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Free Trade, Pesticide Regulation and NAFTA Harmonization

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Pesticides are an important farm input both in terms of cost and in terms of their impact on crop yields and quality. With freer trade in agricultural output, differences in cost of production, yield and quality can have a large effect on competitiveness. Thus there is an increased demand by farmers in Canada and the United States for harmonization of pesticide regulations, and in particular for the option to import registered pesticides for their own use. Under NAFTA the three national governments are moving to make pesticide regulation more uniform, but there are still significant differences in regulatory structure and these effectively preclude direct imports by farmers at this time. Moreover, while farmers believe they would as a group benefit from a single market this is unlikely to be the case. Under the current regulatory system pesticide companies have an incentive to practice price discrimination, which results in farmers with the most inelastic demand facing a higher price. In a single market one would expect prices to equalize, but at a price closest to the price prevailing in the larger-volume market. In addition if one market is relatively small it may no longer be profitable to serve it and those farmers could lose access to certain compounds, because there would be no domestic registration. Thus this paper argues that the welfare gains from introducing free trade in pesticides are more complex than have normally been assumed. In particular, regulators in Canada, Mexico and the United States should consider differences in market structure in their efforts to harmonize pesticide regulations.

Keywords: NAFTA, pesticides, price discrimination, regulation

Introduction

Pesticide price differentials and access to pesticides have emerged as potentially significant trade issues within NAFTA. Because pesticides can only legally be used in a specific country if they have a label that is approved by regulators in that country, it is impossible for farmers to import significant quantities of pesticides. This requirement effectively blocks an element of trade. An important consequence of such government created barriers to trade is that they essentially sustain the practice of price discrimination by chemical companies. In addition, because companies may choose not to pursue registration in one country, this can leave growers with fewer pest control alternatives than their competitors in another country that has a broader set of registered products. As a result pesticide regulation has become a trade irritant. The case of pesticides is also of general interest because it illustrates how regulation and strong product differentiation can have the same effects on trade in terms of market segmentation – with differences in prices and product availability – as those that result from tariffs and quantitative restrictions.

Given this government enforced pattern of market segmentation it is appropriate to start from a model that assumes price discrimination, rather than the usual assumption of a competitive market. Given this assumption one would expect to see differences in prices rather than a uniform price because there is little opportunity for normal arbitrage. An interesting way of phrasing the question then is to ask, Why do we see cases where pesticide prices are comparable?

Pesticide regulation is also of interest because it is one area where NAFTA has resulted in extensive cooperation among the regulatory agencies in Canada, Mexico and the United States to bring about increased harmonization. So there is a clear effort by regulators to try to find ways to resolve the problems of differences in national regulatory standards.

As NAFTA leads to a closer integration of agriculture within North America, and as access to pesticides becomes a more critical factor in production methods, differences in pesticide regulations begin to play a more important role in farm income. Pesticides can be expected to play an even more significant role in the future. While there is likely to be an increase in the volume of production of "organic" products, the vast bulk of North American agriculture will continue to use pesticides. Indeed as technology advances, the importance of pesticides is likely to become even more pronounced as, for example, in the case of the growing use of "Round-Up Ready" seeds.

One cause of complaints by farmers is that pesticides cost more on one side of the border than on the other. Higher prices are seen as creating a competitive disadvantage relative to farmers in another country growing the same crop for the same international market. Price differential complaints tend to be mainly associated with pesticides used on high-volume crops that are sold as commodities on world markets. For these crops output prices do not vary by country and this makes controlling costs a critical element in determining levels of profit among producers.

In addition farmers complain about differences in the availability of specific products. Some pesticides may be unavailable in one country but available in another. On a more refined level, some may be available in both countries but be licensed for application on different sets of crops, once again creating access problems. In general, the current concern with access is more common for minor-use pesticides – that is, uses where demand is relatively low and there is the possibility that the pesticide cannot be supplied on a cost-effective basis under the standard regulatory scheme. However there are occasionally cases where a product is available for a specific use on a major crop in one country and not in others, often because of lags in the regulatory process. In the long run access may become an even more important issue if regulation reduces the incentive for companies to develop and register pesticides in certain countries.

Background information, which provides a context for pesticide policy and trade in North America, is presented in the next section. This is followed by a brief description of the regulatory process, including a description of harmonization goals and steps being undertaken to achieve this goal. Price and availability issues are then described, and conclusions are presented in the final section.

The Context for Disputes

The Role of Pesticides

Pesticides are a class of compounds used in agriculture to enhance the quality and/or quantity of desirable species of plants or animals. Pesticides control pests by killing or weakening them, or by making the treated product unattractive to the pest. Pests take the form of animals, insects, plants, fungi and nematodes, but the defining feature of a pest is that it causes an adverse effect upon some species of plant or animal that the farmer is trying to produce. While natural forms of pesticides have been employed since the very early stages of agriculture, pest management took on new significance following World War II as advances in chemistry and biology

combined with the mechanization of agriculture and widespread use of synthetic fertilizer to transform production technology. The United States Department of Agriculture (USDA) estimates that 86 percent of the acreage planted to five major crops (wheat, corn, cotton, soybeans and fall potatoes) was treated at least once with a herbicide (USDA, 2000, p. 19). Of these crops cotton made the most use of all forms of pesticides and wheat the least. Other USDA analysis shows that fruits and vegetables have far higher per acre use rates and employ a broader spectrum of pesticides (USDA, 2001, p. 13).

But pesticide use has significant inherent costs. Because they are toxic by design, pesticides can harm non-target species, including applicators, bystanders and wildlife. Pesticide residues can become embedded in food products with possible harmful effects for consumers. In addition, intensive use of pesticides often leads to species evolution in the target pests so that they become resistant. As our understanding of the adverse unintended consequences of many older pesticides has grown they have been removed from use and replaced by other compounds that have fewer negative effects. However the search for effective but safe pest control products has become more difficult over time due to pest resistance, government imposing more stringent limits on acceptable risks to non-target species, and the simple fact that we have made all the easy discoveries.

Although the use of pesticides carries an inherent risk, there would be severe costs if their use were prohibited. Table 1 demonstrates the importance of pesticides for the production of some major crops worldwide. Without crop protection (CP in the table) lower yields, greater field and post-harvest losses, and declines in the quality of product would lead to a reduced supply of food and fibre, and consequently higher prices. As a result, there would have to be a significant expansion of land under cultivation, which would bring its own problems in the form of lost species habitat and increased levels of erosion. Finally, cultivation practices would have to return to more intensive use of plows, discs and harrows.

Stakeholder Interests

Because pesticides are both useful and dangerous they have fallen into the group of products that is subject to significant government regulation. In many ways pesticides are like pharmaceuticals, and many of the pharmaceutical companies either still produce pesticides, or once did. Both types of compound are used to reduce or prevent an undesirable effect. Both types of compound have the potential to produce adverse side effects. And our knowledge of the full effects of these products often

comes only well after they have been in use for a significant length of time. While we can devote resources to predicting the effects of the introduction of a chemical compound, be it a drug or a pesticide, into the human population and the environment, we can never be certain that we have identified all the consequences.

Table 1 Impact of Pesticides on Production of Major Crops

Crop	Theoretically Attainable Production	Actual Production Avg. 1990-98	Estimated Production w/out CP	% Decline in Production w/out CP	% Increase in Land to Restore Actual Output
Rice (mt)	1047	509	184	64%	280
Wheat (mt)	831	548	400	27%	140
Barley (mt)	244	172	129	25%	130
Maize Grain (mt)	729	449	295	34%	150
Potato (mt)	464	273	123	55%	220
Soybeans (mt)	152	103	63	39%	160
Cotton (kt)	84.1	52.4	13.9	74%	380
Coffee (kt)	9.8	5.9	3.0	49%	200

Source: E-C Oerke, H-W. Dehne, F. Schonbeck, and A. Weber. Crop Production and Crop Protection Estimated Losses in Major Food and Cash Crops. Amsterdam: Elsevier Science B. V., 1994.

Government regulation of how pesticides are tested, which ones are deemed acceptable to use, how they are produced and marketed and how they are used provides a means to identify and manage risks. Regulation involves benefits and costs for the various parties involved in the process. These are the chemical companies who produce and sell pesticides, the general public who consume food treated with pesticides, farmers who buy the pesticides, bureaucrats who regulate their use, citizens with special concerns about the environment and food safety, and government itself.

While chemical companies often object to the costs incurred in getting a compound through the registration process, they also derive significant benefits from the existence of regulation. While a long registration process is a burden to firms that are applying to register a new product, it is a clear benefit to them when they have succeeded because it provides additional protection from competing compounds. A difficult registration review can significantly augment the window of protection provided by patents.

The general public faces significant information problems in dealing with pesticides in terms of food safety and adverse environmental impacts. Regulation provides assurance that only specific chemicals that have been rigorously tested are being used and that farmers have instructions on the safest way to use those products. Thus the regulatory process is an important part of persuading consumers that food production is being carried out in a manner that protects their interest. Because the costs of ensuring food safety have been reduced, the aggregate demand for food is higher than it would otherwise be. This outward shift of the demand curve results in increased consumer surplus and in benefits for farmers and indirectly for chemical companies.

As a group, farmers benefit from regulation not only because there is an enhanced demand for food, but also because regulation results in their having uniform access to information on how to appropriately use chemicals. Farmers also benefit from the development of new pesticides for two significant reasons. The first is the common problem of pest resistance that makes many compounds less effective over time. The second is a trend to more pest-specific compounds that have shorter half-lives, which when combined with lower levels of applicator exposure, reduces the health risk to farmers and field workers.

Government has a significant incentive to engage in regulation because of its responsibility for maintaining both public health and a high-quality environment. While a scheme of self-regulation by the chemical industry might provide many of the benefits of regulation, there is a larger danger that a major adverse event could occur if a company acted outside the set of internal rules. Government would then be faced with having to reverse any damage to people or the larger environment and then restoring public confidence in pesticide use. Also, by being directly engaged in the registration process, the government has better information on the potential risks and benefits associated with each compound that is on the market.

From an operational perspective, there are potential problems associated with government regulation. These are primarily traditional principal-agent issues involving the bureaucracy. There is the potential for regulators to be captured by special interests who either favor or oppose the use of pesticides, or regulators may shirk their responsibilities to act efficiently, resulting in higher costs. The creation of NAFTA may create a new set of principal-agent problems, where regulators may oppose harmonization because of its implications for their autonomy or staffing levels or perhaps only due to organizational inertia.

The Regulatory Framework

In both Canada and the United States the original objective of pesticide regulation was to protect farmers from inaccurate promises that pests would be effectively controlled by a given compound. Departments of agriculture were the obvious location for this function since efficacy issues were best addressed by agencies with a technical knowledge of farming. In the 1960s a growing body of information on the persistence of pesticides in the environment and their harmful effects upon non-target species of wildlife, especially birds and fish, prompted demands for more thorough assessments of pesticides to determine their environmental fate. Concerns over applicator safety and potential hazards from pesticide residues in food also became significant.

This led to a major redirection of pesticide regulation away from efficacy and toward the unintended consequences of pesticide use. Through the 1960s and 1970s, as scientific knowledge improved and the ability to detect pesticide residues grew, there was increased evidence that many older chemicals had adverse effects that exceeded their benefits. This led to pressure to remove pesticide registration responsibility from agriculture agencies because of a recognized conflict of interest between safety issues and the core agency concern with optimizing the production of food and fibre. In the United States the responsibility rests with the Environmental Protection Agency (EPA), with a focus on the broad protection of human, wildlife and natural habitats, while the Pest Management Regulatory Agency of Health Canada is charged with protecting human well-being. Consequently, the impacts of pesticide regulation on farm profitability and the competitive position of agriculture are secondary elements in the decision process.

In the last decade both Canada and the United States implemented major legislative changes in pesticide regulation. In the United States the Food Quality Protection Act (FQPA) of 1996 significantly changed the way pesticides were regulated although there was no major change in the nature of the agencies responsible for pesticide regulation. The major elements of the FQPA were: repeal of the Delaney Clause to allow the presence of carcinogenic compounds in food if the level of presence is considered to pose no risk; creation of a new standard for assessing exposure, the “risk cup” that looks at all pathways of human exposure to classes of compounds, instead of focusing on exposure on a compound by compound basis; explicit attention to the possibility that infants and children may have more adverse consequences from a given level of exposure than adults; creation of a

relatively short time-line for reassessing the registration status of all licensed pesticides using current standards; and elimination of economic benefit as a factor in the registration decision.

One consequence of the FQPA has been a focus on two broad classes of compounds, organophosphates and carbonates, that are widely used ingredients in insecticides employed both on major field crops and on fruits and vegetables. In many cases there are no obvious substitutes for insecticides based upon these materials and there is a concern that if these products are delicensed there could be significant impacts on production. These impacts could include production practices in other countries if the EPA set maximum residue levels (MRLs) or tolerances at a point where crops treated with the compounds could not enter the United States. However a more likely outcome is that delicensing in the United States would result in similar action in Canada and probably in other countries.

In Canada the Pest Control Products Act of 1995 transferred authority for the regulation of pesticides from a number of agencies, including Agriculture Canada, to Health Canada, and created the Pest Management Regulatory Agency (PMRA) within Health Canada to carry out all federal pesticide regulatory functions. The PMRA is mandated to protect human health and the environment by minimizing risks associated with the use of pesticides. In general, the PMRA and the EPA follow similar procedures when evaluating pesticides for registration. The PMRA continues to examine efficacy as part of the Canadian registration process and, like the EPA, considers exposure levels for children separately from adults. Unlike the EPA, the PMRA has an explicit responsibility to investigate and promote non-pesticide-based control strategies as part of its risk mitigation mandate.

In March of 2002 Health Canada announced a proposal for a major revision of the pesticide regulatory system that if implemented would have the effect of increasing the degree of harmonization of Canadian and U.S. regulatory systems (Health Canada, 2002). Like the United States, Canada would introduce the concept of cumulative effects or “risk cup” that would combine all paths of exposure for a particular active ingredient or set of closely related ingredients. The legislation includes increased safety factors for children to reduce their exposure risk. It also increases penalties for inappropriate use of pesticides and requires that all compounds be reassessed on a regular basis. Significantly, the proposed legislation explicitly recognizes the importance of coordinating the registration process with other countries as a means to improve Canadian farmers’ access to pesticides.

Initially farmers relied upon regulation as a way to ensure efficacy, at a time when firms providing pesticides were less reliable providers of high-quality compounds. Indeed the original function of regulation was to guarantee that pesticides worked as their promoters promised. Over time, as the production of pesticides was taken over by large firms and the registration process became more costly, the regulatory concern with efficacy in the United States became less critical because regulators assumed that firms would not bother to register ineffective compounds. However a more recent issue is that pesticide producers have a significant incentive to recommend a higher than necessary application rate in order to increase sales and to ensure that farmers get a high level of pest control. The proposed new Canadian act re-emphasizes efficacy, in particular the determination of the minimum effective amount of a pesticide that may be used, as a primary means of eliminating excessive use of pesticides.

Process for Resolving Trade Irritants

If potential trade irritants can be resolved in a non-confrontational manner this is to the benefit of both parties. Over time pesticide regulators in Canada and the United States developed informal procedures for coordinating their assessments of pesticides, but even so they occasionally reached different conclusions (Shapiro et al., 1987). Similar informal arrangements existed in other regulatory spheres, for example, pharmaceuticals and environmental protection. Under article 2001, NAFTA created the Free Trade Commission (FTC), consisting of cabinet-level representatives from the three members. The objectives of the FTC are to implement and further elaborate the agreement, and to resolve disputes that may arise. A secretariat and 14 committees and technical working groups (TWGs) were established (Annex 2001.2) to facilitate trade and investment and to ensure the effective implementation and administration of NAFTA. These bodies furnish a means of avoiding formal disputes through discussion and early dialogue on contentious issues. According to article 2001, all decisions of the Free Trade Commission are by consensus "except as the Commission may otherwise agree."[1] Since the committees and TWGs are established by the FTC, their decisions too must be consensual. The number of committees and TWGs has increased to over 30 with much of the growth in areas affecting agricultural trade.

The pesticides TWG was established in 1995 to provide a forum for developing ways to better integrate pesticide registration within the context of each nation's specific legislative framework. It can be seen as a formal recognition of the longstanding collaboration between U.S. and Canadian regulators that has now been extended to include Mexico. While the formal members of the group are in the

respective national bureaucracies, the meetings provide an opportunity for pesticide producers, pesticide users and environmental and human health groups to discuss regulatory processes. A major benefit of the pesticides TWG is that it allows the three regulatory bodies to develop a degree of specialization in terms of some of the basic analytical work, in addition to allowing discussion of ways to minimize trade irritants.

In particular, the TWG has developed procedures for identifying and resolving five categories of trade irritant:

- Category A – An MRL/tolerance exists in the exporting country but it is lower in the importing country, so the product is out of compliance.
- Category B - An MRL/tolerance exists in the exporting country but one does not exist in the importing country.
- Category C – A pesticide-commodity combination is registered in one country but not in another and growers in the country where the use is not registered wish to have that option.
- Category D – A discrepancy is detected resulting from a non-registered use in the exporting country.
- Category E - The exporting country has established a time-limited tolerance but full registration does not exist in the importing country.

Trade Irritant Process Team, 18 December, 1998, p. 1-2

In each case the cause of an irritant is defined as a mismatch in terms of registration status that results in a commodity entering a country without there being an appropriate tolerance level in place for residues. This addresses the first type of trade impact – barriers to trade that arise because of inconsistent regulations on exposure levels among the three countries.

A striking element in this classification scheme is that price differentials are not even mentioned as a potential source of irritation. However farmers have complained on numerous occasions about price differences between the countries, not just the differential availability of pesticides across the border. The simple explanation for the focus on residue tolerances is that registration agencies are not involved in the analysis of prices. Once a compound is on the market their role is to monitor safety and to some extent how well the pesticide does its job. Reinforcing this focus on residue and exposure levels is the right of countries under NAFTA to block imports only where they can show that the residue level is not consistent with domestic standards.

Category C issues do address the important question of differentials in registration status. In this case the remedy involves two distinct elements: the country where the pesticide-commodity pair is not registered should establish a tolerance level to resolve the issue of imported product; then the company that produces the pesticide must decide whether to apply for registration in the country where the use is not allowed. Note that from the perspective of the Trade Irritant Process Team there is no suggestion that equal access is a specific item that should be promoted by the governments as a way to defuse irritants.

Current Harmonization Efforts

Some of the other NAFTA technical working groups function mainly as forums to exchange information on upcoming regulation or perhaps provide opportunities to discuss trade irritants. The NAFTA Technical Working Group on Pesticides has gone further in clearly articulating goals of harmonization and working toward creating a North American market for pesticides in which "growers in all three countries can access the same pest control tools."[2] The TWG on Pesticides recognized, soon after it was formed in 1995, that the NAFTA free trade objective could not be met unless barriers posed by regulation were eliminated. This is also an articulated objective of the main consumers of pesticides (farmers) on both sides of the Canada-U.S. border. In this respect the pestcides TWG appears to be acting more like an EU committee where the objective of a single market is the basic reference which guides regulatory policy.

As noted above, the working group has approached harmonization through agreements on work sharing and the creation of a joint application process that includes a common data submission and format and a coordinated review process. This information is the foundation for work on a NAFTA label that would be used in all three countries. Joint submission is a significant step in reducing the cost of approval of new pesticides. Assembling the data required for registration is both time consuming and expensive especially in a country where the level of expected revenue after registration might be an issue. Work sharing offers the potential of considerable cost saving on the part of the regulatory agencies. Each nation takes a piece of the data in a given registration package and performs an evaluation that will be accepted by the other parties. The additional savings of time and expense and the chance that compounds will be registered in all three countries can have an impact on prices.

Most importantly, with a common label, issues of own-use importation would largely be resolved because every country would have agreed upon a common set of MRLs for the specific applications. Because the label would be legal in each country there would be no reason to block a farmer from crossing the border to purchase a specific chemical. Note that a common label does not have to mean that all uses or application rates are standard. While a farmer in one country could purchase a product that had a common label, it could still only be used for those purposes and at those rates that were legal within that country. In particular, differences in environmental fate and impacts on non-target species could still make some uses possible in one country but not in another[3].

In addition allowable uses could vary from country to country because of differences in the patterns of exposure. The use of a "risk cup" sets an upper bound on exposure to specific classes of compounds. Because patterns of exposure and use of the various classes of compounds could easily vary from nation to nation, even if all three countries adopted the same maximum exposure level, there could be differences in which pesticide-commodity combinations fill up the cup.

If the compliance costs of regulation are reduced through joint registration there are potential benefits in terms of product availability and cost. The extent to which these benefits are passed on to farmers is a major issue dealt with in the next section of the paper.

While there has been considerable progress in finding ways to harmonize the registration process, the initiative is really just beginning, and barriers to free trade in pesticides will remain for many years. There are at present several outstanding differences between the regulatory approaches of Canada and the United States, such as the extent of cost recovery and the Canadian requirement for efficacy testing. Joint submission is currently only an option, although there is an attempt to encourage its use by expedited processing. Only a small number of completely new pesticides are evaluated each year and there are no plans to harmonize the relatively large number of pesticides that have already been approved.

Sources of Conflict

Availability Issues

Decisions on which pesticide/use combinations are approved are largely in the hands of the manufacturers, who must decide whether they want to incur the expense of applying for registration of a pesticide for use on a particular crop. By and large the same pesticides are available for use on the major crops in similar environmental

conditions throughout North America. However this is not always the case, because manufacturers may find that it is not worth the effort it takes to obtain approval if the size of the market may not justify the expense involved.

As a result there may be very few compounds developed for "minor-use" markets, even though from a farmer's perspective there may be no real alternative. Minor-use status is a relative concept. For example much of the fruit and vegetable production even in the United States involves a minor use of pesticides relative to row and field crops like corn and wheat. But fruit and vegetable production in the United States still represents a large enough market that it is worth the support of chemical manufacturers. By contrast, fruit and vegetable production in Canada is both a minor market, relative to row and field crops, and small enough that the volume of sales may not be enough to warrant registering a compound for use in Canada even if it is available in the United States for the same crop.

As regulations became more sophisticated, old products were re-tested to ensure they meet current standards and pesticides are now grouped into classes with maximum exposure levels for the entire class (risk cup). A consequence is that the number of compounds farmers have for managing specific pests in a large number of crops is falling. Pesticides that have been in use for a long time are being withdrawn from the market, either because they do not meet current standards or because they do not have a large enough sales volume to justify the expense of submitting a new registration package. This can leave producers with limited options in terms of pest control strategies and in extreme cases make the production of specific crops unprofitable.

In particular, producers of fruits and vegetables in Canada are concerned that they will soon be forced out of business if many more of the currently available chemicals are withdrawn from use and are not replaced with equally effective products (Canadian Horticultural Council, 2001). Even though it may be possible over time to adjust production practices to use alternative pest control approaches, it is unlikely that most of the existing producers will be able to do so. Their investments are tied up in a production structure that is predicated upon the use of pesticides, and changing that production structure would require major new investments that they cannot afford. If existing compounds were withdrawn in both Canada and the United States but new ones registered only in the United States, a significant trade dispute would be likely to develop. This means that enhancing harmonization is particularly important for minor-use products.[4]

In NAFTA joint registration should have the effect of alleviating the special problems of minor uses. Pesticides can be evaluated by agro-ecological zones,[5] which transcend borders. Bigger North American zones might mean that it is worthwhile for manufacturers to apply for registration (bear the up-front costs of registration) in cases where it would otherwise not be economical in one or both countries individually. Joint registration may effectively be moving certain pesticide/use combinations out of the minor-use category. However, the increasingly restrictive policies for registering pesticides raise the costs of development, and the cost to obtain approval of new pesticides may more than offset the gains from joint registration. There is no NAFTA process for funding the costs of registering minor-use pesticides and joint registration itself may provide an incentive for NAFTA governments to free-ride on minor-use pesticides.

Most of the NAFTA harmonization processes already in place are related to improving availability. A key point is that the harmonization procedures are moving at a glacial place from the perspective of farmers because they only affect registration of future pesticides. There is no process to harmonize the availability of pesticide/use combinations already allowed and these will continue to dominate pesticide use for decades. This lack of a harmonization process to resolve differences in pesticide/use combinations is particularly striking in view of the APQA review of these currently being undertaken by the EPA and the proposed new Pest Control Products Act in Canada. It would seem that there would not be a lot of additional costs, particularly with work-sharing, in extending the terms of reference of this review to resolving cross-border differences in registered pesticide/use combinations.

Cross-Border Price Differences

Implicitly, patent and brand name rights allow a company to exercise market power as a means of recovering the research and development investment needed to bring a new pesticide to market. A company is therefore allowed to price its product at the point where marginal revenue equals marginal cost in each market, and there is no reason to think they would equalize prices across countries. Practices such as volume discounts are common examples of methods used to discriminate among buyers and offer a lower price to market segments with a lower demand elasticity. Such practices are only possible where transaction costs or legal barriers prevent arbitrage among buyers.

A key aspect of the economic analysis of price discrimination is that only marginal costs enter into pricing policy. Costs of registration and research are fixed

costs and do not affect marginal costs after a pesticide has been developed and registered for use. The manufacturer equates marginal cost to marginal revenue in each market. However, for a firm that plans to remain in operation for an extended period of time and is producing products that have a significant probability of becoming ineffective due to species adaptation, recovering fixed costs is critical if there are to be funds available to develop new compounds.

Some analysis and more than a little intuition are probably needed to determine marginal revenue. A product may be registered for use on several different commodities in each market and there may or may not be good substitutes available for each use. For example, consider the situation of canola producers interested in using a certain pesticide on both sides of the border. It may make a difference to the manufacturer's pricing policy if the product is registered for use on potatoes, especially if potato growers are large potential users of the pesticide. The availability of substitutes for the pesticide for the potato use may be another important factor, as well as whether the main substitutes are produced by the same manufacturer or by a competitor. This hypothetical example illustrates that there may be many factors on the demand side that have nothing to do with canola that may influence the manufacturer's pricing policy.

The border, when combined with the separate regulatory systems, provides a legal basis for price discrimination. In this case, the monopolist prices in each country according to the following:

$$MC = MR_1 = p_1\left(1-\frac{1}{\eta_1}\right) = MR_2 = p_2\left(1-\frac{1}{\eta_2}\right)$$

where MC is marginal cost, MR_i, p_i and n_i are marginal revenue, price, and demand elasticity respectively in country i. This implies that a higher price will be charged in the country with the less elastic demand and the price will only be the same if by chance the demand elasticity is the same. Since elasticities depend both upon the slope of the curve and a specific price-quantity combination on the curve, this is an unusual event. In addition, as already noted, pesticide companies price discriminate within a country through volume discounts and promotional pricing.

Farmers' demand for pesticides is a derived demand. We might expect that demand will be more inelastic if substitutes for the pesticide are not nearly as effective, if the pesticide is a small portion of the total cost of inputs and if the demand for the product produced by the farmers is relatively inelastic. This will vary from one side of the border to the other both for economic reasons and because there

are two regulatory systems. Differences in agricultural policy support programs may shift the effective farm commodity supply functions thereby altering farm-level demand for pesticides. In particular, even though market prices for commodities may be about the same in both countries the aggregate return to farm production is made up from market revenue and government transfers. It seems reasonable that chemical companies would consider these in their pricing decisions. Differences in demand will also occur if the same pesticide is registered for different commodities on either side of the border. Availability of different substitute pesticides on either side of the border can also have an effect.

Surveys of price differentials have been conducted for a number of years (McEwan and Deen, 1997 and Carlson et al., 1999). Taylor and Koo (2001) provide a recent comparison of price differentials between North Dakota and adjoining Canadian provinces. These surveys ask pesticide dealers in both countries that are relatively close to the border to provide retail sales prices for specific compounds. The prices are standardized for units and concentration of the effective ingredient and then adjusted using the prevailing exchange rate. Carlson et al. (1999) report average prices for the period 1993-97 for 32 pesticides; their data are summarized in table 2. For 8 of the 32 the difference between average prices is less than 5 percent of the average price in both countries. Prices were lower in Canada for 16 of the 32 and this is especially likely to be the case for herbicides. Prices were lower in the United States for 8 pesticides, 7 of which are "other pesticides".

Table 2 Comparison of Average Pesticide Prices in Manitoba with North Dakota/Minnesota, 1994-99

Price Situation	Herbicides	Other Pesticides	Total
Less expensive in Canada	11	5	16
No difference*	6	2	8
Less expensive in the U.S.	1	7	8
Total	18	14	32

Source: Gerald Carlson, John Deal, Ken McEwan and Bill Deen. "Pesticide Price Differentials Between Canada and the U.S. 1999," p. 14.

Note: * Difference is less than 5 percent of the average price in both regions.

Several factors that have nothing to do with price discrimination may result in differences in mean prices between the two countries:

- Mean price differences may be within the price variability in both countries so that differences in the means are just chance outcomes rather than systematic results.
- Price variability may be caused by variability in the cost structure of retailers.
- Some retailers may be using particular chemicals as loss leaders.

McEwan kindly shared his 1997-2001 data on five pesticides to allow evaluation of these possibilities.

McEwan collected price information for up to five retail outlets in 11 Canadian locations in Ontario, 11 times a year. Similar information was collected from seven U.S. locations in the North-Central states. Before supplying the American data he performed exchange-rate and unit-of-measure adjustments. Then, for the analysis presented here, deflated prices were regressed against a system of trend and dummy variables for location to determine mean and variance by location. The estimated equations are summarized in table 3 while figure 1 shows differences in price distributions for three representative compounds.

The top element of figure 1, Treflan, shows a pattern of mean and variance that is highly homogeneous within each country and across the border. There is very little evidence of differences in cost structure or that retailers in any of the locations use Treflan as a loss leader. The second and third elements of the figure show very different results obtained for Roundup and Malathion. Roundup is much more expensive in the United States, while Malathion is significantly more expensive in Canada. The homogeneous price pattern within each country and the significant difference between countries imply that we are not seeing the effects of retail-level phenomena but rather the effects of the pricing policy followed by the manufacturer, such as simple price discrimination.

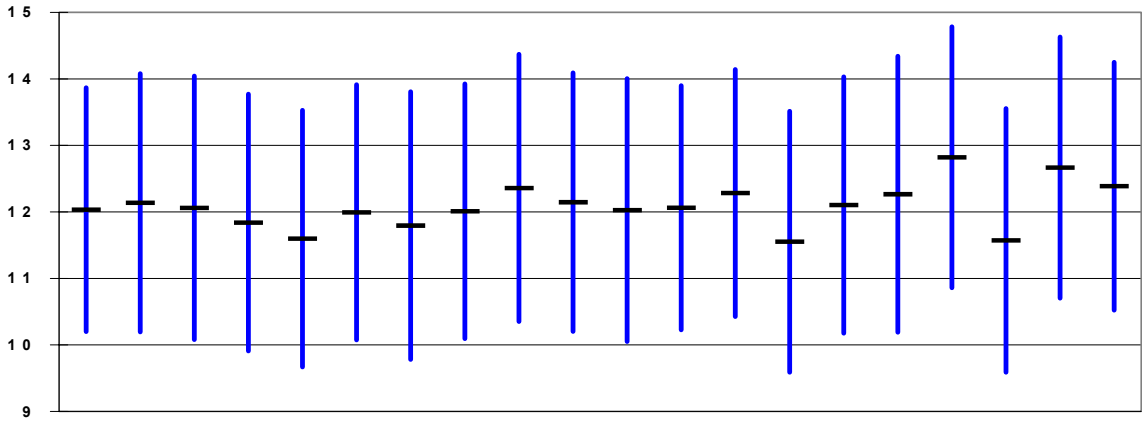
Table 3 Summary of Regression Results

Variable / Statistic	Treflan	Roundup	Malathion
Range of location coefficients:			
Canada	-0.43 - 0.33	-0.35 - 0.44	-0.69 - 0.92
	(5 of 11)	(5 of 11)	(9 of 11)
United States	-0.73 - 0.72	-0.82 - 0.80	-0.60 - 0.82
	(6 of 7)	(5 of 7)	(6 of 7)
Trend in Canada	-0.016	-0.017	0.044
	(-10.5)	(-9.3)	(29.7)
U.S. trend differential	-0.021	-0.007	-0.024
	(-7.7)	(-2.5)	(-10.6)
Constant	12.88	12.66	7.25
	(311.2)	(273.6)	(196.6)
U.S./Canada differential	0.41	4.45	-0.76
	(9.9)	(96.0)	(-20.7)
R-squared adjusted	0.31	0.92	0.68
Mean dependent variable	12.13	11.27	8.23
Regression standard error	0.91	1.28	0.90

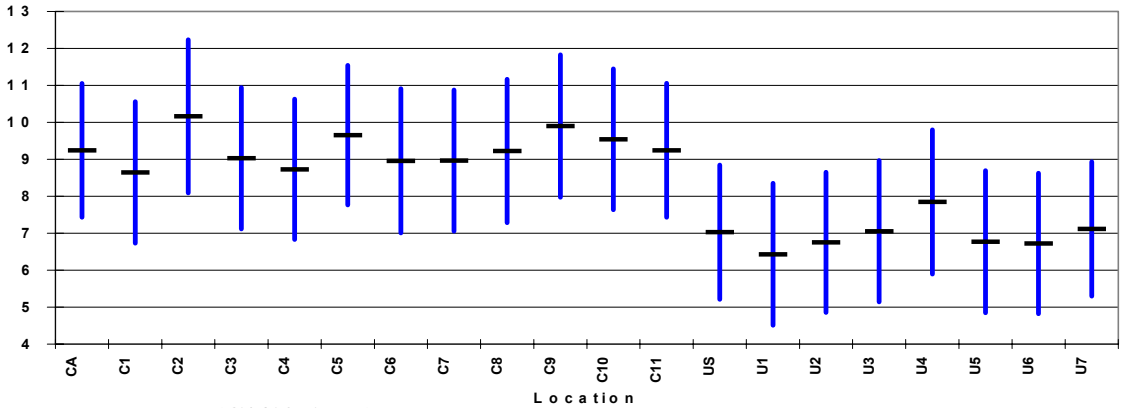
Note: T-Statistics are reported in parentheses. For the location coefficients, the number significantly different from zero at the 95 percent confidence level is given.

Other more complicated marketing strategies could also result in the price patterns observed. Companies might be expected to recover the cost of registration in their wholesale prices and cross-subsidize registration costs in one country with revenues from another. In addition each country provides patent protection for a defined length of time, which creates an incentive for chemical companies to attempt to recover their investment costs within the patent life so they have adequate revenue to remain in business on an ongoing basis. The registration process takes place within this patent window, and as the regulators in Canada have already recognized that the process takes longer in Canada, there is a shorter period of time available to the company to recoup its costs, and hence a higher price is required. While these may be factors in pricing policy, the contrasting results for Roundup and Malathion suggest that demand factors are important at least for some pesticides.

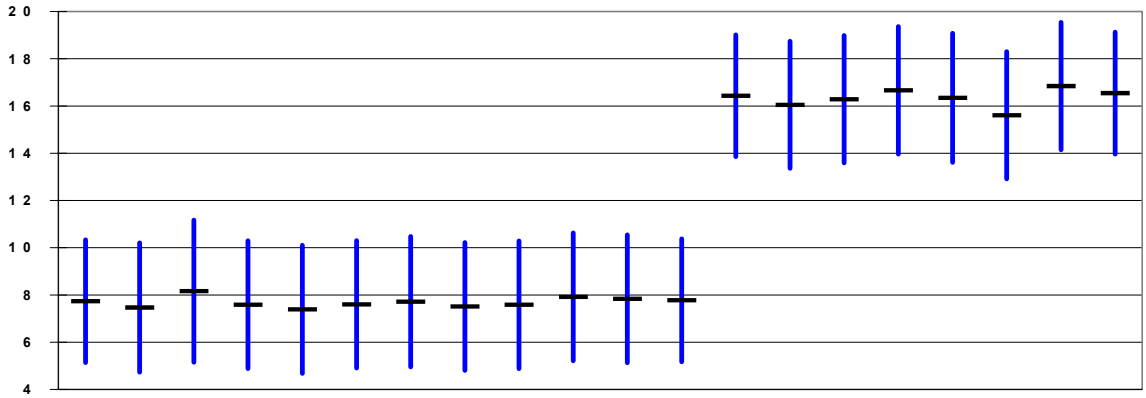
Figure 1 95 percent Confidence Intervals for Treflan, Roundup and Malathion for Canadian and U.S. Locations



Treflan (C$/9.45 litres)



Roundup (C$/10 litres)



Malathion (C$/10 litres)

Price discrimination is a regular business practice. The only restriction on price discrimination in Canadian law circumscribes its use among purchasing competitors.[6] Interestingly this is exactly the issue raised by farmers on both sides of the border who are concerned that the pesticide pricing puts them at an unfair disadvantage with competitors across the other country. But Canadian competition law cannot protect farmers from price discrimination among producers in different countries. Patents and other marketing rights are extended to the companies so that they can recover the cost of product development and approval. Indeed, it would be surprising if chemical companies did not practice price discrimination since this provides greater returns; not to do so would violate management's duty to shareholders. The entire regulatory process creates segmented markets. To the extent that price discrimination is a significant factor in providing a high enough rate of return to justify investing in research and development of new pesticides it may even provide long-run benefits to farmers and society even though it has short-term costs.

Conclusion

Pesticides are controlled substances in the three NAFTA counties, so how they are regulated greatly influences pest control strategies available to farmers. Because pesticides are an increasingly important part of the most common farm production technologies and because NAFTA has essentially opened the borders to the free flow of agricultural products, differences in how pesticides are regulated can affect the competitive position of farmers in the three countries.

However, the other side of the pesticide issue is that pesticides can have undesirable consequences in terms of human health impacts and adverse environmental impacts. While the level of human health impact does not vary significantly from citizen to citizen, this minimal variation does not necessarily hold for environmental fate. Different ecosystems may be more or less susceptible to the same quantity of pesticide. The current focus of the Technical Working Group on Pesticides is on ensuring that countries establish maximum residue levels on the basis of legitimate public health concerns, not as a form of non-tariff barrier. Differences in lifestyle and climate may result in different risk exposures that would require differences in allowable uses on different sides of the border. Thus even if everyone agrees on a common science protocol, the regulatory decisions may differ.

Given the longstanding existence of farmer complaints about pesticide price differentials and differences in availability among countries, it is reasonable to ask why NAFTA did not allow free trade in pesticides. It isn't possible to give a definitive

answer, but several factors may have been important. While Canada and the United States have historically cooperated at a technical level in both pesticide and pharmaceutical regulation they have not always reached the same conclusions in interpreting analytical results. In addition there are significant differences in the laws governing the regulation and use of pesticides that address issues beyond trade concerns. Most importantly in both the earlier Canada–United States treaty and NAFTA each country reserved the right to establish domestic safety standards that could not be challenged under NAFTA. Obviously allowing own-use imports by farmers would weaken these protections.

Despite the potential for different decisions, there are still strong arguments for harmonization and it is likely that a harmonized regulatory system would result in relatively few exceptions. Because registration involves large up-front outlays that can only be recovered over an extended period of time, cost reductions in the registration process can make a difference in availability, especially for minor-use compounds. Similarly, harmonization of registration procedures can also lead to simultaneous registration that is advantageous to the regulatory agencies, the pesticide manufacturers, farmers and consumers.

National pesticide regulatory agencies are developing ways to share work loads in registration, ensure that common protocols are adopted and work toward common maximum residue levels of pesticides in food products. These changes will in the long run harmonize pesticide availability and reduce the problem of minor uses. However this approach does not address the second trade issue of differences in price affecting the competitive position of farmers.

Significant cross-border price differentials exist for some pesticides, including large-volume products, so market size differences do not provide an obvious explanation. But for other compounds there is no significant cross-border price difference. These observations can be interpreted in two different ways. The first is that the existing system in essence creates a segmented market that allows manufacturers to practise price discrimination in setting prices on both sides of the border according to demand elasticity. Because a pesticide can only be used in a country if it has a national label, there is an effective barrier to arbitrage. A second interpretation is that cross-border differences in price reflect real differences in marketing and distribution costs, so there really are two different products being sold.

The analysis presented here finds no evidence of significant differences in prices by location on either side of the border. That is, prices within each country do not greatly differ. The analysis further demonstrates that prices for some pesticides are

significantly higher in Canada, prices for others are significantly higher in the United States, and there is no difference in cross-border prices for still other pesticides. This result is entirely consistent with a price discrimination marketing policy with more inelastic demand in Canada for some pesticides, more inelastic demand in the United States for others, and competitive markets on both sides of the border for a third group of pesticides.

Price discrimination has important implications for policy. First, it means that although the current harmonization policy may eventually address problems farmers have with product availability, it is unlikely to affect the prices they pay for pesticides or alleviate instances of significant cross-border price differences. Costs of registration comprise a fixed cost incurred in bringing a pesticide to the market. Lowering this fixed cost should affect the decision to enter the market but does not affect pricing after the decision has been made. Thus farmers and consumers will only receive limited benefits from the current harmonization policy. With complete harmonization, prices in each country will continue to reflect differences in demand elasticities as long as manufacturers have the ability to differentiate their products. Even a more drastic institutional change such as a single NAFTA agency responsible for pesticides would not in itself solve the price discrimination problem and "develop a North American market for pesticides."

Price discrimination depends on the prevention of arbitrage among markets. One way to allow arbitrage would be to allow farmers to import pesticides for their own use from other NAFTA countries. This policy is effectively a variation of recognizing the equivalence of the other country's regulatory system and could be followed by each country individually or in partnership with other NAFTA countries.[7]

Of course there must be some supporting institutional changes to make sure that risks posed by the use of pesticides are not increased. There needs to be a NAFTA label showing restrictions on use by agro-ecological zone in all countries. The EPA and PMRA would need some time to complete the work already initiated on the NAFTA label. It may be there are some differences in risk exposure because of cross-border differences in lifestyle which would call for specific exemptions on the right to import for own-use. The regulatory agencies might need a transition period to review regulations, identifying instances where exposure might be an important factor. Currently all pesticide imports are "positive list" items; their importation is automatically prohibited. Allowing importation for own-use would convert regulating their trade to a "negative list" system. The process of adapting to a policy of own-use imports would compel the regulatory agencies to implement effectively harmonized

regulatory procedures in terms of chemical availability, accepted uses, permitted application rates, environmental restrictions and public health standards.

It is interesting too to speculate whether the results found in this paper for pesticides are a special case or an example of a more general issue with trade within North America under NAFTA. Clearly the regulations on pesticides are among the most restrictive so it may indeed be a special case. However, regulatory product approvals are an increasingly widespread characteristic of the markets and it is likely that cross-border differences in regulations make it easier to maintain market segmentation in these cases. Motor vehicles are an obvious case in point, where there are differences in such things as seat belts and emission control devices. It is not clear either that regulatory approvals are necessary to create the conditions for market segmentation. It may be that patents or even clear brand differentiation are sufficient to create the conditions for market segmentation and the disproportionate retention of the benefits of free trade by those owning the patents and brands. If so we may have to allow end-users access to cross-border markets to make sure the gains from free trade move beyond the manufacturing gate.

These recommendations reflect a continental assessment of social welfare. Obviously the existing system conveys benefits to pesticide manufacturers, but it also benefits those farmers who pay the lower price. Arbitrage necessarily raises the price for one group as it lowers the price for another. While aggregate social welfare increases because we are able to reduce some dead weight losses associated with price discrimination, it is prudent to remember that distributional issues play a large role in public policy.

Finally, the case of pesticides may offer some interesting implications for multinational institutions. The TWG on Pesticides demonstrates that many of the benefits of a North American regulatory system may be achieved through co-operative work arrangements among existing agencies. The right to freely engage in cross-border commerce may be the additional element needed to get the regulatory co-operation required to make it work. If we can succeed at attaining harmonization with pesticides, we will not need to consider centralized Brussels-type institutions. The additional costs of yet another layer of bureaucracy may be avoidable while encouraging existing national institutions.

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Endnotes

* Cameron Short of Agriculture and Agri-Food Canada and I presented an earlier version of this paper at the Canada/Mexico/United States Trade Disputes Workshop at Puerto Vallerta Mexico, March 2002. His ideas are an integral part of this paper and I am grateful for his efforts to improve this work. Helpful comments of two reviewers for *The Estey Centre Journal of International Law and Trade Policy* are also acknowledged with thanks. While the broader issues discussed apply to all three countries, the examples of pricing differences are restricted to Canada and the United States. The views in this paper are solely those of the author and should not be attributed to either the University of Kentucky or Agriculture and Agri-Food Canada. This is a journal article 03-04-033 of the Kentucky Agricultural Experiment Station.

1. United States Environmental Protection Agency, "The North American Initiative: A Report on the North American Free Trade Agreement Technical Working Group on Pesticides 735-R-01-002," p. 1.
2. United States Environmental Protection Agency, "The North American Initiative: A Report on the North American Free Trade Agreement Technical Working Group on Pesticides 735-R-01-002."
3. Arguably a single label in conjunction with own-use imports could require greater monitoring of farmers to ensure they are complying with label requirements. However this monitoring process is already in place and would only require a marginal increase in effort.
4. New funding for minor-use registration in Canada was announced in May. The funding will be used to conduct field trials and laboratory analysis in conjunction with the counterpart U.S. IR-4 program. The first joint review of minor-use registration was announced in July.
5. The agencies have developed harmonized agro-ecological zones for this analysis.
6. Consumer and Corporate Affairs Canada Bureau of Competition Policy. "Price Discrimination Enforcement Guidelines," Available at http://strategis.ic.gc.ca/SSG/ct011403.html
7. One of the problems of free trade, well known to anyone living near the border, is that cross-border shopping has become much more complex because tariffs are far more complicated and regulations more pervasive than they used to be. Most of the free trade happens at the wholesale level, while retail-level trade has become much more restrictive.

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