Pesticide Regulation Under NAFTA: Harmonization in Process?

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Abstract

Different standards in pesticides and pest protection have often been used as trade barriers, whether real or manufactured. While harmonization is often touted as a means to limit the ability of domestic (protectionist) interests to use standards as a barrier to trade, the process of harmonization itself is subject to rent-seeking. In this paper, we explore the harmonization of standards that affect pesticide use in NAFTA and ask whether the process is benefiting any groups more than others. There is evidence that patented pesticide producers have greater access to the harmonization process and may be using harmonization to raise costs to their rivals while preserving their ability to price discriminate.

Introduction

Harmonization of environmental standards is often seen as a panacea – limiting the use of differential standards as a trade barrier, and blocking a potential 'race to the bottom' where countries use declining environmental standards as a source of competitive advantage. Although it is widely recognized that industries lobby to affect the setting of domestic environmental standards, including using them as a source of protectionism, it is less often recognized that the harmonization process itself is subject to rent-seeking. This paper uses harmonization of pesticide regulation in NAFTA to consider the role of various interest groups in determining what rules get harmonized, and to what standards.

Intensive agro-chemical use is a central component in modern food production; government regulation of chemical use and phyto-sanitary rules are key elements in assuring food meets consumer, health and environmental safety standards. Pesticide regulations can act as barriers to trade, hindering both trade of chemicals and agricultural production. Finding an appropriate balance between trade liberalization and environmental, health and consumer protection has been a well-publicized issue in academic and policy circles. The North American Free Trade Agreement (NAFTA) provides an opportunity to investigate the process of regulatory harmonization under trade. In this paper, we ask what has been the degree of harmonization in pesticide regulations in the three NAFTA countries? Second, we ask whether there are specific policy areas where harmonization has not been achieved, and if so, why? We hope to provide a better understanding of the process of harmonization, how it relates to the various stakeholder groups and its implications for trade and the environment in the three countries.

In this paper, we first review some theoretical literature on environmental standards and harmonization under trade to determine the costs and benefits from harmonization. Next, we discuss the market structure in the pesticide industry, to identify the different actors and different roles for regulation. We then give a brief background on pesticide regulation in the three countries and we discuss the attempts to create international standards affecting pesticides and plant and animal health. Section five presents the various interest groups and, using two simple economic models, walks through their presumed objectives from harmonization. The section ends by posing various hypotheses on the results from harmonization. Next, we consider the observed results from harmonization and compare them to our hypotheses to determine which groups appear to be dominating the process. We end with conclusions and recommendations.

Harmonization of Environmental Regulations

To understand the issues around the harmonization of standards, one first needs to understand the purpose of standards. Standards can address a number of market imperfections and failures. Many standards are meant to address asymmetric information, such as labelling standards or efficacy standards on pesticides to decrease transaction costs and avoid the lemons problem. Environmental standards are generally meant to limit the production of externalities and to provide public goods. For example, regulations over chemical use can limit the pollution entering the environment. Food quality and worker safety requirements can raise the average health status in an economy, with spill over benefits into higher productivity.

Standards are not costless. Often standards impose a fixed cost on firms in terms of product design, testing and certification. Many standards also involve recurring costs such as maintaining quality control, training and other increased marginal costs associated with producing a higher-quality product. To the extent costs are fixed, standards can provide an advantage to large firms in global competition (Maskus and Wilson, 2000).

Each country develops its own standards – many of which are complex, multidimensional and therefore not easily coordinated or ranked. Domestic regulations reflect the culture, development and other features of the home country, usually addressing national problems (Meilke, 2001). These different standards can lead to trade tensions, increase costs to exporters and raise concerns among domestic producers who believe they are facing 'unfair' competition. Nonetheless, these standards have been created to meet a domestic political bargain, (or a domestic social optimum if one feels optimistic about the local government), and therefore one would anticipate imposing a constraint of harmonization will lead to a standard that is desired less domestically.

When is it beneficial to harmonize standards across countries? Standard trade theory is based on comparative advantage, and Krugman (1997) and Bhagwati (2003) have noted that one potential source of comparative advantage is different standards across countries. As long as these standards regulate domestic externalities, there is no (trade) reason for the country with higher standards to harmonize. A second argument against harmonization is that environmental regulations in a country are presumably geared to its specific environmental needs. The nature of externalities may vary by country, which implies that the first best solution is different standard in each country. Given that some externalities are difficult to measure, they are often addressed by process standards, which in turn will vary with local technology. Further, different countries will have different demands for environmental quality. For example, the demand for public goods will depend on income levels, relative endowments of factors, information, technologies, and other variables (Maskus and Wilson, 2000). Thus, the derived demand for standards is expected to be quite different between countries, particularly between countries in different stages of development (Krugman, 1997; Bhagwati, 2003; Vogel, 2000; Maskus and Wilson, 2000). Last, as indicated above, since domestic regulations are part of a domestic bargain, local groups may feel they have more input in this process, and therefore be more likely to support (comply to and/or monitor) regulations set at a domestic level, as opposed to those set internationally. The more the international harmonization process is inaccessible and obscure, the more likely domestic groups will prefer locally-determined regulations.

There are a number of counterarguments that make a case for (some) harmonization of standards. Forcing companies to meet different standards increases transactions costs, and the potential reduction in cost may outweigh the decrease in comparative advantage (Baldwin, 2000). For example, if each country required a separate test for the toxicity level of a pesticide, it will make registering a product in multiple countries difficult (and expensive) whereas perhaps only one test is sufficient. Second, in a related argument, differential standards can segment markets, by erecting barriers to entry and increasing market power. If some of the firms are involved in both markets, they can use these barriers to engage in price discrimination. Third, harmonization is needed to address externalities that are international in nature. Pest movement and some environmental externalities caused by pesticides are not constrained by national borders, and as immigration grows, some health concerns are increasingly international in scope. Third, lack of harmonization can be used as an argument for using regulations as a barrier to trade (as noted above). Equally, differential standards may allow producers in one country to argue for lower environmental regulations because their competitors have an 'unfair comparative advantage' otherwise (Vogel, 2000). This argument has certainly been used in the United States to protect the use of methyl bromide past the date when developed countries were supposed to ban its use. Fourth, since regulations can be used as barriers to trade, harmonization can place constraints on the ability of governments to set discriminatory standards. There are numerous examples where the domestic industry managed the regulatory agenda, usually in an effort to protect themselves from competition. Examples include U.S. CAFE standards which primarily penalized foreign car importers, and gasoline reformulation requirements which set different baselines for domestic and international firms (Vogel 1998) to name a few. Therefore, limiting the more distortionary options by imposing harmonization may improve domestic as well as international welfare.

Background on the Pesticide Industry

When studying the effect of regulatory harmonization, one needs to consider the specific attributes of the pesticide market. Not all pesticide firms are the same, and their goals from harmonization are equally different. The pesticide market can be loosely thought of as consisting of two groups: the first group is comprised of large, multinational firms specializing in developing and selling patented products. The bulk of business for the companies in this group is largely high value, proprietary products, while including some off-patent chemicals, with lower profit margins. Crop Life is their internationally-active lobby group. The second group includes firms which license these products and produce them when they are off-patent. This second group is generally comprised of smaller national companies and operates without a multinational lobby group. Thus, one can conceive of production occurring either by oligopolistic patent-holding firms, or the competitive fringe, producing generic products.

Whether producing patent products or generics, the are two types of operations in pesticide industries: one is the 'real or true' manufacturer, which is a firm that starts with raw materials or basic chemicals and produces or synthesizes from them the active ingredients (AI) which are the essence of the pesticide or drug. The AI, which normally is produced at high levels of concentration (80-98% purity) is then ‘formulated’ or diluted into a commercial product (usually 50% or less concentration) by a firm – usually called a ‘formulator’ – and put in such a form that allows it to be sprayed or broadcast. The farmer then dissolves or prepares a solution mainly using water as a vehicle, to reach the crops targeting the pest at economic levels and acceptable levels of safety. The first level is the more sophisticated process, requiring an industrial plant or factory whereas the second is a simple process needing less advanced facilities. The first type of operation is primarily located in Europe, the United States and Japan (e.g. Monsanto, Dow AgroSciences, BASF) and there is limited AI production in Canada and in Mexico, mainly the last phases in products like 2,4-D, glyphosate and some older organo-phosphate (OP) insecticides. However all three countries have formulators. Producers of patented products will generally use subsidiaries as their formulators, whereas generic formulators exist and are sometimes able to access their AIs from China and India.

Once patent protection lapses, a product becomes “generic”, i.e. any company can manufacture and sell it. But this does not imply market accessibility; it is one thing to be able to source and manufacture the product, the other is being able to get it registered. Without registration, a pesticide cannot be sold. Registration requires information packages containing details not only about industrial production but also about efficacy, toxicology, environmental impact, formulation, inert ingredients, labels, compatibility with other products, etc. It is here where the lack of harmonized regulations plays a vital role in protecting business and limiting competition; the industrial process maybe open to smaller entrants, but the regulatory package or information on efficacy, environmental and health safety is still owned by the original company. Thus, successful application for registration of a generic pesticide can become difficult unless an agreement is reached with the original owner of the product and its regulatory information. In the United States, companies can have access by paying for file sharing from the original registrants, to access their own registration, but after ten years of harmonizing efforts, in Mexico generic producers do not have the same possibilities as their counterparts in USA.

A second method used by the patent firms to compete against their generic counterparts is vertical integration. Consider the glyphosate herbicide business; before patent expiration around the year 2000, the only firm in the market was Monsanto with Round up™ and variations of the same product. Monsanto has managed the loss of patent superbly by placing emphasis on plant capacity, costs, raw material advantages and the signing of licensing agreements with the main competitors like Syngenta, Dow, Cheminova, Nufarm, BASF and others to supply their glyphosate and support their efforts in accessing registration, while legally challenging firms outside their control (Agrow, 2006).

The agrochemical and pesticide industry has undergone rapid consolidation in the last decade at the global level (Table 1). For most of the last century, the chemical industry had built its base on several pillars: the pharmaceutical industry, bulk chemicals, specialty or fine chemicals and agrochemicals. In the late 1980´s, most companies started divesting their strategic units and in the 1990´s and a stagnant world pesticide market triggered several major rounds of consolidation. Corporations initiated a rationalization drive, bringing about a smaller group of financially stronger companies whose strategy has been aimed at pursuing the high-value, patent-protected, specialized markets of pesticides and recently, seed and biotechnology. Bayer CropScience, the largest company in the sector came about through the acquisition of one the leading German competitors, Aventis, a subsidiary of the large conglomerate Hoechst, which itself had been created by consolidating the agricultural interests of several European and American companies. Another leading example is Monsanto, which acquired major seed companies around the world for their biotech-pesticide strategic linkage, like Agrow, DeKalb (corn, sorghum, alfalfa), Delta Pine (cotton), Seminis (horticulture) and setting up a separate entity for pharmaceutical business under the name of Pharmacia. As a result of this process (Table 2), the new enlarged agrochemical companies have amassed a large list of active ingredients (AI´s) which comprise high-value patent protected compounds and biotechnology traits along with their generic or off-patent agrochemicals.

Some authors (Ollinger and Fernandez-Cornejo, 1998) argue that this consolidation has been helped by the increase in environmental regulation. Research & Development, (R&D) expenditures in environmental clearance of new products is more expensive with increased liability issues. Second, as registration takes longer, there is less time left on the patent when the product finally gets to market. Since all of these added costs are fixed, they all increase the economies of scale.

Table 1: Consolidation Intensity – Top 6 Firms, 2004 and 1995

Company	Nationality	Turnover	Market		Sales	Market
		US$ billion	Share		US$ billion	Share
		2004	2004		1995	1995
Bayer	German	6.1	19%	Ciba	3.3	11%
Syngenta	Swiss	6.0	18%	Monsanto	2.4	8 %
BASF	German	4.1	13%	Bayer	2.37	8%
Dow	USA	3.4	11%	Zeneca	2.36	7%
Monsanto	USA	3.4	11%	Agrevo	2.34	7%
Dupont	USA	3.2	10%	Dupont	2.32	7%
Total industry		32.6	100%		30.0	100%
Top six companies		25.05	77%		15.0	50%

* does not include seeds/biotechnology

Source: Agrow

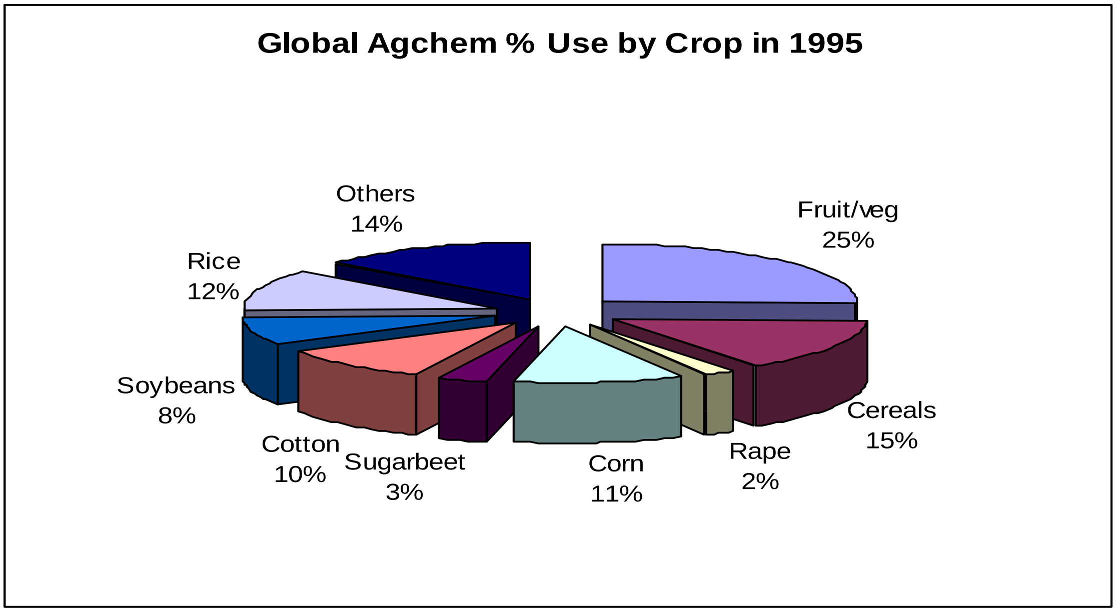
Table 2: Recent Global Agrochemical Industry Consolidation Path

Current Corporation	Predecessors/Former Units or Companies
Bayer Crop Science	Bayer, Aventis, Hoechst, Schering, Roussel, Rhone-Poulenc, Union Carbide, Gustafson
Syngenta	Zeneca, ICI, Stauffer, Ciba-Geigy, MSD, ISK, Sandoz
BASF	BASF, American Cyanamid, Microflo
Dow	Dow, Eli Lilly, Rohm & Haas
Monsanto	Monsanto, Haarz Seed, Seminis, Asgrow, DeKalb Genetics
Dupont Ag	Dupont, Pioneer Hybrids; Griffin

Consolidation is also occurring over products. Too many products can turn into high, slow moving inventories due to the highly seasonal nature of the business and can cause financial difficulties since keeping toxicological and environmental packages up to date in different countries around the world is a challenge and an expensive exercise. In response to increasingly stringent environmental and health regulations companies are now marketing fewer high value specialty chemicals. For example BASF has declared that it will concentrate on proprietary products (high value-patent protected), a move recently confirmed by the sale of Microflo, a generics producer it had acquired in the United States less than six years ago, to the Japanese company Arysta in March 2006. BASF has also announced its intention to go from more than 300 actives in 2000 to around 100 by end 2006, ultimately focusing on about 60 core active ingredients.

Additionally, one recent strategy by corporations has been to identify the top ten crops and pests by crop around the world, focusing R&D efforts more narrowly for larger financial rewards, leaving smaller crops without chemical protection (Figure 1) (Ollinger *et al.*, 1998). This consolidation is a matter of concern for governments and farmers, particularly those that produce minor crops within their country or even in cases where crops are of ´only´ national importance such as agave in Mexico. The regulators and the industry blame each other but have been unable to cooperate (harmonize) and design a system that allows for low cost registration for pesticides for ‘minor crop use’. In California, in 1997, 19 crops of the total of 350 commodities produced in the state consumed 83 percent of all pesticides and 71 percent of all applications; with only four pesticides accounting for close to 70 percent of the total volume applied in 1996 (Wilhoit *et al.*, 1999).

Figure 1: Agrochemicals by Crop in the World in 1995



Pesticides generally have very price inelastic demand schedules (McEwan and Deen, 1997; Lichtenberg and Zilberman, 1998). Because of this, market growth occurs primarily through expansion of acreage (Fox and Weersink, 1995). In the last 20 years, the global market for agrochemicals had been stagnant, with a slight increase in the quantity of herbicides used, but a decrease in the use of insecticides. The adoption of soil conservation tillage and biotechnology coupled with low commodity prices may be some causes behind the decline. For the first time in the past ten years, in 2004 global trade in agrochemicals has increased (4.6 percent) primarily due to increasing demand in developing countries, in particular the two main Latin American markets, Brazil and Argentina as well as an increase in China.

Background on Pesticide Regulation

Regulations affecting pesticides are particularly complex as they involve setting standards at several market levels. Since pesticides are an input, there are product regulations governing both the pesticide itself and the end agricultural product, as well as being process standards associated with the use of pesticides in the production of the final good. Further, since pesticides are meant to address a threat to agricultural production, there are regulations that govern the pest itself that affect pesticide use. Thus, harmonization may occur over regulations on the final good, for example a tomato, which faces regulations over the maximum pesticide residue allowed. Harmonization may also occur over regulations governing the pesticide's registration which is determined by criteria including its efficacy, toxicity levels, etc. Further, each country has different use (or process) regulations that govern such issues as how and when the pesticide is applied, how soon farm workers can enter the sprayed field. These regulations are intended to minimize health hazards for farm workers and negative environmental externalities. Last, there are rules to protect plant and animal safety that govern the transmission of the pests themselves. Each country has sanitary and phytosanitary regulations that can be used to block imports of an agricultural product if it is shown that the product would introduce a new pest or disease.

The United States has had a long tradition of having pesticide regulation, starting with the Federal Insecticide Act enacted in 1910, and evolving into the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) under the control of USDA in 1947, and moving to the EPA with its creation in the 1970´s. Canada and Mexico, following the United States, had dealt with pesticide regulation mainly under the ministries of agriculture since the last century. In 1995, jurisdiction in Canada was transferred to the Pest Management Regulatory Agency (PMRA) under the Ministry of Health and in 2005 in Mexico it came under the Comision Federal para la Prevencion de Riesgos Sanitarios (COFEPRIS) also under the Ministry of Health. The profile of these agencies and their national political clout is different between the three countries, which makes agreements across borders challenging.

A number of significant changes in domestic regulations have occurred since NAFTA was implemented. In the United States, the Food Quality Protection Act (FQPA) was adopted in August 1996 and draws innovative elements into the regulatory framework such as the notion, of using health issues as the most relevant criteria of approval for pesticides. This change includes measuring the cumulative effects of various pesticides and a new safety standard for pesticide residues emphasizing the health of infants and children. Lastly, the FQPA requires that all pesticides will be reviewed periodically (EPA, 2006a).

The first major change to the regulatory framework was that the FQPA established a rule that each pesticide must be found to have a "reasonable certainty that no harm will result from aggregate exposure." This is a fundamental change, effectively incorporating the precautionary principle in U.S. regulation. Thus, absence of data showing the product is harmful is not sufficient to deem that the product is safe (Swinton, 2001).

A second fundamental change is that all sources of exposure, whether they come from food, drinking water, household and other non-agricultural uses should be considered when setting tolerance levels (maximum limits for pesticide residues in foods). It also considers the cumulative effects of pesticides and other substances with common mechanisms of toxicity. In the past, each pesticide and its toxicity level was assessed by US regulators individually, the new FQPA approach modified the risk assessment model by looking at the interaction of several pesticides with each other and their impact on the environment and humans. This 'whole cup' approach is innovative, but it has raised concerns with pesticide users in terms of balancing one pesticide against another.

The third significant innovation was the consideration of the special sensitivity of infants and children to pesticides when setting tolerance levels. Specifically, the EPA is to apply an extra tenfold margin of safety if there is any uncertainty about how a substance could affect children. Last, in the past, tolerances were set such that if there was any risk of the pesticide residue posing a risk of cancer, no tolerance was allowed. However, sensitive groups, such as children and pregnant women were not considered separately, nor were other serious effects such as produced by estrogen-mimicking compounds.

By August 2006, the EPA is to reassess all existing tolerances and exemptions from the requirement of a tolerance, for both the active and inert ingredients in pesticide products. The EPA is forcing all chemicals to be re-registered and assessed to the new tolerance levels. Every registered pesticide will then be re-registered on a suggested 15-year cycle.

The FQPA also established an expedited process for safer pesticides such as biopesticides, including exempting some AI's (for example, food products such as herbal oils) from registration (EPA, 2006b, c). As well, the FQPA set aside grants to fund pesticide registration for small market 'minor use' crops. However the EPA has been criticized for not using these provisions to their fullest potential (Benbrook, 2001, p4).

Note that the regulations surrounding tolerances hit some crops more than others. In particular, the production of fresh fruits and vegetables, specifically those consumed in proportionally larger quantities by children, are the most affected. These crops also tend to be 'minor use' crops – not the large pesticide markets like corn, soybeans and cotton. For example, all fruit uses of methyl parathion were cancelled in 1999, but grain applications were still allowed (Schierow, 1999).

One concern with the FQPA is the large amount of latitude left in the hands of EPA employees. The FQPA provides little guidance on how pesticides should be weighed against one another, which is particularly important given that tolerances are set using a combination of chemicals. Similarly, for minor use and alternatives, employees have a great deal of discretion, implying that firms may not be treated the same, or that a change in employee may mean having to redo various aspects of the registration.

Canada introduced new legislation in October, 2000 called the Pest Control Products Act (PCPA). The PCPA took many of the fundamental aspects from the FQPA, such as the use of the precautionary principle, and the notion that tolerances should be set based on exposure from many sources, not just the pesticide in question. It also adopted the idea that tolerances should be set for sensitive groups such as children and pregnant women. Last, it moved to re-register all pesticides, comparing them to the new tolerance levels, and will continue to require re-registration after every 15 years.

A number of differences persist. Even though the overall philosophy of the regulations is the same, the tolerances and registration regulations are different. Thus, if a firm wants to register a pesticide in both US and Canada, they must do testing in each jurisdiction, and submit the results to both authorities (the United States does not require the data to be submitted while Canada does). The rules around minor use in both countries seem to be bound by a common spirit but its application differs widely in each nation, no common applications have been logged so far. As well, Canada has been much slower to adopt expedited processes for safer pesticides, and, although the PMRA adopted "reduced risk" language in 2002, they have yet to change their registration process to exempt food products or generate other registration tracks for pesticide alternatives.

In Mexico, as of December 28th, 2004, the Federal Commission for the Protection against Sanitary Risks (COFRPRIS), a branch of the Department of Health is the regulatory agency responsible for registering pesticides. Residue limits are set by both COFEPRIS and the National Institute of Ecology (INE). The technical and environmental data is analyzed by the Department of Environment and Natural Resources (SEMARNAT) while the Department of Agriculture (SAGARPA) is responsible for assessing the effectiveness of pesticides. Since March 29, 2005, Mexico has adopted a new regulation, the *Reglamento en Materia de Registros, Autorizaciones de Importación y Exportación y Certificados de Exportación de Plaguicidas, Nutrientes Vegetales y Sustancias y Materiales Tóxicos o Peligrosos,* that governs registration, import and export authorizations and export certificates for pesticides, plant nutrients and toxic or dangerous substances and materials. This Regulation specifies that COFEPRIS will register pesticides and establish MRLs for food by assessing and reviewing pesticide registration applications and data. Until further guidelines are established, Mexico may accept USEPA tolerances or Codex Alimentarius MRLs (TWG, 2005).

There have been a number of attempts to develop a global set of standards for pesticides and plant and animal health. With the elimination of tariffs, technical standards and sanitary (animal) and phyto-sanitary (plant) (SPS) regulations have grown in importance. SPS measures are aimed at ensuring food quality and safety of imported commodities to avoid introducing pests (new) into any region or country. Their use has been controversial. In a number of cases they have become tools to limit trade.

With the creation of the WTO, and the adoption of the agreement on the Application of Sanitary and Phytosanitary Measures – SPS measures are to be based on scientific evidence, non-discriminatory and applied only if necessary. The WTO article 5.6 of the SPS Agreement rules that member-states shall ensure that measures do not restrict trade beyond achieving appropriate levels of phyto-sanitary protection. The SPS Agreement encourages countries to use existing international standards (eg. Codex Alimentarious) and requires scientific justification for standards that are higher. Specifically, the country has to show scientific evidence that imports would cause potential (plant or animal) health problems.

Related to the SPS Agreement, the Agreement on Technical Barriers to Trade (TBT) is meant to define and separate acceptable safety, information and quality requirements, from simple barriers to trade. Like the SPS Agreement, the TBT Agreement requires that countries treat imported products the same ways as they treat domestic products in terms of their quality, information and safety requirements. Unlike the SPS agreement, however, the TBT agreement allows higher standards for a number of reasons, including differences in technologies, geography, and does not demand the rigorous level of scientific justification required by SPS (Schmitz *et al.*, 2002).

There are a number of international rules governing the regulations of agricultural chemicals. These rules, such as the SPS and TBT agreements, aim to limit the ability of countries to use these regulations as effective barriers to trade by creating a harmonized set of standards to regulate the true externalities associated with pesticide use. The OECD has become actively engaged in the harmonization of pesticide regulatory frameworks in developed countries (OECD, 2006). In 1992, the OECD established the Pesticide Forum, now called the Working Group on Pesticides with the aim of helping countries manage the risks arising from the use and the from registration of pesticides. Canada and the United States have announced last year that they will be aiming to harmonize their regulatory systems by region (NAFTA, EU), create a system of global data dossiers, and generally make registration in multiple countries easier. Notably, Mexico is not part of the declaration.

Interest Groups and Their Objectives for Harmonization

To be able to determine who is driving (or at least benefiting from) the harmonization process, one needs to first understand the objectives of the various interest groups involved. The interest groups we consider include farmers, the agrochemical industry, consumers and environmentalists. As noted above, the agrochemical industry is complicated in that there are two types of products: patented and generic, and two types of producers: the large, multinational firms involved in research and development, who produce both the patented products and the generics, and the often country-specific producers and formulators of the generic products. Because the producers of the patented products inherently have market power, both in producing the on-patent products (by definition) and in producing the generics (by licencing arrangements), one has to consider models with market power. One such is Salop's model on raising rivals costs, where a firm can lobby for (or impose industry-level) standards that are harder for a rival to meet than for itself. This strategy is particularly relevant in considering harmonization. Since we also see different prices and differential access to products in the three NAFTA countries, we also want to consider that firms may be engaging in price discrimination. We will use these models to explore who may win and lose from harmonization of different regulations.

First, let us review the key findings of the raising rival's costs model. The model is usually predicated on an oligopoly or a dominant firm facing a competitive fringe. The firm faces two strategic decisions, to choose quantity/price and to choose the level of a standard for the industry. One can imagine this occurring by either the firm setting a voluntary industry standard or lobbying for a certain level of government regulation. The intuition is that by setting a standard that is easier for it to meet than its competitors, it can gain a competitive advantage that more than offsets its own increase in cost. This strategy may involve choosing a standard that is actually higher than socially optimal. Consider a regulation that imposes a fixed cost, for example, a regulation requiring detailed testing before a pesticide can be brought to the market. This kind of regulation is easier for a larger company to meet than a smaller company, and therefore may be encouraged by the dominant firm to raise the costs of its smaller rivals.

Various authors have shown that this intuition holds for harmonization. A country that favours its domestic industry will argue to harmonize to the level of standards for which they have a comparative advantage (Fischer and Serra, 2000, Copeland, 2001, Ganslandt and Markusen, 2001 and McAusland, 2004). Even without market power, this may result in standards being set that are stricter than socially optimal (Gulati and Roy). Thus, in our case, one might anticipate that patent protected pesticide firms located in the United States would like set regulatory standards such that they raise the costs to their counterparts based in Europe and Japan, as well as raising costs to generic producers.

The second model we explore is that of price discrimination. Given the different prices and differential access to chemicals in the three countries, and further, given that most of the pesticide producers are active in all three countries, one might suspect that the (patent) firms are price-discriminating. In this case, the markets where the firm faces the more elastic demand would expect to see the lower price, whereas the market with more inelastic demand would presumably see the higher price. The chemicals used in the more important crops in the two countries seem to face lower prices (such as canola in Canada and corn in the United States). If firms are price discriminating, they have an incentive to support regulations that effectively block arbitrage.

Note that although price discrimination is often targeted as undesirable by consumers, removing price discrimination will raise price as often as it lowers it. Assuming that allowing arbitrage would not increase the number of firms active in the market, Freshwater and Short, (2005) estimate that the welfare of crop producers will go down if price discrimination was removed in pesticides between Canada and the United States. In a number of instances, where the United States currently faces higher prices, the decrease in price will be small whereas the offsetting increase in price in Canada will be large, due the differences in market size. They also note that if price discrimination were no longer possible, some of the currently low-priced markets may no longer have access to the chemical as the price increases past their willingness to pay. Thus, allowing arbitrage without increasing firm entry will not necessarily benefit agricultural producers.

By improving consumer information on competing goods, standards can increase the elasticity of substitution of demand (Harrison *et al.*, 1996; Maskus and Wilson, 2000). Because regulations standardize many of the key product characteristics and performance is guaranteed, products become closer substitutes. Thus, trade liberalization generates a more elastic increase in demand for imported goods under standardization than under non-standardization (Baldwin). This is of particular concern to producers of import-competing products, where a market has already been established, and information is already clear to the consumer. Thus, these producers may have a further concern with the harmonization of standards. They would also want to block entry into small markets (say for specific crops) where they have market power.

Patent firms also have an incentive to reduce the pesticide costs that are specific to them, but not to their patent producer or generic counterparts. Thus, rules harmonizing data collection, so firms who are doing the field testing can generate the supporting documentation for registration more easily/cheaply would be desirable. However, since generic producers have to access the test data from the original patent firm, keeping property rights over that data is presumably also important.

Since there is a fixed cost associated with the registration of a certain chemical/crop/country combination, pesticide firms have an incentive to concentrate their markets. Therefore they gain from increasing specialization in agricultural production. To do this, they have an interest in harmonizing the product standards around agricultural produce, so that tomato trade, for example, can flow freely among the three countries.

Because the pesticide producers operate in numerous countries, they have experience coordinating activity across several countries. In this sense, of all the interest groups, they are most able to take advantage of an international regulatory process.

Domestic generic pesticide producers will presumably want to reduce costs of registration, specifically easier access to data to register new products as they come off-patent. That said, they will want to keep barriers to imports, since they tend to produce for the domestic market.

The consumers of pesticide products, agricultural producers, generally stand to gain from harmonization on pesticide rules due to increased access to chemicals and potentially lower price, reducing their cost of production. Export-oriented producers will also benefit from harmonized agricultural product standards, reducing existing barriers to trade, or the uncertainty associated with potential trade barriers. By contrast, import-competing producers would presumably like the ability to block imports. Thus, they have an incentive to block harmonization of standards to give them a back door for protectionism when needed. Unlike the pesticide manufacturers, agricultural producers are primarily organized at a national and/or commodity level, and will presumably have less access to decision-making at the international level.

The other groups we consider are environmentalists and consumers. Environmentalists want to minimize pollution caused by pesticide use and will generally want very restrictive rules on pesticide use. At least some environmentalists will be concerned with pollution caused in other countries as well – therefore the environmentalists will want to use harmonization to raise standards in all countries. That said, environmentalists tend to be organized better at the national level.

The last group we consider are consumers, who we assume care about having access to safe food at relatively cheap prices. Given that objective, our consumers will want liberal regulations on pesticides, but tight product standards on food itself. Consumers tend not to be well organized into lobbies at either the national or international level.

Given the relative influence of the groups internationally, we hypothesize that the producers of the patent pesticides will have the largest influence. If they do, we would anticipate that they may use the harmonization to raise their rival's costs – both to other patent producers and to generics. One way they could raise costs to firms from outside NAFTA is by harmonizing to something other than a recognized international standard, such as that proposed by the OECD. They would also want to block a move to make it easier for generic firms to register off-patent products. Thus, we hypothesize that they will retain the requirements that firms submit detailed test data and preserve strong property rights over that data. They will want to lower requirements where the costs of meeting those requirements primarily apply to them (or they have no comparative advantage in meeting these requirements). This may include harmonizing the standards for registration, but retaining the benefit from being active in each country. Similarly, where costs of registration are not sufficient to keep out competition, and the domestic firms have no comparative advantage in meeting the registration requirements, the firms may lobby to lower the costs of registration. However, where registration costs are sufficient to keep out competition, firms already in those markets will presumably be interested in retaining those barriers to entry. Thus, the firms will likely lobby against harmonization of smaller markets. Similarly, they may want to keep barriers to entry in place against alternative pesticides.

In general, if patent firms are engaging in price discrimination, they will want to block harmonization that would allow arbitrage. Thus, they would want to keep high use requirements, and limit the ability of retailers to source chemicals from outside the country. That may include limiting harmonization around labelling, or other country-specific regulations. This does not mean that producers of pesticides are opposed to all forms of harmonization. If the pesticide industry is dominating the bargain over harmonization, we would expect to see harmonization of product standards around agricultural products, to encourage trade in the final goods, and therefore to increase the concentration of crops in a single country.

Last, import-competing agricultural producer groups may be able to influence the harmonization process to block harmonization with their primary competitors. The lack of common rules around pesticide use gives the import-competing sector a ready excuse to launch a trade dispute when domestic prices are low. For example, this kind of tactic has been used by U.S. growers in avocados and tomatoes against their Mexican counterparts.

In the next section, we compare these predictions against what we have observed in the harmonization attempts to date. If we can detect who is benefiting from the pattern of harmonization it gives us an indication of who is driving the process.

What We See From Harmonization

In 1996, a NAFTA Technical Working Group (TWG) was established to develop a North American market for pesticides by harmonizing pesticide regulation in the three countries (TWG, 2001). The TWG has become a forum to better integrate pesticide regulations within the context of each country's institutions. The group is attempting to reach this target by sharing work and reducing the cost of assessing and regulating these products for industry and the national authorities. According to the official Mexican document published by the Ministry of Employment, Work and Social Prevention (STPS) in 2000, "the drive aims to harmonize regulations for pesticides, assessment criteria and maximum residue levels (MRLs) while sorting out trade disputes without compromising health, environmental quality, food quality and the development of regulatory capacity" (STPS 2000).

The TWG meets annually with stakeholders, be they from the pesticide industry, grower organizations or environmental groups. There is evidence that patented producers, through their industry organization, Crop Life, are highly involved in process, while generics and agricultural producers are not. From the TWG minutes, there seem to be key roles adjudicated to global pesticide industry and government federal agencies leaving behind farmers, NGO's and consumers. For example, the Industry Working Group, which represents the pesticide industry at the TWG, has made submissions reported in the minutes of every annual stakeholder meeting since its creation in 1998, and several executive meetings, whereas representatives from growers were reported only in the minutes from the 2001, 2002 and 2003 meetings, where they were generally outnumbered by the industry representatives. There was only one submission reported from a representative from alternative agriculture (in 2001), and, although the World Wildlife Fund has presented at several meetings, in the 2001 Milestone report, their representative noted that she felt the focus of the TWG had been directed too much at facilitating trade, and not enough at promoting better environmental outcomes (TWG meeting minutes, various years).

Successful regulatory harmonization has been spotty. There has been great progress made in some areas such as setting common maximum residue limits for produce, to allow agricultural goods to flow (reasonably) freely across the border. Other areas, such as pesticide registration, have not progressed nearly as far, leaving producers in the differing countries facing different pest-control options at different prices. In this section we will walk through the evidence of where harmonization has been successful, and where substantial differences among the regulatory systems persist.

First, as evidence that harmonization is still far from complete, we see that pest and pesticide regulation are still serving as barriers to trade. One of the best known SPS disputes in NAFTA has concerned the import of avocados from Mexico into the United States. Back in the early part of the last century, a ban on Mexican avocados was imposed in the United States after a 1914 discovery of seed weevil in Mexican groves. More recently, concerns have turned to fruit fly infestations in the Mexican crop. At the time, the ban may have been appropriate given control of the two pests was difficult. In the meanwhile, the registration of new agrochemicals and the advent of integrated pest management (IPM) have allowed for control of the insects and Mexican exports to Japan and Canada meet stringent standards based on both strategies. Mexico has always maintained that the ban could not be technically justified and was kept in place, even against the advice of the U.S. Department of Agriculture (USDA), to protect U.S. avocado producers in California (Orden, 2004).

The grower lobby, the California Avocado Commission (CAC) fought hard against the opening of the U.S. market and managed to impose stringent growing regulations for Mexican growers in the State of Michoacán, among them the treatment of Mexican avocados with pesticide which ensured high probability of elimination of exotic pests, the establishment of pest free-zones, and testing and monitoring on Mexican orchards by USDA inspectors. Finally in 1997, after eight years of negotiations, the USDA eased the ban, allowing a small quantity of Mexican imports to be sold in the Northeastern United States during winter months, to mitigate pest introductions due to adverse climatic conditions. Over the past few years, the number of states has increased and the latest regulatory change in January 2005 meant Mexico can export year-round to 47 states. The ban on exports to California, Florida and Hawaii – the three avocado-producing states – will continue until 2007 (Washburn, 2005).[1]

Another illustrative example of SPS issues generating barriers to trade is the potato wart, a fungal disease found by the Canadian Food Inspection Agency (CFIA) in Prince Edward Island in 2000 and reported to the USDA under the existing NAFTA mechanisms. The CFIA conducted research and showed beyond reasonable doubt that the disease was contained and limited to part of a small field in PEI, nevertheless USDA implemented a quarantine closing the border to all potatoes from PEI. The CFIA and the U.S. Animal and Plant Health Inspection Service (APHIS), reached an agreement to achieve the necessary control and inspection to resume exports to the United States, which was later repealed by the Americans. Canada then initiated consultations through the NAFTA dispute resolution panel, a bilateral working group was established while politicians tried to solve this dispute which affected a perishable commodity. Finally borders were reopened after setting up a three year monitoring plan

[1] Meanwhile, Chile entered the market, which may have eased the pressure for protection against Mexican imports in the United States.

by both agencies. At the time of the dispute, North America had been facing a potato surplus and falling prices, which may have contributed to the trade tension.

Domestic pesticide rules can also be used as an effective barrier to trade. After the adoption of the FQPA, in 1999 the EPA placed restrictions on the use and tolerance levels for chlorpyrifos. The tolerances were reduced for apples and grapes, but notably, they were removed completely for tomatoes. Tomatoes were treated differently because of the availability of alternatives, along with the fact that tomato imports from Mexico had the highest residues of chlorpyrifos (Benbrook, 2001). Thus, it is likely easier for U.S. producers to adopt alternatives than their Mexican counterparts.

One result of the lack of harmonization is the persistent price differentials and varying degrees of access to pesticide in the three countries. Canadian farmers, with smaller volumes than the United States enjoy lower prices than their American counterparts on some products, paying around 60 percent less for glyphosate herbicide at retail levels. By the same token, American farmers pay higher prices for the insecticide malathion (Freshwater and Short, 2005). As indicated in the Agriculture and Agri-Food Canada Report prepared by McEwan and Deen, price differences between U.S. and Canada were recorded for 7 key products, indicating that some herbicides were cheaper in Canada but some insecticides and fungicides had lower prices in the USA. Most of these products are generics, so one would anticipate that patent protected products would have an even greater potential for price discrimination. U.S. farmers have long complained about higher prices in their country if compared with Canada, just as Mexican farmers generally complain about higher prices in the country if compared with the United States. One key goal of harmonization, a North American market for pesticides, has not yet been met.

As two further examples of differences in the markets in the three countries, we explore pesticide access in the potato industry in the three countries and the three country's differing reactions to the phase-out of methyl bromide. Potato wart disease and the crop are interesting subjects for pesticide regulatory behaviour analysis in NAFTA. The potato crop is grown in the three member countries of NAFTA and is imported and exported among Canada, Mexico and the United States. According to U.S. potato industry statistics, U.S. exports to Mexico and Canada grew in the first years of NAFTA, but 2004, Canada had grown in the U.S. market by supplying growing volumes, including higher added value, processed products (frozen potatoes and french fries). (Huffaker, 2004)

Growing potatoes is an intensive activity, both in terms of inputs and capital, and the crop is host to a wide variety of pests that damage foliage and tubers. Agrochemicals are the cornerstone of successful potato farming. Most potato farmers rely on chemical insecticides as the base of pest management tactics against soil pests. These insecticides are often formulated as granular products (active ingredient sprayed on mineral or bio granule) which are then broadcast at planting time or after, usually mixed with fertilizers. A problem with this type of pesticide and their application is that the relative high toxicity of the products and the physical site of application (on top soil or below surface) make it easy for wild birds and other species to become involuntary targets and be killed.

In the Fraser Valley in Western Canada numerous deaths of eagles and hawks, raptors and water fowl have been reported as a result of the application of some granular insecticides. (Elliot *et al.,*1997). An additional source of concern is the effect of pesticides leaching to water bodies and ground reservoirs. As a consequence, most of these granular insecticides have been banned in Canada and farmers in the region are left without tools to effectively control insect soil pests (Vernon, Robert, BC Pest Management Assoc, 2006).

Even though potato farmers compete on a global market, Canadian farmers are not able to source in Canada the same pesticides as their counterparts in Mexico and the United States, leaving them with limited options for pest management and impairing their profitability due to a non level playing field across NAFTA. For example, producers in both the United States and Mexico are able to use Phorate, Carbofuran, Aldicarb and Fensulphion against soil insect pests in potato production, whereas these chemicals are restricted to Western Canadian producers.

A second example of the differences in access to pesticides is the reaction to the Montreal Protocol with regards to Methyl Bromide (MB). This example shows how even after agreeing to a common course of action, the relative size of the affected domestic industry will lead to different outcomes. MB is a highly toxic and very effective fumigant (biocide) to treat a varied range of pathogens and diseases affecting high value agricultural crops for almost 40 years. MB is used mainly as a soil disinfectant prior to planting horticultural crops which are very sensitive to losses arising from fungus and bacterial diseases but also from insects and weeds; MB is injected into the soil and allowed to remain in it under a plastic cover to eliminate micro-organisms, weeds and insect pests. It is also used extensively in greenhouses for sanitization. MB plays key role in growing horticultural crops, like strawberry, tobacco, asparagus, flowers, potatoes, tomatoes, peppers, cucumbers and other produce. The EPA estimates that of all MB used in the USA, over 40 percent goes into two crops: tomatoes and strawberries.

As MB degrades ozone, it is a product whose regulation is of truly international concern. Even so, NAFTA member states have not agreed on a common approach. It may have to do with the different importance at national level of horticultural production, the clout of the chemical producers (and whether these are established in the countries). As part of the Montreal Protocol, an international treaty signed by over 180 countries designed to control the production and consumption of certain ozone-depleting substances, including methyl bromide, developed countries around the world have agreed to stop its use in their agriculture by 2005. Since 1997, Canada, a relatively small user, has promulgated regulations to meet its Montreal Protocol commitments (PMRA, 2004). By 2005, Canada had all but banned MB, while Mexico, as developing country has the right to a flexible approach but is phasing out MB stepwise by 2015. The United States on the other hand, a large user and manufacturer, has left the door open with a clever clause denominated Critical Use Exemption (CUE) where the United States has requested 9,921 tonnes of Methyl Bromide be considered 'critical use'. The global requested critical use exemptions for Methyl Bromide total 16,917 metric tonnes, meaning that the United States has requested more 'critical use' exemptions than all other countries combined. The Bush administration has threatened to ignore the treaty altogether if their 'critical use' demands for Methyl Bromide are not met (Sierra Club, 2006)

After ten years of harmonization efforts, we have three radically different approaches to the regulation of a chemical like methyl bromide, Canada, who never was a heavy user, has banned the product for agricultural use in 2005 and promotes alternative technologies skewed towards Integrated Pest Management, IPM. The Canadian approach usually favours environmental considerations especially since the local industry would only be hurt on a small scale. Probably the farm lobby in Canada is less powerful than the environmental lobby, a different situation in the USA, itself a heavy user in a high value industry and powerful lobbies in the intensive horticultural production (strawberries in particular).

Last, consider the insecticide lindane. By Jan 1, 2005, lindane was no longer allowed for use in Canada. However, at the same time, Mexico still allowed its se for parasite control and on livestock, while the United States still allowed its use as a seed treatment on corn, wheat, oats and sorghum. (TWG, 2004). Although lindane is banned for use on canola crops in the United States, the Canadian government's move to do the same prompted a suit by Crompton Corporation. The company claims that the Canadian government broke an earlier agreement it made through the PMRA. Crompton had agreed to stop manufacturing lindane products at the end of 1999 pending a full PMRA review of the pesticide's safety, to be completed by the end of 2000. At the same time, the US EPA was completing its own review and re-registration of lindane for a number of other uses in the United States. In 2001, U.S.-based Crompton Corporation sued the Canadian government for banning the chlorinated insecticide lindane, seeking US$ 100 million under NAFTA's Chapter 11 investor-state mechanisms. In a push for 'harmonization' of regulations, Crompton Corp.claims to have agreed that it would not request the reinstatement of lindane in Canada if both the PMRA and the EPA found it unsafe for use on canola. However, the agreement also stipulated that if any national agency deemed lindane safe for use on canola, then it would have to be reregistered in Canada. Trade may have had something to do with the rule change. In 1998, the U.S. EPA indicated that it would be illegal to import Canadian canola seed treated with lindane into the United States, since treatment with lindane was not a registered American use (although its use on other seeds is approved). This prompted immediate concern among Canadian canola growers, and discussions began among the PMRA, U.S. EPA, Canola Council of Canada and Canadian Canola Growers Association and registrants to implement a voluntary withdrawal of lindane (NTREE 1999, Natural Life Magazine 2002). On the other hand, others have argued that Crompton saw the Canadian government's move as a threat to its interests in the United States. While this was occurring in Canada, the Crompton

Corporation was aggressively pressing for the re-registration of lindane in the United States, and Canada's phase out was seen to threaten their chances. (Pesticide Action Network North America, 2006).

Some of the largest differences in access pertain to the registration of safer pesticides. Various alternatives to the traditional pesticides, like naturally derived compounds, are not being made available in Canada due to difficulty, length and lack of clarity in the registration process. Pesticides made from products that are already allowed as food products, such as botanical oils, do not need to be registered. Neither Canada nor Mexico has adopted this exemption as of yet. Other, safer pesticides can be fast-tracked in the United States under the ‘reduced risk’ standards of EPA, which encourages the registration of products with low risk profile to users by setting incentives like shorter registration process. Known as ‘EPA Reduced Risk Initiative’, begun in 1993, it aims at providing incentives to companies to make safer products available to the market, environment and consumers. Unfortunately neither Canada nor Mexico have brought their approach closer to U.S. guidelines in practical terms; for the latter countries have a similar philosophical policy, but no effective way of ensuring that safer products get to market faster. Current regulations are the result of evolving systems tailored to agro-chemical industry needs, making it difficult to speed-up registration of safer products in Canada.

One place where there has been progress is the harmonization of tolerances or maximum residue limits (MRLs). As of 2002-03, the TWG had developed procedures for typical irritants around residues (MRL) and availability of products, but going further it recently set out to achieve a “North American market for pesticides in which growers of the three countries can access the same pest control tools” (Freshwater and Short, 2005). By 2001, 12 common MRLs had been established by the TWG, and others that have been sources of trade irritants have been targeted (TWG, 2001; TWG, 2005). For other MRLs, the TWG is harmonizing data requirements and procedures.

The group has worked to lower the costs of registration across countries through work sharing and common registration data submission, tied to a coordinated review process. This includes the development of a regional label. However, neither of these goals has been reached, the review processes are still separate although some progress on data requirements has been achieved between Canada and the United States. Interestingly, data privacy rules have been maintained in the harmonization process, meaning that generic companies still need to negotiate with the patent holder to access data for registration.

When an agreement has been reached to harmonize, one of the questions remaining is which standard to harmonize to. Probably due to size, although likely helped by the location of the pesticide industry, much of the harmonization has occurred to U.S. regulations. In the early 1980´s, pesticide registration in Mexico was easier if the chemicals had EPA established residue tolerances, an easy hurdle for American chemical companies, as opposed to the European or Japanese companies which rely on Codex alimentarius tolerances. By these means, American chemical corporations have had an edge over their European counterparts, who had to engage in costly and lengthy negotiations with the regulatory authorities for the establishment of local tolerances. At the same time, Mexican farmers were aware that using products without the U.S. tolerances could mean rejection by U.S. buyers or at border controls, if residues were spotted. Thus, even though Mexico has sat as an active member of the FAO Codex alimentarius, the body which sets residue tolerances at world level, in its regulatory framework has traditionally paid more attention to residue limits set by EPA in the United States, its most important trading partner.

Other examples of harmonization to U.S. standards include the Canadian adoption of the concept of cumulative exposure in setting MRLs. Similarly, Mexico has adopted articles from FIFRA. Mexico and Canada share some systems for chemical residue analysis developed in Canada, while the United States and Mexico employ the same IR-4 methods for the establishment of tolerances in the "minor use" sector, as is the case of papaya and imaclopride, an insecticide of a relatively new technology called neo-nicotinoids against sucking insects. Further, the Mexican government allows USDA-APHIS farm inspectors in Mexico, pre-qualifying pesticide application, residue levels and pests standards on fruit and vegetable for export. This is still the case for tomato, cucumbers, peppers and avocado production in the key states of Sinaloa, Guanajuato and Michoacán.

One place where the United States adopted a Canadian rule was with the creation of an expedited registration for a fee. This requirement inherently favors large patent producers, given that (a) they have an incentive to register the product as quickly as possible, to maximize the usable time of the patent and (b) they can afford the fixed cost.

Interestingly, where harmonization has made the greatest leaps has often occurred in the private sector. For example, since President Salinas amended article 27 in the Constitution allowing "ejidos" communal lands to be sold or rented out, a number of U.S.-based industrial producers have expanded to Mexico. Large U.S. producers, brokers and processors of commodities are either contracting out agricultural production on Mexican farms or buying the farms to grow crops for urban local consumption or for export, under U.S. conditions, including the agrochemical use pattern and techniques. Thus, harmonized pesticide rules are of great value.

American vertically integrated operators in horticulture like tomatoes, peppers and broccoli, including packing houses in central Mexico and the North West produce crops in line with U.S. pest management programs and specifications. Firms like Del Monte, Campbell, Gerber and Heinz were operating successfully in Mexico before NAFTA, and the current conditions allow for the mobility of produce and operations between regions and countries.

Other examples are consumer product companies like Mars (chocolates, snacks and pet food); the company has an ever growing demand for peanuts, the season in the United States is short, while in Mexico it can be grown twice a year at lower costs than in the USA. The field managers hand the crop husbandry guidelines including the exact Georgia pesticide lists to local suppliers to be sourced and by farmers to be applied. This is at the heart of industrial agriculture and it is not possible, with different regulatory systems.

Conclusions

Different standards in pesticides and pest protection have often been used as trade barriers, whether real or manufactured. While harmonization is often touted as a means to limit rent-seeking by domestic (protectionist) interests, the process itself is also subject to rent-seeking, particularly by those interests organized at an international level. In this paper, we present evidence that pesticide rule harmonization has been influenced by patent pesticide producers.

Specifically, we argue that in places where harmonization has occurred has often served to raise the costs of local firms competing with locally established MNC proprietary (patent) producers – whether to generics or to EU/Japanese patented competition. For example, harmonizing regulations to the United States as opposed to the OECD creates a comparative advantage for pesticide producers located in North America. As well, harmonizing data requirements while preserving property rights over the data lowers the costs of registration facing large firms that hold chemical patents, while retaining the barriers to entry facing generics. Similarly, other harmonization efforts, such as around MRLs, serves to aid the chemical industry by increasing their market size and concentration.

There is also evidence that patented producers have been able to limit potential for arbitrage, preserving their ability to price discriminate. That said, it is unclear if price discrimination actually harms the consumer, and in some cases, eliminating price discrimination without decreasing barriers to entry may actually reduce access to pesticides in some markets. The existing difference in pesticide availability is perhaps of more concern than differences in price. Producers, particularly those of smaller market crops in the specific country, tend to have many fewer pest control options than their counterparts in the larger market. For those pesticide producers active in those smaller markets, it is in their interest to retain those barriers to entry.

Meanwhile, the limited harmonization that has occurred is not sufficient to stop domestic rules being used as trade barriers in times of large crops and low prices, as in the case of potatoes. There are interesting possible coalitions between small-market producers in the United States who have access to pesticides that are unavailable in Canada and Mexico and pesticide companies who have exclusive product in small-markets in Canada and Mexico. Thus, one cannot count on pesticide manufacturers to counter the pressure from protectionist agricultural lobbies to push for small-market access programs.

In conclusion, if harmonization is to improve welfare, the market power implications of harmonization need to be considered. Desired regulatory changes that have the potential to increase market power of some firms could be counterbalanced by decreasing other barriers to entry. For example, given the concerns raised with the latitude of officials in determining the exact baselines for registration, improving the transparency of the registration processes in all three countries would be a start.

As farmers are the primary consumers of pesticides, increasing their role in the harmonization process may help balance the strong voice of the patent industry. Particularly producers of small-market crops (which may mean that these producers are not organized) should have a key role in setting the priorities for harmonization. One area that clearly needs attention is increasing entry, particularly for small-market and alternative pesticides. The U.S. program of expediting and helping fund minor-use pesticides has been deemed successful, and while Canada has minor use program, there are still numerous farmers without the same pesticide access as their counterparts in the United States (such as in the case of potatoes). Mexican farmers potentially face greater barriers since their government does not currently help fund the registration of minor-use pesticides. Canada has also indicated that fast-tracking the registration of safer pesticides is a priority, but here again is a place where the United States is much further ahead.

That said, complete harmonization is likely not politically possible, nor even necessarily desirable. In those areas where countries cannot harmonize their standards, setting clear and transparent rules will help alleviate the ability of those rules being used as a tool for rent-seeking. It is also clear that harmonization is not sufficient to limit the push for protectionism. Thus, there needs to be access to some dispute settlement mechanism, whether through the standard NAFTA panel process, or a combination of the NAFTA panel and the Commission for Environmental Cooperation.

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