see that the Convention starts by restricting and banning substances that had been domestically regulated in the United States, whose patents had long expired and whose production had long been phased out in the country. As years go by, we see that listing patterns tend to become more closely related to what happens in Europe in terms of domestic regulation. This apparent shift in domestic regulatory patterns influencing the Convention merits further investigation, as it has implications for other divides we observe in regulatory preferences between the United States and Europe (Drezner, 2007). Furthermore, I point out to the fact that the United States has never ratified the Stockholm Convention, even though it was among its first signatories on May 23rd, 2001. The United States shows the same behavior regarding the Rotterdam and the Basel Conventions. Now, the fact that the U.S. has not ratified the Conventions does not mean that American chemicals manufacturers do not influence the regime. As a matter of fact, CropLife International, the largest international commercial association of agricultural firms has been a strong pres-

ence in the Convention's meetings as an observer and it has openly declared its support for the agreement [16]. CropLife International is formed by BASF (Germany), Bayer (Germany), Corteva (U.S.), FMC (U.S.), Sumitomo Chemical (Japan) and Syngenta (Switzerland). It can be argued that Corteva and FMC but also other major firms' American subsidiaries have their interests represented in this Convention whose work affects their interests directly.

Now, another piece of evidence that points towards the argument that substances are restricted at least partially as a function of the market opportunities they offer to major producers is the indication that the number of POPs that could potentially be listed under the Stockholm Convention is incredibly large. In an article published by Atmospheric Pollution Research, Scheringer et al. (2012) estimate that 510 chemicals exceed the technical screening criteria established by the Convention in its Annex D and could be considered POPs - even using uncertainty ranges, the number would be between 190 and 1200 chemicals. Out of the estimated list of 510 chemicals, 10 are high-production volume products in the EU and 249 are pre-registered in the block. The authors point that even the lower bound (which they call "very POP") represents an incredibly high number of chemicals that far exceed the Convention's technical capacity to regulate and suggests that some kind of prioritization will be necessary. As my study suggests, it is not altogether clear that such prioritization will strictly follow technical criteria.

6 Conclusion

This study examines the role of corporate interests in shaping global regulatory agreements. In a nutshell, it explores how innovative firms can be supportive of stringent regulation on their own activities because such stringency allows them to benefit from the introduction of more profitable substitutes for the products and processes that regulatory

[16]For instance, see "Plant science industry supports science-based implementation of UN Stockholm Convention", available on `https://croplife.org/wp-content/uploads/pdf_files/News-Release-Plant-science-industry-supports-science-based-implementation-of-UN-Stockholm-Convention.pdf`

agreements restrict.

As a part of a larger project, I focus on the hazardous chemicals regime, comprised by the Basel, the Rotterdam and the Stockholm Conventions. I show evidence that the Stockholm Convention is the one countries sign onto and ratify more quickly among the three, being the agreement that effectively restricts or bans specific substances and thus allows innovative firms to profit from product substitution. I also examine country-level evidence that shows that more innovative jurisdictions (as proxied by those that have more registered patents in the industries affected by the regime) are more likely to adhere to the agreements. Finally, I compile firm-level evidence that indicates that the less innovative firms within a given affected industry by the regime are more likely to frame the Stockholm Convention as a risk, whereas the most innovative firms tend to view the agreement as an opportunity. This firm-level evidence is consistent with the pattern that substances are restricted by the chemicals' regime as either patents expire, domestic regulation takes place or voluntary phaseouts are announced by manufacturers.

More work is needed to further support the overarching argument made by this study. Specifically, an in-depth look into the markets for substitutes of the listed products will allow stronger conclusions on the proposed mechanism, that is, that innovative firms profit from restriction because they can introduce more profitable substitutes.

One policy implication to be considered is that if the Convention just formalizes chemicals that have been already phased out by major producers, then does it effectively improve global governance? As mentioned, POPs are extremely hazardous products for both the environment and human health and precisely because of their persistence, we may not even have a full understanding of their consequences to wildlife and human wellbeing. However, even a more cynic interpretation of the real effects of the Stockholm Convention allows for some hope. Perhaps the Convention reduces incentives for major chemical manufacturers to engage in a race-to-the-bottom (Mosley and Uno, 2007; Vogel, 1997). Absent the Convention, major manufacturers might have been encouraged to keep two lines of products, one

safer for advanced markets that have more stringent domestic rules and a less safe one for the developing world. When the Convention formalizes restrictions on hazardous chemicals, it makes global production and distribution harder, which incentivizes producers to phase these products out. For instance, in its 10-K form filed for the fiscal year of 2017, KPM Chemicals Inc indicated the potential need to move its facilities that produce pentachlorophenol from Mexico to the United States:

"The Conference of the Parties ("COP"), comprising representatives from countries that have ratified the treaty known as the Stockholm Convention, met in May 2015 and considered the classification of penta as a persistent organic pollutant ("POP"). The COP accepted the recommendation of the United Nations Persistent Organic Pollutant Review Committee that the use of penta should be banned except that its use for the treatment of utility poles and crossarms could continue for an extended period of five to ten years. We supply penta to industrial customers who use it primarily to treat utility poles and crossarms. The United States is not bound by the determination of the COP because it did not ratify the Stockholm Convention treaty. Canada and Mexico are governed by the treaty. Our sole penta manufacturing facility is located in Matamoros, Mexico. As a result of the classification of penta as a POP, the Mexican government has requested that we relocate our penta manufacturing facility. We are in the process of identifying potential sites in the United States for such relocation. No assurance can be given that we will not incur significant expenditures in connection with such relocation, that we will find an adequate location within the required timeframe, or that the ultimate action of the COP will not have a material adverse effect on our financial condition and results of operation."

As the firm's statement indicate, relocation is rife with uncertainty and potential high costs, so even keeping two lines of products - one for markets subject to the Convention and another for markets not binded by its commitments - is not a simple solution. This kind of

firm behavior suggests that the chemicals' regime might have been successful in inducing a race-to-the-top (Prakash and Potoski, 2007; Saikawa, 2013).

Of course, this does not solve the problem that generics of hazardous substances keep being produced in several countries, but one could argue that the counterfactual could be much worse, with higher volumes of hazardous, persistent chemicals being produced and traded every year. Another possibility is that the Convention works as a informational device that teaches governments around on the world on the hazards of POPs and indicates safer replacements. Even under this simpler mechanism, we can see that manufacturers would have an incentive to focus on less hazardous replacements, which then would make the Convention effective. This project will keep expanding on these possibilities in order to contribute with our understanding about the immense universe of global regulatory agreements.

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