A "Modified Prisoners' Dilemma" Approach to Progress in the World Trade Organization's Agricultural Trade Negotiations

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Agricultural trade policy is a sensitive subject for many interest groups, and it has garnered even more attention than usual in recent years. Governments in large, developed countries such as the United States and members of the European Union intercede in the markets for agricultural goods to ensure that their domestic farmers are not excessively harmed by fluctuations in the prices of their goods or increases in competition from abroad. Government intervention in agricultural markets in the United States dates back as far as 1933 and the Agricultural Adjustment Act, which restricted production of some crops, so farmers could achieve stability by charging prices higher than they could charge if they had excess output (Spartacus Educational 2007). The European Union similarly has established measures to protect its own farmers.

While farmers benefit from these protective measures, other groups are affected adversely. Obviously, consumers of agricultural goods suffer when the prices for these goods are raised artificially; for example, a Supreme Court decision in 1936 declared the Agricultural Adjustment Act unconstitutional because it benefited one group (farmers) at the expense of another (consumers) (Spartacus Educational 2007). When government export subsidies for agriculture are the measure at hand, taxpayers or other potential recipients of government assistance lose out because they do not receive the government transfer, which is allocated to another group. Further, groups in other countries may be affected by these policies that originate only in one country.

That is, since agricultural markets are interconnected to the high degree to which they are today, one country's policies typically affect many others. Namely, with respect to agriculture, developed countries' policies have profound effects on developing countries because agricultural production is one of the most viable options for economic activity in relatively low-income countries. Agricultural intervention by governments in developed countries artificially lowers costs for their protected farmers and forces others – often those who already struggle with poverty – to restrict production or leave their respective markets entirely. Further, some governments in the developing world may depend on the income generated by agriculture to maintain health, education, and other public services. A study by Francois, van Meijl, and Tongeren (2003) estimated a potential $196 billion global welfare gain from 50% cuts in farm subsidies and tariffs (Anderson 2004). For net consumers of agricultural goods in the developing countries, export subsidies in other countries lower the market prices they face, which has a positive effect on their incomes. These and other tensions have made achieving a consensus in agricultural trade policy issues exceedingly difficult, especially since these measures have staunch supporters among farming interests in the developed countries. In a 2005 speech before the United Nations General Assembly in New York City, U.S. President George W. Bush asserted, "[The] United States is ready to eliminate all tariffs, subsidies, and other barriers to free flow of goods and services as other nations do the same. This is key to overcoming poverty in the world's poorest nations" (Bush 2005). However, these same trade issues still are problematic today.

In this paper, I first describe agricultural trade's traditional role as a contentious issue, with an emphasis on trade negotiations under the General Agreement on Tariffs and Trade (GATT) and later the World Trade Organization (WTO). In the second section, I examine the

perspectives of traditional international trade theory as well game theory to understand the static and dynamic effects of various trade arrangements and strategic interactions between major players such as the U.S. and the E.U. In the third section, I attempt to go beyond the limitations of these two approaches by presenting a model in which modifications of the classic prisoners' dilemma, understood as changes in government priorities, may allow a free trade outcome to be sustained. This model yields four particular avenues for progress in the WTO's stalled agricultural trade negotiations, and finally I use these four avenues to establish brief policy recommendations for the WTO and other interested parties.

I. Agricultural Trade in Global Context

The General Agreement on Tariffs and Trade (GATT), established after World War II to support the recovery of global economic activity, engineered great reductions in barriers to international trade from 1947 until 1993. However, as tariffs (taxes on traded goods) declined significantly and the global economy grew more complex, governments resorted to other kinds of trade barriers, including subsidies and market arrangements with competitors, to protect their own industries, and GATT's relevance to the modern arena of world trade dwindled. (See page 10 for a discussion of barriers to trade.) Late trade negotiations under the GATT focused on contentious issues such as nontariff barriers, intellectual property rights, services trade, and agricultural trade, and the "Uruguay Round" of trade negotiations under the GATT almost collapsed until members reached a last-minute agreement in 1993 (Husted and Melvin 2001).

Most likely, the largest obstacle to GATT's success in the Uruguay Round was the issue of trade in agricultural goods, due to the heavy involvement of both developed and developing countries in agricultural trade. Although tariffs on agricultural products fell under GATT's jurisdiction, GATT members including the U.S., Japan, Korea, and the E.U. obtained waivers and continued to use tariffs and quotas to protect agriculture, while levels of protection fell for most manufactured goods (Husted and Melvin 2001). Though such nations were hesitant to jeopardize their protectionist policies, the U.S. and the E.U. reached a compromise in November 1992 to allow the Uruguay Round to achieve a conclusion. However, the end of the talks saw the World Trade Organization (WTO) replace the GATT as the accepted framework for world trade.

1999's Seattle Round was the first WTO Ministerial Conference, or general assembly, held inside the United States, and it created a high level of awareness among U.S. citizens that not all people were content with the extant trends of globalization. Rather, the duration of the talks in Seattle was marked by active protests of the WTO and its ideals. According to reporters John Burgess and Steven Pearlstein (*Washington Post*, December 4, 1999), agricultural trade again "was perhaps the biggest issue standing in the way of a deal, which would have laid out subjects to be negotiated over the coming three years. The United States pressed Europe to agree to 'eliminate' its huge export subsidy program; Europe was willing to scale it back, but refused to end it." As in Uruguay, agricultural trade proved to be a roadblock in the Seattle Ministerial Conference. In the future, agriculture – and economic development more broadly – would draw even more attention from the WTO.

A. The Doha Development Agenda

The WTO's 2001 Ministerial Conference was held in Doha, Qatar, partially in an attempt to prevent the degree of visibility of criticism that marked the previous conference. Physical distance from Seattle did not reflect a procedural distance from controversial issues, though. The Doha Round's agenda included agriculture, services, intellectual property rights, debt and

finance, development, and dispute settlement (World Trade Organization 2006). The Doha Declaration, the major result of the conference, reaffirmed members' commitments to ongoing agricultural negotiations initiated in 2000, and enumerated goals including "substantial improvements in market access; reductions of, with a view to phasing out, all forms of export subsidies; and substantial reductions in trade-distorting domestic support" (World Trade Organization 2006). Further, the Declaration included a commitment to establish modalities, or targets for achieving negotiation goals, for progress in agricultural issues by March 31, 2003, and to submit proposals based on these modalities by the start of the next Ministerial Conference.

This September 2003 Ministerial Conference held in Cancun, Mexico, was designed as a stock-taking meeting where members would determine how to conclude the remaining negotiations, including those begun in agriculture and services in early 2000 (World Trade Organization). However, this conference ended without achieving any meaningful consensus. In the Cancun Ministerial Declaration, members first agreed to conclude the negotiations initiated at Doha – including "with respect to rules and disciplines and related legal texts [in agriculture]" – by January 1, 2005 (World Trade Organization 2006). Elsewhere in the document, members reaffirmed language from previous declarations and goals and deadlines previously set, but extended the timetable for their achievement. Unfortunately, the January 1, 2005, deadline also passed without any closure in the negotiations.

The WTO held its sixth Ministerial Conference from December 13-18, 2005, in Hong Kong. Notably, the ministerial declaration included an agreement to eliminate all forms of export subsidies and export measures in agriculture by the end of 2013. The agreement is progressive so that the greatest part of the reduction in trade barriers will occur early in the implementation period (World Trade Organization 2006). With respect to food aid, a potentially trade-distorting support, the declaration stated that food aid would be maintained at an adequate level and that emergency situations would be handled, though the group would be mindful of "commercial displacement" and loopholes for continued export subsidization (World Trade Organization 2006). Specifically with respect to cotton, the declaration stated that: "all forms of export subsidies for cotton will be eliminated by developed countries in 2006"; "developed countries will give duty and quota free access for cotton exports from least-developed countries from the commencement of the implementation period"; and "trade distorting domestic subsidies for cotton production should be reduced more ambitiously than under whatever general formula is agreed and that it should be over a shorter period of time than generally applicable" (World Trade Organization 2006). Even with these developments, though, many still left Hong Kong believing the negotiations' successes were limited, at best.

That is, elements of the ministerial declaration geared toward a free trade outcome in agriculture may have been the results of strategic actions by participants intended to achieve other, longer-term outcomes. For example, one *Economist Intelligence Unit* article suggested that the E.U., which already offered duty- and quota-free access to the poorest countries and participated minimally in cotton production, supported the elimination of cotton subsidies to challenge the United States' position and draw attention away from its own reluctance to reduce its farm tariffs ("Doha's Hard Truths" 2005). On the other hand, the article suggested that the United States did not commit itself to include sensitive goods such as sugar or textiles in its own commitment to duty- and quota-free market access ("Doha's Hard Truths" 2005).

Perhaps not surprisingly, the end-of-April 2006 deadline passed without any breakthroughs. On the contrary, this failure to move seemed to doom the talks more than any before it. On July 1, WTO Director-General Pascal Lamy declared the Doha Round negotiations

had reached the "crisis" stage (World Trade Organization 2006). On July 24, the WTO's leader decided to suspend the Doha Round. Later, Lamy provided his outlook for 2007 in a late 2006 column in *The Economist* magazine. He described two challenging characteristics of agricultural trade: first, the majority of the poorest individuals in developing countries practice subsistence farming, and changes in policy might upset their livelihood; second, farmers receiving government subsidies or benefiting from import barriers possess heavy political influence and desire to maintain the status quo. Lamy's fundamental requirement for a solution recognized that "the logjam in these negotiations must be broken through revised positions from the major players which lead to template agreements for trade in agriculture and manufactured goods" (2006). Is there really any chance for trade liberalization in agriculture, the most troublesome issue in the world economic forum for over a decade? Or, are there insurmountable barriers that will impede President Bush's determination, expressed in September 2005, to remove trade barriers in agriculture? International trade theory possesses the tools to determine a rational outcome based on the priorities of all parties involved.

II. Literature Review

Economists understand controversial trade issues within the broader scope of international trade theory. At its foundation, trade theory, like other subdivisions of economic theory more generally, looks to Adam Smith (1776) and *The Wealth of Nations*. Smith began his investigation into the differences in economic success across countries by discussing the division of labor. Since human beings depend on others for some of the necessary things in life, and appeal to others based on mutual self-interest and not benevolence, Smith argued that individuals choose their occupations based on the discovery of their own talents, and use the unwanted part of their own production to acquire commodities from others (1776). Countries in trade theory models are analogous to Smith's individuals insofar as they specialize and have differential abilities in the production of different commodities.

Arguably, scholar David Ricardo made the other fundamental contribution to international trade theory with the notion of *comparative advantage* in his 1817 book *Principles of Political Economy and Taxation*. Comparative advantage can be understood most clearly as distinguished from *absolute advantage*, which is closely related to Smith's discussion of the division of labor. That is, on the international marketplace, one nation is understood to have an absolute advantage over another nation, with respect to some good or service, if the former nation requires fewer inputs – less labor and capital – than the latter does to produce that good or service. Conceivably, one nation could have an absolute advantage with respect to *all* goods and services on the marketplace, and on these grounds, it would be self-sufficient and would not need to trade with any other nations. Ricardo's comparative advantage goes a step further to show that trade is beneficial to all parties, even in this hypothetical and highly unlikely scenario.

A national allocation of resources that respects comparative advantage recognizes that a nation, as a whole, can consume more goods and services if it specializes in some particular industries in which it is especially efficient (relative to other nations and with respect to other industries), and trades its excess output with other nations to consume outside goods and services. This scheme generates more consumption than a closed plan by which the nation produces internally everything it consumes. According to Ricardo, "At the same time that capital is liberated from the production of [goods newly to be imported], more must be employed in manufacturing those commodities with which foreign commodities are purchased" (1817). Using England and Portugal to illustrate his point, Ricardo argued that consumers of wine in England

and consumers of cloth in Portugal would be better off if England specialized in cloth, and Portugal specialized in wine, and the two countries traded with each other. The consumer classes would have access to a greater variety of goods for a lower price. Further, traditional international trade models demonstrate that total production of both goods and national welfare for both nations will rise.

But, what of the winemakers in England and the cloth makers in Portugal? If England's winemakers could not compete with Portugal's, the new competition from abroad likely would initiate exit from England's wine market. Further, Portugal's cloth makers – more efficient than England's cloth makers, in Ricardo's example – likely could not stay in the cloth market if they were relatively less efficient than Portugal's winemakers. To protect domestic producers from some of the consequences of free trade, policy makers throughout history have established several methods to hinder trade. The most basic example is a tariff on imported goods, which increases their price and may make consumers indifferent between them and the domestic goods produced less efficiently and sold for a naturally higher price. Alternatively, import quotas restrict the number of units of a certain commodity that may be imported, although they do not fix a price; if quotas are too restrictive, exorbitant prices and illegitimate black markets may emerge as a result. While these measures support domestic producers by reducing the perceived advantage held by competitors abroad, subsidies aim to encourage domestic producers by compensating for some of their inefficiency, or accentuating their advantage if they are comparatively efficient. A domestic subsidy, in the case of England and Portugal above, for example, might be supplied to England's winemakers to enable them to remain in business. On the other hand, an export subsidy aims to induce producers to export their products to other nations. A significant enough subsidy may change a nation's status from a natural importer to an exporter of a given commodity. Standard trade models based on Ricardian comparative advantage typically support free trade and illustrate how interventions such as tariffs and subsidies introduce inefficiencies into trade. That is, trade models illustrate that interventions can redistribute resources from one group to another, although this cannot be done without a reduction in the overall resources available. By its nature, trade affects different parties – whether producers and consumers, or importers and exporters – differently.

The special interests of groups who stand to gain or lose from trade introduce strategic considerations into trade theory. John Nash's Nobel Prize-winning contributions to game theory, which formally model outcomes of strategic interactions among "players," therefore had a profound impact on the contemporary understanding of trade theory. After game theory began to take hold in economic analysis, Krugman argued, "[The] case for free trade is currently more in doubt than at any time since the 1817 publication of Ricardo's *Principles of Political Economy*" (1987). He suggested that this doubt rested within economic theory itself, though, and not merely within the arena of political influence. Models based on Ricardian comparative advantage assume "perfect competition," a system based on large numbers of small consumers who take prices as given, and large numbers of small producers who cannot unilaterally affect market prices. Perfectly competitive markets are efficient because they generate market-clearing prices that equalize supply and demand.

On the other hand, Krugman argued:

> […T]he traditional constant returns, perfect competition models of international trade have been supplemented and to some extent supplanted by a new breed of models that emphasizes increasing returns and imperfect competition. These new models call into doubt the extent to which actual trade can be explained by comparative advantage; they also open the possibility that government intervention in trade via import restrictions, export subsidies, and so on may under some circumstances be in the national interest after all. (1987)

For example, Krugman pointed out that authors since the late 1950s described grounds for trade other than comparative advantage, although they struggled to model them in the accepted general equilibrium framework of perfect competition. According to Krugman, economists emphasized economies of scale – advantages stemming from an increased scale or size of operation – in particular as an important cause of trade, but, "Except under the implausible hypothesis that economies of scale are completely external to firms, increasing returns must lead to imperfect competition. Yet until the late 1970s, there was no generally accepted way to model imperfect competition in general equilibrium" (1987). During the 1970s, developments from Spence (1976), Dixit and Stiglitz (1977), and Krugman (1979), followed by Dixit and Norman (1980) and Lancaster (1980), increased the clarity of understanding of increasing returns (Krugman 1987). According to Krugman, "The main new insight from these models was that to the extent that trade driven by economies of scale is important in the world economy, imperfect competition is important as well" (1987). These new developments did not immediately challenge the policy environment that resulted from models of perfect competition and Ricardian comparative advantage; Krugman pointed out that introducing increasing returns would only strengthen the notion that trade benefits its participants (1987).

However, under assumptions of imperfect competition, the "trade vs. no trade vs. protected trade" scheme is different from the scheme offered by models of perfect competition. That is, "[As] soon as the respectability of non-comparative-advantage models in international trade was established, international trade theorists began to ask whether the new view of the *causes* of trade implied new views about appropriate trade *policy*" (Krugman 1987). Krugman offered a scenario featuring Boeing and Airbus as competitors for a world jet market to illustrate that in a market with only a few firms, governments could intervene to shift profits from a foreign firm to a domestic firm, thereby increasing the national welfare (1987). Krugman assumed that there were no domestic consumers, so the national welfare could be equated with producer surplus, and that "economies of scale [were] sufficiently large [such that] there is only room for one profitable entrant in the world market as a whole; that is, if two firms were to enter they would both incur losses" (1987). Consequently, the strategic interaction between Boeing and Airbus can be represented in a 2x2 payoff matrix, presented in Table 2.1.

Table 2.1: Competition between Boeing and Airbus

	Airbus Produce	Airbus Do Not Produce
Boeing Produce	(-5, -5)	(100, 0)
Boeing Do Not Produce	(0, 100)	(0, 0)

In other words, if Boeing and Airbus decide to produce, they will both make losses because there is not enough of a market to justify having two large producers. (In parentheses, Boeing's payoff is given first and Airbus's payoff is given second.) If neither produces, neither will realize any gains. If one firm produces but the other does not, the firm that produces will enjoy exclusive market share. However, if the government of "Europe" offers Airbus a production subsidy of 10, the conditions under which the strategic game is played change. The new conditions are presented in Table 2.2. Now, in any case, Airbus is better off producing. (The production strategy therefore is said to "dominate" the alternative strategy.) Boeing's best reply to production by Airbus is to not produce, so the subsidy of 10 guarantees an extra profit of 100 for the government of Europe (Krugman 1987). According to Krugman, this result is not exclusive to export subsidies; import protection can deter foreign entry when significant domestic markets exist for some commodity (1987). Ultimately, Krugman argued, "The strategic trade policy argument thus shows that at least under some circumstances a government, by supporting its firms in international competition, can raise national welfare at another country's expense" (1987).

Table 2.2: Effect of a subsidy for Airbus

	Airbus Produce	Airbus Do Not Produce
Boeing Produce	(-5, 5)	(100, 0)
Boeing Do Not Produce	(0, 110)	(0, 0)

Brander (1987) covered similar conceptual ground. Advocating "a modest departure in the direction of realism from standard theory," Brander argued that imperfect competition, or any failure of markets to be efficient in general, could lead to different results for national welfare from typical models of perfect competition (1987). More specifically, Brander argued that appropriate interventionist policies could have desirable effects, including profit-shifting and home market protection (1987). Describing a situation similar to Krugman's two-player strategic game above, Brander reiterated that a subsidized firm rationally would expand its output, causing its rival firm to reduce its own output in a limited market. Thus, the subsidized firm realizes a savings in the form of a transfer as well as an increase in profits based on the change in the strategic environment. This "strategic effect" of an export subsidy "implies that profits to the domestic firm rise by *more* than the amount of the subsidy. The benefit to the firm exceeds the cost to taxpayers" (Brander 1987). Furthermore, Brander argued, consumers of the subsidized good would benefit because the subsidized firm would enjoy lower production costs from economies of scale. However, since an export subsidy in this case shifts profits from foreign to

domestic firms, such a policy must be viewed as predatory and, according to Brander, may be "more acceptable if [it is] in retaliation than if [it is a] 'first strike'" (1987). According to Brander, the benefits to the subsidized firm and the market's consumers outweigh the loss to the "prey," because a strategic measure reduces the market power of a firm in an imperfectly competitive market and moves the market toward productive efficiency (1987).

Home market effects rely on economies of scale or decreasing average costs. Importantly, Brander's analysis of home market effects revealed that import tariffs or quotas could have the same strategic impact as export subsidies. For example, if, a firm's production efficiency increases as it produces more, protecting the firm domestically – say, with a tariff on the imports of its competitors – will enable it to increase domestic production and thereby compete more efficiently in its foreign market (Brander 1987). Brander argued, "As before this will allow the domestic firm to compete more successfully and earn higher profits in export markets than it otherwise would" (1987). Similarly, in a market with "quite a few firms" but constant incremental costs and high initial fixed costs, either domestic protection or export subsidies would promote additional production by a firm and thereby reduce the firm's average costs, since the fixed cost per unit falls as the number of units produced increases. According to Brander, the two arguments are similar, but neither could be explained by a perfectly competitive model because perfect competition does not allow for economies of scale (1987).

Beyond an environment of firms, Brander (1987) also considered strategic interactions between governments. That is, if one government pursues predatory trade policies, most governments would not passively allow that to happen. Unfortunately, the "home market protection" scenario breaks down into a basic strategic situation commonly known as the "prisoners' dilemma" (Brander 1987). A representation of home market protection is represented in Table 2.3.

Table 2.3: Illustration of home market protection

		E Cooperate	E Defect
A	Cooperate	(400, 400)	(50, 500)
A	Defect	(500, 50)	(100, 100)

Essentially, for two countries A and E, each is best off defecting – where to "defect" means to utilize domestic protection – when the rival country does not defect. If both countries defect, there is not enough market share to justify supporting two firms, and the total payoff is 200; if neither government intervenes, the total payoff is 800 (Brander 1987). However, regardless of the rival country's actions, defecting is always a best response for each country so the total payoff of 200 will be realized.

According to Brander, international treaties usually aim to induce countries to cooperate so mutually beneficial outcomes can be achieved, but "the problem with such agreements [as the GATT, and now the WTO] is that individual countries have incentives to cheat or defect […] In the case of GATT, success in getting tariff reductions has occurred simultaneously with major increases in other forms of trade intervention" (1987). Indeed, the models advanced by Krugman, Brander, and others address concerns highly relevant to an understanding of controversial trade policies in agriculture as well as efforts to reform these policies through the WTO.

A. Modeling Strategic Interactions in Agricultural Trade

Abbott and Kallio acknowledged the contributions of game theoretic analysis to research in international trade, citing a "revolution […] driven by the failure of existing models to account for key observed trade practices, including the existence of and importance given by government policy to export subsidies" (1996). Specifically with respect to agriculture, Abbott and Kallio noted that McCalla (1966) characterized wheat trade as a two-player interaction between the United States and Canada, and that others recognized that countries including Japan, the former Soviet Union, and Australia wielded market power in wheat trade (Abbott and Kallio 1996). However, since analysis of trade policy to that point rarely addressed imperfect competition, and even more rarely included game theory, Abbott and Kallio aimed to adopt a framework similar to the one used by Krugman (1987) and Brander (1987) to assess the rationality of the GATT – the predecessor of the WTO – as it dealt with agricultural trade issues (1996).

Namely, Abbott and Kallio pointed out that the institutional structures governing trade interactions greatly affected the outcomes, and that GATT, once established, changed the prevailing institutional structure (1996). More specifically, the authors noted, "A few large countries or regional blocs engage in trade of commodities; they are not 'small countries' as required in traditional trade theory" (1996). Furthermore, "[Both] the United States and EU claim to be matching the other's export subsidies, suggesting that mutual reform might be advantageous. Kennedy, von Witzke, and Roe demonstrate that for wheat subsidies this interaction can be viewed as a classic prisoners' dilemma game" (Abbott and Kallio 1996). Abbott and Kallio's own model "is utilized to illustrate under differing institutional arrangements [game structures] the levels of export subsidies [or taxes – the strategies], net exports, and the political payoffs for four regions [or players]: the United States, European Union, CAIRNS, and Importers" (1996). (The CAIRNS group is a group of developed and developing agriculture-exporting countries.) This model addresses the importance of special interests for the determination of agricultural trade policy captured by using a government payoff function that "is a weighted sum of producer surplus, consumer surplus, and government budgetary expense, and the potential strategic interactions among players, since their strategies [export subsidies] give rise to differing payoffs depending upon opponent's strategies" (1996). In other words, each player in the game is assigned a payoff function with weights on producer surplus, consumer surplus, and government expense. Abbott and Kallio assumed that the U.S. assigned an importance of 1.15 for producers and 0.85 for consumers, the E.U. assigned an importance of 1.30 for producers and 0.90 for consumers, CAIRNS assigned an importance of 1.10 for producers and 1.00 for consumers, and the importing countries assigned 1.00 to both (1996). (These weights reflect a preference for producers over consumers within the U.S., the E.U., and CAIRNS, with the greatest favoritism toward producers observed in the E.U.)

By adjusting these weights, or changing assumptions about market conditions, Abbott and Kallio observed different outcomes. To solve the game, the authors determined stable "Nash equilibrium" outcomes from which no one would unilaterally diverge, "assuming the United States and European Union independently maximize their own welfare, with the subsidy level of the opponent taken as given" (1996). The authors concluded that wheat trade is subject to a prisoners' dilemma, similar to the situation described by Brander (1987), because unilateral policy reform in the direction of freer trade harms the reforming country and benefits the country that retains its subsidies (Abbott and Kallio 1996). According to the authors, "GATT could have taken the players out of their prisoners' dilemma, and permitted a cooperative solution, or free

trade, to prevail. But the major players have market power in trade, so continuation of a trade intervention may indeed be rational, and, with their redistribution goals, subsidies may remain a second-best policy instrument" (1996). Even now, as Abbott and Kallio (1996) determined, the WTO has an opportunity to eliminate a prisoners' dilemma in agricultural trade, but only if it can overcome the defensiveness of the countries with market power in agriculture.

On the other hand, Trandel and Skeath (1996) provided a mathematical framework examining and extending the claim of Brander (1987) that the strategic profit-shifting effect of an export subsidy benefits firms more than it hurts taxpayers, and therefore raises national surplus. However, Trandel and Skeath's model does not assume that government policy decisions manipulate the incentives of firms; rather, they model internal political pressures aimed to manipulate a government to maximize something other than the national surplus (Trandel and Skeath 1996). (That is, Trandel and Skeath modeled a government exhibiting favoritism toward producers in a strategic environment.) The authors noted that "analyses often conclude that governmental 'favoritism' of commercial interests has a detrimental effect on overall national welfare. The fact that this favoritism exists in spite of its presumed harmful overall effect is often attributed to differences in the amounts of political influence wielded by competing interest groups" (1996). To a large extent, especially in the media and within political dialogue, the difference in political influence among various interests is assumed to play a large role in the determination of agricultural trade policy.

Trandel and Skeath combined Brander's (1987) notion of profit shifting with Abbott and Kallio's (1996) approach using a government objective function as a weighted sum of several goals (1996). Trandel and Skeath argued, "[If] a country's government designs its policy while placing firms' interests first, that country can experience a larger equilibrium true national surplus [weighting profit and tax cost equally] than it would experience if its government acted to maximize that surplus" (1996). Again, this outcome occurs because the firm saves the cost of the transfer from taxpayers and gains profit in a strategic setting when its government changes the incentives of its rivals, as Brander (1987) argued.

Trandel and Skeath's model produced a few important results. First, "a government's overweighting of profit can be self-perpetuating since it can inadvertently increase national welfare" by reaping gains from strategic effects, making omnipresent political pressure from special interest groups unnecessary (1996). That is, if pressure at one time leads a government to favor producers once, effects in a strategic environment may shift profit to the government's country and regularize its strategic behavior. Second, if a government more closely aligns its interests and its actions with maximizing national welfare, treating all groups equally, national welfare actually may fall. According to the authors, "[In] international markets in which strategic issues are important, we may not be likely to observe many instances of unilateral 'reform' in which a country reduces the extent to which its government favor commercial interests […] since such reform may well reduce equilibrium national welfare" (Trandel and Skeath 1996). Finally, Trandel and Skeath found that if two countries match each other's strategic behavior, both national surpluses fall (1996). Their results are consistent with the results of other authors and reflect accurately the troublesome points of contemporary agricultural trade debates.

B. Resolving the "Old" with the "New"

Krugman (1987) and Abbott and Kallio (1996) declared a "New International Economics" and a "New International Trade Theory," grounded in game-theoretic analysis of trade situations and a conception of imperfect competition. Both the new international trade

theory and the "old theory" based on Ricardian comparative advantage have important limitations, so an analysis of these shortcomings may reveal an appropriate manner in which to understand agricultural trade and its effects on the world economy.

Ashraf, McMillan, and Zwane (2005) highlighted the importance for trade outcomes of local characteristics of countries as well as income levels within countries. The authors conducted a macro-level study of the effects of the developed countries' agricultural trade policies on the poorest developing countries, augmented by a case study of Mexico's corn farmers. The authors found that developed country subsidies are positively correlated with average incomes for food-importing countries and negatively correlated with average incomes for food-exporting countries. Further, in Mexico, the authors concluded that – since the signing of the North American Free Trade Agreement, which reduced tariffs on trade between the U.S. and Mexico, but not U.S. subsidies – the poorest corn farmers have been largely unaffected because they consumed corn but did not sell corn in the market prior to NAFTA, medium-income farmers suffered a sharp drop in real income due to the fall in the market price for corn, and high-income farmers realized a gain in real income (Ashraf, et al. 2005).

The authors noted that their study was limited by the data set they used and limited in its approach to only first-order effects. That is, the study considered the short-run effects of globalization in Mexico but neglected to consider changes in supply and demand for corn or "the general equilibrium effects on employment patterns, wages, the price of other factors and technological innovation" (Ashraf, et al. 2005). Whether the poorest farmers, or at least some of them, would find it profitable to enter the market for corn in the absence of foreign production subsidies is an interesting, but more dynamic, consideration. Ultimately, the study is useful because it found that "the majority of poor countries are net importers of both cereals and food but net exporters of agricultural products as a whole" (Ashraf, et al. 2005). Developed countries' subsidies are positively correlated with developing countries' incomes as long as they depress prices of grains and food, but negatively correlated with developing countries' incomes if they are applied to developing-country exports such as cotton, dairy, or sugar (Ashraf, et al. 2005). However, while models of trade capture surplus effects sufficiently well, unfortunately, they do not always capture the effects on the producers who lose from foreign protection, even in countries that should, as a whole, be better off.

In some developing countries, agricultural production drives overall economic activity, so decreased producer surplus in their case might be devastating. For example, in a 2003 statement before the WTO, Burkina Faso's President claimed, "Mali, [in 2001], received 37 millions of dollars in aid, but lost 43 millions due to lower export revenues as a consequence of other producers' cotton subsidies" (Global Policy Forum 2003). More generally, the president argued that farmers in Burkina Faso, Mali, and Benin could produce cotton $0.50/kg more cheaply than farmers in developed countries, though the developed countries' subsidies eliminated their competitive advantage. According to the president,

Cotton holds indisputably a strategic position in our countries' development policies and poverty reduction programmes. While cotton accounts for only a small portion of economic activity in industrialized countries, in all our States, it represents a determining and critical factor for poverty reduction policies as well as for political and social stability. Through induced effects on infrastructure development, education and basic health services, cotton production acts as an essential link within our [African] countries' development strategies. (Global Policy Forum 2003)

Unfortunately, traditional models of international trade based on fairly homogenous countries cannot capture such effects, which are correlated with the relative success of a specific, large subset of producers within a country's economy. The models provided by traditional trade theory explain many aspects of trade interactions well, but are limited in important ways by the assumptions of perfect competition and homogenous countries.

C. Limitations of the Strategic Trade Policy Framework

Discussions of agricultural trade policy based on game-theoretic analysis and strategic interactions are at best limited, as well. For example, Trandel and Skeath (1996) argued that political pressure is less important than people typically believe, since profit shifting raises national welfare once export subsidies are established. Removing subsidies would decrease national welfare, so political pressure is not necessary to maintain subsidies as a viable policy decision. However, this strategic trade argument only supports the idea that subsidizing an industry with increasing returns can return profit beyond the cost of the subsidy; the framework does not explore the notion that an industry is the *most efficient* (or comparatively most efficient) industry in a given economy. That is, a country might subsidize agriculture and achieve a positive profit-shifting effect, while providing resources to a different industry entirely would be even more beneficial. Eliminating protection via export subsidies would decrease national welfare *in the short run*, but the improved performance of the other industry would have the potential to achieve a *higher* level of national welfare *in the long run*. Since this particular example would adversely affect domestic farmers and involve a shift of resources away from agriculture toward another potentially more competitive and more profitable industry, political pressure from representatives of agriculture would aim to maintain policies geared toward protectionism. In other words, the potential strategic benefits from supporting an industry with access to economies of scale do not overrule the basic principle of comparative advantage.

Another shortcoming of the strategic trade policy approach is that the current sentiment surrounding the WTO and United States foreign policy strongly supports free trade. This issue, however, can be remedied within the strategic trade policy model itself. Abbott and Kallio (1996) and others utilized a framework with government objective functions as weighted sums of different policy goals whose "weights," or relative importance, could be adjusted. Conceivably, this approach can accommodate an international climate that emphasizes development and open markets for the least developed countries. Furthermore, as the least developed countries continue to lag behind their industrialized counterparts, international organizations such as the United Nations pressure the industrialized world for sizable outflows of foreign aid. Outflows of aid can be modeled as another item in a government's budgetary expenses, which would be less important if open markets enabled the least developing countries to grow independently. Both of these factors – an emphasis on development and the costs of foreign aid – can be incorporated into formal models of strategic determination of agricultural trade policy, and both would make a free trade outcome more desirable for industrialized countries.

Even Krugman (1987) listed a number of potential difficulties arising from trade policy based on strategic trade. First, governments must possess a large amount of information or deal with a high degree of uncertainty when predicting how other players in strategic trade games will act or react (Krugman 1987). Second, if a successful policy were implemented in a market that would support a few firms, excess returns might flow to new firms instead of the government that established the policy (Krugman 1987). Third, to reiterate from above, trade policy has general equilibrium effects and a government risks overall losses if it supports the wrong

industry (Krugman 1987). (This effect highlights the importance of, and increases the requirement for, information about the effects of various policies.)

While these effects reduce the potential benefits from strategic trade policy, Krugman (1987) cited the potential for retaliation and improper domestic politics as reasons to avoid strategic trade policy altogether. That is, he also acknowledged the possibility of a prisoners' dilemma outcome in trade, "where each country is better off intervening than being the only country not to intervene, but everybody would be better off if nobody intervened" (1987). Further, he noted what many others have noted, that interventions based on the strategic trade policy framework can raise incomes for small, well-defined groups at the expense of larger, more widely dispersed groups, creating opportunities for political pressure. Thus, neither traditional models of trade nor game-theoretic models have a monopoly on appropriate trade insights, but both frameworks offer some insights toward a desirable policy outcome.

III. A Simple Model of Strategic Agricultural Trade Interaction

Based on the analysis to this point, current trade arrangements between the United States and the European Union – the two most influential players in global agricultural trade – should be represented as a classic prisoners' dilemma. In order to investigate Abbott and Kallio's claim that the WTO can help to remove the prisoners' dilemma, let G = the government objective function for the U.S. as well as the E.U.; G will be a weighted sum of the components arising from the analysis of the trade environment to this point. As in Abbott and Kallio's analysis, assuming different government priorities, understood as changes in the weights, or coefficients, on various values, will produce different policy outcomes. For example, G will include the nominal value of returns for protected industries with an implicit weight ("P"). Similarly, G will also be increased by weighted measures of general equilibrium benefits for other industries ("I"), benefits for domestic consumers ("C"), positive externalities from agricultural production ("E"), a favorable policy environment for developing countries ("d"), and net welfare gains for developing countries ("$I_{E(xporters)} - I_{I(mporters)}$"). (An alternative argument for protection of agriculture despite decreasing rural populations is that there is a positive externality, E, from maintaining the traditional agricultural sector.) G will be decreased by weighted measures of the cost of any subsidies ("S") and any domestic political loss from unfavorable policy action ("L"). Table 3.1 illustrates payoffs to the governments of the U.S. and the E.U. based on trade in a market for a "sensitive" good such as sugar or cotton. (Here, N and n in the matrix mean "do not protect" and P and p mean "protect." In brackets, the U.S. payoff is given, followed by the E.U. payoff. P* is an optimal profit-shifting effect when one country protects and the rival country does not, where 0<P<P*. L* is the high political cost of the decision not to protect when the rival country protects, where 0<L<L*. Changes in signs assume (P, p) is the status quo in place.)

Table 3.1: An illustration of the determinants of the choice of agricultural trade policy

		European Union n	European Union p
United States	**N**	[I+C+d+($I_E - I_I$)+S-P-E-L, I+C+d+($I_E - I_I$)+S-P-E-L]	[I+C+S-P-E-L*, P*+E-I-C-S]
United States	**P**	[P*+E-I-C-S, I+C+S-P-E-L*]	[P+E-I-C-S, P+E-I-C-S]

Consider a standard prisoners' dilemma scenario in which a country realizes its maximum payoff (4) when it protects and its rival country does not. (The numerical values of the payoffs are meant to be illustrative only and do not correspond to any measured or estimated values.) Coordinated free trade produces the maximum combined payoff (3+3 = 6). Decomposing the payoffs in this standard game using the variables enumerated above, 4 corresponds to $P^*+E-I-C-S$ for each player, and 3 corresponds to $I+C+d+(I_E - I_I)+S-P-E-L$ for each player.

Table 3.2: Prisoners' dilemma representation of agricultural trade interaction

		European Union n	European Union p
United States	N	(3, 3)	(-1, 4)
United States	P	(4, -1)	(1, 1)

In the game presented in Table 3.2, (1, 1) is the Nash equilibrium outcome. The United States prefers protection whether the European Union protects or not, and the European Union shares this preference with respect to the U.S., so protection is the "dominant strategy" for each player. Assuming the U.S. and the E.U. begin in (P, p), the Nash equilibrium scenario in which both players protect, neither side has an incentive to reform unilaterally (which would reduce the individual payoff from 1 to −1 in either case), so a measure of progress may be to establish (N, n) at least as a sustainable outcome.

Consider the modified situation presented in Table 3.3. Now, the U.S. is indifferent between the payoffs in (N, n) and (P, n), and the E.U. is indifferent between the payoffs in (N, n) and (N, p). However, if faced with a choice between (N, n) and (P, n), the U.S. would choose (N, n); choosing otherwise would prompt the E.U. to retaliate with its own protection, effectively giving the U.S. a choice between a sustainable payoff of 4 or the sustainable payoff of 1 from the initial Nash equilibrium outcome. Similarly, the E.U. would choose (N, n) over (N, p). Therefore, equalizing the payoffs from free trade with the payoffs from "lone protector" status for each country would eliminate the incentive to defect from free trade, which would be a significant result.

To understand how these payoffs can be "equalized", consider the decomposition of the payoff to lone protector status, which is the maximum individual payoff in the standard game, relative to the free trade payoff. Normally:

(1) $[P^*+E-I-C-S] > [I+C+d+(I_E - I_I)+S-P-E-L]$

Table 3.3: Modified prisoners' dilemma representation of agricultural trade interaction

		European Union n	European Union p
United States	N	(4, 4)	(-1, 4)
United States	P	(4, -1)	(1, 1)

Upon rearranging the inequality to gather like terms, the inequality also can be expressed as:

(2) $[P^*+P+2E+L] > [2I+2C+2S+d+(I_E - I_I)]$.

Increasing the right-hand side of (2) also would increase the right-hand side relative to the left-hand side in (1), rendering the free trade payoff of 3 closer to the maximum individual payoff of 4 in the initial prisoners' dilemma. (Table 3.3 represents the increase of the right-hand side of (2) up to equality with the left-hand side of the equation.) That is, any increase in the right-hand side of (2) would make trade liberalization more likely, and equalizing each side would make a free trade outcome sustainable, if it were realized.

The procedure of increasing the right-hand side of (2) relative to the left-hand side maps very naturally to observable issues in the current policy debate surrounding the deadlock in the WTO's trade negotiations. First, increasing the importance of conditions in developing countries for domestic governments will increase the implicit weight on $[d+(I_E - I_I)]$ as a component of government payoffs, and increasing $[d+(I_E - I_I)]$ will increase the right-hand side of (2) directly. Second, increasing the weight on, or importance of, 2C (a measure of benefits for domestic consumers) relative to L (a measure of political unrest among agricultural producers) will increase the right-hand side of (2) relative to the left-hand side; emphasizing the reduction in inefficiency costs to consumers that would offset losses in the agricultural sector will accomplish this. Third, decreasing the weight on 2E (a measure of the positive externality from agricultural production) relative to 2S (the cost of subsidies) will increase the right-hand side of (2) relative to the left-hand side, and publicizing more productive uses for the billions spent on agricultural programs than the maintenance of the traditional agricultural sector can achieve this. Finally, increasing the weight on 2I (a measure of benefits for initially unprotected industries) relative to P*+P (a measure of extra returns for protected industries) will increase the right-hand side of (2) relative to the left-hand side, and allowing for the allocation of government resources to industries potentially more competitive than the agricultural sector will accomplish this. Each of these four opportunities can improve the likelihood of a sustainable free trade outcome for trade in agricultural goods, and a detailed exploration of each opportunity follows here.

A. Specific Examples of the Model's Results

Increasing $[d+(I_E - I_I)]$ will increase the right-hand side of (2), and there are at least two ways to raise the importance of this measure. While the World Trade Organization has been promoting development through trade liberalization, the United Nations has advocated a development approach based heavily on aid from developed to developing countries. In September 2000, the U.N. adopted its Millennium Declaration, outlining eight "Millennium Development Goals" (MDGs) aimed at solving the significant problems affecting the least-developed countries by 2015 (United Nations 2005). The MDGs are associated with a popularized call on developed countries to donate 1% of their GDP annually toward aid to developing countries, in the interest of achieving the MDGs in a timely manner. Developed country restrictions on agricultural trade are recognized as an obstacle to development in many regions: E.U. agricultural policies for sugar, wheat, and milk, for instance, have reduced incomes and employment in Mozambique, Swaziland, Kenya, Nigeria, Senegal, and other African nations (Frith 2006). In particular, reducing or eliminating agricultural subsidies may spark development abroad without requiring a substantial outflow of foreign aid, and promoting development through liberalization would increase the importance of $[d+(I_E - I_I)]$ to governments' payoffs.

Second, especially from the standpoint of the U.S., promoting the importance of the economic conditions faced by developing countries will help the U.S. project a more consistent and more acceptable foreign policy. That is, the U.S. has advocated economic and political freedom abroad, but thus far, it has failed to practice economic freedom within its domestic

policies in a significant way. The U.S. Congress passed DR-CAFTA – a free trade agreement with Central American nations dealing heavily with agricultural products – but this regional progress has yet to translate into a global agreement. Also, non-agricultural industries in the developed countries stand to gain if a reduction in agricultural protection yields greater market access in non-agricultural markets abroad. Trade negotiators from the developed countries have addressed this point, and this beneficial market access tradeoff, expressed as an increase in $[d+(I_E - I_I)]$ in the model presented here, would make sustainable free trade more likely.

Increasing the implicit weight of 2C relative to L will increase the right-hand side of (2) relative to the left-hand side, reinforcing the notion that agriculture's special interests align against the interests of most consumers. With respect to the political context of global trade negotiations, agriculture's special interests own a commanding amount of political influence, but that amount need not translate into a monopoly. In most cases in the developed countries, consumers' interests oppose organized agriculture's interests, but the stakes for consumers are very widely dispersed among a large number of people; the viability of agricultural production is of primary importance for a relatively small number of individuals. However, the aggregate costs to consumers of inefficient trade policies are large. For example, Europe's Common Agricultural Policy may cost taxpayers close to 4 billion pounds annually and add over 800 pounds per year to the average family of four's food bill; a 2004 study by the U.S. International Trade Commission estimated that eliminating the protective scheme for sugar alone would return over $1 billion to the U.S. economy (Frith 2006; Heritage Foundation 2005). The costs extend also to producers of sugar-containing products (SCPs): a study by the U.S. Commerce Department suggested three jobs in confectionery manufacturing are lost for each job protected in sugar growing or sugar harvesting by the U.S. sugar program ("Sweet Opportunity" 2006). Organized agricultural special interests have a large stake in maintaining the status quo, but other groups would gain tremendously from liberalization in agricultural trade. In the context of the model, emphasizing gains to consumers of once-protected agricultural products (2C) can reduce the agricultural sector's role as a deterrent to trade liberalization (L).

Emphasizing 2S, the cost of subsidies, relative to 2E, any positive externality gained from agricultural production, will raise the right-hand side of (2) relative to the left-hand side. Often, taxpayer funds allocated toward agricultural protection find inefficient uses. According to a report on a federal drought aid program by Gilbert Gaul, Dan Morgan, and Susan Cohen (*Washington Post*, July 18, 2006), "[The U.S.] Livestock Compensation Program cost taxpayers $1.2 billion during its two years of existence, 2002 and 2003. Of that, $635 million went to ranchers and dairy farmers in areas where there was moderate drought or none at all." Further, this compensation depended on the number of livestock owned, and not proof that any actual damages had been incurred due to drought. Similarly, the same group (*Washington* Post, July 19, 2006) reported on a federal emergency milk program that cost taxpayers about $400 million. Once this program was implemented to protect states affected by a drought in 2003, distributed stockpiles of powdered milk ended not with the distressed farmers, but in "states with no drought" or with "middlemen in Mexico and other countries," creating "millions of dollars in profits" for the assisted farmers. Here, as well, there may be some benefit to society from maintaining the traditional agricultural sector (2E), but this benefit may be neutralized by knowledge of the wasteful methods used to maintain it (2S). An appreciation for the severity of this waste can be understood as both an increase in the implicit weight on 2S and a reduction in 2E in the model.

Finally, raising 2I, the weighted measure of benefits to initially unprotected industries, relative to P*+P, a measure of benefits to the protected agricultural sector, will raise the right-hand side of (2) relative to the left-hand side; the safeguards provided for agricultural producers adversely affect other producers that do not receive the same treatment. Clearly, large tax revenues must be raised to provide for the elaborate safeguards in place. However, the most important issue with respect to agriculture as it relates to other industries is market access. The developed countries' intransigence in trade negotiations to protect agricultural producers potentially has prevented other industries from gaining access to potential customers abroad. On the other hand, non-agricultural market access (NAMA) has been recognized as a primary goal for the U.S. as well as other developed countries in the WTO, but, according to Tom Wright (*New York Times*, July 18, 2006), major developing countries, including Brazil and India, are just as insistent that farm subsidies and tariffs be weakened before they open their markets. Of the four opportunities for change identified in the model – focusing on conditions in developing countries, focusing on consumers of agricultural products, focusing on inefficiencies generated by agricultural protection, and focusing on non-agricultural industries, specifically with respect to market access – this final issue is the one most apparent in the current trade negotiations, although progress appears to be quite slow. A breakthrough in market access in the developing world, along with the increased availability of government resources (2I) would help to offset the reduction or removal of protection in the agricultural sector (P*+P) and contribute to the sustainability of free trade in agriculture, consistent with the model presented here.

After considering the opportunities, costs, and benefits of liberalization, Anderson (2004) emphasized the need for "stronger lobbies for freer [trade] and investment, to counter the lobbying of entrenched protectionist forces," which is consistent with the results of the model presented here (namely, that opportunities for progress in liberalization appear in raising awareness among consumers and affected industries as well as creating support for developing countries' efforts towards growth). However, the expiration in 2007 of President Bush's "fast-track" authority to approve any potential trade agreement poses a challenge. Right now, President Bush can approve or reject any trade agreement that might come before him without giving Congress a chance to approve or reject particular items within the agreement. This authority will expire in late 2007 if Congress chooses not to renew it. While some believe the fast-track authority will expire – which would provide only another obstacle for the completion of the Doha Round – WTO Director-General Pascal Lamy argued that if the talks progress and Congress can receive "something that must be preserved, built upon, and concluded, the outcome may well be different. An agreement underpinning American growth, promoting poverty alleviation in the developing world, and enhancing global cooperation is without question in the interest of the United States" (Lamy 2006).

Looking forward, Lamy argued that an increase in bilateral and regional trade agreements would result from a failure of the Doha Round negotiations (2006). These agreements have important disadvantages; namely, developing countries "often must accept unwelcome conditions as the price for striking a deal with much more powerful trading partners," and all nations must deal with "different rules of origin, tariff levels, and customs procedures" arising from a preponderance of regional agreements (Lamy 2006). Also, Lamy suggested governments would resort more to the WTO's dispute-settlement system to resolve issues, but that "rule-making through litigation" may not be a sustainable practice (2006). Both of these suspicions elicit the feelings of mistrust implicit in the prisoners' dilemma: the first, because bilateral and regional agreements normally involve close trading partners and avoid coordination on the global

level, and the second, because referring a fellow WTO member to dispute settlement reflects an adversarial arrangement. The 2005 Ministerial Conference in Hong Kong, and later 2006 meetings in Geneva, resembled the prisoners' dilemma game in which the players wanted their opponents to give in without having to surrender any ground themselves. However, in the WTO, many different players are playing many different games while negotiating trade conditions across a range of goods and services. The opportunities presented above should represent a starting point for the WTO or individual member nations genuinely committed to achieving free trade.

IV. Conclusion

The WTO established the Doha Development Agenda in 2001 to address the concerns of the least developed countries and to emphasize open markets for agricultural products, though agricultural issues have created an environment of slow progress towards the goals of the "Doha Round." Unfortunately, Brander (1987), Abbott and Kallio (1996), and others found similarities between markets for agricultural products and the classic prisoners' dilemma game, in which players rationally protect their own interests at the expense of a mutually beneficial outcome. In imperfectly competitive markets, as well as in the prisoners' dilemma scenario, countries have an incentive to "cheat" – to employ subsidies or tariffs – to raise their own national welfare, as Trandel and Skeath determined, at the expense of rival countries and firms (1996). However, most of the factors determining the decisions of the governments involved either are personal perceptions or transfers subject to public policy. Changing assumptions about the importance of these factors to the governments involved changes the nature of the interaction, and may even eliminate its prisoners' dilemma characteristics.

Specifically, the simple model of agricultural trade between the U.S. and the E.U. presented in Table 3.1 illustrates four extant opportunities for promoting trade liberalization. (This analysis has argued that trade liberalization is desirable based on its effects on consumers and unprotected industries in the countries employing trade barriers as well as its effects on producers in developing countries who face artificially high competition arising from trade barriers.) The opportunities for promoting trade liberalization include: increasing the importance of the global economic conditions faced by developing countries; raising awareness among consumers of the artificially high prices they face for agricultural goods, in order to offset the political pressure from special interest groups to maintain agricultural trade barriers; raising awareness of the manner in which government revenue is spent for subsidies and emphasizing that government funds can be spent for goals other than maintaining the traditional agricultural sector; and raising awareness among executives and citizens that resources directed toward agricultural trade barriers can be reallocated toward potentially more efficient industries or back to taxpayers, and that market access achieved in trade negotiations should spur economic growth.

Developed countries have an opportunity to assist development by eliminating harmful trade practices as well as an opportunity to support their own economies by negotiating freer access to consumers in developing nations. For their own consumers, developed countries can offer the prospect of lower prices for agricultural goods in exchange for the displacement of some individuals currently employed in the agricultural sector. Creating a strong voice representing consumers can offset some of the political loss involved from upsetting agriculture's strong special interest voice. Similarly, at a time when numerous interests vie for federal attention and funding, raising awareness of the often-inefficient nature of subsidies and agricultural trade barriers may reduce the perceived social benefit of maintaining a traditional

agricultural sector. Raising awareness and creating a voice among executives and taxpayers in industries that do not receive subsidies or other protection can provide a force to oppose the strong political pressure to maintain the existing level of agricultural protection in developed countries. These four opportunities rely on communication and dissemination of information to alter the public's perception of the current trade and international affairs environment. According to the model developed here, pursuing any or all of these will improve the likelihood that a free trade outcome in agriculture can be sustained.

The model presented in this paper can be enriched or extended in a few ways. First, the "modified prisoners' dilemma" model might incorporate more sophisticated game-theoretic techniques to involve multiple players, not just the U.S. and the E.U. Developing country players would not have interests that can be represented symmetrically with the developed countries' interests, as the interests of the U.S. and the E.U. are represented in this model. Second, the model might acknowledge current data to provide an indication of the feasibility of each of the opportunities identified, thus providing for a ranking of the opportunities for progress. Third, the model might form the foundation for cost-benefit analyses of potential trade liberalization scenarios established within the WTO by indicating how various groups might gain or lose. Alternatively, the modified prisoners' dilemma approach might be applied to a variety of other situations, such as military escalation, corporate strategy, and voter behavior, to reveal potential unanticipated outcomes. In this case, the model has identified several areas for loosening the deadlock in the Doha Round trade negotiations, which, in 2007, will have serious effects on developed and developing countries alike if it fails or if it moves forward.

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