Appendix B—Conceptual Framework and Simulation Model

This analysis extends the estimated results from the supply response model developed for the study to draw out the implications of marketing loans for dry peas and lentils on world prices and trade volume, using a simulation model adapted from Sumner (2005).

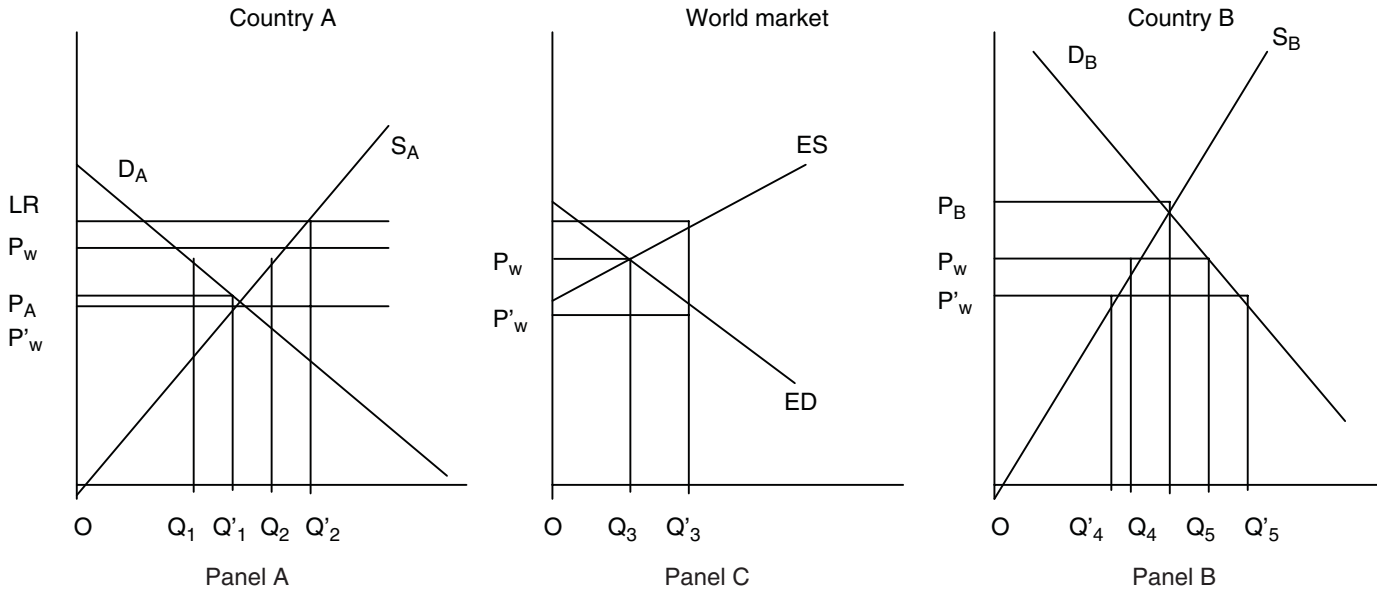
Conceptual Framework

The conceptual framework is a two-country, one-commodity trade mode (fig. B-1). Supply and demand functions for a particular commodity are represented in panel A for country A (the United States), in panel B for country B (the rest of the world (ROW)), and in panel C for the world market.[1] Let S_A and D_A be the supply and demand curves for dry peas or lentils in country A. Similarly, let S_B and D_B be the supply and demand curves in country B. In the absence of trade, the two markets clear prices at P_A and P_B, where the quantities supplied equals the quantities demanded. Trade of the commodity between the two countries without government intervention allows exportable supply of the commodity in country A to be shipped to country B, as the commodity price moves above P_A but below P_B. Excess supply in the world market is the horizontal difference between the supply and demand curves in country A as the commodity's price moves upward from P_A in country A. Similarly, excess demand is the horizontal difference between the demand and supply curves in country B as the price moves downward from P_B. The trading equilibrium is identified by the intersection of excess supply and excess demand curves, which yields the market clearing price of P_w. The volume of trade at this world price level equals the volume of export (Q_1Q_2), the difference between quantity supplied (OQ_2) and domestic use (OQ_1), in

[1]In some trade applications the relevant market is not the "world market" but a smaller region (Sumner; Schnepf and Womach). An obvious question is whether North America should be treated as a region separate from the ROW, especially if this study focuses on the trade impact exclusively on the Canadian pulse industry.

Figure B-1

The conceptual framework of a two-country, one-commodity trade model



country A. This trade volume also equals the volume of import (Q_4Q_5), the difference between quantity demanded (OQ_5) and quantity supplied (OQ_4), in country B. In the world market panel, this volume of trade is denoted by quantity OQ_3, where the export equals import.

Marketing loans for U.S. producers of dry peas and lentils have the potential to affect world prices and exports. The loan rate (LR) becomes the effective grower price when the expected grower price is below the loan rate, causing the supply curve in country A and the excess supply curve (ES) in the world market to become a kinked supply curve. A kink is also introduced in the excess supply curve at the loan rate level.

Under this market condition, where the expected grower price is below the loan rate, the quantity supplied in country A becomes OQ_2' up from the previous OQ_2. In the case of dry peas or lentils, this conceptual framework assumes that additional production induced by marketing loans for either dry peas or lentils would be channeled into export markets. The feed market of the U.S. dry pea industry is largely undeveloped and is likely to remain so until the industry can provide a consistent, sustainable supply of dry peas for feed mills. Additional production of lentils would be channeled into export markets, because lentils are primarily used as human food. As a result, the volume of exports increases from Q_1Q_2 to $Q_1Q'_2$—the sum of Q_1Q_2 and $Q_2Q'_2$—in country A and imports by country B also increase from Q_4Q_5 to $Q'_4Q'_5$—the sum of Q_4Q_5, Q'_4Q_4, and $Q_5Q'_5$. The world market is cleared at a new world price level (P'_w), where the quantity of excess supply (OQ'_3) intersects with the excess demand curve (ED), with a volume of trade at OQ'_3.

Simulation Model

The simulation model measures what the world price levels would have been if the marketing loan programs for dry peas and lentils, as they existed under the 2002 Farm Act, had been removed. While Sumner focuses on major grains and covers the whole array of government subsidies, the model in this study focuses on dry peas and lentils and is limited to marketing loans. Also, the impact of marketing loans on world price is derived from the expected grower price instead of from the realized market prices over recent years, which were treated in the Sumner study as though they were representative of future expectations. Finally, the supply price elasticity and the impact of marketing loans on U.S. exports, as obtained directly from results of the supply response model, are used to estimate the impacts on world prices and volume of trade on the world market.

Consider the supply and demand functions for dry peas or lentils in the United States and the rest of the world with the following general structure in logarithmic differential form:

(A-1) $\quad dlnS_u = \varepsilon_u\ (dlnEFP)$

(A-2) $\quad dlnD_u = \eta_u\ (dlnP)$

(A-3) $\quad dlnS_r = \varepsilon_r\ (dlnEP)$

(A-4) $\quad dlnD_r = \eta_r\ (dlnP)$

where Su and Sr are the supply curves in the United States and the rest of the world, respectively, and Du and Dr are the respective demand curves. EFP is the expected effective grower price facing U.S. growers of dry peas or lentils, which is the sum of the expected grower price and loan deficiency payment (LDP) or marketing loan gain (MLG) from the marketing loan when the expected grower price is lower than the loan rate. Otherwise, the expected grower price is EFP. Producers in the rest of the world respond only to the expected grower price (EPr) in the absence of a marketing loan program. Consumers (and buyers) in both the United States and the rest of the world respond to the market clearing price (P) in an otherwise largely free trade context.

Since EFP= EP_u + LDP when the expected grower price is below loan rate, this implies that:

(A-5) $$dlnEFP = \alpha\ dlnEPu + (1-\alpha)\ dlnLDP$$

Where: $\alpha = EP_u / (EP_u + LDP)$, and
$1-\alpha = LDP / (EP_u + LDP)$

The percentage change in the total supply of dry peas or lentils in the world market ($dlnS_w$) is the weighted percentage change in the supply in the United States and the rest of the world, that is,

(A-6) $$dlnS_w = \delta_{su} dlnS_u + (1- \delta_{su})\ dlnS_r$$

$$= \delta_{su}\ \varepsilon_u\ (dlnEFP) + (1- \delta_{su})\ \varepsilon_r\ (dlnEP_r)$$

$$= \delta_{su}\ \varepsilon_u\ (dlnEP_u) + \delta_{su}\ \varepsilon_u\ (dlnLDP) + (1- \delta_{su})\ \varepsilon_r\ (dlnEP_r)$$

where δ_u and $(1- \delta_u)$ are the share of U.S. and the rest of the world production of dry peas or lentils in the world market, respectively. Similarly, the percentage change in the total demand in the world market ($dlnD_w$) is the weighted percentage change in the demand in the United States and the rest of the world, that is,

(A-7) $$dlnD_w = \delta_{du}\ (dlnD_u) + (1 - \delta_{du})\ dlnDr$$

Substituting equations (A-2) and (A-4) into (A-7) yields:

(A-8) $$dlnD_w = \delta_{du}\ \eta_u\ dlnP + (1- \delta_{du})\ \eta_r\ dlnP$$

The percentage change in world price in the world market is determined by equating $dlnS_w = dlnD_w$, which is solved as:

(A-9) $$dlnP = [\ 1/ (\delta_{du}\ \eta_u + (1- \delta_{du})\ \eta_r\ ] \cdot [\ \delta_{su}\ \varepsilon_u\ \alpha\ dlnEP_u + \delta_{su}\ \varepsilon_u\ (1- \alpha) dlnLDP + (1-\delta_{su})\ \varepsilon_r\ dlnEPr]$$

However, since the U.S. dry pea or lentil industry is likely a price taker, the percentage change in the expected grower price would follow that of the world price, implying that:

(A-10) $$dlnEP_u = dlnEP_r = dlnP$$

Setting $dlnS_w = dlnD_w$, the percentage change in the world price if marketing loan for dry peas or lentils in the United States is removed (that is, dlnLDP = - 1) becomes:

$$(A\text{-}11) \qquad dlnP = -\left[\delta_{su}\, \varepsilon_u\, (1-\alpha) \right] / \left[\delta du\, \eta_u + (1-\delta_{du})\eta_r - \left[(\delta_{su}\, \varepsilon_u\, \alpha) + (1-\delta_{su})\varepsilon_r \right] \right]$$

Key parameter values assumed in deriving the percentage change in the world price resulting from the hypothetical removal of the marketing loan in the base scenario for the 2003 U.S. dry pea crop are:

ε_u = 0.28
ε_r = 0.28
δ_{su} = 5.7%
δ_{du} = 1.0%
α = 80%
$1-\alpha$ = 20%
η_u = -0.7
η_r = -0.7

Substituting these key parameter values into equation (A-11), the percentage change in the world price is estimated at 0.33 percent, meaning that world price of dry peas in the world market in 2003 would have increased by 0.33 percent if the U.S. marketing loan program had been removed. This finding suggests that the implementation of the dry pea marketing loan lowered the world price by 0.33 percent for the 2003 crop—a negligible impact. Critical factors behind this result include: (1) the small 5.7-percent share of U.S. dry pea production in the world market, (2) a modest 20-percent share of revenues from LDP, (3) an inelastic supply elasticity of 0.28, and (4) an inelastic demand price elasticity of -0.7.[2] Alternatively, marketing loans for dry peas are estimated to have lowered the world price by 0.55 percent if a smaller demand price elasticity (-0.3) is assumed. The impact of the marketing loan on the world price for lentils is of similar magnitude, although larger supply elasticity could exert a greater impact. However, the impacts are even smaller for the 2004 and 2005 dry pea crops and are virtually nil for the 2004 and 2005 lentil crops.

The future impact of the marketing loan program on the volume of exports depends on whether a U.S. feed market can be developed to absorb additional production of dry peas caused by marketing loans. The trade impact of increased U.S. exports would be particularly felt by Canadian pulse growers. Most of this volume would likely be transshipped through Canada from North Dakota and Montana due to transportation economics. The impact of marketing loans on the volume of U.S. exports would have been smaller in 2004 and 2005 and limited to a surplus induced by acreage expansion in North Dakota.

Additional production stimulated by marketing loans for lentils most likely would have been channeled to export markets because lentils are used primarily for food. However, the impact of marketing loans on exports was limited to that caused by acreage expansion in North Dakota and Montana in 2003. There were no such impacts from the 2004 and 2005 crops.

[2]If the appropriate U.S. supply elasticity turns out to be greater than that estimated over the study period, then the impact of marketing loans on the world price would be greater.