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Environmentally Adjusted Measures of Gains From Trade Liberalization: The Case of U.S. Corn Production

by

Walaiporn Intarapapong

A DISSERTATION

Presented to the Faculty of
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Under the Supervision of Professor E. Wesley Peterson

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GRADUATE COLLEGE
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Environmentally Adjusted Measures of Gains From Trade Liberalization: The Case of U.S. Corn Production

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University of Nebraska, 1999

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Most studies of the impact of trade liberalization focus on conventional efficiency gains without including the link between production and the environment. This study attempts to estimate welfare effects of subsidy reduction including both the economic and the environmental impacts of U.S. corn production.

Comparative statics approach is applied to estimate welfare change due to subsidy reduction. Seemingly Unrelated Regression technique is applied to estimated corn supply, input demand, and corn demand through translog profit function and LA/AIDS model. Once this system is estimated, the elasticities can be used in a comparative static framework to assess the impact of trade liberalization on production, input demand, and excess supply. However, before estimating, testing for stationarity of the data was performed to prevent the spurious model.

Nebraska was used as a representative for environmental impact due to the difficulty to aggregate the dissolved nitrogen in groundwater which corresponding fertilizer applications from the site-specific. The value of nitrogen fertilizer is estimated from the shadow price of the producer, and consumer's willingness to pay, adopted from separated study.

The model is used to simulate the evolution of U.S. and world corn markets to the year 2000. Baseline projections are compared with projections based on the assumption that subsidies are reduced 20 percent in line with the Uruguay Round, and an increase in world corn demand by 2 and 5 percent. The results indicate that the environment impact in terms of a reduction in nitrate contamination in groundwater of trade liberalization is small as compared to the efficiency gains from the subsidy reduction. Nevertheless, these results are lower-bound estimates because other environmental impacts, i.e. pesticides, soil erosion, wetland loss have not been included. Moreover, nitrogen fertilizer used for corn production is not the only source of nitrate contamination of groundwater.

Therefore, it reinforces the conceptual argument that trade policy may not be an effective tool for environmental protection. Using trade policy to correct a negative environmental externality may not be efficient. To account for the externality problem, measures which directly correct the source of the problem seem preferable.

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TABLE OF CONTENTS

Page

Chapter **Page**

LIST OF FIGURES

Figure **Page**

LIST OF TABLES

CHAPTER 1

INTRODUCTION AND LITERATURE REVIEW

1.1 Statement of the Problem

The relationship between international trade and the environment has received increased attention in recent years (Anderson, 1992a). This is partly due to the stimulus of recent international negotiations on both environmental institutions, for example, the Rio Summit and the Montreal Protocol, and trade agreements, notably the North American Free Trade Agreement (NAFTA) and the Uruguay Round of the GATT. Discussions of trade and the environment have been carried out by scholars and politicians as well as those with particular agendas related to commerce, the environment, the well-being of indigenous people, and a host of other issues (Anderson and Strutt, 1996; Antle and Crissman, 1994).

Agricultural production is dependent on the use of natural resources such as land and water. In addition, modern agricultural systems generally rely on a wide range of industrial inputs such as fertilizers and pesticides that can affect environmental quality. Agricultural goods are also widely traded although until the Uruguay Round agreement (URA), rules to govern the use of agricultural trade barriers were largely absent from the GATT (Bredahl, et al., 1996). The URA's provisions on agriculture have been considered a significant step toward liberalizing global agricultural commerce. They cover the issues of domestic subsidies, tariffs, import quotas, export subsidies, and certain health and safety standards. Lower agricultural trade barriers will lead to adjustments in output and trade patterns and these adjustments will have an impact on the use of environmental inputs as well as the other inputs that may affect environmental quality (Anderson and Strutt, 1996).

The United States is a leading producer and exporter of agricultural goods. Within the United States, corn is one of the most important sectors. Total U.S. corn production has increased since the 1930s, more than doubling since 1965 (Mercier, 1989). Markets for corn in the United States have been subjected to heavy federal government intervention since the Agricultural Marketing Act of 1929. These interventions have included price supports, allotments, production controls, acreage diversion programs, set-asides, deficiency payments, disaster relief and many others. The main purpose of these programs has been to address the problem of low farm income, price instability and periodic surplus stocks (Mercier, 1989). The most recent agricultural legislation affecting corn markets is the 1996 Federal Agricultural Improvement and Reform (FAIR) Act which eliminated many of the programs that had been incorporated into past Farm Bills. Both domestic farm legislation and the URA will affect U.S. corn production, consumption and trade (USDA, 1996).

The purpose of this study is to estimate the economic benefits and costs of liberalization of the world corn market including both the gain from trade and the impacts on the environment. Corn production may cause environmental damage as a result of cultural practices such as fertilizer and pesticide use. As production changes due to the reduction of the subsidies and other trade barriers, these environmental side-effects will also change. Along with the efficiency gains due to the reduction of the market distortion and the savings to taxpayers resulting from lower subsidy costs, society will also benefit from reductions in environmental damage if the effect of trade liberalization is to lower the level of production.

1.2 Objective

Agricultural production is clearly related to the state of the environment. The United States appears to have a comparative advantage in the production and exportation of major temperate-zone primary commodities. If agricultural trade liberalization should give rise to an expansion of U.S. corn production, and agriculture is a polluting industry, this expansion will generate environmental damage. At present, studies on the impact of trade liberalization focus on the conventional efficiency gains from trade and little has been done to examine the link between corn production, trade and the environment. The objective of this study is to estimate the environmental impact associated with the corn production, and the full effect of subsidy reduction under the URA including both the gains from trade and the environmental impacts.

1.3 Literature Review

The literature on trade and the environment can be classified roughly into four areas according to whether the focus is primarily on legal institutions as opposed to technical and economic impacts or whether it is written from a predominantly environmental or free-trade perspective. Environmentalists concerned with legal institutions, for example, worry that GATT/World Trade Organization rules will undermine national and international legislation designed to protect the environment (McGeorge, 1994).

Advocates of free trade, on the other hand, have long been bothered by the potential for environmental legislation to be used as de facto protectionism designed to circumvent GATT/WTO provisions aimed at reducing trade barriers (Anderson and Blackhurst, 1992).

This second set of issues includes the concerns of many economists that international environmental agreements will incorporate trade sanctions or other forms of trade restrictions as the preferred method for punishing countries for violations, putting such agreements in direct conflict with trade agreements aimed at reducing trade barriers (Peterson, 1994).

The research proposed for this study focuses on the issues related to the impact of trade on the environment rather than these institutional controversies. The specific issue dealt with in this study is only one of a wide range of issues discussed in the literature. In this chapter, studies relevant to the issues of the international trade and environment are reviewed. This section is divided into 3 parts: trade liberalization and environmental protection, trade growth and the environment, and agriculture and the environment.

1.3.1 Trade Liberalization and Environmental Protection

Whether international trade causes environmental degradation or not has long been debated. Johnson and Beaulieu (1996) provide a useful taxonomy of the issues linking trade and the environment. They note five general arguments on these relationships. First, trade may lead to growth that has a negative impact on the environment. Second, GATT/WTO trade rules often appear to undermine national environmental measures. Third, trade liberalization and international investment could lead to pressures to lower domestic environmental standards. Fourth, GATT/WTO trade rules prevent the use of trade barriers to force compliance with domestic measures aimed at protecting the global environment. Fifth, trade institutions are not open and transparent.

The argument that international trade promotes economic growth at the expense of resources and the environment is incomplete and misleading. It is true that expanded economic activity, without environmental regulation can put pressure on the environment. However, economic growth can be managed in an environmentally sustainable way. Moreover, wealth created by economic growth can be directed toward environmental protection. In addition, it is likely that higher income generated by economic growth will lead to an increase in demand for environmental protection. This is because economic growth causes important changes in behavior patterns, including decliines in population growth, more skillful management of resources due to expanding investment in education, and improved definitions of private property rights. Evidence seems to suggest that as a poor country initially increases its production, pollution increases, but as incomes rise, pollution eventually decreases (Grossman and Kruger, 1993). The relation of trade, growth and environmental protection will be discussed in detail in the next section.

Trade rules may put pressure on environmental standards when there is no clear environmental agreement to complement trade agreements. The tuna-dolphin case is a classic example of how GATT rules might undermine national environmental standards. A Federal court of the United States ordered Mexican tuna banned because dolphins in the eastern Pacific Ocean were killed in the purse seine nets used to harvest tuna, violating the US Marine Mammal Protection Act of 1972 (Esty, 1994). Mexico requested a GATT dispute settlement panel arguing that its right to sell tuna in the United States had been violated. In 1991, the GATT dispute panel concluded that the United States had violated its

GATT obligations. The U.S. action might have been justified, if it had been taken in the context of an international agreement. Even though the GATT has never formally adopted the dispute panel's recommendation, the tuna-dolphin case seemed to put trade obligations above environmental concerns (Esty, 1994).

Another example of conflicts between trade and environmental laws is provided by the first ruling of the WTO. Venezuela and Brazil argued that a regulation issued by the US Environmental Protection Agency (EPA) in 1993 had discriminated against their gasoline exports. According to the Clean Air Act of 1990, all gasoline sold in the United States is required to be made with reduced pollution-causing chemicals. Due to a lack of data from foreign refiners, the EPA applied strict standards to imported gasoline. For US gasoline, refiners were simply required to return to 1990 standards (Zarocostas and Maggs, 1996). The WTO ruling means the United States has to change the provisions of the Clean Air Act, pay compensation to the affected countries, or accept trade retaliation.

Another concern about free trade is the migration of polluting industries to pollution-havens for the sake of competitiveness, and the attempt of host countries to attract investments by imposing low environmental standards (Johnson and Beaulieu, 1996). The concern is that internalized external costs due to stringent environmental standards are a burden on firms, and might lead to an adverse effect on competitiveness. Regulated firms might find it difficult to compete with firms located in countries with low environmental standards. This in turn could put pressure on governments in countries with stringent regulations to lower these standards so as not to place domestic firms at a competitive

disadvantage. Many low income countries are unable to enforce stringent environmental regulations. However, the fear that the lack of regulation will provide an incentive for firms to re-locate appears to be unfounded. Low and Yeats applied a modification of Balassa's revealed comparative advantage (RCA) model to such pollution-intensive products as iron and steel and metal manufactures in 109 countries. They conclude that dirty industries account for a growing share of exports of some developing countries, but " ...differences in environmental policies among countries were not a cost factor that influenced the location of investment in dirty industries" (Low and Yeats, 1992, p. 103).

The stringency of environmental standards does not necessarily have a negative effect on firms. It depends on the structure of the industry. For some industries the environmental regulations can reduce costs of production, by lowing input prices or by increasing the productivity of their inputs. For example a food processing industry can reduce its cost of production if the water used is less polluted. In a recent survey of research on the effect of environmental regulations on U.S. manufacturing industries, Jaffe et al. (1995) conclude that there is little evidence to support the idea that environmental regulations reduce competitiveness. Tobey (1993) analyzes five manufacturing industries judged to be pollution-intensive. He also finds that trade patterns do not appears to be greatly influenced by environmental regulations. As Tobey (1993) notes, because the costs of pollution abatement in U.S. manufacturing are modest, one would not expect environmental regulation to have a large impact. Whalley (1991) draws different conclusions from his review of empirical studies based on general equilibrium analysis of major regulatory initiatives, such

as carbon taxes to control global warming. He finds that such interventions could alter relative costs sufficiently to have an important impact on trade flows. Winters (1992) also notes the potential for significant shifts in trade patterns if binding quantity limitations on carbon emissions are imposed.

The fourth issue identified by Johnson and Beaulieu (1996) concerns enforcement of environmental rules. The use of trade restrictions to promote environmental protection has been discouraged by the GATT/WTO. This argument has been shown in the case of tuna-dolphin. The United States attempted to force Mexico to comply with the U.S. Marine Mammal Protection Act by using trade barriers but was found to be in violation of its GATT commitments. However, trade barriers are not the only way to obtain agreement on international environmental standards. The problem with the US position on the tuna-dolphin case is that it was a unilateral effort to force another country to abide by its rules and there exists no international agreement on dolphin protection along side the GATT's agreement on trade issues. It is generally preferable to develop multilateral agreements to protect the global environment rather than to impose unilateral measures. In addition, integrating environmental rules into trade agreements as was done with the NAFTA side agreement on the environment may represent a more reasonable approach (Runge, 1990). However, in practice, it may not be effective since developing countries do not have access to the necessary technical and financial resources to participate on an equal basis with richer countries, and it may be that the developing countries would bear heavier burdens (Johnson and Beaulieu, 1996).

The last argument against the current trade regime is the lack of transparency and of openness. The environmentalists complain that the negotiations leading to trade treaties are largely conducted by governments without allowing other major interested groups such as environmental NGOs to participate. However, the NGOs became major actors in crafting the NAAEC (North American Agreement on Environmental Cooperation) and ensured that NAAEC was opened up to public input (Runge, 1990). These five issues illustrate the range of potential conflicts between the institutions and practices related to trade liberalization and environmental protection.

The issue of concern for this study is the impact of expended trade on the environment. In the following section, literature related to this issue will be reviewed.

1.3.2 Trade Growth and the Environment

For some environmentalists, trade itself is a cause of environmental damage either to neighboring countries through pollution associated with transportation or as a consequence of production processes, i.e. environmental damage due to the chemicals used in agricultural practices. In other words, trade liberalization can lead to the environmental degradation due to expansion in economic activities that generate negative environmental externalities. This argument can be represented as in Figure 1.1 where a supply relationship reflecting private

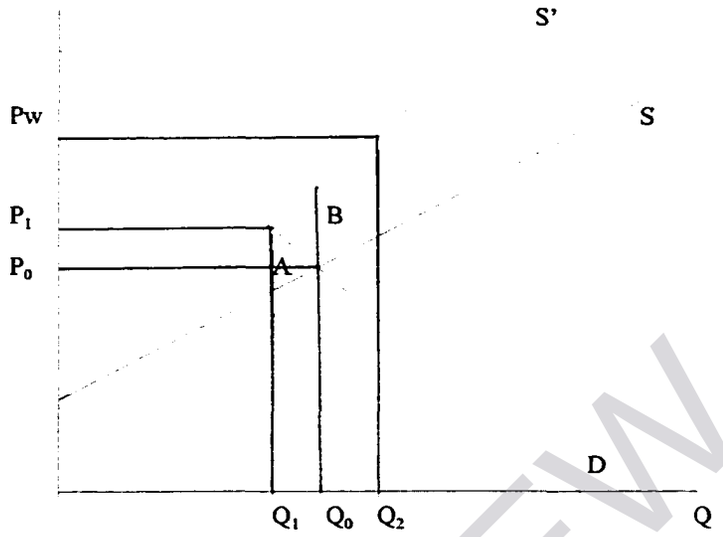

Figure 1.1 Welfare Effect due to Trade Liberalization

marginal costs (S) and another supply relationship reflecting social marginal costs (S') are shown. With no trade and ignoring marginal social costs, the country produces at point Q_0 where the supply schedule reflecting private marginal costs intersects demand. Because the negative externality is produced jointly with production of the good, without charging its costs to the producer, too much production takes place, and market price does not reflect the full opportunity cost of this good. The intersection of S' with the demand schedule, D, establishes an equilibrium at P_1 Q_1. P_1 is higher than P_0 reflecting the full opportunity cost of the externality. At Q_0 P_0, society bears the social costs as area A which is the wedge between S and S' up to the vertical segment above Q_0.

Suppose that opening this market to world trade causes output to expand to Q_2 because the world price is higher than the autarky price P_0. The expanded production adds area B to the social cost of producing this good. Without correcting this externality, society

bears this cost as a consequence. Note, however, that there will be opposite effects if the country is an importer.

More importantly, it is interesting to point out that even if trade is prevented, some pollution still exists. The effective way to correct the environmental degradation associated with production is by internalizing external costs shifting S to S'. Trade per se is not the cause of the pollution. Environmental degradation is often a consequence of economic activities regardless of how those activities are influenced by trade. Trade policy instruments are unlikely to be the first-best way to overcome those problems. The first-best solution to an externality is to correct the sector or source where the externality or distortion exists by equating marginal private cost to marginal social costs (Bhagwati, 1971). The policy instrument chosen should be closely related to the problem to be solved. Both Runge (1990) and Anderson (1992b) show that opposition to trade liberalization is an inefficient way to reduce the environmental damage associated with agricultural production. Reduced U.S. exports would not correct the problem because production for domestic use would continue. To account for such costs, taxes, setting a quota, standards or even assigning property rights is theoretically desirable.

To analyze environmental taxation, Whalley and Wigle (1991) developed a model that captures trade, production, and consumption of carbon based and non-carbon based energy products, as well as energy-intensive manufactures and other goods of six major world trading areas. They conclude that a carbon-based consumption tax can help to slow down the build-up of atmospheric carbon dioxide. However, taxing is not necessarily the

best option in all cases. In certain circumstance, it may lead to the problem of over-exploitation. For example, in the case of developing countries, natural resources are extracted by lower income subsistence workers whose demand for consumption goods is inelastic. Anything that decreases the price of the resource can increase poverty and lead to more extraction. Taxes can have this effect because they can decrease the demand for environmental goods, which are a main source of income for the subsistence sector (Chichilnisky, 1994).

In the same study Chichilinisky (1994) suggests that a better defined property right in natural resources in developing countries can lessen the problem of over-exploitation. This is because the ill-defined property rights to common pool natural resources, which are usually exploited as common property can lead to over-exploitation as a result of overuse by free riders. To account for the externality problem, the measures which directly correct the source of the problem should be considered as the first choice. In this case, the problem is related to property rights and its solution would be best accomplished through legal redefinition of property rights.

However, in reality, it may not be possible to achieve first-best solutions. In a second best world, it is interesting to know what the empirical impact of expanded trade on the environment is (Anderson and Strutt, 1996). As a second best policy, for international trade, tariffs seems to be an instrument that an importing country can use to deal with the international externality problem. Baumol (1971) suggests that as long as effective international agreements for correcting the international externality have not been reached,

selective restrictions may have to be considered. Imposing appropriate duties on the polluting output may have a moderate impact on the nation's welfare.

Several methods have been used to estimate the welfare effects of trade liberalization. A number of the studies discuss conventional efficiency gains and a few include environmental impacts (Anderson and Strutt, 1996). Most of them employ either general or partial equilibrium methods for their models. The partial equilibrium analysis is an attempt to reduce a complex problem to a more manageable form by isolating one sector of the economy and ignoring the interaction between that sector and the rest of the economy while the general equilibrium analysis allows for interaction between the related sectors (Landreth and Colander, 1994). Partial equilibrium models include detailed descriptions and policy variables but are criticized for not considering inter-sectoral effects. On the other hand, general equilibrium models often lack the market detail of partial equilibrium models. Hazleading (1991) mentions that in order to build general equilibrium models, much extra work is required. It may not be worthwhile if the problem being analyzed is too small to generate significant equilibrium feedbacks. For capturing specific market behavior, a partial equilibrium model approach may be better.

Empirically, most trade studies analyze the conventional efficiency gains from trade liberalization. Few of them quantitatively estimate the environmental impact. For general equilibrium analysis, Deardorff and Stern(1986) apply their Michigan model with 34 major industrialized and developing countries, 22 tradable and 7 non-tradable industries in each country and the rest of the world. Reducing tariffs in industrialized countries leads to an