Trade Gains and Welfare Costs of Income Stabilization Programs for Hog Producers in Quebec

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The welfare costs of deficiency payments for an exported commodity may, under certain conditions, outweigh the gains from trade. The potential welfare impacts of stabilization programs in the hog sector in Quebec are estimated, based on a partial equilibrium framework, and elasticity estimates drawn from other sources. The results indicate that the loss in surplus in Quebec as a result of deficiency payments is very modest at approximately $8.5 million or 1.7% of the value of production. Meanwhile, the net gains from trade remain on the order of $14 million.

In this paper, the analytical framework described by Schmitz and Chambers was applied to evaluate the potential welfare effects flowing from the current stabilization programs supporting the hog sector in Quebec. The analysis focuses on the domestic impacts of these programs since, as indicated by Schmitz and Chambers, whether or not there are significant international implications associated with the use of support programs, there may be important domestic welfare costs of which policy makers should be aware.

Introduction

Price and income stabilization programs for farmers often contain a significant level of subsidization, and the consequent effects of these agricultural subsidies have been drawing increased attention, particularly in the context of trade relations. The focus of investigation is usually on the impact on the importing country and when injury is found, it may lead to retaliatory actions such as countervailing duties.

Recent examples of such actions in agricultural trade between Canada and the United States include the U.S. countervailing duty on imports of Canadian hogs (1985) and the Canadian duty on imports of U.S. corn (1986). In both cases, deficiency payments to producers

figured prominently as the primary form of subsidization. With regard to hogs, the U.S. Department of Commerce determined that the injury to U.S. pork producers from subsidized production in Canada warranted a countervailing duty of 4.39 cents (Canadian) per pound for live hogs.[1]

The precise effects of Canadian stabilization programs in the hog sector have been the subject of ongoing dispute. In the case of Canada-U.S. trade in hogs, Gilmour and Cluff argued that the determination of injury was based on incorrect analysis and demonstrated that the impact of Canadian stabilization programs was likely much less than estimated by the U.S. Department of Commerce (Grimes). Analysis by Martin and Goddard supports the contention that stabilization programs have had little influence on production levels, and therefore, on Canadian exports of hogs and pork to the U.S. This conclusion is also supported by Churches who could not find empirical evidence linking stabilization programs and regional hog supply in Canada.

Similarly, Rowsell and Kenyon found that Canadian hog production was affected more by the administration of supply management programs in dairy and poultry and that increased exports to the U.S. have been mostly due to favourable exchange rates. However, it

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may be a mistake to place too much emphasis on the role of exchange rates. Both Chadee and Coleman and Meilke have suggested that the exchange rate effect was relatively minor, since the effects of the devaluation of feed prices was proportionately greater than on hog or pork prices, thus attenuating the exchange rate impacts on production and exports.

Besides the question of injury to the importing country, another aspect to be considered in the analysis of the impact of these programs is the welfare gains and losses within the country or region of origin when the commodity in question is exported. Assuming there is some effect on production, the impacts on exports could nevertheless be minor relative to the domestic impacts. Schmitz and Chambers demonstrated that the welfare costs flowing from the introduction of a deficiency payment for an exported commodity, under certain conditions, can outweigh the gains from trade in that commodity. When there is a large difference between a support price and the market price in the presence of elastic domestic supply, a country with an open economy could be better off by abandoning trade in that commodity.

This result is particularly relevant when the direct costs of deficiency payment programs are large, for even though policy makers may be reluctant to abandon such programs, they should be aware of their potential welfare and trade implications, beyond their simple fiscal consequences.

Pork Production, Trade and Stabilization in Quebec

Pork production in Quebec has doubled since the mid-seventies, bringing the Province from a deficit position to a point where more than one-third of output is now surplus to provincial needs (Table 1). Most of this surplus is exported to the United States and Japan, representing approximately 50% of total Canadian exports to these markets. The balance of the surplus (perhaps up to 20%) presumably flows to other parts of Canada.

Much of the expansion of pork production, which reached a peak in 1981, occurred prior to the establishment of provincial stabilization programs and may therefore be attributed to market forces such as low feed costs relative to pork prices, low real interest rates, and high unemployment (low opportunity cost for

labour). As previously noted (Rowsell and Kenyon), supply managment policies that restricted the expansion of dairy and poultry production also contributed.[2] Owen identifies this limitation as possibly the most important factor. Other contributing factors were the high degree of vertical integration by feed companies, interest rate subsidies, and ease of access to credit through government sources.

However, even before production reached its peak, market conditions had begun to change. Rising production costs and declining prices contributed to a squeeze of producer incomes, triggering stabilization programs which had already been established but had been relatively idle.[3]

In 1978, the Quebec Government introduced an income stabilization plan for piglets, followed in 1981 by a plan for market hogs. In both cases, producer participation in these plans has been voluntary, but requires a commitment for five years. Moreover, producers pay a fee to be eligible for benefits, with government committed to contribute two dollars for each dollar contributed by producers.

Under these plans, deficiency payments are made to participating producers when annual average market prices fall below estimated production costs, based on a representative farm production model. The history of producer participation, contributions and compensation under these plans is summarized in Table 2.

The program is designed to have no pre-announced target price as such, so as production decisions are being made, producers are uncertain whether there will be a payment. Although they might be able to form a reasonable conjecture of the effective floor price that the program provides, any payments under these programs are made in the year following the period in which the majority of piglets or hogs are marketed.

The same principle applies to the federal stabilization program under the Agricultural Stabilization Act, through which payments are triggered when average current market prices

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[2] Indeed, the early expansion of pork production in Quebec began shortly after a federal government decision to reduce industrial milk production by cutting quota. This decision was particularly painful for Quebec agriculture where nearly half the total industrial milk production occurs.

[3] For example, pork stabilization payments under the amended Federal Agricultural Stabilization Act occurred only five times from 1975 to 1986, three of which were since 1980.

Table 1.   Quebec Production, Consumption, Exports and Prices, 1976–85

Year	Pro- duction	Con- sumption	Estimated Net Exports	Market Price	Net Stabili- zation	Support Price	Year Received
	— — — — — (000) tonnes — — — — — —			— — — — — — — — $(1981) Cdn/cwt — — — — — — — —			
	(a)	(b)	(c)	(d)	(e)	(f)	(g)
1976	138.7	156.5	(17.8)	101.21	—	79.94	—
1977	155.2	157.7	(2.5)	86.61	—	77.78	—
1978	191.1	163.3	27.8	93.59	—	72.72	—
1979	238.2	184.1	54.1	78.75	5.23	83.98	—
1980	293.3	199.9	93.4	63.77	6.65	70.42	69.00
1981	309.3	193.8	115.5	68.57	3.82	72.39	75.22
1982	301.7	180.4	121.3	73.64	(1.01)	67.82	77.46
1983	295.6	186.5	109.1	60.37	15.20	75.57	59.36
1984	306.3	182.7	123.6	59.40	3.73	63.13	74.60
1985	286.4	187.7	98.8	53.86	4.04	57.90	57.59
Average							
1976–80	203.3	172.3	31.0	84.79	2.38	76.97	—
1981–85	300.0	186.2	113.7	63.17	5.16	67.94	68.85

(a) Data for 1976–83 are from Owen (1984). 1984–85 are estimated by inspected slaughter plus net exports of live hogs times average trimmed carcass weight of 61 kg (135 lbs.).

(b) Estimates based on average per capita consumption for Canada times Quebec population.

(c) Based on production (a) minus consumption (b).

(d) Market prices are those reported for index 100 hogs at Montreal until 1982 and Toronto prices thereafter (since Montreal series was discontinued) deflated by the consumer price index, 1981 = 100.

(e) Net Stabilization payments are calculated in the following manner:
  i) payments net of producer premiums under the Quebec piglet program in $ per piglet, multiplied by 0.5 to reflect the approximate proportion of production eligible for both Quebec programs (i.e., farrow-to-finish operations), divided by 1.7 (hundredweight per market hog) to convert to per cwt., plus
  ii) net stabilization payment to producers under the Quebec market hog program ($/cwt.), plus
  iii) federal stabilization payments to Quebec producers, not participating in the provincial program, in $ per cwt. (i.e., total payments divided by hundredweight of pork produced, and the Consumer Price Index (1981 = 100). All amounts for year t are based on payments made in year t + 1).

(f) Support prices for 1976–78 are those calculated under the federal program; from 1979 forward, support prices are calculated as market price in year t plus net stabilization payment in year t (i.e., $FY_{t,t+1}$)

(g) Support prices calculated for year received treats stabilization payment as part of the price in the year in which it was actually received. Hence, in this way, support in year t equals market price in year t plus net stabilization payment in year (t − 1) in column (e).

fall below 90% of the most recent 5-year moving price, adjusted for inflation in the cash costs of production. Although calculations of support levels and payments (if any) are now made on a quarterly basis, much of the actual compensation has been distributed at least a year after the marketings occurred.

Since 1981, under the federal program, which now applies only to the domestic portion of total production, Quebec producers have recieved payments totalling nearly $17 million (70 cents per hog marketed). Producers are not eligible for the benefits of both the Provincial and Federal programs.

Given the uncertain nature and delayed payment feature of these programs, and the fact that support levels are based on some portion of production costs or historical price levels, it might be argued that they are unlikely to un-duly influence production levels and, by definition, cannot exceed long run equilibrium prices. However considering the fact that payments were made, from one program or another in six years of the past seven, their trade and welfare effects might be questioned on the basis that these programs have now become part of producer expectations. Market and estimated support prices since 1976 are shown in Figure 1.

Methodology

According to the partial equilibrium model developed by Schmitz and Chambers (1986), the critical determinants of trade gains and welfare losses resulting from deficiency payments in an exporting country are the level of sub-

Table 2.   Income Stabilization Insurance Participation and Payments in Quebec

Program and Year	No. of Producers Covered	Producer Contri- bution	No. of Animals Insured	% of Hogs Marketed	Compensation Paid Gross Total	Net Total	Net Per CWT Produced
		($ Million)	(000 head)	(%)	($ Million)		($ cwt.)
	(a)	(b)	(c)	(d)	(e)	(f)	
Piglet Program							
1978–79	246	—	—	—	—	—	—
79–80	783	0.70	1,190	30	7,773	7,073	1.34
80–81	1,498	2.05	2,788	58	7,422	5.372	0.83
81–82	1,491	2.43	2,947	60	2,433	0	0
82–83	1,405	2.30	3,035	64	0	(2.300)	(0.34)
83–84	1,759	2.88	3,500	75	29,254	26.374	4.04
84–85	1,788	4.91	3,626	73	24,986	20.076	2.99
85–86	2,121	8.05	4,149	89	19,044	10.944	1.74
86–87	2,187	10.00	4,250	na	0	10.000	na
Market Hogs							
1981–82	817	1.48	1,484	30	11,188	9,704	1.42
82–83	921	2.67	1,780	38	0	(2.670)	(0.40)
83–84	1,270	3.17	2,115	45	51,046	47.873	7.33
84–85	1,567	10.82	2,704	54	24,416	13.601	2.02
85–86	1,804	13.32	3,331	71	36,140	22.817	3.62
86–87	1,882	13.68	3,420	na	0	(13.679)	na

Source: Regie Des Assurances Agricoles du Quebec, Annual Reports and Other Documents

(a) This represents producers participating in the program.

(b) Based on premiums ranging from $8 per sow in 1978 to $40 per sow in 1986 for the piglet program and $1.00 per hog (1981) to $4 per hog (1986) in the market hog program.

(c) Estimates based on the following calculations:
Piglet Program—Producer contribution divided by premium rate per sow multiplied by assumed annual production of 17 piglets per sow;
Market Hogs—Producer contributions divided by the premium rate per hog.

(d) Data in column (c) as percentage of total hogs marketed.

(e) Total compensation paid to producers.

(f) Compensation paid (col. (e)) minus producer contributions (col. (b)).

sidization of the commodity and the price elasticities of supply and demand in both the exporting and importing regions. This model is illustrated in Figure 2.

Figure 2-A represents the market in the exporting region (Quebec) and Figure 2-B, the external market consisting of Quebec's export supply function (ESx), and the excess demand function (EDm) of the importing regions. In the absence of trade distortions, and ignoring transfer costs, the equilibrium price is established at Pf, with quantity FG traded. At this point, consumer surplus in the exporting region is represented by the area AFPf and producer surplus by the area HGPf. The area FGI represents the trade surplus, or net gain from trade, in the sense of a quasi-rent larger than the consumer loss from engaging in trade.

If a deficiency payment is introduced, such that the support price Ps is above the free market equilibrium price Pf, the domestic supply curve now becomes SxBQs'.[4] There is still some debate regarding how producers would actually view this support payment, but if it is assumed that they can correctly anticipate it and regard it as establishing a floor price, then this methodology can be interpreted as establishing an upper bound on the welfare impacts of such payments. In this case, the quantity supplied increases from Qs to Qs', requiring the price to drop to Po in order to clear the market. In the international market (Figure 2-B), this has the effect of transforming the excess supply function to the kinked curve represented by NMESx, with the segment below M corresponding to the new, perfectly inelastic portion of the domestic supply curve in the exporting region. Trade expands to the quantity EC.

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[4] This presumes that producers know the stabilized price and regard it as a floor price.
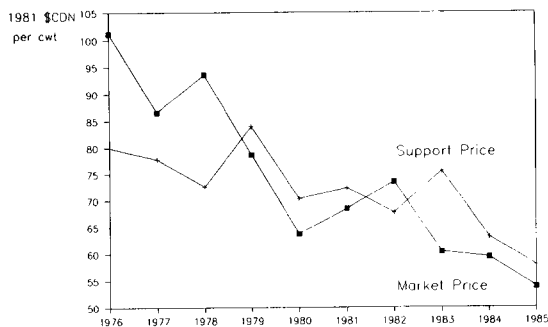
Figure 1. Comparison of Market and Estimated Support Prices for Hogs in Quebec, 1976–85

In looking for gains and losses resulting from the deficiency payment, first consider producer surplus in the exporting region. Under the program, producer surplus expands to the area HBPs. The increase over the original position corresponds to the area bounded by PfGBPs. Consumers in the exporting region also gain; consumer surplus increases to the area AEPo. This reflects the increased volume

purchased by domestic consumers at the reduced market price resulting from the deficiency payment program. In this case, the amount of gain, compared to free trade, is represented by the area PfFEPo.

Unfortunately, in this case, the expenditure by the government on the deficiency payment (area PsBCPo) is greater than the combined increase in consumer and producer welfare. Thus, there is a net loss in economic surplus from the exporting region corresponding to the area FGBCE. As noted by Schmitz and Chambers, this net loss is composed of the loss in trade surplus (FGDE) resulting from a lower price without reduced costs, and the efficiency loss (BCD) associated with producing that portion of output for which marginal costs exceed marginal revenue.

Schmitz and Chambers also decompose the total deficiency payment (PsBCPo) into what they identify as a pure export subsidy (TBCE) and a domestic consumer subsidy (PsTEPo). In their construction, this export subsidy exceeds the domestic subsidy, which they interpret as indicating that economic surplus is transferred to the importing regions. In fact,
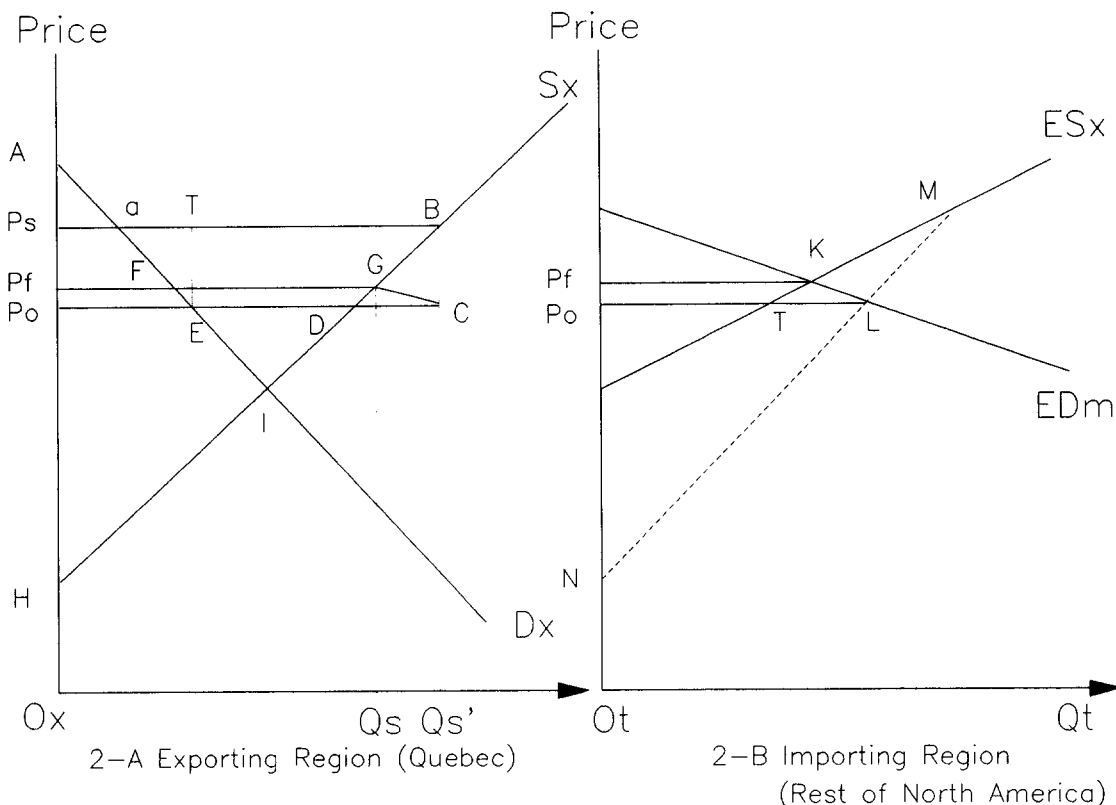
Figure 2. Effects of Stabilization Subsidies on Trade and Welfare

the surplus transferred is equal to the area PfKLPo (Figure 2-B) which is not directly related to the relative sizes of the above subsidies. To illustrate, while keeping the rest of the figure in its place, imagine shifting the ordinate in Figure 2-A to the left, so that the size of the domestic market expands relative to the quantity of product exported. In this way, the size of the domestic subsidy can be made as large as desired without affecting the size of the welfare transfers.

Alternatively, the transferred surplus can be related to the loss in trade surplus (FGDE) which is equal in area to the trapezoid PfKTPo in the importing market, and a remainder (TLK) which is equal in area to the triangle GCD which represents part of the domestic efficiency loss (BCD). The difference in these last two areas (GCB) represents the actual deadweight loss resulting from the subsidy. Schmitz and Chambers (page 39) refer to the larger area FGBCE as a ''deadweight loss'', but it is GCB that is deadweight in the sense of a net loss of welfare, taking both trading regions into account.

Thus, although the subsidy increases domestic consumer and producer surplus, there is also net loss of economic surplus by the exporting region, part of which is captured by the importing region, with the remainder representing a deadweight welfare loss.

This framework was applied to the income stabilization insurance programs for pork production in Quebec using data drawn from this sector for the period 1981–85, (Table 1). The monetary data in this table and the results are all expressed in constant 1981 dollars. Several simplifying assumptions are applied to this analysis. First, although producers participate in either the provincial or the federal program, it was assumed that all producers receive the average payment, net of producer premiums, for the two programs taken together, (column e, Table 1). It was also assumed that stabilization payments are viewed by producers as part of the market return, (i.e. a component of price); finally, rather than attempt to estimate the supply and demand elasticities, these were based on other studies with the aim of being as realistic as possible.

Using these elasticities, supply, demand, and import demand were derived as linear functions, using data averaged over the period 1981–85 and again for 1983, a year during which the subsidy was particularly high. In Figure 2-A, points B and E are known and

using the assumed elasticities, the demand, supply and excess supply curves can be generated.[5] Point L and the assumed import demand elasticity are used to generate the import demand curve.

In order to test the sensitivity of the results to the elasticities used, various values were assumed for both the exporting region (Quebec), and the importing region, represented by the U.S. The elasticities utilized in this analysis were based on estimates provided by previous research. Gilmour and Cluff utilize estimates of Canadian long run supply of 0.4 and demand of -0.85. Given the specialized and capital intensive nature of hog production in Quebec, supply is likely to be somewhat less price elastic than in the major grain producing areas of North America where more production alternatives exist. An estimate of 0.3 for Quebec was provided by Agriculture Canada. Other recent estimates include Churches (0.2, short run for Quebec), and Coleman and Meilke (0.10, 0.28) (short run, long run, for eastern Canada). Martin and Goddard estimated price flexibilities of the U.S. price with respect to Canadian exports that suggest import demand elasticities ranging from -3.3 to -8.3.

Results

According to the results in Table 3, (all expressed in constant $1981) it is evident from this simple analysis that the welfare costs associated with these stabilization programs are not very large, especially when placed in the context of the value of production or exports. The maximum calculated loss of surplus to Quebec (BCD + FGDE) as a result of the deficiency payments was approximately $8.5 million, for the year 1983. By comparison, production had a value on the order of $500 million and exports about one third of this amount. This means that the maximum loss of surplus to Quebec would represent about 1.7% of the value of production or about 5% of the value of exports. Meanwhile the net gains from trade (EDI-BCD) are still positive and are on the order of at least $14 million.

The results are sensitive to changes in the

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[5] For example, using the 1981–85 averages, point B represents production of 300 thousand tonnes at a support price of $67.94 per cwt. point E corresponds to consumption of 186.2 thousand tonnes at the market price of $63.17/cwt, and point L corresponds to 113.7 thousand tonnes of exports at the same market price.

Table 3.   Welfare and Trade Implications of Hog Stabilization in Quebec

| Year	US Import Elast.	Quebec Supply Elast.	Production Subsidy Cost (BCD)	Remaining Gross Trade Gain (EDI)	Net Trade Gains (EDI–BCD)	Lost Trade Surplus (FGDE)	Dead-weight Loss (GBC)
1981–85				$(1981) Million Canadian			
(average)	3.3	0.3	0.464	30.304	29.840	1.753	0.404
	8.3	0.3	0.464	30.304	29.840	0.919	0.432
	3.3	0.4	0.619	26.138	25.519	2.202	0.516
	8.3	0.4	0.619	26.138	25.519	1.174	0.563
1983							
	3.3	0.3	2.982	22.301	19.319	3.697	2.635
	8.3	0.3	2.982	22.301	19.319	1.917	2.799
	3.3	0.4	3.976	17.795	13.819	4.522	3.382
	8.3	0.4	3.976	17.795	13.819	2.363	3.657

elasticities assumed and the general direction of effects is indicated by Figures 3 through 5. Like the results of Schmitz and Chambers, as the Quebec elasticity of supply increases, so does the net loss of surplus (BCD + FGDE), and the deadweight loss (GBC) in the exporting region. This is indicated by the results in Table 3, but is further illustrated in Figure 3 which shows the response of these two measures to changes in the domestic supply elasticity, over the range of 0.1 to 3.0, for the two alternate import demand elasticities used in Table 3.

Increasing the elasticity of supply also results in a decrease in the net gain from engaging in trade. Over the range of supply elasticities for Quebec which could be considered plausible, (perhaps 0.1 to 1.5) the net gains

from trade decay by about 90%. Although the net gain from trade is shown to be sensitive to the elasticity of supply, from the policy point of view a result that is perhaps more interesting is that the net gain from trade falls to zero at the point that the Quebec supply elasticity reaches 2.1, as shown in Figure 4.[6] This point is independent of the assumed elasticity of import demand, but it is influenced by the domestic elasticity of demand. As domestic demand becomes more elastic, the point at which net gains from trade reaches zero declines but the relationship is not dramatic.

The data in Table 3 also indicate that as the import demand elasticity increases, the net loss of economic surplus (FGBCE) in Quebec decreases, but the deadweight loss increases.
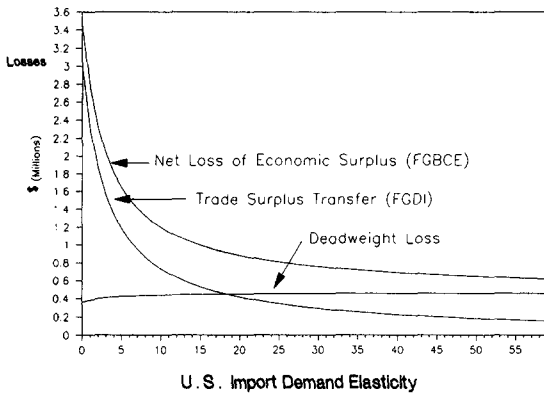
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[6] This is based on 1981–85 average market data with the import demand elasticity set at −8.3.
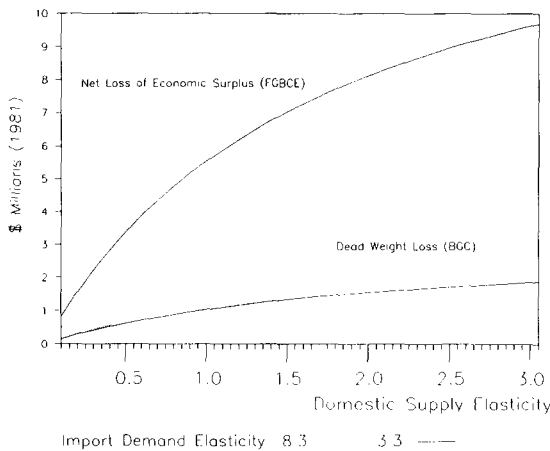
Figure 3.   Sensitivity of Deadweight and Surplus Losses to Assumed Domestic Supply and Import Demand Elasticities
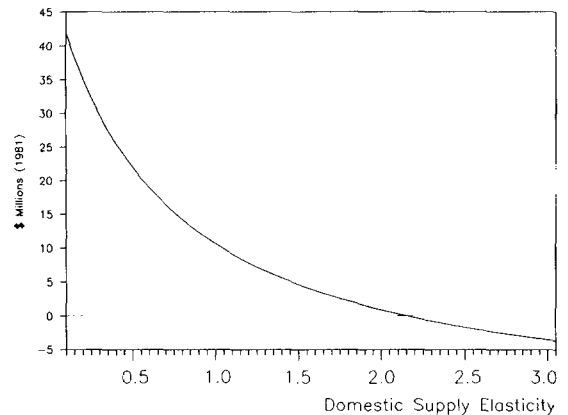
Figure 4.   Sensitivity of Net Trade Gain to Assumed Domestic Supply Elasticity

Figure 5.　Welfare Transfers and Deadweight Losses

In order to give a greater appreciation of the sensitivity of these results to the chosen import demand elasticity, these measures, and the transfer of trade surplus (FGDE) were calculated over a range of import elasticities and are reported in Figure 5. As is evident from the figure, both the trade surplus transfer and the loss of surplus fall off quite rapidly as the import demand elasticity increases, but the deadweight loss is not greatly affected.

Conclusions

It has been argued that the domestic implications, in terms of trade gains and welfare and efficiency losses, from the subsidization of an exported commodity might, under some circumstances, be as important as the international price effects. This does not appear to be the situation in the case of hog stabilization in Quebec. By making use of the assumption that producers view the stabilization programs as establishing a price floor, this analysis provides estimates of the upper bounds of the welfare losses in the Quebec hog sector due to this form of subsidy.

When considering the loss of economic surplus from the use of such programs as compared to free trade, although the loss is sensitive to both the elasticities of domestic supply and import demand, the loss is relatively small over the plausible ranges which might be envisaged for these two parameters. Likewise,

the remaining net gains from engaging in trade are quite sensitive to the domestic elasticity of supply. However, the elasticity of supply would have to reach 2.1 before the benefits of trade would be erased. Thus, under present conditions, policy makers can be fairly certain that although there is a theoretical welfare cost to the use of deficiency payments in this sector, it is not substantial enough to offset the theoretical benefits of trade.

Similarly, unless the conditions of highly elastic export supply and import demand are met in other cases, the prospect of welfare losses through trade may not be a strong incentive for countries to reduce the level of stabilization.

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