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National Security and
International Affairs Division

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February 26, 1999

The Honorable Byron L. Dorgan
United States Senate

Subject: Methodological Considerations for a Study of Pesticide Price Differentials in the United States and Canada

Dear Senator Dorgan:

Differences in the prices of agricultural pesticides in the United States and Canada are one of several important issues in bilateral trade discussions. Farmers in each country have voiced concern that they face consistently higher prices for pesticides than they would on the other side of the border. In December 1998, the two countries signed a Record of Understanding that addresses several long-standing agricultural trade issues. As part of that agreement, they committed to carry out a jointly conducted pesticide price comparison study; this study would be completed in 6 months.[1]

You asked us to review methodological issues related to carrying out a price comparison of agricultural pesticides in the United States and Canada. As agreed with your office, this letter provides an overview of technical issues that should be addressed when designing an international price-comparison study of agricultural pesticides.

SUMMARY

This letter does not advocate a methodology to carry out the U.S.-Canadian pesticide price comparison, nor does it recommend how to assess the causes of price differences. Rather, this letter highlights some issues and elements that experts agree are critical to this type of study.

Agricultural economists and experts with knowledge of pesticide issues concur that the design of the study requires a clear articulation of the specific goals and that the methodological approach be consistent with these goals. The purpose of the study largely determines technical issues, such as what crops to consider, which classes of pesticides to include, the regions in the two countries to analyze, the method of summarizing price differences, and the choice of exchange rate. The permutations are infinite, but the sample of pesticides analyzed will frame the interpretation of the study's results. Experts also agree

[1] Some of the other issues included in the Record of Understanding are transportation of U.S. grain through Canada, quarantine restrictions on animal trade, and cooperation on biotechnology issues.

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that a rigorous study of price differentials should contain measures of the reliability of the data, statistical tests evaluating the accuracy of the results, and an exploration of the sensitivity of the results to alternative methodologies. In addition, the price study should include explicit caveats and a discussion of limitations in the data and/or the analysis.

BACKGROUND

Agricultural pesticides in both the United States and Canada are highly diversified chemical products, most of which fall into three major categories: herbicides (to control weeds), insecticides, and fungicides (to control fungal infections on crops). Pesticides are developed and used with particular crops and pests in mind.[2] Agricultural pesticides sold at the retail level contain one or more active ingredients that eradicate or control pests, such as glyphosate, 2,4-D, or acetochlor. Pesticides can also include inert ingredients that do not directly affect the pest but, nonetheless, may be crucial for pesticide performance.[3]

Pesticides are registered separately for use in Canada and the United States. In both countries, the company seeking the registration must submit proof that the pesticide does not pose an unacceptable risk to humans or the environment. Yearly maintenance fees are charged for pesticides used on large market crops (cotton, soybeans, and wheat) as well as for pesticides used on minor crops, such as fruits and vegetables (carrots, berries, and Belgian endive).[4] Experts report that in order to maximize profits, companies first register their pesticides for large market crops with higher expected sales volume and then seek registration for pesticides for smaller crops with lower expected sales.[5] Therefore, crops that have recently been introduced to the market or small-market crops usually have fewer pesticides available.

Companies choose whether to register a pesticide for use on a particular crop in the United States, Canada, or both countries. A pesticide registered for a particular crop in one country may or may not be registered for that crop in the other country. However, even if the exact same or substantially similar pesticide is for sale in Canada, U.S. farmers face restrictions on importing the pesticide for use on their fields in the United States. According to a Canadian official, Canadian farmers also face restrictions on importing U.S. pesticides for use in Canada.

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[2] For example, in Canada, Hoe-Grass 284® is used on several crops such as wheat, soybeans, and potatoes to control weeds such as wild oats, green and yellow foxtail, and Persian darnel; however, it is not for use on corn and it does not control Russian thistle, stinkweed, or quackgrass. Its equivalent product in the U.S. is Hoelon®.

[3] Some inert ingredients are needed to help keep the pesticide spray in solution while it is in the spray tank or to improve the way it sprays, sticks to, or penetrates the crop. Without these inactive ingredients, some pesticides would be considerably less effective at controlling their target pest.

[4] In Canada, companies are also charged a fee when they submit an application for a new pesticide registration.

[5] Claude Courbois, "Determinants of Pesticide Registration for Food Crops," Paper presented at the American Agricultural Economics Association, 1998 Meeting (Salt Lake City, UT: May 14, 1998), p. 2. See also, Michael Ollinger and Jorge Fernandez-Cornejo, "Innovation and Regulation in the Pesticide Industry," Agricultural and Resource Economics Review, V.27 #1, pp. 15-27.

Observers have noted that cross-border prices vary for identical or similar pesticides and that sometimes the reported price differences are substantial.[6] At different points in time and for different classes of pesticides, farmers in each country have voiced concern that they face consistently higher prices for pesticides than they would on the other side of the border. GAO found few studies that examine patterns of pesticide price differentials in the two countries.

GOALS OF STUDY DETERMINE METHODOLOGY

Experts in statistics, agricultural economics, and the pesticide market concur that the goals of the price study should largely determine the design and methodology of the study. Important methodological decisions to be made include the type of price data, the unit of analysis, sample selection, and currency conversion to allow international comparison. While the particular characteristics of pesticides complicate the analysis, the choice of methodology should be consistent with the goals of the study.

Price Data

Researchers experienced in price analysis affirm that the goals of the study largely determine which price is chosen for carrying out the analysis, but they also point out that the availability of data may limit the options. There are several types of prices that can be used as the basis of an international comparison of agricultural pesticide prices. The type of price used in the study has implications for the inferences that can be drawn from the findings. For example, should the study consider the price that farmers paid for the pesticide, the "suggested retail price," or the price that a distributor quotes in his price list? Should the price include taxes, rebates, application fees, discounts, or any other price adjustments? If the study aims to examine the differences that farmers pay for name-brand commercial pesticides, then the researcher should collect data on the prices paid by farmers. If a researcher is more interested in differences that formulators[7] or distributors pay on either side of the border, then he or she should collect data on a different set of prices.

Unit of Analysis

Another example of how the purpose of the study affects methodological considerations is the issue of the unit of analysis. The unit of analysis determines whether the study compares the prices of name-brand products or the prices of active ingredients found in a variety of products in the two countries. Researchers agree that a meaningful price comparison must strive to compare the prices of identical or nearly identical items. However, this goal of an "apples to apples" comparison is complicated because some pesticides are not available in both countries. It is reported that identical pesticide formulations can also have different names, be packaged in different sizes, or be distributed or manufactured by different

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[6] One would expect prices to differ when resale across the border is illegal or costly. With geographically segmented markets, the characteristics in each country (demand for the product, patent protection, regulatory environment, transportation costs, taxes, etc.) influence the price in the country, permitting nearly identical products to sell for different prices. Price variations also occur within national boundaries. Pesticide prices within the United States vary by state, region, and crop application.

[7] Formulators are companies that purchase all or some of the chemical components they need to create a final pesticide product.

companies in the United States and Canada. Furthermore, the inactive ingredients, as well as the proportion of active ingredient to inactive ingredients, can vary even for products with the same name.

An alternative to comparing identical commercial pesticide products is to calculate and compare the price of the active ingredients found in these products. For example, the U.S. Department of Agriculture (USDA) calculates the average prices of the main active ingredients used in pesticides in the United States.[8] A researcher using this data can compare the relative prices of the most common active ingredients found in the multitude of name-brand formulations. Commercial marketing firms, on the other hand, gather and present data for a sample of name-brand formulations of pesticides. This data facilitates comparison of the price of a specific product to competing products in particular crop and regional markets.

Again, determining the appropriate unit of analysis depends upon the final goal of the study. A researcher may choose to compare name-brand product prices if, for example, the purpose is to compare the price paid by U.S. farmers for a liter of Roundup® to the price paid by Canadian farmers for the same product. On the other hand, a researcher may choose to compare active ingredient prices if the goal is to look at how much farmers in the United States and Canada paid for an active ingredient found in a selection of commercial herbicides applied to corn and wheat.

Sample Selection

Experts point out that the purpose of the price study should also determine the criteria for selecting the sample of pesticides included in the study. The sample of pesticides for comparison can be restricted by crop, class of pesticides, or geographic region, although the sampling options may be limited by availability of data. For example, a researcher may choose to study fungicides and insecticides applied to potatoes in Idaho and Alberta, or all herbicides applied to corn, wheat, and barley in three provinces and bordering U.S. states. If time-series data is used, the fact that some pesticides are newly registered or lose their registration in one or both countries may lead to samples of pesticides that differ over time. The permutations are infinite, but the sample of pesticides analyzed will frame the interpretation of the study's results.[9]

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[8]See Agricultural Prices (Washington, D.C.: USDA/National Agricultural Statistics Service [NASS]). The method NASS used imputes a value to an active ingredient based on the proportion of the active ingredient found in the formulation. For example, a $625 gallon of Pursuit® that has a formulation of 50 percent imazethapyr, the active ingredient, yields a $312.50 price for the 0.5 gallon of imazethapyr. This method, therefore, assumes that all inert ingredients have the same value per unit as the active ingredient in each formulation. There is some debate over whether this is a valid method of estimating the price of active ingredients in pesticides.

[9] The issue of sample selection would also incorporate methodological problems such as how the sample of data sources was constructed. For example, in a data set of prices gathered from farmers, it would be important to know if the sample was representative of farmers (in terms of farm acreage or technology) in the two counties.

Summarizing Price Differences

Experts have pointed out that the method of summarizing price differences is fundamentally determined by the goals of the study. The preferred method of summarizing price differences is to construct a price index that shows how the average price of pesticides varies across countries. A researcher can gather data on pesticides in the sample and compare prices of pesticides one by one, but in order to summarize the overall differences in pesticide prices in the two countries the researcher must calculate an average price or price index. There are a number of methods for constructing the index. For example, one could construct a simple arithmetic average of prices (sum and divide by the number of pesticides in the sample), or assign weights to the pesticide prices based on criteria such as volume of sales of the pesticide, acres applied, pounds of active ingredient applied, etc.

Currency Conversion

Researchers conducting international price comparisons recognize that these studies have an added dimension of complexity because they require converting currencies. A researcher confronts a variety of conversion methods, but purpose and availability of data drive the method chosen. While it is relatively straightforward to convert from metric to U.S. units of measurement (liters to quarts), currency conversions are not straightforward. One problem is that exchange rates vary over time. Ideally, the exchange rate should correspond to the same time period for which the price data was gathered. Pesticide price data may be gathered over a period of days or weeks during the growing season or on different days in the two countries. It is possible to use daily, weekly average, end of period, or annual exchange rates–the appropriate choice depends on the price data and the purpose of the study.

TECHNICAL MEASURES OF ACCURACY AND RELIABILITY

Experts also agree that a complete study of price differentials must include measures of accuracy of the results and tests of data reliability. Some analysts also suggest that a study include an examination of how the results might change if alternative methodologies were applied. A researcher can use several methods to verify data reliability or the accuracy of their estimates. However, the results of the study will be more credible if a rigorous examination of validity and reliability is included.

STUDY LIMITATIONS AND CAVEATS

Explicit caveats and discussion of limitations in the data and/or the analysis are essential elements of any economic analysis with policy implications. As previously discussed, technical issues can be resolved in a variety of ways and each methodological choice will affect the outcome of the study. Other researchers may make different methodological choices, get different results, and come to different conclusions.

Data limitations may result in methodological approaches that are not ideally suited for the purpose of the study and any contradictions between method, data and purpose should be explicitly addressed in the report. For example, pesticide prices are not static. Prices change from season to season in the United States and Canada. New pesticides enter the market, and others are taken off the market. The demand for different pesticides depends on the kinds of pests that farmers need to control. Therefore, a study based on a one period cross-section of

agricultural pesticide prices in the two countries only shows price differences at that one point in time. An important caveat for such a study is that its findings may not be generalizable to other time periods or for all pesticides.

The methodological issues previously discussed demonstrate that there are multiple methods to carrying out such a study. The researcher should explicitly recognize that the methods chosen will affect the outcome of the study.

SCOPE AND METHODOLOGY

In order to identify technical issues common to international price comparisons and pesticide price studies in particular, we conducted a review of the pertinent literature. We also reviewed analyses of the pesticide industry, pesticide usage, and studies of the relationship between regulation and pesticide registration in the United States.

To compare different methodologies used to compile price data sets, we reviewed the documentation of a number of sources of data including the NASS's survey of prices paid by farmers for agricultural chemicals, a description of the methodology followed by Statistics Canada to compile average pesticide prices and the pesticide price index for Canada, a study of farm input prices from 1993 to 1997 in Ontario and border states in the United States, and the description of the survey methodologies used by private sector marketing firms and consultants that collect price data.

To draw on the expertise of those who collect and analyze pesticide price data, we spoke to pertinent government officials in the United States and Canada and private marketing consultants. At NASS, we interviewed agricultural statisticians in the Livestock and Economics Branch charged with the design, implementation, and compilation of the pesticide price surveys USDA carried out. Similarly, at Statistics Canada, we interviewed officials who calculate the farm input price index and oversee the pesticide price surveys. From the private sector, we spoke with statisticians and methodologists who collect and analyze pesticide price data.[10]

In order to gather opinions of experts about the principal issues involved in carrying out the study of pesticide price differentials, we interviewed researchers that either specialized in issues of price indexes and price comparisons or were recognized experts in pesticide issues. These researchers included economists at USDA's Economic Research Service, the Bureau of Labor Statistics, North Dakota State University, North Carolina State University, and the University of Minnesota. We also spoke to marketing experts from pesticide manufacturers that operate in both the United States and Canada.

For information on pesticide registration procedures in the United States and Canada, we consulted guidance documents on the registration process issued by the U.S. Environmental Protection Agency and the Pest Management Regulatory Agency of Canada. We also

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[10] We spoke to individuals responsible for survey design and data compilation at Doanes Market Research (St. Louis, MO), Criterion Research Corp.(Toronto, Canada), Produce Studies Ltd. (United Kingdom), and Development Planning Research Association (DPRA) (St. Louis, MO).

interviewed an official from each agency who is responsible for pesticide registration procedures.

In order to learn about farmers' concerns regarding pesticides and their prices, we interviewed officials from farmer organizations in the United States and Canada. We also interviewed a private, independent agricultural consultant with expertise in pesticide issues along the United States-Canadian border.

We conducted our work between December 1998 and February 1999 in accordance with generally accepted government auditing standards.

AGENCY COMMENTS

We discussed a draft of this letter with the Director of the Market and Trade Economics Division of USDA's Economic Research Service and a Trade Policy Officer in USDA's Foreign Agricultural Service. The director stated that the letter addresses the major methodological issues that would arise in a pesticide price comparison study and would be very helpful to USDA as it conducts its study. The officer also stated that the letter would be helpful to USDA.

As agreed with your office, unless you publicly announce the contents earlier, we plan no further distribution of this letter until 30 days after its issue date. At that time, we will provide copies to interested congressional committees and the Secretary of Agriculture. We will also make copies available to other interested parties on request.

Please contact me at (202) 512-4128 if you or your staff have any questions regarding this letter. Major contributors to this letter were Phillip Thomas, Kimberly Gianopoulos, Samantha Roberts, and Valérie L. Nowak.

Sincerely yours,

Benjamin F. Nelson

Benjamin F. Nelson, Director
International Relations and Trade Issues

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