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THE IMPACT OF GOVERNMENT INCENTIVES FOR BEEF PACKER ADOPTION OF BOXED BEEF PROCESSING TECHNOLOGY.

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ABSTRACT

A static synthetic simulation model illustrated the impact of government incentives to beef packer adoption of boxed beef processing technology in Canada. Adoption was modelled as a reduction in the marketing margin between the farm and retail level. Two options for assistance were compared. The first was a tax credit equal to the 7 % Goods and Services Tax charged on assets purchased for technology adoption. The second was a conditional grant equal to half the value of these assets. Total welfare was demonstrated to increase 2.4 %, or $132.3 million in Western Canada and 2.3 %, or $80.1 million in Eastern Canada. Western and Eastern cattle producer welfare increased slightly. Nationally, consumer welfare experienced small growth. Beef packers had the most significant welfare increase; nationally, this figure increased 6.6 %, or $ 208.2 million. The net present value for the tax credit option was $1,481 million over a 15 year period. The NPV for the conditional grant was $1,529 million over the same time frame. Returns such as this are hoped to be large enough to encourage technology adoption by beef packers. Once adoption occurs, the beef packing sector may provide enough stability to the domestic cattle market to allow the government to divorce itself from market stabilization programs.

In the last 20 years the North American beef industry has undergone radical change. A marked trend towards concentration of packing plants at the source of live cattle has occurred. This evolved as a cost saving measure since transportation costs are lower for beef than for cattle. Changes in the level of processing have also occurred. Boxed beef has become the major processing technology.

Many of these changes, however, have only occurred in the United States. With few exceptions, Canadian beef packers have retained the traditional carcass beef system of merchandising.

This paper shall assess the impact of boxed beef technology adoption by Canadian beef packers. A problem statement will put the current environment into historical perspective. Next, a theoretical framework will illustrate the impact of further processing technology adoption. Following this, will be a discussion of options for government assistance. A synthetic model of the North American beef market is then used to demonstrate the impact of this adoption on various market participants.

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PROBLEM STATEMENT

The Canadian beef processing sector has lagged behind its U.S. counterpart for sometime. From 1982 to 1991 Canadian beef packing plant numbers declined from 144 to 104, while fed and mature cattle slaughter volume declined from 3.3 to 2.4 million (Cranfield 1992 pp. 22-24). Concurrently, the four largest plants share of slaughter grew from 19.1 % to 35.9 % (Cranfield 1992 p. 29). Since the early to mid 1970's a similar trend has occurred in

the U.S. (Ward and Sersland 1986 pp 2-5).

Coinciding with increased U.S. slaughter plant concentration was a rise in the volume of beef marketed as boxed beef. In 1979, 43.5 % of all U.S. beef was boxed (Nelson 1985 p. 18); this figure has recently been estimated to be as high as 95 % (Townshend et al 1991 p.2-8).

By breaking carcasses into primal or subprimal cuts packers assume the role of a retail meat department; subsequently the value added by beef packers increases. Centralized beef processing also reduces labour requirements and improves processing efficiencies through labour specialization. Given that packer labour rates are generally lower than those at the retail level, a cost savings would accrue to retail stores through reduced meat room labour requirements. These savings are then bid into the price paid by retailers, thereby increasing the value of packer level beef processing activity.

In spite of the advantages of further processing, Canadian packers have been reluctant to adopt boxed beef technology. As of August 1992, only two Canadian plants were boxing beef on a consistent basis, while another was expanding to accommodate this process. This lack of responsiveness has limited Canadian packers contribution to the beef sector.

By adopting boxed beef technology, processors will have access to a larger market. This should result in more cattle being slaughtered domestically and an increase in exports of comparatively higher valued beef. This would serve to strengthen Canada's net agricultural trade position.

Packer reluctance to adopt further processing technology may be attributed to historically thin profit margins and declining domestic slaughter volumes. Combined, these factors have contributed to a long term situation of low returns to beef production and processing. By allowing for potentially higher returns through financially induced technology adoption, the government may contribute to growth and development in the Canadian beef industry,

To facilitate adoption, however, the risk of failure must be reduced. If packers have less to lose then they may be more willing to innovate, use new technology and pursue market opportunities. In this light, government can be used as a vehicle to bear risk and finance adoption.

A value added incentive/assistance program is proposed. This program is based on the premise that the amount of government assistance is dependant on the increase in revenue generated by further processing endeavours. This is appropriate intervention since most sectors of the market, including the government, would benefit.

THEORETICAL FRAMEWORK

The adoption of further processing technology (such as boxed beef technology) is a cost saving measuring on the part of the processor. This is typified by a reduction in the marketing margin between the farm and retail level. Processors marginal cost curve shifts down, and with it the retail beef supply curve.

As Fisher (1981 p.261) pointed out, perfectly elastic marketing input supply functions occur in industries with excess capacity. As this is the case in the beef sector, we expect technology adoption to also shift the marketing input supply curve down through reduced beef processing costs. This occurs since relatively lower cost processing level capital is replacing higher cost retail level labour. Consequently, the farm level demand curve shifts up and to the right.

In summary, the marketing input supply curve shift is expected to increase processor demand for inputs. However, the price of these inputs would fall by a greater percentage then the increase in demand (ie inelastic input demand). A smaller

marketing margin results, with the reduction bid into cattle prices as well as being passed along the marketing chain to the retail level. Cattle prices are expected to rise, retail beef prices should fall and domestic slaughter could increase.

Note that a shift in the marketing input supply curve is equivalent to an input demand shift resulting from technological change (Mullen et al 1988 p. 246). Either way, a smaller marketing margin results.

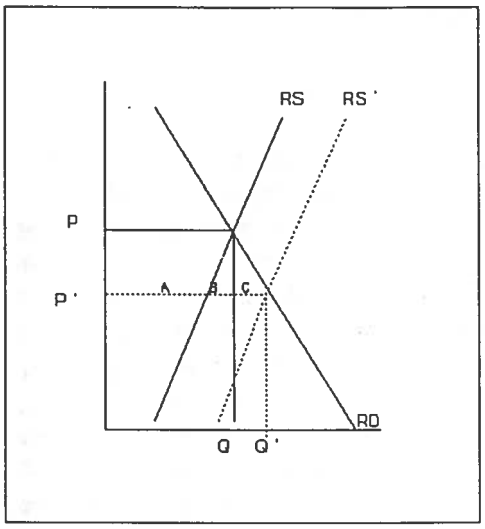

Figure 1 RETAIL LEVEL SUPPLY AND DEMAND

Holloway (1986) illustrated the welfare effects of a reduction in the marketing margin through derived supply and demand curve shifts. In figure 1, the change in consumer welfare is (A+B+C); figure 2 shows the change in producer welfare as (F+G+H) and in packer welfare as (D+E-F-A-B-C). The net change to society is (D+E+G+H). Therefore, consumers and producers benefit as will processors, provided that (D+E) is larger in size than (F+A+B+C).

The first option for government assistance is a one time tax credit based on the increased level of value added resulting

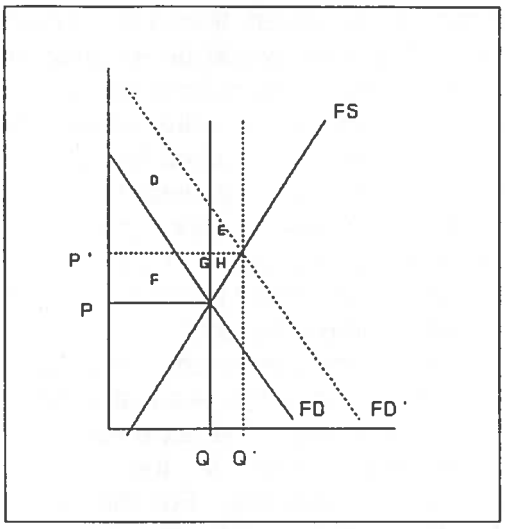

Figure 2 FARM LEVEL SUPPLY AND DEMAND

from the adoption of capital embodying new technology. In this case, the credit would be equivalent to the 7 % Goods and Services Tax (GST) charged against any land, equipment or facilities required to adopt further processing technology.

Approval for this credit must be granted prior to the purchase of these inputs; it is not retroactive. Additionally, the credit would only be given once a proven increase in value added was achieved. An obvious fault with this arrangement would be lost government tax revenue.

Therefore, a second alternative is proposed. Here, a joint venture would give beef packing firms access to government funding. Grants would be given on the same basis as in the tax credit scheme and for the same land, equipment and facilities. However, processors would be required to pay the grant back if certain conditions are met. Primarily, repayment would be linked to the increase in value added generated by this new technology.

If the packer reached an agreed upon target value added (TVA) then none of

the grant would be repaid. If a portion of the target was achieved, then a proportional amount of the grant would be returned and the government would absorb the loss. If there were no change in value added, then the packer would be required to repay the grant in its entirety. By undertaking this approach, the government assumes a portion of the projects risk. In doing so, the government might entice firms into pursuing further processing activities.

Aside from investment and program administration costs, the financial costs of the two options vary. The tax credit option has associated with it the loss of government tax revenue. For the second option, the government would not be remunerated if the firm achieved their TVA. For both options, the packing firm may have the cost of foregone revenue due to plant shut down if renovations were required.

In this framework, financial benefits are dispersed to packers, producers and consumers. Packers experience increased throughput which contributes to higher revenue. Producers benefit through higher live cattle prices, and consumers through lower retail beef prices. A change in the distribution of financial benefits to other members of the marketing chain also arises through increased cattle and beef marketing in Canada.

As well, since Canada is a net cattle exporter, increased farm level demand in an inelastic supply environment serves to reduce live cattle exports and increase beef exports as domestic beef supply would exceed domestic beef demand.

MODEL AND DATA

A static synthetic simulation model representing the North American cattle industry in 1989 was utilized to estimate retail and farm level equilibrium prices, quantities and net trade. Cattle production, processing and trade was endogenized for Western and Eastern Canada and the U.S.. Beef consumption and trade was endogenized at a national level for both countries. Net beef trade from Canada and the U.S. to the rest of the world was exogenous in the model. All prices were deflated by the respective Consumer Price Indexes and converted to Canadian dollars. Elasticities were obtained from regression results, and a previously constructed synthetic model (table 1).

ASSUMPTIONS

There are several key assumptions made in this analysis. First is that North American beef is a homogenous product. For simplicity, high quality beef is not distinguished from manufacturing beef. Second, processors do not discriminate between fed and mature cattle. Third, free entry and exit from the industry is allowed. Fourth, a reduction in the marketing margin is incorporated as a $7 CWT upward shift in the farm level demand curve. This value was obtained from Duewer and Nelson, who showed a $6 CWT (U.S.) difference between cattle prices paid by plants with slaughter only facilities and those with slaughter and processing technology (Duewer and Nelson 1991 pp. 38-40). Finally, adoption of further processing technology by beef packers forces a consolidation of the 122 cattle slaughter plants Canada had in 1989. Given that most Canadian plants are small and many are outdated (Townshend et al 1991 p.2-7) this last assumption is reasonable.

SIMULATION AND RESULTS

Results indicate that producer revenue in both Western and Eastern Canada increased by 0.13 %, while producer welfare rose by nearly 0.12 % in each region (table 3). Western cattle producer welfare grew by $2.01 million and Eastern producer

welfare by $1.21 million. These increases are consistent with a shift up and out of the derived demand curve.

Increased farm level demand for live cattle resulted in a larger domestic slaughter and reduced net live cattle exports. Net beef exports to the U.S. subsequently rose by 50 %, while increased domestic beef supply lowered retail prices by nearly 0.02 %. Growth in domestic beef disappearance was a consequence of this price movement. An outcome of the total domestic situation was a 0.03 % increase in consumer welfare; this is equivalent to $0.9 million.

As pointed out by Holloway (1986 p.9.), total welfare changes must be measured at one market level in a vertically related market. As specified earlier, area (D+E+G+H) in figure 2 measures such a change. Total welfare in this framework increased by 2.4 % in Western Canada and 2.3 % in Eastern Canada, or $132.3 million and $80.1 million respectively.

Packer welfare was shown earlier to equal the change in total welfare less the increase in producer and consumer welfare. Measuring consumer welfare nationally, but producer welfare regionally makes this calculation difficult. Nevertheless, total welfare net of producers share was $130.24 million for the West and $78.9 million in the East. Nationally, packer welfare increased by $208.2 million, or 6.6 %.

By treating the above packer welfare increase as an additional annual cash flow, we can calculate the present value of the increased return to fixed factors of production. A 10 % discount rate was assumed over a 15 year period. Given this, returns to beef processing at a national level would be $1,584 million higher over the 15 year period. Here, increased packer revenue and welfare stems from a higher level of value added generated at the packing plant.

In terms of costs, construction and renovation are the most significant. U.S.D.A. estimates have placed the total cost of a new slaughter/processing plant at approximately $12.9 million (Duewer and Nelson 1991 p.40.). Renovation costs to upgrade from a slaughter only to a slaughter/process facility have been placed at $0.7 million[1] (Duewer and Nelson 1991 pp. 30-32). Assuming that rationalization results in 7 new and 30 refurbished plants, then total plant costs would be as follows; $90.1 million for the 7 new plants and $20.6 million for the 30 renovated slaughter/processing plants.

Given these costs, the tax credit scheme would cost the government $6.3 million for 7 new plants and $1.4 million for 30 renovated plants. In total, this option could amount to $7.7 million.

For the conditional grants, the government provides $45.1 million for the construction of 7 new plants and $10.3 million for plant refurbishing, or $55.4 million in total. Assuming 100 % of all TVAs are reached, then none of this would be repaid (table 4).

Based on the above information, the net present value for each option can be determined by subtracting the construction and renovation costs from the additional 15 year cash flow of $1,584 million and then adding the government funding as a one time cash flow in year one. For the tax credit option, the NPV ends up being $1,481 million. Under the conditional grant option, the NPV would be $1,529 million. The latter assumes 100 % realization of the target value added.

With the difference between the two NPVs being 3 %, it would seem that the packing industry and government may be indifferent to which program is used. However, packers might prefer the conditional grant since it provides more funding in the short term. Quite naturally, one would assume that the government would prefer the tax credit scheme due to the smaller amount of money involved.

Nonetheless, it is important to realize that no matter what happens the cost of the

tax scheme will be known with certainty. The cost of the conditional grant option is uncertain. Therefore, decision makers need to exercise caution when evaluating the viability of such a program, even though it is the larger of the two incentives. After all, a situation exists where a larger tax credit, or some other form of tax benefit could be allowed. Additionally, it would be erroneous to ignore administrative costs of both options. This latter cost and the complexity of program delivery may in fact be the deciding factor as to which alternative was implemented

CONCLUSIONS

Irregardless of which delivery method is utilized, the impact of beef packer adoption of further processing technology is significant. This is reflected in increased packer welfare and revenue. This lends itself to increased resource allocation to more profitable beef packing enterprises. In addition, industry consolidation resulted. All of these factors serve to further strength the effect of boxed beef technology adoption.

Lower retail beef prices, combined with larger domestic beef disappearance was a direct consequence of further processing technologies. Resultant from the price and consumption movements, consumer welfare increased. Additionally, increased domestic slaughter meant reduced net exports of lower valued live cattle while net exports of higher valued beef increased.

The reduced marketing margin which accompanied processing technology adoption also benefited cattle producers. Domestic cattle prices were shown to have been bid up, while slaughter volume increased. This aids in stabilizing the domestic cattle market since Canadian beef packers would have to outbid their U.S. counterparts for Canadian cattle. This occurs since the cost of operating with excess capacity is typically larger than the cost of bidding up the price of cattle in order to maintain optimal levels of slaughter. It is therefore in the packers best interest to ensure an adequate supply of cattle.

Herein lies the additional benefit of this program. Once established, Canadian packers may provide enough stability in the domestic market to allow the federal government to divorce itself of market stabilization programs. In doing so, producers and packers benefit as a result of their own economic activities. Since market intervention is eliminated, or at least reduced, then the industry should become more responsive to market signals.

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APPENDIX 1

TABLE 1. ELASTICITIES OF SIMULATION MODEL PARAMETERS

ELASTICITY	CANADA	United States
BEEF DEMAND-OWN PRICE	-0.85	-1.0
BEEF DEMAND-INCOME	0.70	0.70
CATTLE SUPPLY-OWN PRICE	0.80	0.80
SLAUGHTER-RETAIL PRICE	0.223	0.223
SLAUGHTER-FARM PRICE	-0.29	-0.29
CANADA/U.S. RETAIL PRICE LINKAGE	0.82	
CANADA/U.S. FARM PRICE LINKAGE	0.6139	

TABLE 2. SIMULATION RESULTS

	CANADA	WESTERN CANADA	EASTERN CANADA	UNITED STATES
RETAIL BEEF PRICE				
BASE	4.03942			3.78311
SHOCK	4.03864			3.78222
BEEF DISAPPEARANCE				
BASE	978.93265			24179.88858
SHOCK	979.09449			24185.62396
NET BEEF TRADE				
BASE	30.01762			
SHOCK	45.11561			
STEER PRICE				
BASE		1.21592	1.29784	1.17524
SHOCK		1.21683	1.29881	1.17667
CATTLE SUPPLY				
BASE		2280.4361	1245.3319	33331.757
SHOCK		2281.7979	1246.0756	33364.767
CATTLE SLAUGHTER				
BASE		1831.1946	1110.3132	33916.017
SHOCK		1861.999	1127.7938	33902.263
NET CATTLE TRADE				
BASE		449.2415	135.0187	
SHOCK		419.7989	118.2818	

TABLE 3. REVENUE, EXPENDITURE AND WELFARE MEASUREMENTS

	CANADA	WESTERN CANADA	EASTERN CANADA	UNITED STATES
PRODUCER REVENUE				
BASE		876.31	510.79	26665.32
SHOCK		877.49	511.48	26723.7
		(0.13)	(0.13)	(0.22)
CONSUMER EXPENDITURE				
BASE	3954.32			91475.19
SHOCK	3954.21			91475.19
	(-0.003)			(0.00)
VALUE OF LIVE CATTLE TRADE				
BASE		172.63	55.38	
SHOCK		161.44	48.55	
		(-6.48)	(-12.34)	
VALUE OF BEEF TRADE				
BASE	121.25			
SHOCK	182.21			
	(50.3)			
TOTAL WELFARE GAIN		132.31	80.06	-4.44
PRODUCER WELFARE				
BASE		1663.70	969.74	23503.69
SHOCK		1665.77	970.95	23551.36
GAIN		2.07	1.21	47.67
PACKER WELFARE GAIN	208.2			-76.46
CONSUMER WELFARE				
BASE	3156.85			57275.75
SHOCK	3157.75			57300.12
GAIN	0.9			24.35

TABLE 4. COST TO GOVERNMENT OF THE TWO OPTIONS UNDER DIFFERENT LEVELS OF REALIZED TARGET VALUE ADDED

PERCENT OF TARGET	TAX REBATE	CONDITIONAL GRANT
0	0	0
25	1,937,551	13,839,656
50	3,875,103	27,679,313
75	5,812,655	41,518,970
100	7,750,207	55,358,627

APPENDIX 2

New plant construction costs:

- based on 75 head per hour line speed, working 40 hours a week, 2 shifts per day and a total annual slaughter capacity of 281,250 head of cattle

	$ (1981 U.S.)	$ (1981 CND)
LAND	199,200	164,201
FACILITIES	8,230,629	6,784,560
EQUIPMENT	7,188,907	5,925,862
TOTAL	15,618,736	12,874,625

Renovated plant costs:

- based on 10 head per hour line speed, working 36 hours a week, 2 shifts per day and a total annual slaughter capacity of 33,750 head of cattle.

	$ (1981 U.S.)	$ (1981 CND)
FACILITIES	429,520	354,056
EQUIPMENT	403,297	332,440
TOTAL	832,817	686,496