

# Transitions in Agbiotech: Economics of Strategy and Policy

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EDITED BY  
William H. Lesser

*Proceedings of NE-165 Conference  
June 24-25, 1999  
Washington, D.C.*

*Including papers presented at the:*

*International Consortium on Agricultural Biotechnology  
Research Conference  
June 17-19, 1999  
Rome Tor Vergata, Italy*

PART SEVEN: Labeling and Marketing

**35. An Economic Model of Agricultural  
Labeling Policy Harmonization in  
International Trading Systems**

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## Chapter 35

### **An Economic Model of Agricultural Labeling Policy Harmonization in International Trading Systems**

*Lee Ann Jackson<sup>1</sup>*

#### **Introduction**

In February 1999, 170 nations met in Colombia to negotiate a protocol on biosafety for new crop varieties created through modern biotechnology techniques. The debate in this meeting focused on how to develop an internationally accepted protocol that would complement existing national regulations, protect the environment, and promote public confidence in biotechnology. Notwithstanding the promise of these new genetic for agriculture, health, and other uses, delegates deadlocked over an international mechanism for ensuring biosafety. This deadlock reflects the controversy associated with these new technologies and growing concern with potential risks associated with genetically modified organisms (GMOs).

While the international debate concerning appropriate safeguards becomes more heated, the biotechnology industry rapidly develops new genetic varieties of crops. In response to these new crops, countries are developing a wide variety of approaches to evaluate and manage the potential risks associated with these products, and to inform consumers. Not surprisingly, systems of regulations on GMOs differ widely among countries and these divergent regulations may impede the movement of biotechnology products across national borders, acting as non-tariff barriers.

National regulations and standards may act as non-tariff barriers by requiring compliance at levels that impose differential costs and burdens on importers or exporters. By inhibiting market access, standards may also lead to lower levels of consumer welfare. On the other hand, if standards converge they can also facilitate trade and contractual relationships, leading some policy makers to advocate standard harmonization in order to promote unobstructed trade. The argument for standards harmonization has two parts: that standards faced by importers and exporters should not discriminate against one or the other; and that standards should constitute an obligation that is neither too high nor too low. Whatever a country's national standard may be, countries collectively gain social welfare from matching their standards with other countries, so that products from one country may be more easily traded with other countries. However, government preferences differ, as do those of producers and consumers, over the appropriate level of standards in different countries. Hence, harmonization involves a struggle between sovereign countries, each with their own national standards, over whether and to what extent an international standard should apply. By reducing the "noise" of many and varied national standards, harmonization thus helps to coordinate trade according to common and reciprocally recognized principles. On the other hand, countries whose

standards have been set so as to impede imports or promote exports may resist harmonization.

This paper addresses the issue of harmonization from two perspectives. First, a general equilibrium economic model that describes national economies with and without labeling regulation is presented. Secondly, an international trade negotiation model highlights national incentives for committing to harmonization. The paper proceeds in the following manner. Section two introduces the context of trade conflicts over GMOs. Section three briefly presents relevant literature on modeling labeling and standards and approaches to analyzing strategic international trade. Section four presents a general equilibrium model for national economies with and without labeling regulations that can be used to examine the equilibrium outcomes when countries have similar or divergent regulations on GMOs. Section five describes the strategic nature of negotiations for harmonization with uncertainty about future costs. Section six concludes with a discussion of the possible policy implications of this research.

## **Background**

Agricultural GMOs are created by endowing traditional crop varieties with new characteristics, such as pesticide production or herbicide resistance. This modification may be an alteration of existing genes within the plants, or an addition of genes from other organisms. New varieties include Bt corn, Bt cotton and Roundup-Ready Soybeans. Bt crops have been altered to include a sequence of genes from the bacteria *Bacillus thuringiensis* that allows the plants to produce a natural pesticide. Farmers planting Bt crops use less pesticide than with traditional varieties, however they also pay a premium for GMO seeds. Roundup-Ready Soybeans are soybeans that have been transgenically altered to withstand the application of the herbicide Roundup-Ready. Farmers planting Roundup-Ready soybeans require fewer applications of herbicide and may use less soil disturbing tillage practices. In the U.S. from 1997 to 1998 the area planted in GMO crops has more than doubled, increasing from 8.1 million hectares to 20.5 million hectares, indicating that farmers find these new crop varieties profitable. The potential proliferation of these types of GMOs has lead to public scrutiny of new government regulations concerning their production, use, and ownership.

Many countries are considering imposing labeling requirements on agricultural products based on GMO content. These labeling schemes would require new processing mechanisms in order to achieve the regulated GMO content of final products. In the international arena, national labeling requirements will affect the traded levels of these products as well as the distribution of costs and benefits associated with their use. Differences among countries' regulations and standards concerning GMOs have already been a source of trade tension between the U.S., European Union (E.U.) and developing countries such as Brazil.

National policy concerning GMO production and trade is influenced by different interest groups, including producers, industry and consumers, each of which will be

directly affected by GMO regulatory policy. Industry is currently developing many new crop varieties and opposes government intervention that would increase their costs of production. While producers seem to be embracing these new technologies, consumer views are less homogeneous. Consumer worries center around the potential spread of these genes to weedy relatives and the development of pesticide resistance in insects that could lead to eventual reduction in efficacy of the Bt pesticide. However, consumers are less informed than industry and producers about the potential distribution of costs and benefits associated with these standards. Divergence in national regulations has inevitably occurred and fueled the controversy over the legitimate use of labeling regulations as technical barriers to trade.

Faced with these internal dynamics countries then enter into international trade negotiations concerning whether to mandate labeling. Each country faces uncertainty as to the how their future national political climate will influence costs and benefits of trade agreements. This difference in expected political state of the world influences each country's willingness to enter into trade agreements.<sup>2</sup>

As mentioned above, many countries are considering labeling requirements for agricultural products containing GMOs. Labeling requirements create standards at a national level since labels must indicate the allowed mixture of GMO and traditional crops. Even if two countries label, they may set their allowed GMO content for traditional crops at different levels. These differences in standards may also act as non-tariff barriers. For example, one trading partner might require labeling for all product that contains more than 5% GMO product, while another trading partner has a less stringent requirement of labeling only when the product has a greater than 20% GMO content. Such requirements and the associated standards will affect the traded levels of these products as well as the distribution of costs and benefits associated with their use. Divergent national regulations have lead to conflicts over trade policy that are likely to be settled through dispute resolution in the World Trade Organization.

The World Trade Organization (WTO) contains several agreements that are directly applicable to the issue of the use of labeling as non-tariff barrier. The Sanitary and Phytosanitary agreement covers health and safety standards on food and agricultural goods, while the Technical Barriers to Trade agreements(TBT) covers environmental measures. These agreements seek to control trade interventions so that they do not entail arbitrary or unjustifiable discrimination. In the case of GMO labeling regulations, disputes in this area are likely to be adjudicated under the TBT agreement, which deals with technical regulations generally, rather than health and safety measures (Stewart and Johanson, 1999). The WTO plays a crucial role in defining the rights and responsibilities of its member countries and will thus influence the outcome of conflict over agricultural standards.

## **Relevant Literature**

The following section briefly reviews the relevant literature on standards in international trade and game theory in relation to trade negotiations on standards.

### ***Labeling and Standards***

Standards refer to specific technical characteristics of goods. They may refer to stylistic elements of products, such as the difference between IBM and MacIntosh computers. They may describe desirable, or undesirable, production practices, such as U.S. standards that required that imported tuna be harvested with dolphin friendly techniques. Or, they may refer to product "purity" such as standards for the hormone content of beef imports. In the case of trade restrictions on GMOs, the relevant standards would determine acceptable levels of GMO content in agricultural crops. Due to the differences in types of standards and the difficulty in capturing the essence of these product characteristics, the approaches vary widely and include among others partial and general equilibrium models, models based in industrial organization theory and models based on club theory.

The simplest models for examining the effects of standards do not model them directly as goods or as characteristics of goods, but rather model their effect on costs of production or on the proportion of factors available for production. In partial equilibrium analysis the defining assumption is that imposing standards changes cost structure of the industry, shifting the supply curve up (Brown et al., 1996). These types of analyses depend upon traditional "triangle" surplus measures. Welfare costs are compared by examining the net gains, or losses, to society. These approaches can also be used to examine cases where standards are matched abroad. When a country is a net importer of a good and a common global standard exists, the country will suffer a loss of welfare, because consumers of the imported good must pay a higher world price, but do not benefit from the standards abroad. Hence the models indicate the importance of terms-of-trade effects with multilateral standards.

With a few changes this partial equilibrium approach may be altered to reflect general equilibrium relationships, and be used to examine the effect of standards on the distribution of benefits in equilibrium. In general equilibrium, compliance with standards will require the use of factor endowments, altering the prices and distribution of products in the world equilibrium. In scenarios in which standards use multiple factors, the proportion of standards used in the industry in question will influence the effect of standardization. In a general equilibrium model, the terms-of-trade effects of standards is only influenced by the proportion of factors used in enforcing and implementing the standards in relation to the world factor endowments. Many analyses of this type focus completely on supply side effects, neglecting consumer preferences and thus missing a potentially large component in determining the effects of standards on welfare.

Other analyses of standards acknowledge their potential role as public goods. As mentioned above, standards may be considered a form of public good because once adopted and reciprocally observed, they are non-rival and their benefits are non-excludable. Casella (1996 and 1997) pursued a general equilibrium analysis of standards as public goods, in which standard setting occurs at the national level, or as a result of a group of private agents in an industry adopting standards as a "club. Her formalization of the trade-off between economies of scale and variety allows her to examine the role of industrial groups in determining standards. The consideration of the public good attributes of standards is particularly relevant to the case of GMO product standardization, in which countries may benefit from increased market access if standards are harmonized.

Other analyses focus on the regulatory effect of standards rather than their public good nature. Ulph (1997) follows this in a case combining environmental policy and international trade in a model in which he analyzes the effects of emissions standards as environmental policies. In this analysis, environmental standards are modeled as restrictions on production functions. They set an upper limit on the aggregate emissions, thus defining the producers' problems as one of maximizing a restricted revenue function. This approach suggests the incorporation of standards through constraining the producers' optimization problem.

The proposed model uses a general equilibrium approach to trade modeling linked to a game theoretical model. On the consumers' side in order to capture the GMO characteristics of the agricultural good affected by standards, the proposed model follows an approach suggested by Diao and Roe (1997) in which a characteristic is embodied in final goods through input use. In the following model relative GMO content of agricultural products is embodied into agricultural goods, assuming that specific inputs into the agricultural process alter the purity of the final agricultural goods, introducing health related characteristics. Assuming that consumers care about the final level of this characteristic of agricultural goods, the model is able then to articulate the equilibrium effects of standards on prices and allocations of final products.

The producers' problem also changes with labeling. If labeling is required, producers must segregate traditional from modified crops. Segregation is costly and the costs are spread between production of the pure traditional good and the modified good.

### ***Government Trade Policy Decisions***

Although the above literature helps in understanding the implications of standards within international trade setting, the strategic nature of national policy formation at the international level also plays an important role in determining the final outcome of conflict over regulatory policy. One analytical approach posits that governments seek to maximize their political support (see Hillman, 1982; Grossman and Helpman, 1994 and 1995). This describes the breakdown of effects on industry and consumers. Grossman and Helpman have pursued this branch of the endogenous tariff formation literature. In their 1994 paper, they suggest a government objective function which, rather than simply

combining a weighted average of different groups' welfare, is based upon government preferences over campaign contributions and voter well-being.<sup>3</sup>

In other recent literature in this area, Aidt (1997) and Findlay and Wellisz (1996) provide examples of complex models that augment traditional general equilibrium models with endogenous tariff formation components. Aidt (1997) analyses a small Hecksher-Ohlin-Samuelson (HOS) economy that includes a political market in which the demand side is composed of two factor lobbying groups and the supply side is composed of simple influence function. Findlay and Wellisz (1996) address the welfare effects of endogenously determined tariffs. They modify a simple general equilibrium model to include the process of tariff formation as a function of disagreement between opposing groups. Neither of these strands of the literature explicitly acknowledge the strategic nature of government policy choices within the international context, when national policies create non-tariff barriers to trade.

Although government trade policy decisions are linked to their constituents' interests, they are also influenced by their international relationships and, for members of the WTO, by the way these relationships are structured by the WTO. In the case examined with this model, each country chooses national labeling policy that alters their international trading relationships. In particular, governments' obligations are defined by the institutional settings within the WTO that lead to trade rulings that may constrain their ability to make decisions based exclusively upon the best interest of their constituents.

Two authors propose theories of how institutional constraints may act to facilitate national cooperation in the international trade arena. Sugden (1984) develops a theory of voluntary contributions that states that given certain institutional constraints, the classic free rider problem associated with public good production may be solved. Sykes (1991) examines institutional mechanisms within the WTO that encourage trade agreement in the face of uncertainty. He presents a simple model in which negotiating nations weigh the utility of entering into a trade agreement against the utility of the status quo (protected trade). In his model, the benefits of entering into a trade agreement are known with certainty but the costs are uncertain. The addition of uncertainty into models of strategic trade policy provides insight into the types of institutional mechanisms that encourage nations to enter international agreements that might constrain their domestic policy choices.

### **General Equilibrium Model**

For the sake of analytical clarity, the model described below examines a binary governmental regulatory decision: label or not label. In this case labeling restrictions represent a type standard, since labeling differentiates products according to their GMO content. The model implicitly assumes that labeling in both countries defines the same level of GMO content. The model describes two types of economies: an economy with labeling and an economy without labeling and is intended to present a stylized example



of the economic impacts of the current controversy over GMO labeling between the E.U. and U.S.

The model has two critical features designed to allow it to capture the characteristics of economies using labeling strategies. First, in the version of the model that assumes that nations are implementing labeling, adding labeling regulations changes the processors' production technology. Second, the model assumes that consumers in both countries have preferences that are separable in GMO and traditional products when these goods are labeled. This feature leads to demand in which consumers will choose either traditional crop varieties or GMO crops, but only under very limited price conditions will they choose to consume combinations of both types of crops.

Consider a modified Heckscher-Ohlin model with two countries, four inputs, two intermediate outputs and two final outputs. Production is assumed to be perfectly competitive. In the next two sections national models are specified with and without labeling requirements.<sup>4</sup>

### ***National Model without Labeling***

This non-labeling economy is composed of two final goods ( $x$  and  $y_3$ ), three sector-specific factors ( $v_x$ ,  $v_a$ , and  $v_m$ ), one mobile factor ( $v_L$ ) two intermediate goods ( $y_1$  and  $y_2$ ) and a representative consumer. Let the economy be described in the following manner.

Technologies for the four production sectors may be written:

- (1)  $x = f(v_{Lx}, v_x)$
- (2)  $y_1 = h_1(v_{L1}, v_{a1})$
- (3)  $y_2 = h_2(v_{L2}, v_{a2})$
- (4)  $y_3 = k(v_{L3}, v_m, y_1, y_2)$

where  $x$  is the aggregate production and marketing technology for the rest of the economy,  $y_1$  is the production technologies for primary agricultural goods (normal corn),  $y_2$  is the production technology for the primary production technology for primary GMO agricultural goods (Bt corn), and  $y_3$  is the marketing technology when the two primary agricultural goods are treated the same. Note that in this scenario, the marketing production function potentially uses both primary agricultural goods. Since labeling is not required, the technology does not differentiate between the two goods during processing. However, the costs of  $y_1$  and  $y_2$  will differ depending upon the type of GM O characteristic that has been added to  $y_2$ .  $y_2$  is likely to cost less than  $y_1$  and will therefore be chosen by the agricultural processor as an input.<sup>5</sup>

Utility for the representative consumer may be written,

- (5)  $U = U(x, y_3, ay_3)$

where  $a$  represents embodied characteristics of agricultural crops.<sup>6</sup> The  $a$ 's are generated by production functions and are embodied in final goods through the use of inputs and through particular production processes. The amount of embodied GMO content per unit of food, depends upon the amount of input (say capital) used per unit of  $y_3$  produced.

Resource constraints are as follows:

$$\begin{aligned} (6) \quad & \sum_{j \in M} v_{Lj} \leq v_L \quad \text{where } M=x,1,2,3 \\ (7) \quad & v_{a1} + v_{a2} \leq v_a \\ (8) \quad & v_x \leq v_x \\ (9) \quad & v_m \leq v_m \end{aligned}$$

Define  $C_x$  and  $C_{y3}$  to be the unit cost functions for manufactured and final agricultural products and  $G$  is total national GDP. Given  $p_x$ ,  $p_3$ ,  $v_x$ ,  $v_a$ ,  $v_m$ , factor market clearing conditions, sector factor demands and the following equations define an equilibrium.

$$\begin{aligned} (10) \quad & p_x = C_x \\ (11) \quad & p_{y3} = C_{y3} \\ (12) \quad & x = f(v_{Lx}, v_x) \\ (13) \quad & y_1 = h_1(v_{L1}, v_{a1}) \\ (14) \quad & y_2 = h_2(v_{L2}, v_{a2}) \\ (15) \quad & y_3 = k(v_{L3}, v_m, y_1, y_2) \\ (16) \quad & x^d = x^d(p_x, p_{y3}, G) \\ (17) \quad & y_3^d = y_3^d(p_x, p_{y3}, G) \\ (18) \quad & E(x) = x^d(p_x, p_{y3}, G) - x \\ (19) \quad & E(y_3) = y_3^d(p_x, p_{y3}, G) - y_3 \\ (20) \quad & p_x E(x) + p_{y3} E(y_3) = 0 \end{aligned}$$

where (10)-(11) represent the zero profit condition, (12)- (15) represent the supply functions, (16) and (17) represent the consumer demand, (18) and (19) represent excess demand, and (20) is Walras' law.

Note that it is also possible to define sectoral and national GDP functions from the above equations.

$$\begin{aligned} G_x &= g_x(p_x, w) v_x \\ G_{y1} &= g_{y1}(p_1, w) v_a \\ G_{y3} &= g_{y3}(p_3, p_1, w) v_m \\ G &= G(p_x, p_1, p_3, w, v_x, v_a, v_m) \end{aligned}$$

### ***National Model with Labeling***

The model describing a country with labeling policy differs from the economy without labeling in three ways. First, the intermediate agricultural crop is differentiated

into two types: separated GMO product and separated traditional product.<sup>7</sup> Similarly, utility also includes differentiated products. Finally, the production of the final agricultural goods ( $y_{31}$  and  $y_{32}$ ) includes an additional cost, in the form of labor used to segregate and label products. Equations (1), (21)-(22) define the national economy with labeling.

$$\begin{aligned}
(21) \quad & y_1^s = s_1(v_{L1}^s, y_1) = s_1(v_{L1}^s, h_1(v_{L1}, v_{a1})) \\
(22) \quad & y_2^s = s_2(v_{L2}^s, y_2) = s_2(v_{L2}^s, h_2(v_{L2}, v_{a2})) \\
(23) \quad & y_{31} = k_1(v_{L31}, v_{m1}, y_1^s) = k_1(v_{L31}, v_{m1}, s_1(v_{L1}^s, h_1(v_{L1}, v_{a1}))) \\
(24) \quad & y_{32} = k_2(v_{L32}, v_{m2}, y_2^s) = k_2(v_{L32}, v_{m2}, s_2(v_{L2}^s, h_2(v_{L2}, v_{a2}))) \\
(25) \quad & U = U(x, y_{31} + y_{32}, a_1 y_{31} + a_2 y_{32})
\end{aligned}$$

Resource constraints are as follows:

$$\begin{aligned}
(26) \quad & v_{Lx} + \sum_{i=1,2} (v_{Li} + v_{Li}^s + v_{L3i}) \leq v_L \\
(27) \quad & v_{a1} + v_{a2} \leq v_a \\
(28) \quad & v_x \leq v_x \\
(29) \quad & v_{m1} + v_{m2} \leq v_m
\end{aligned}$$

Equilibrium may be defined in a similar fashion as the above model and sectoral and national GDP functions are also computable:

$$\begin{aligned}
G_x &= g_x(p_x, w) v_x \\
G_{y1} &= g_{y1}(p_{y1}, w) v_{a1} \\
G_{y2} &= g_{y2}(p_{y2}, w) v_{a2} \\
G_{y31} &= g_{y31}(p_{y31}, p_{y1}, w) v_{m1} \\
G_{y32} &= g_{y32}(p_{y32}, p_{y2}, w) v_{m2} \\
G &= G(p_x, p_{y31}, p_{y32}, w, p_{y1}, p_{y2}, v_x, v_m)
\end{aligned}$$

### ***Trade between Two Countries***

The two-country model considers the two national models together and requires that world markets for final outputs clear. Input markets need only clear within each country, since factors are not internationally mobile. The two-region model is calculated for three cases: both countries are labeling, both countries are not labeling, and one country (say the E.U.) requires labeling while the other country (say the U.S.) does not. The fourth case in which the U.S. requires labeling and the E.U. does not will not be examined, since this is an unlikely policy scenario.

Assume that both countries have the same technologies, and preferences. Countries differ in their factor endowments and their labeling strategies. The specification of utility should permit identical preferences to allow aggregation. Countries have quasi-homothetic preferences which leads to the result that countries may differ in the amount of embodied good they prefer, and hence support differences in consumer preferences for labeling regulations (Diao and Roe 1996).

Due to the complexity of the analytical solutions to the above problems, a numerical estimation procedure will be used to examine the international trade effects of national regulations. Three cases will be examined: both countries labeling, both countries not labeling and one country labeling/one country not labeling. In preliminary estimations, the case in which both countries are labeling will assume that countries choose the same standard for their labeling requirements. The non-labeling case acts as the status quo, against which results from the other cases are compared. Running these cases with different parameter estimates, will indicate which parameters determine the resulting distribution of benefits and trade flows.

### **Harmonization and Trade Agreements**

The trade equilibrium outcome dictates each country's payoffs of choosing a particular regulation strategy given the choices of their trading partners. A numerical analysis of the above models of international trade can provide estimates of exports, imports, GDP and consumer utility under various policy scenarios. A simple framework examines the tradeoffs inherent to various policy choices.

Consider the case in which the status quo, without a trade agreement, is for the E.U. and the U.S. to have divergent national regulations. Assume that the E.U. has imposed labeling regulations, while the U.S. does not require labeling. Due to the non-tariff barrier effect of the divergent labels, the global economy suffers a deadweight loss. In the absence of the WTO, the E.U. and the U.S. enter into negotiations over the harmonization of labeling policy. Each negotiator has a utility function that represents national political support and is a function of producer and consumer welfare. Assume that the level of utility achieved in this status quo is  $X$  for E.U. and  $x$  for the U.S.

Countries will choose to alter their policies when they are indifferent between the new policy outcome and the status quo. If they agree to harmonize policies, international economic efficiency is enhanced. Each country will experience an increase in utility due to the removal of trade barriers and increased market access. Consumers and producers in both countries benefit from increased trade. Let these gains be called  $Y$  for the E.U. and  $y$  for the U.S. Assume that  $X$ ,  $x$ ,  $Y$  and  $y$  are known with certainty.

The harmonized policy, however, also results in utility losses for each negotiator, both in terms of losses to consumers and losses to producers. Unlike the benefits, the costs are not known with certainty a priori. They depend upon the state of the world - in particular, the relative political strength of consumer and producer. However, both negotiators know a priori the probability distribution of  $\theta$ . Assume that the utility lost with harmonization is  $C(\theta)$  for the E.U. when labeling is the common policy and  $c(\theta)$  for the U.S. when not labeling is the common policy.

If the status quo is assumed to be divergent labeling requirements, then harmonization will occur when either both countries require labeling or neither country requires labeling. The E.U. will agree to alter their existing regulations if and only if the

negotiator is at least indifferent between utility level of the status quo and the utility level with harmonized regulations requiring no labeling:

$$E_{\theta}u_A = E_{\theta}[X + Y - C(\theta)] \geq X$$

Similarly for the U.S., the payoff to harmonizing regulations around labeling is

$$E_{\theta}u_B = E_{\theta}[x + y - c(\theta)] \geq x$$

Consider the costs to each country of harmonizing. If both countries decide to label, then both countries gain from improved international economic efficiency. The E.U. negotiator incurs political costs because producers must now compete with imported goods. E.U. consumers do not incur costs, since the labeling strategy has not changed. In the case of the U.S., consumers are indifferent towards labeling so do not incur costs with the imposition of labeling requirements. However, U.S. producers incur an additional cost due to change processing requirements associated with labeling. If both countries decide not to label, then E.U. producers still incur costs from increased competition. However in this case, E.U. consumers also lose, because they no longer have access to product information from labeling. In the U.S., consumers are still indifferent to the lack of labeling and producers do not incur additional labeling costs. Therefore, if the inequalities defined above hold, the U.S. prefers to harmonize around not labeling, while the E.U. prefers to harmonize around labeling.

The problem has the structure of the classic prisoner's dilemma. Without an institutional framework defining mutual obligations, countries do not have incentives to deviate from their status quo policy choice. National regulations will diverge and neither country benefits from facilitated trade. The tension, then, is between the international benefits of market access and "private" national costs. Countries do not consider the full social benefit of increased market access and are thus unlikely to harmonize without institutional constraints.

This analytical framework linking numerical simulations of a general equilibrium economy to strategic policy decisions will clarify several issues. First, what factors effect the distribution of benefits from various national policies under different harmonization scenarios? Secondly, how do fundamental characteristics of the national economies influence country incentives to harmonize? Finally, how does the equilibrium efficiency change under different policy scenarios?

## Conclusions

The findings of this research will provide economic insight into three critical questions central to the debate over policy harmonization and international trade. First, the economic model will support a political economic analysis of labeling strategies at a national level. Labeling policies act as non-tariff barriers, altering the relationship between trading partners. Within the national economies, some sectors will benefit from

a particular labeling strategy, while others will be harmed. The general equilibrium model will illustrate the nature of these impacts within the national economies.

The model will also indicate the magnitude of the difference in global social welfare with divergent and harmonized labeling policies. Three cases will be examined: neither country labeling, both country labeling, and the case with divergent policies. The results of this exercise will provide a preliminary measure of the size and distribution of societal benefits and costs of policy harmonization.

Finally, the model will highlight the role the WTO dispute settlement mechanism plays in harmonization. The model described above raises interesting issues about the appropriate role of the WTO in regulatory harmonization. The WTO provides information and monitors signatory behavior that supports the development and maintenance of clear commitments between member countries. Institutional mechanisms embedded within the WTO also affect nations' rights and obligations with regards to other signatories. In order for trade agreements to encourage harmonization of national policies, the WTO must include mechanisms that both provide incentives for signatories to live up to their commitments and allow them to refuse to harmonize given justified cause.

### Endnotes

<sup>1</sup>Lee Ann Jackson is Ph.D. candidate, Department of Applied Economics, University of Minnesota. The author acknowledges C.F. Runge for useful comments.

<sup>2</sup>A country's ability to enforce standards will also introduce a bias in negotiation outcomes, trade flows and, ultimately, consumer welfare. A country with effective enforcement capabilities may be less willing to negotiate harmonized policies, particularly those that are costly, with a country that has the reputation for being unable to enforce regulations.

<sup>3</sup>In this type of model changes in international structure would alter equilibria by endogenously changing the political support function. They model a two stage non-cooperative game, in which lobbies simultaneously choose their political contribution, then government sets policy.

<sup>4</sup>The model, as described here, focuses exclusively on the act of labeling. In reality the issue is more complex, since countries also have preferences on the level of standard used in content labeling.

<sup>5</sup>Assuming that each of these technologies may be represented by the classic Cobb-Douglass technology, the solution to this problem resembles the solution to a problem based on intermediate inputs.

<sup>6</sup>The utility function is a strictly quasi-concave, continuous function of the final rest of the economy good and food.

<sup>7</sup>This functional change does not capture the entire nature of the effects of labeling. It ignores the transactions costs associated with processing two types of products. Processor may specialize in processing one type crop, or they may choose to process both. However, with labeling they will incur extra costs if they process both types of products because in order to keep traditional and GMO crops separate they must alter their processing techniques. Although, in other labeling cases, such as with labels on BSE beef content, labeling has lead to an increase in the price of the pure good, no a priori evidence indicates which crop will incur these additional costs.

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