Volume 13 Number 1 2012/p. 14-25 esteyjournal.com

The Estey Centre Journal of
International Law
and Trade Policy

The Complexities of the Interface between Agricultural Policy and Trade

The world is full of complexities, making empirical welfare economics difficult.

Andrew Schmitz

Troy G. Schmitz

Associate Professor, Agribusiness and Resource Management, Arizona State University

Andrew Schmitz

Professor and Eminent Scholar, Food and Resource Economics, University of Florida

This paper is based in part on a presentation at the July 2010 Agricultural and Applied Economics Association meetings, Denver, Colorado. We thank Carole Schmitz for her comments on earlier drafts.

Tariff and non-tariff barriers are widespread as applied to agricultural trade. The theory of gains from trade considers the impacts of free trade relative to no trade and to non-tariff barriers, while the theory of agricultural policy generally places little weight on the international trading sector. However, it is necessary to combine agricultural policy with the international trading sector so that agricultural policy instruments such as price supports are considered together with barriers to trade such as tariffs. This is possible within the context of welfare economics when considering the costs and benefits of alternative agricultural and trade policies.

Keywords: agricultural policy, biofuels, export taxes, gains from trade, tariffs

Introduction

The discussion of gains from trade goes back at least to Adam Smith (Letiche, Chambers, and Schmitz, 1979). A significant body of literature now exists on the impact of removing tariff and non-tariff barriers. This literature falls under the heading *gains from trade*. This topic is also taken up in welfare economics, in part because gains-from-trade proofs often make use of the concept of economic surplus, that forms the basis of modern welfare economics (Just, Hueth, and Schmitz, 2004).

Paralleling the discussion on gains from trade is the literature on the welfare economics of agricultural policy and its impact on trade. It is possible for policy to impact trade even in the absence of tariffs and quotas.

With the above discussion in mind, there appears to be a great deal of confusion over what is meant, at least in empirical modeling, about the economic gains from moving to freer trade. For example, does moving to freer trade mean eliminating farm programs, or eliminating tariff and non-tariff barriers, or does it mean something different? The welfare economics of farm policy contains trade, but trade is only one aspect of policy models.

What is even more confusing is the discussion of the net gains from trade for countries in aggregate versus the net gain from trade for a single country. It turns out that the welfare impact for an individual country imposing tariffs or price supports can be large, but the impact when exporters and importers are considered together is relatively small. In welfare models of policy and trade, distributional impacts can be significant even though the inefficiency impacts can be small.

The purpose of this paper is to help clarify the meaning of such terms as *gains from trade, the welfare impact of agricultural policy,* and *the interface between trade and policy.* In the discussion, several models are brought forward that include two distortions, such as price supports and import controls coupled with policies that affect inputs used to produce outputs. In these cases, the results require a cautious interpretation.

Gains from Trade, Tariffs, and Export Taxes

The concept of gains from trade is usually discussed in the frame of a comparison between free trade and no trade. From a technical standpoint, the gains from free trade are measured as areas above excess supply curves and below excess demand curves (see the technical annex). In a general equilibrium context, there are losers and gainers from trade, but on net, all countries gain from free trade. This general statement pervades the economic literature and is the basis for much of the empirical work on the impact of freer trade in agriculture.

The common trade-distorting instruments, such as tariffs, export taxes, and production quotas, can also be discussed within the context of welfare economics. Individual countries can gain from such trade instruments, but the gains are less than what the trading partners lose. In other words, there are net losses from the use of trade instruments. Thus the outcome of trade barriers does not satisfy either the Pareto nor the Compensation principle (see the technical annex).

From a technical standpoint, the optimal welfare tariff is one where the importer acts as a monopsonist against an exporter, while in the optimal export tax case the exporter acts as a monopolist against an importer. In the case of the optimal revenue tariff, the government in the importing country behaves as both a monopsonist and monopolist. Also the net welfare costs of these trade instruments are given by deadweight loss (DWL) triangles. Of the instruments, the optimal revenue tariff leads to the greatest net welfare cost.

Optimal Byrd Tariff

In many models of international trade, little emphasis is given to processors and other sectors beyond the farm gate. However, under the optimal Byrd tariff, where the tariff revenues go to the petitioners for trade litigation, processors play a key role as they are often the sector that brings legal action against another country for unfair trade practices (Schmitz, Seale, and Schmitz, 2006). Under the Byrd tariff, processors, for example, can gain relative to free trade as they have the potential of gaining through lower import prices and higher internal prices than would otherwise be the case. Under the Byrd Amendment processors can theoretically extract large hidden rents by receiving monopolistic and monopsonistic rents.

There can be large distributional effects from the Byrd tariff, as in the classic tariff models, but the net welfare effect for both countries taken together can be small. (The welfare effect of price distortions can be significant for an individual country, but the net gains from trade, taking into account trading partners, can be relatively small.) Like classic tariff models, the Byrd tariff generates net welfare costs that can be summarized as a DWL triangle.

Trade Elimination and Policy Switching

One can derive models where, if one takes into account retaliatory action by an importer in response to a tariff policy by an exporter, a situation can arise where trade ceases. In addition, under retaliatory action, tariffs can give way to production subsidies (see the technical annex). As a result, even if one correctly measures the impact of production subsidies in a trade context, the policy instrument that gives rise to the subsidies can be a tariff. Note that production subsidies are common worldwide, including those in China. We hypothesize that many of these subsidies can be a result of early tariff protection.

In a two country model, the gain in absolute size to Country A from retaliation is far greater than either the gain or loss to Country B. (The loss may be positive or negative depending on price elasticities and the size of the tariff.) There is policy switching, and the net improvement from this subsidy is positive. Country A gains while Country B loses, but on net (i.e., both countries taken together), there is a net welfare gain by Country A from retaliating to Country B's use of the tariff.

Production Quotas

Production quotas have long been used for traded commodities. Two examples include the early U.S. production quota programs for peanuts and tobacco. In a seminal paper, Paul Johnson (1965) argued that there could be net benefits from the U.S. tobacco program because production quotas gave rise to monopolistic prices being charged to tobacco importers. In essence, this argument runs counter to results for a closed, no-trade model where production quotas result in net welfare costs.

Voluntary export restraints are common in international trade (Bredahl, Schmitz, and Hillman, 1987). This type of restraint essentially involves a production quota for exporters. In this case, the producers in both the importing and exporting countries gain. At the extreme, the voluntary export restraint is equivalent to the optimal export tax discussed earlier, but the tax revenue resides with export producers.

Price Supports and Exports

When modeling the impact of price supports, one clearly has to incorporate both the domestic and trade sectors. It is difficult for one to speak about trade in the absence of agricultural policy. Also, it is necessary to include price supports and their impact on trade along with input subsidies. These two distortions can lead to both large trade and welfare effects. The case of U.S. cotton policy clearly highlights that the impact on trade can be significant along with the welfare cost. Furthermore, there can be negative gains from trade, a concept often ignored in trade discussions.

Consider the case where trade takes place in the presence of domestic agricultural policy but in the absence of any tariff or non-tariff barriers. The interesting result is that, from the exporter's perspective, the cost of price supports is far greater than the net cost for both the exporter and importer taken together. Also, the net effect is a

DWL triangle, as was the case for trade in the presence of tariffs and export taxes discussed earlier.

Key points:

- Price supports result in increased exports.
- There are net welfare gains to the exporter from removing the price support, but the importer loses.
- There are “negative gains” from trade in the sense that the exporter can be better off with no trade than with trade under price supports (Schmitz, Schmitz, and Dumas, 1997).
- Trade can be impacted by domestic farm policy in the absence of tariff or non-tariff barriers.
- The net welfare cost of exporter price supports for the aggregate of both exporters and importers can be far less than the net cost for the exporter from the use of price supports.

Input Subsidies and Price Supports

The motivation for the theory that combines price supports and water subsidies was the Brazilian lawsuit against the United States’ cotton policy. The Brazilians contended that the U.S. cotton policy significantly depressed world cotton prices. In the technical annex, we show a theoretical model that contains both cotton price supports and water subsidies. On the basis of the analysis, we found that the U.S. cotton policy depressed world cotton prices by about $0.18 to $0.22 per pound (Schmitz et al., 2010). The welfare costs of the U.S. cotton program were empirically estimated to be large. The history of the Brazilian lawsuit and the outcome are contained in Powell and Schmitz (2005). In the court ruling in favour of Brazil, the argument made was that the U.S. cotton policy resulted (according to lawyers) in a significant price suppression of world cotton prices (although from an economic perspective, it is unclear what percentage drop in price is needed for there to be a significant price suppression effect).

The model in the technical annex focuses on the interaction of input subsidies and price supports, which for our purpose include countercyclical payments (CCPs) and loan rate payments (LRPs). We analyze these instruments taken together and individually, and demonstrate that they operate in a multiplicative rather than an additive manner. In this model, the relative magnitude and distribution of the rents depend largely on the size of demand and supply elasticities, the amount of exports, and the per unit cost of the water subsidy. For example, the more elastic the supply, the greater the DWL triangle; also, the higher the proportion of domestic production that is exported, the greater the net cost of the combined subsidies. Using this model framework, Schmitz, Schmitz, and Dumas (1997) show theoretically and empirically the existence of negative gains from trade for U.S. cotton.

A combination of the two subsidies distorts output more than when each one acts alone, causing the multiplicative effects of the two instruments to be greater than a mere summation of the individual effects. Both of these effects increase the size of the price support payments made by the government, and in conjunction with price supports, the aggregate size of the input subsidy is greater than in the absence of price supports.

Key points:

- The combination of price supports and input subsidies can lead to negative gains from trade.
- There are gainers and losers from domestic policy distortions (e.g., importers and domestic producers gain at the expense of domestic taxpayers).

Supply Management and Border Controls

Two distortions often exist together, such as import quotas along with production controls — the case of Canadian supply management. Here the welfare costs can be large or small even though trade may not be restricted as a result of supply management. In addition, this type of modeling highlights an element often ignored in trade analysis — the impact of trade on sectors beyond the farm gate, such as processors.

The model by Vercammen and Schmitz (1992) considers together import quotas and domestic production controls. The impact of supply management depends in part on the level of the constraint placed on imports. The tighter the import control, the greater will be the welfare cost of supply management. Regardless of the constraint placed on imports, the net effect of supply management is given by a DWL triangle.

An interesting aspect in supply management models is the value attached to production quotas. Quota values play a major role in determining compensation to producers and landowners if the policy containing production controls as a key ingredient is terminated. For example, in the buyout of the U.S. peanut program, government compensation to producers and landowners was based largely on peanut quota values (Schmitz and Schmitz, 2010a). Quota values would also play a role if, for example, supply management–type programs in Canada were eliminated.

Key point:

- Supply management can result in large welfare costs, but it need not cause trade distortions.

Biofuels

One of the most difficult exercises in empirical welfare economics is conducting a benefit-cost analysis of the U.S. corn ethanol program (Schmitz, Moss, and Schmitz, 2007). This is because energy is used to produce corn which, in turn, through subsidies, is used to produce energy. Direct production subsidies are not the only policy instruments that affect trade. For example, with ethanol production, even in the absence of price supports, trade is affected by indirect subsidies to corn producers via tax credits to ethanol processors and tariffs on ethanol imports. In this case, corn producers win while other groups lose, including livestock producers.

The study by Schmitz, Moss, and Schmitz (2007) of the impact of ethanol tax credits clearly highlights the need to identify the gain to processors and other sectors beyond the farm gate. Also, government policy plays a key role in the analysis. For example, net welfare gains increase when one takes into account the impact of ethanol production on the lowering of farm subsidies.

The analysis of production subsidies can be complex and difficult. In the ethanol case, one has to consider additional elements that are not easily captured in the corn market. One has to account for environmental impacts, the value of distillers grain, and the impact on the government payment of a corn farm subsidy. Also, perhaps more importantly, general equilibrium effects have to be considered. For example, how does ethanol consumption affect the overall fuels market? As we show in Table 1, the net welfare gains from providing ethanol tax credits can be positive if ethanol has a positive price-depressing effect in the overall fuels market. Du and Hayes (2008) argue, for example, that the impact of ethanol on the fuels market can be quite large (between \$0.29 and \$0.40 per gallon). Along the same lines, Zilberman et al. (2011) contend that fuel prices are impacted partly because the OPEC strategy of production controls is related to the U.S. ethanol policy. The debate over ethanol subsidies continues. Many of the components of an ethanol corn model, such as whether or not the price impact on the overall fuels market is significant, are open to debate.

Trade becomes an integral part of biofuels policy. First, there are exports and imports of ethanol. Second, trade is created from one of the ethanol byproducts, namely distillers grain (DG). Since 2002, U.S. ethanol production has increased by an average of 26 percent per year, reaching nine billion gallons in 2008. As a byproduct of dry-mill ethanol production, distillers grain production also increased rapidly, reaching approximately 20 million metric tons (million tonnes) in 2008 (Fox, 2009).

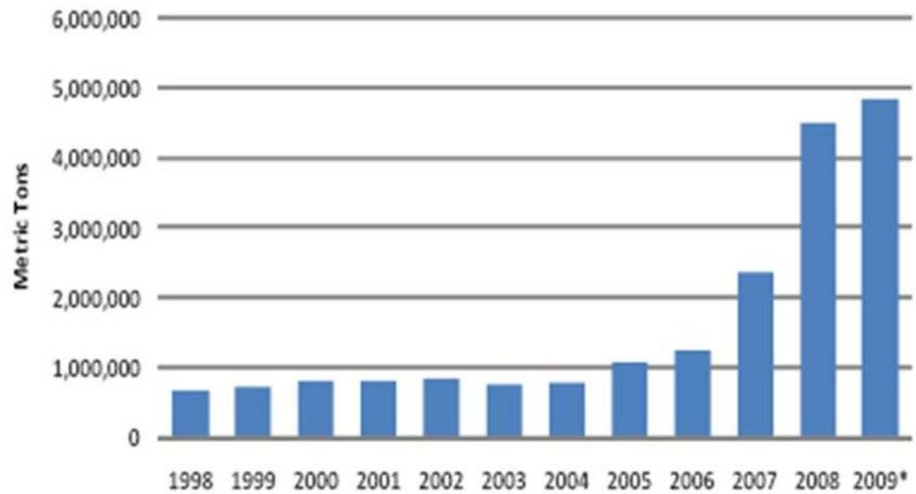
From 1995 to 2004, U.S. exports of DG averaged about 740,000 tonnes, ranging from 526,000 tonnes in 1996 to 842,000 tonnes in 2002 (Figure 1). Mexico and Canada accounted for approximately 43 percent of DG exports by the United States in

2007 and 2008. Canadian imports peaked in 2008 at roughly 800,000 tonnes, but fell to 600,000 in 2009 (Figure 2).

Table 1 U.S. Ethanol and the Broader Fuels Market

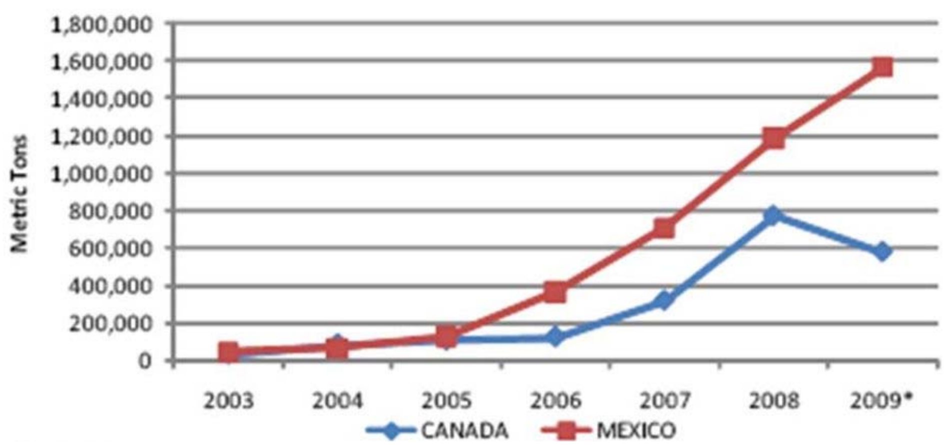
	Supply elasticities (corn)			
	0.4	0.5	0.6	0.7
	Shift based on 2006 market conditions			
Gasoline market price ($/gallon)	2.969	2.969	2.969	2.969
Gasoline market quantity (billion gallons)	139.726	139.730	139.733	139.733
Gain in consumer surplus (billion dollars)	4.369	4.390	4.411	4.411
Loss to gasoline/oil producers (billion dollars)	−4.358	−4.378	−4.399	−4.399
Loss to foreign producers (billion dollars)	−3.042	−3.057	−3.071	−3.071
Loss to domestic producers (billion dollars)	−1.307	−1.314	−1.320	−1.320
Gain to ethanol producers (billion dollars)	0.046	0.046	0.046	0.046
Net welfare gain (billion dollars)	3.107	3.122	3.138	3.138
	2.0 billion bushel shift in demand			
Gasoline market price ($/gallon)	2.961	2.961	2.961	2.961
Gasoline market quantity (billion gallons)	139.897	139.904	139.907	139.907
Gain in consumer surplus (billion dollars)	5.397	5.439	5.460	5.460
Loss to gasoline/oil producers (billion dollars)	−5.379	−5.421	−5.442	−5.442
Loss to foreign producers (billion dollars)	−3.753	−3.782	−3.797	−3.797
Loss to domestic producers (billion dollars)	−1.614	−1.626	−1.633	−1.633
Gain to ethanol producers (billion dollars)	0.069	0.070	0.071	0.071
Net welfare gain (billion dollars)	3.852	3.883	3.898	3.898

Source: Schmitz, Moss, and Schmitz (2007)



*Projected based on Jan-May
Source:USDA-FAS http://www.fas.usda.gov/ustrade/USTExHS10.aso?0/=

Figure 1 U.S. exports of DG, 1998–2009.



*Projected based on Jan-May
Source:USDA-FAS http://www.fas.usda.gov/ustrade/USTExHS10.aso?0I=

Figure 2 U.S. exports of DG to Canada and Mexico.

Conclusions

This paper demonstrates the interconnection between trade policy and agricultural policy. Because of the significant role played by agricultural policy, its impact cannot be discussed without being placed in a trade context. Agricultural policy can impact agricultural trade in the absence of tariff and non-tariff barriers. Likewise, trade policy can impact agriculture even if agricultural policy instruments are absent. However, both are important and have to be modeled together, and the results should be discussed in the context of welfare economics, where gainers and losers and welfare net impacts are identified.

Empirically, the importance of combined trade and policy instruments depends in part on the time period covered by the analysis. For example, throughout much of the history of U.S. policy, the impact was significant, because U.S. farm policy established target prices for major commodities that were well above market prices. However, as of early 2011, market prices were significantly above target prices (Table 2). For example, cotton and corn prices were more than double the target prices set in the 2008 U.S. Farm Bill. Also, higher commodity prices give rise to importers lowering tariff and non-tariff barriers (Schmitz and Schmitz, 2010b). As a result, the impacts of farm policy (in conjunction with tariff and non-tariff barriers) are highly dependent on the extent to which time periods are included where target prices are binding.

Table 2 U.S. Target Prices and Futures for Selected U.S. Commodities

	Target price	Futures [March 1, 2011]
	(dollars)	(dollars)
Corn (dollars/bushel)	2.63	7.29
Cotton (dollars/bushel)	0.71	1.98
Wheat [CBT] (dollars/bushel)	3.92	8.07
Soybeans (dollars/bushel)	5.80	13.61

References

Bredahl, M., A. Schmitz, and J. Hillman. 1987. Rent seeking in international trade: The great tomato war. *American Journal of Agricultural Economics* 69(1): 1-10.

Du, X., and D. J. Hayes. 2008. *The Impact of Ethanol Production on U.S. and Regional Gasoline Prices and Regional Gasoline Prices and on the Profitability of the U.S. Oil Refinery Industry*. Working Paper 08-WP 467. Ames, IA: CARD.

Fox, J. A. 2009. *Export Markets for Distillers Grains*. North American Institute for Beef Economic Research (NAIBER), Kansas State University Agricultural Experiment Station and Cooperative Extension Service, Manhattan, KS.

Johnson, P. 1965. The social cost of the tobacco program. *Journal of Farm Economics* 47(2): 242-255.

Just, R., D. Hueth, and A. Schmitz. 2004. *The Welfare Economics of Public Policy: A Practical Approach to Project and Policy Evaluation*. Northampton, MA: Edward Elgar Publishing.

Letiche, J. M., R. G. Chambers, and A. Schmitz. 1979. The development of gains from trade theory: Classical to modern literature. In *Economic Perspectives: An Annual Survey of Economics*, edited by M. Ballabon. NY: Gordon and Bresch Publishing.

Powell, S. J., and A. Schmitz. 2005. The cotton and sugar subsidies decisions: WTO's dispute settlement system rebalances the agreement on agriculture. *Drake Journal of Agricultural Law* 10(2): 287-330.

Schmitz, A., C. Moss, and T. G. Schmitz. 2007. Ethanol: No free lunch. *Journal of Agricultural and Food Industrial Organization* 5(2): Article 3. http://www.bepress.com/jafio/vol5/iss2/art3.

Schmitz, A., C. B. Moss, T. G. Schmitz, H. W. Furtan, and H. C. Schmitz. 2010. *Agricultural Policy, Agribusiness, and Rent-Seeking Behaviour.* Second Edition. Toronto: University of Toronto Press.

Schmitz, A., J. Seale, and T. Schmitz. 2006. The optimal processor tariff under the Byrd Amendment. *International Journal of Applied Economics* 3(2): 9-20.

Schmitz, A., and T. G. Schmitz. 2010a. Benefit-cost analysis: Distributional considerations under producer quota buyouts. *Journal of Benefit-Cost Analysis* 1(1): Article 2. http://www.bepress.com/jbca/vol1/iss1/2.

Schmitz, A., and T. G. Schmitz. 2010b. US and EU agricultural policy: Divergence or convergence? In *The Economic Impact of Public Support to Agriculture: An International Perspective*, edited by V. E. Ball, R. Fanfani, and L. Gutierrez, 41-66. NY: Springer Publishing.

Schmitz, T., A. Schmitz, and C. Dumas. 1997. Gains from trade inefficiency of government payments and the net economic effects of trading. *Journal of Political Economy* 105(3): 637-647.

Vercammen, J., and A. Schmitz. 1992. Supply management and import concessions. *Canadian Journal of Economics* 25(4): 957-971.

Zilberman, D., D. Rajagopal, S. Sexton, G. Hochman, and T. Serra. 2011. The economics of biofuels, food, and the environment. In *The Economics of Alternative Energy Sources and Globalization*, edited by A. Schmitz, N. Wilson, C. Moss, and D. Zilberman, chapter 3. UAE: Bentham Science Publishers.

Volume 13 Number 1, 2012/p. 26-42 esteyjournal.com

The Estey Centre Journal of
International Law
and Trade Policy

Technical Annex

The Complexities of the Interface between Agricultural Policy and Trade: The Economic Assessment

Troy G. Schmitz

Associate Professor, Agribusiness and Resource Management, Arizona State University

Andrew Schmitz

Professor and Eminent Scholar, Food and Resource Economics, University of Florida

This document is the technical annex to the full paper "The Complexities of the Interface between Agricultural Policy and Trade" which is available separately.

As we discuss below, the welfare economics of trade and agricultural policy should incorporate tariff and non-tariff barriers together with policy instruments such as price supports. Only in so doing, does one capture the true distributional impact along with net welfare costs and benefits from trade in the presence of distortions that arise from both trade instruments and agricultural policy. It is important to consider the distributional implications for a given country along with net welfare costs and benefits of a particular program regime. Equally important, one should consider the net welfare costs and benefits for importers and exporters taken together. Interestingly, it turns out that an aggregate net welfare cost from distortions brought about through direct trade barriers or agricultural policy can be relatively small and can be expressed as a deadweight loss (DWL) triangle.

Gains from Trade, Tariffs, and Export Taxes

We portray in Figure 1 the concept of *gains from trade* and, separately, the welfare impact of tariffs and export taxes. As we show, the net welfare impact from the standpoint of both exporters and importers taken together of either tariffs or taxes turns out to be a deadweight loss triangle. In Figure 1 we assume, for simplicity, the exporter supply is S_f (which we set equal to the excess supply curve ES_f), and the orresponding marginal outlay curve is *MO*. For the importer, the demand is given by D_d (which we set equal to the excess demand ED_d). Free trade is given by P_f and Q_f.

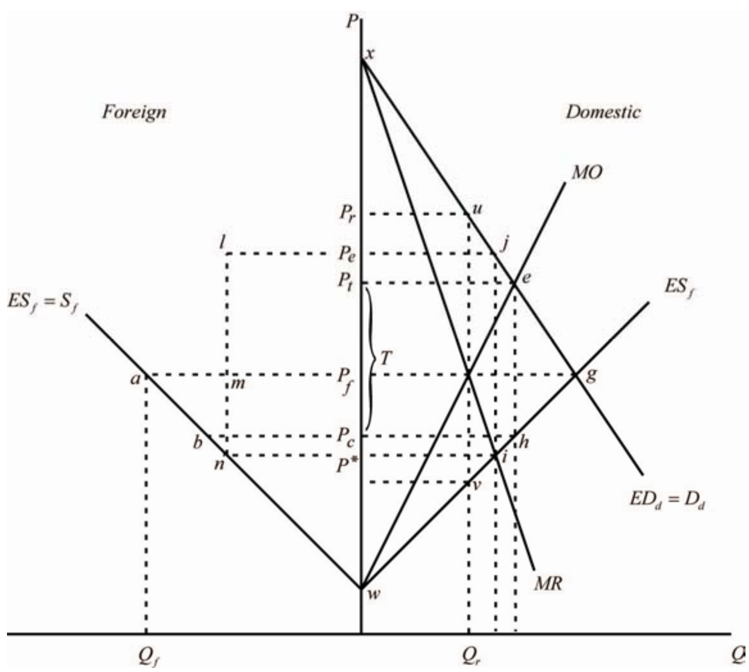


Figure 1 Gains from trade, tariffs, and export taxes.

The gains from trade are given in Figure 1 and are determined by the area above the excess supply curve and below the excess demand curve for the free trade price P_f. The gains from trade are given by (*xwg*).

Now consider the effect of an optimal welfare tariff *T*, determined where *MO* crosses D_d. The tariff causes the price to increase in the domestic market to P_t, but the price in the foreign market falls to P_c. The loss to the exporter from the tariff is ($P_f abP_c$). The exporter gains from the tariff by an amount [($P_tP_c he$) – ($P_tP_f ge$)]. The loss to the exporter from the tariff is greater than the gain to the importer. Also, the net cost of the tariff from a global perspective is the DWL triangle (*ehg*). This DWL triangle is smaller than the net loss for the exporter from the tariff.

What does an optimal export tax look like? It is determined by the intersection of the marginal revenue curve *MR* with S_f. Unlike with the tariff case above, the importer loses and the exporter gains from an optimal export tax. The loss to the importer is ($PeP_f gj$). The gain to the exporter is [($lmP_f Pe$) – (*anm*)]. The overall net welfare cost is the DWL triangle (*jig*). This DWL triangle is smaller in size than is the loss to the importer which is measured by the change in consumer surplus.

The optimal government revenue tariff is also shown in Figure 1. The domestic price is P_r and the corresponding imports equal Q_r. In this case, the net welfare cost of the tariff equals (*uvg*).

Optimal Byrd Tariff

Most models do not consider economic activities past the farm gate other than the behaviour of consumers. One exception is the supply management model, which is discussed later. Schmitz, Seale, and Schmitz (2006) derived the optimal Byrd processor tariff in a vertical market structure. They considered a group of processors, referred to as the processing industry, who buy inputs for processing from abroad and from domestic producers. The excess supply curve for the exporter of an input for processing is *ES* (Figure 2). The importer's domestic supply schedule for producing the same input is S_d. The demand curve for the processor's output is D_c. The processor's derived demand curve for the input is D_d. The free trade price for the input is P_f and exports are Q_f.

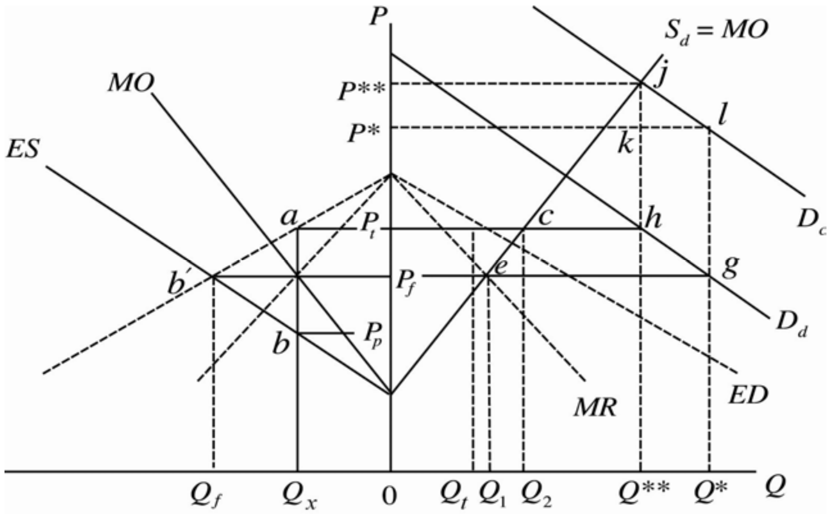


Figure 2 The optimal Byrd processor tariff.

Source: Schmitz et al. (2010)

Under free trade, the raw-product processor will purchase Q_f from abroad at price P_f and will purchase Q_1 domestically at price P_f . The total outlay for the raw product will become ($P_f Q_f + P_f Q_1$). In essence, the processor's input totals ($Q_f + Q_1$), which is Q^*. A portion of the processed input comes in the form of imports, and the remainder is produced domestically. Under constant processor costs, given the consumer demand for the final product D_c, the processor will produce Q^* and will sell the final product at P^*.

Suppose the processor is effective when lobbying for a tariff on the product of size (P_t - P_p). The processor now imports only Q_t (which equals Q_x of exports) of the input to be processed at price P_t. Under the Byrd Amendment, tariff revenue abP_pP_t will be reimbursed to the processor; hence, its effective outlay on imports will be reduced to P_pQ_t. On the other hand, raw-product processor expenditures on domestic inputs will increase from P_fQ_1 to P_tQ_2. Combining these two effects, total expenditures by the processor on purchases of both imports and the domestic raw products will actually decrease when the tariff revenue is rebated to the processor. When compared with free trade, a tariff of size (P_t – P_p) will cause the processor to process Q^{**} of the input for sale at price P^{**}.

The optimal processor tariff is derived where the marginal outlay curve *MO* intersects the marginal revenue curve *MR* associated with the excess derived demand curve *ED* in Figure 2. The optimal processor tariff is thus $(P_t - P_p)$. Imports for the profit maximizing processor under the tariff are represented by Q_t , for which the processor pays producers in the exporting country price P_p. Producers in the importing country now will receive a higher price of P_t, but consumers also will be charged a higher price. Export producers will lose $(b'bP_pP_f)$, import consumers will lose (P_tP_fgh), domestic producers will gain (P_tP_fec), and processors will gain (abP_pP_t).

At the optimal tariff $(P_t - P_p)$, processor profits are at a maximum. Essentially, the government tariff policy will create non-competitive rents for the processor. A processor under the Byrd Amendment will gain (abP_pP_t) from the tariff relative to free trade, which is exactly equal to the tariff revenue rebated to the processors by the government.

As in the above model, there can be large distributional effects from a tariff, but the net welfare effect for both countries taken together can be small. This can be seen from Figure 2, where the net welfare cost of the Byrd tariff is the DWL triangle (*ab'b*).

Trade Elimination and Policy Switching

Consider now a price support model combined with tariffs (Figure 3), where the free trade price is give by P_f. The gains from trade equal (*bcd*). The introduction of a price support with no retaliation from the importer results in a welfare cost of (*abcde*) that exceeds (*bcd*).

What if the importer retaliates with an import tariff of *T*? Price falls to P_w and exports cease to exist. The tariff adds an additional cost to the exporter of (*edf*). In the model, the effects of both price supports and tariffs are shown.

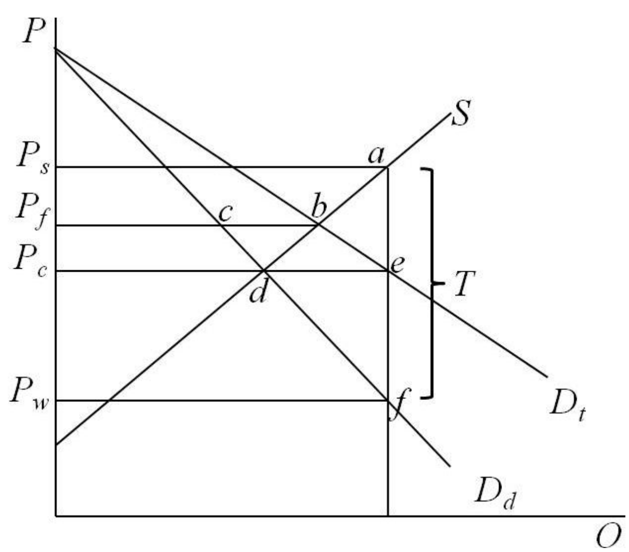


Figure 3 Trade elimination.

Consider Figure 4, where tariffs would cause the adoption of price supports but would not appear in an empirical assessment of tariff impacts. In Figure 4, S is the supply curve for the exporter (Country A) and S_m is the supply curve for the importer (Country B). The free trade price is P_f and exports total Q_f.

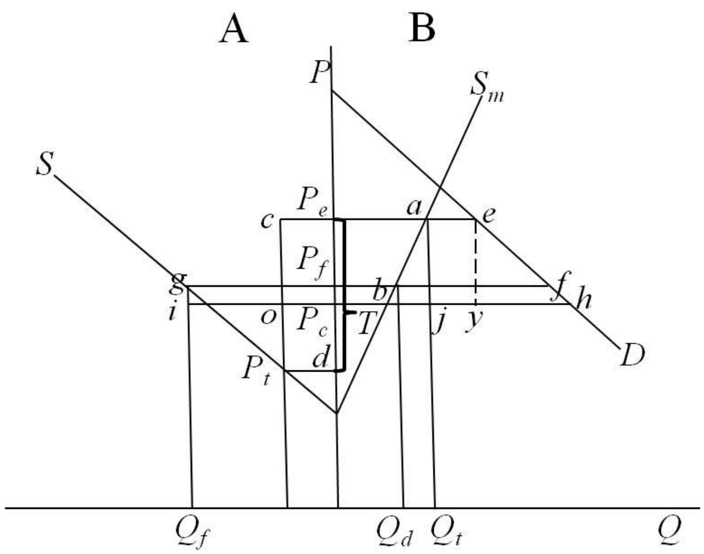


Figure 4 Policy switching.

Suppose that Country B imposes a tariff of size T. Exporters lose ($P_f gP_t d$). From Country B's perspective, producers gain ($P_e P_f ba$), consumers lose ($P_e P_f fe$), and the government gains tariff revenue of ($cP_t dP_e$).

What if Country A retaliates to the tariff by providing its producers a price support scheme that re-establishes the price to P_f? In order to maintain rents of ($P_e P_f ba$) for its producers, Country B will have to replace the tariff with a production subsidy. The effect is to cause the consumer price to fall to P_c. The treasury cost to Country A is ($P_f giP_c$). The treasury cost to Country B is ($P_e P_c ja$), but in Country B, tariff revenues disappear and consumers gain ($P_e P_c he$). The net welfare effect for B is [($ajhe$) – ($P_e cP_t d$)]. For Country A, the net gain is [($P_c iP_t d$) – ($P_c giP_f$)]. Note that the gain to Country A in absolute size from retaliation is far greater than either the gain or loss to Country B. (The loss may be positive or negative depending on elasticities and the size of the tariff.) Also note that there is policy switching, and the net improvement from this subsidy is positive. Country A gains while Country B loses, but on net (i.e., both countries taken together), there is a net welfare gain by Country A retaliating to Country B's use of the tariff.

In the presence of two distortions, how are the effects different from free trade? For Country A, relative to free trade, the loss from the subsidy is ($P_f giP_c$). For Country B, the net loss is [($P_f P_c hf$) – ($P_e P_c ja$)]. The loss to the importer (Country B) is greater than for the exporter (Country A). Note: This result need not be a response from Country A to Country B due to a tariff in Country B. If Country A imposes a production subsidy, Country B might retaliate with a subsidy also!

Production Quotas

Production quotas have long been used for traded commodities. Examples include the early U.S. production quota programs for tobacco and peanuts. Consider figure 5, where the foreign supply curve is given by *ES* and the domestic demand is *D*. The free trade price and quantity are P_f and q_f, respectively. Under a production quota introduced by an exporter, price increases to p_1 and quantity decreases to q_1. Domestic consumers lose from the production quota by an amount ($p_1 p_f\, da$), while foreign producers gain by ($p_1 p_f ba – bcd$).

The net gain from free trade, with the quota removed, is (*acd*). However, note that the gain is smaller in magnitude than is either the net producer gain from the quota or the consumer cost from the quota.

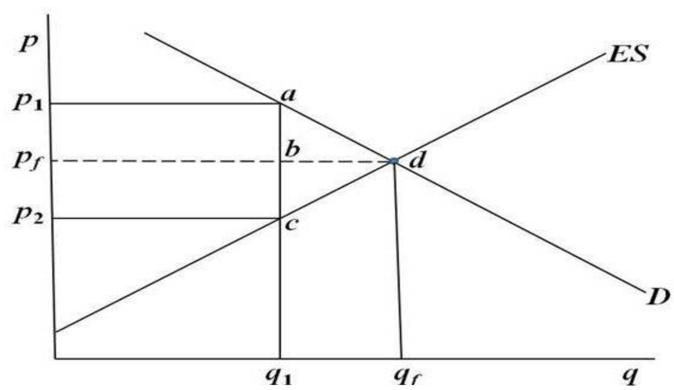


Figure 5 Production quotas and trade.

Key points:

- Imperfect competition can lead to sizeable welfare gains for those countries or players with market power. However, these gains individually can be larger than the net gains from free trade where distortions are absent. This is also the case for the size of the negative impact on consumers brought about by imperfectly competitive behaviour.

- The net gains from trade can equal the deadweight loss triangle.

Price Supports and Exports

Unlike closed models, we consider the case where trade takes place in the presence of domestic agricultural policy. There are neither tariff nor non-tariff barriers in this model. In figure 6, domestic supply is given by S_d. Total demand is D_t (foreign demand, which is not shown), and domestic demand is D_d. The no trade price is P_0 and quantity is q_0. The free trade price is P_f and exports total (*ab*). In this model, the gains from trade are given by (*abc*).

Suppose now a price support P_s is introduced. Output increases to q_s and the consumer price falls to P_1. Relative to free trade, producers gain ($P_sP_f\,ag$). Domestic consumers gain ($P_f\,P_1db$) while the foreign country gains (*bdea*). The government treasury cost totals (P_sP_1eg). The net welfare cost of the price support for the home country is the cross-hatched area (*bdega*). The net welfare cost for both the importer and exporter, taken together, is (*aeg*).

Note the interesting result that from the exporter's perspective, the cost of price supports is far greater than the net cost for both the exporter and importer taken together. Also, the net effect is a DWL triangle, as was the case earlier for either tariffs or export taxes.

Consider the impact of a tariff (without price supports) that lowers the price from P_f to P_1. The free trade gains from trade of (*bca*) are reduced by (*bb'a'a*) due to the tariff. Note that the impact of the tariff is much smaller than the welfare cost of a price support in the absence of tariffs.

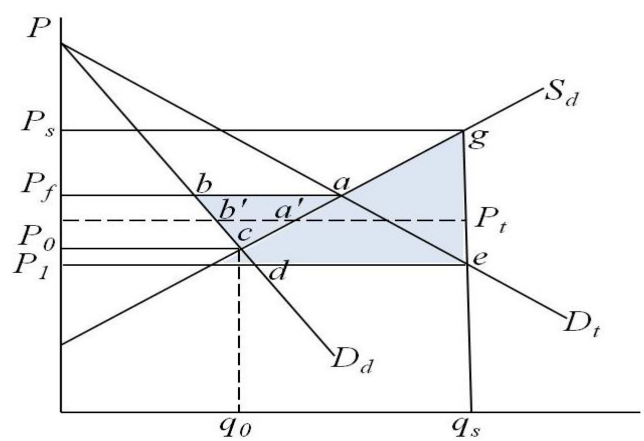


Figure 6 Negative gains from trade and policy distortions.

Key points:

- Price supports cause trade to increase.
- There are net welfare gains to the exporter from removing the price support, but the importer loses.
- There are *negative gains* from trade in the sense that the exporter would be better off with no trade than with trade under price supports (Schmitz, Schmitz, and Dumas, 1997).
- Trade is impacted by domestic farm policy rather than by tariff or non-tariff barriers.
- The net welfare cost of price supports for the aggregate of both exporters and importers is far less than the net cost for the exporter from the use of price supports.
- The aggregate net welfare cost of price supports turns out to be a DWL triangle, as was the case for tariffs and export taxes.

Input Subsidies and Price Supports

What happens to subsidy impacts in the presence of trade? Consider Figure 7, where the domestic demand is D_d and the total demand is T_D. The net cost of the input subsidy that shifts supply from S to S' is given by (*cdeab*). The cost is greater than (*abe*) because of the slippage effect (*cdeb*), which is the cost of subsidizing importers.

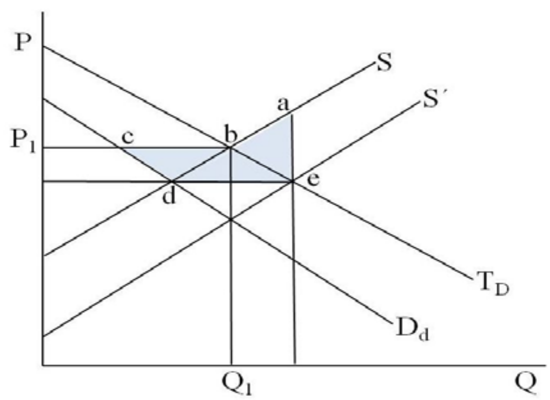


Figure 7 Input subsidies and trade.

Here we focus on the interaction of input subsidies and price supports, which for our purpose include countercyclical payments and loan rate payments. We analyze these instruments taken together and individually, and demonstrate that they operate in a multiplicative rather than an additive manner. Figure 8 presents a combined input subsidy (e.g. a water subsidy) and a price support payment (e.g. a price support on cotton). In addition, Figure 8 explicitly represents each policy program instrument separately. In the model, *S* and *S′* represent, respectively, the supply curve with and without the water subsidy. The domestic demand curve is D_d and the total demand curve is T_D.

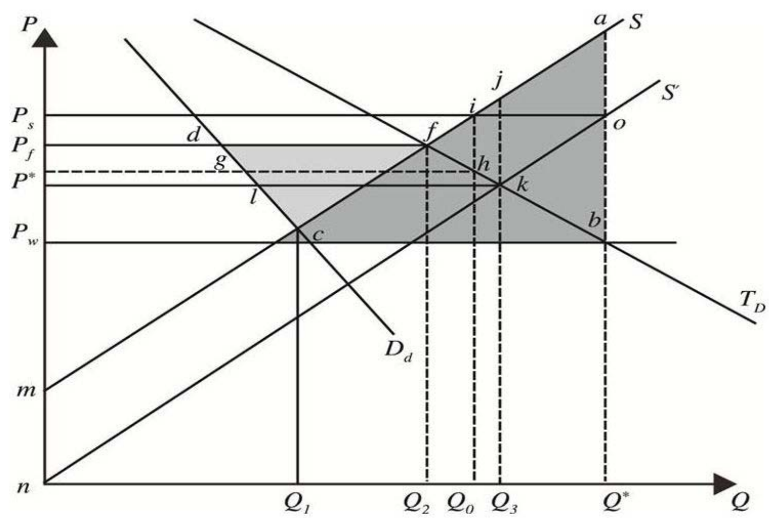


Figure 8 Multiplicative effects of water subsidy and cotton price supports: the ME model.

Source: Schmitz et al. (2010)

Under the multiplicative effects (ME) scenario given, the support price for cotton is P_s, the water-subsidized supply curve is *S′*, output quantity is Q^*, and the world price is P_w. Domestic producers receive ($P_s\ P_f$ *fmno*) as a net gain, while domestic consumers gain ($P_f\ P_w$ *cd*). Also, (*dcbf*) is referred to as slippage, representing rents received by importing countries. The cost to the government for the input subsidy is (*mnoa*), while the cost of the government price support payments equals ($P_s\ P_w$ *bo*). Therefore, the combined net domestic cost to society of the two subsidies applied together is (*dcbaf*). The net cost comparison is made with reference to point *f*, where P_f and Q_2 are free from distortions.

In this model, the relative magnitude and distribution of the rents depends largely on the demand and supply elasticities, the amount of exports, and the per unit cost of the water subsidy. For example, the more elastic the supply, the greater is the deadweight loss; also the higher the proportion of domestic production that is exported, the greater the net cost of the combined subsidies. Using this model framework, Schmitz, Schmitz, and Dumas (1997) theoretically and empirically show for U.S. cotton the existence of negative gains from trade.

For the theoretical ME model, depicted in Figure 8, domestic cotton producers gain more rents from the water subsidy (*mnoi*) than from the price support payments ($P_s P_f fi$) although the majority of the price support payments from the government go to domestic consumers ($P_f P_w cd$) and to foreign countries (*dcbf*), rather than to producers. However, the actual distribution of these rents is an empirical matter that illustrates how parameter changes affect the calculation and distribution of the subsidy rents and welfare losses. A combination of the two subsidies distorts output more than when each acts alone, causing the multiplicative effects of the two instruments to be greater than a mere summation of the individual effects. For example, looking at Figure 8, the production quantity Q^* is established where the target price P_s intersects the input-subsidized supply curve *S′* at point *o* instead of at point *i* (associated with quantity Q_0), given only a price support. Thus, adding the water input subsidy to the price support increases production from Q_0 to Q^*. In addition to increased output, there is a significant decrease in the world price as it falls to P_w. Both of these effects increase the size of the price support payments made by the government, and in conjunction with price supports, the aggregate size of the input subsidy is greater than it is in the absence of price supports.

Key points:

- The combination of price supports and input subsidies can lead to *negative gains from trade* (i.e., *dcf* < *dcbaf*).
- There are gainers and losers from domestic policy distortions. For example, importers and domestic producers gain at the expense of domestic taxpayers.
- The net gain from free trade for both importer and exporter (taken together) is (*afb*), which is much smaller than is the net welfare gain for the exporter, which is (*dcbaf*).

Supply Management and Border Controls

Certain models of trade have to consider import quotas and domestic production controls. This is true, for example, for Canadian supply management (Vercammen and Schmitz, 1992). Both policy instruments are modeled in Figure 9. Domestic demand is given by the curve D_0 and domestic supply is *S*. Under free trade, the domestic (border) price is P_b, domestic production is Q_1, and domestic consumption is Q_2. Imports total ($Q_2 - Q_1$).

Under supply management, imports are restricted to ($Q_2 - Q_1''$). Now domestic producers face the demand curve D'. For the domestic producers to maximize profits, the production quota is set where the marginal revenue curve MR equals the supply curve S, which results in domestic production Q_m. Producers gain ($P_eP_bea - ehi$). The quota value for any producers will be the discounted value of ($P_e - P_s$) per unit of quota. The total approximate quota value for the industry will be the discounted value of (P_eP_sha).

In Figure 9, consumers lose (P_eP_bdb) and importers gain ($aecb$). The availability of import quotas gives importers (many of whom are also domestic food retailers) incentives for rent-seeking behaviour because import quotas have value equal to [($P_e - P_b$)(Q'_1 - Q_m)], or ($aecb$). This value arises because importers buy the product at P_b and sell it in the domestic market at P_e. Canadian dairy producers challenged, in the courts, the right of importers to capture these rents; however, the decision ruled in favour of the importers. Combining triangle (bcd) plus triangle (ehi) in Figure 9 generates a DWL triangle that represents the welfare loss of the supply management program.

The impact of supply management depends in part on the level of the constraint placed on imports. The tighter the import control, the greater will be the welfare cost of supply management.

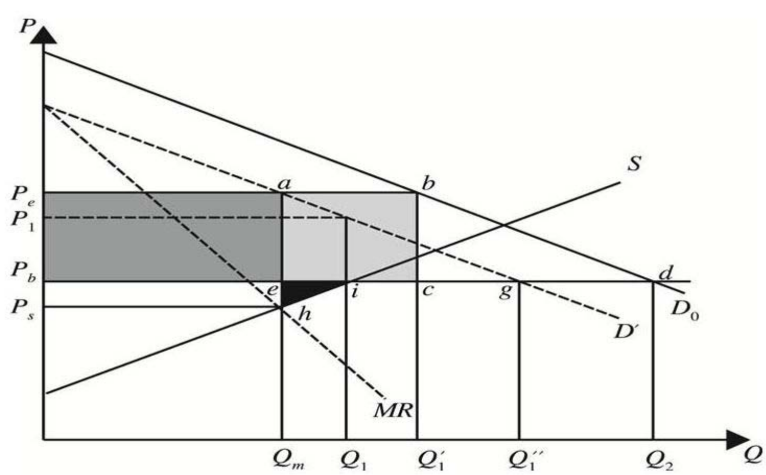


Figure 9 Model of supply management.

Source: Vercammen and Schmitz (1992)

Key points:

- Supply management can result in large welfare costs but needs not cause trade distortions. For example, in Figure 9 one could draw the demand curve D' through the point i, in which case supply management would not have a trade distortionary effect even though it would result in inefficiency losses.
- Because of the nature of demand and the allocation of the output to various markets, conflicts often arise between producers and industrial processors. We show that processors can gain from supply management. Unfortunately, in many trade models, the impacts of removing distortions focus only on producers and consumers and ignore processors and other players in the vertical marketing channel.

Biofuels

Direct production subsidies are not the only policy instruments that affect trade. For example, with U.S. ethanol production, even in the absence of price supports, trade is affected by indirect subsidies to corn producers via tax credits to ethanol processors. In this case, corn producers win while consumers lose, and the value of corn exports may decrease. From a general equilibrium context, one has to explore the welfare effects taking into account the cost of the subsidy and the impact of ethanol production on the overall fuel market. The study of the impact of ethanol tax credits clearly highlights the need to identify the gain to processors and other sectors beyond the farm gate. Many studies on trade estimate only the impact of a policy change on producers and consumers.

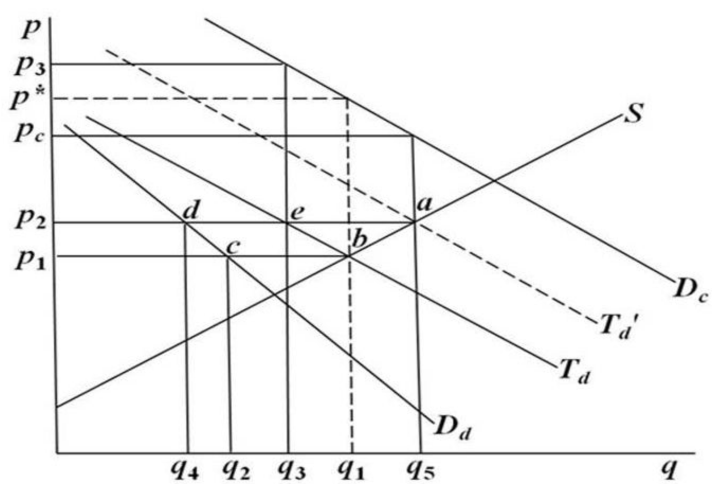


Figure 10 Biofuels.

In Figure 10, S is the supply curve for corn, and the derived demand curve for corn in the absence of ethanol production is given by T_d, where D_d is the domestic demand for corn. The farm price is given by p_1 and production of corn is q_1. The consumer price for corn products is p^*. Suppose now that the U.S. ethanol tax credit of \$0.56 per gallon to ethanol processors causes the total demand curve for corn to shift to T_d'. The corn price increases to p_2, and output increases to q_5. There is also a tariff on the imports of ethanol into the United States. This further adds to the incentive to use corn for ethanol production.

However, the food price for corn-containing products increases to p_3 as less corn is consumed as food. The amount of corn used for ethanol is ($q_5 - q_3$) or (ea). As a result of the tax credit for ethanol processors, corn producers gain (p_2p_1ba), while domestic consumers and corn importers lose (p_2p_1be). The change in corn export revenue is ($cq_2q_1b - dq_4q_3e$).

Figure 11 presents a more complex model where ethanol is produced from corn. For the U.S. corn market, S is the supply schedule and D_T is total demand. Given the loan rate under the 2002 Farm Security and Rural Investment Act, farmers receive a price of P_{LR} or each bushel of corn produced, yielding a total production of q_s bushels. Given a domestic demand curve of D_d and an export demand curve of D_e, the total demand curve is D_T.

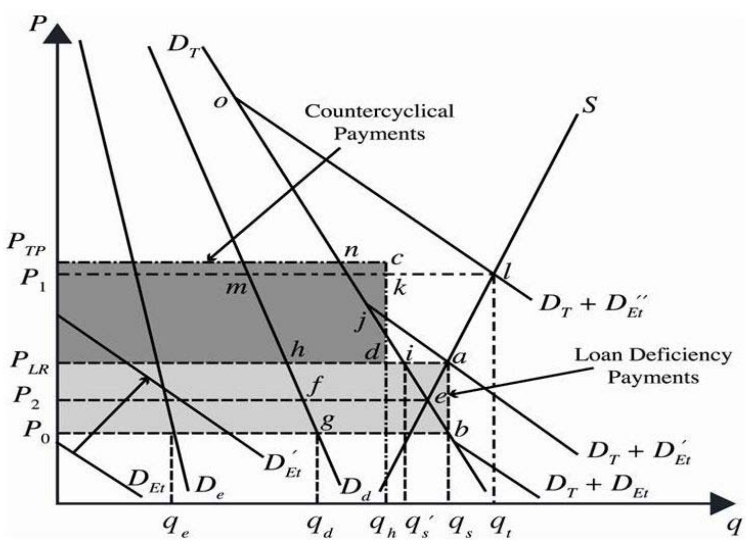


Figure 11 Ethanol effects: direct and indirect subsidies.

Source: Schmitz, Moss, and Schmitz (2007)

These demand curves result in a market clearing price of P_0. With this market clearing price, q_d is consumed domestically and q_e is exported. At this equilibrium, the loan deficiency payments paid to farmers based on the level of production are represented by the area ($P_{LR}abP_0$). In addition, farmers receive a countercyclical payment based on their historical level of production q_h (typically 85 percent of historical yields) and the target price (P_{TP}). Graphically, this payment is depicted by the area ($P_{TP}cdP_{LR}$). The net cost of the subsidy program from the U.S. perspective is ($aefgb$), of which ($efgb$) is a gain to importers (the *slippage* effect).

In this original equilibrium, we assume that the market clearing price (P_0) is less than the choke price for the derived demand curve for corn used to produce ethanol (D_{ET}). Thus, given the total demand curve of ($D_T + D_{ET}$), no ethanol is produced. Next, we assume that increases in the price of gasoline shift the derived demand for corn used to produce ethanol outward to D'_{ET}. This changes the shape of the total demand curve to ($D_T + D'_{ET}$). This rightward shift in the derived demand for corn from ethanol producers is sufficient to raise the equilibrium price of corn to the loan rate, eliminating the loan deficiency payments to farmers. Thus there are no direct subsidies based on production, but there are indirect subsidies to corn producers via ethanol tax credits.

Consider further the demand for corn derived from ethanol production. Starting from D'_{ET} (which assumes a fixed oil price), a sufficiently large increase in corn prices (above P_2) chokes off the demand for corn to produce ethanol. This point represents the corner solution in Figure 11. However, if one assumes an increase in oil prices for a given price of corn, the derived demand curve for corn shifts to the right.

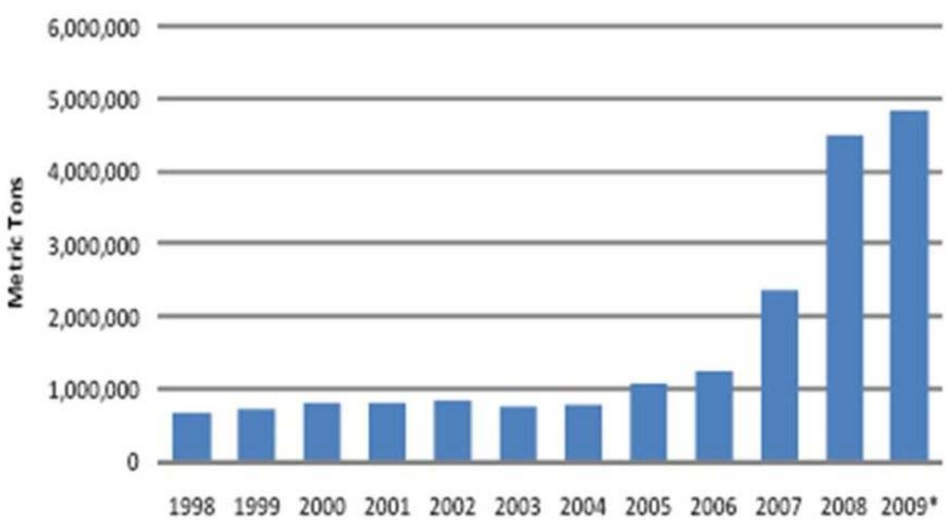
In the first case, we assume that producers are not impacted by ethanol demand even though corn prices rise. This is because the loan deficiency payments no longer exist (and the countercyclical payments remain unchanged). Also, an important result is derived from the observation that market clearing prices rise from P_0 to P_{LR}, causing both domestic and export demand to fall for those components making up demand D_T (the demand for corn for ethanol is q_s - q'_s). Domestic consumers now pay a higher price for corn and related products, given demand D_d. Likewise, foreign importers pay a higher price for the corn they import.

To further show the interrelationship between ethanol production and government payments to corn farmers, we assume that the derived demand for corn used to produce ethanol shifts farther outward to D''_T. This increased derived demand causes the total demand for corn to shift outward to ($D_T + D''_{ET}$), increasing the market equilibrium price to P_1 and the equilibrium quantity to q_t. Comparing this equilibrium with the equilibrium at the loan rate, producers gain ($P_1 laP_{LR}$). However, part of this gain ($P_1 kdP_{LR}$) is offset by reductions in the countercyclical payments to farmers. Thus the net producer gain is (*kdal*). This shift results in an economic loss to domestic consumers of ($P_1 mhP_{LR}$) and a loss to foreign consumers of (*mndh*). Completing the model, the economic gain for ethanol producers is the area (*onl*).

If the demand for ethanol shifts even farther to the right than D''_{ET}, all government payments (including countercyclical payments) are eliminated. Thus there is a direct linkage between the tax credit to ethanol and farm program payments.

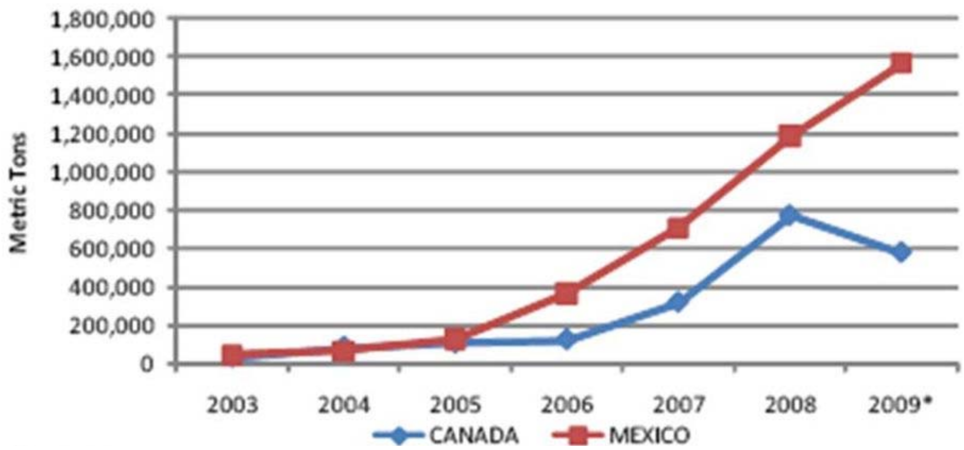
Since 2002, U.S. ethanol production has increased by an average of 26 percent per year, reaching nine billion gallons in 2008. As a byproduct of dry-mill ethanol production, distillers' grain (DG) production also increased rapidly, reaching approximately 20 million metric tons (million tonnes) in 2008 (Fox, 2009).

From 1995 to 2004, U.S. exports of DG averaged about 740,000 tonnes, ranging from 526,000 tonnes in 1996 to 842,000 tonnes in 2002 (Figure 12). Mexico and Canada accounted for approximately 43 percent of DG exports by the United States in 2007 and 2008. Canadian imports peaked in 2008 at roughly 800,000 tonnes, but fell to 600,000 in 2009 (Figure 13).



*Projected based on Jan-May
Source:USDA-FAS http://www.fas.usda.gov/ustrade/USTExHS10.aso?0/=

Figure 12 U.S. exports of DG, 1998–2009.



*Projected based on Jan-May
Source:USDA-FAS http://www.fas.usda.gov/ustrade/USTExHS10.aso?0I=

Figure 13 U.S. exports of DG to Canada and Mexico.

Key points:

- The analysis of production subsidies can be complex and difficult. In the ethanol case, one has to consider additional elements that are not easily captured in the corn market. One has to account for environmental impacts and for the value of distillers gain. Also, perhaps more importantly, general equilibrium effects have to be considered. For example, how does ethanol consumption affect the overall fuels market? As we show in Table 1 (of the main paper), the benefit-cost ratio for providing ethanol tax credits can be greater than one if ethanol has a positive price-depressing effect in the overall fuels market. Du and Hayes (2008) argue, for example, that the impact of ethanol on the fuels market can be quite large (between $0.29 and $0.40 per gallon) but many others disagree on an impact this large. Along the same lines, Zilberman et al. (2011) contend that fuel prices are impacted partly because the OPEC strategy of production controls is related to the U.S. ethanol policy.
- Government policy plays a key role in analysis. For example, net welfare gains increase when one takes into account the impact of ethanol production on the lowering of farm subsidies.
- While the domestic distortions created by subsidies can be significant, the impact of these subsidies on trade can be small indeed.
- In these models, while it is necessary to estimate the impact on ethanol producers such as Archer Daniels Midland (ADM), this can be an extremely difficult exercise, partly because of the proprietary nature of data on companies such as ADM.