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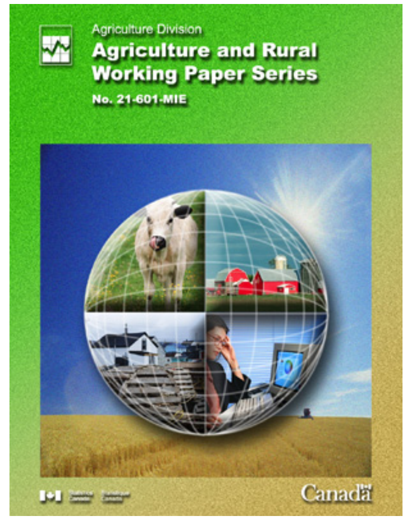
The Competitiveness of Canada's Poultry Processing Industry



by Hao Liu, John C. Henning, Paul J. Thomassin
and Laurie Baker

Agriculture Division
Jean Talon Building, 12th floor, Ottawa, K1A 0T6

Telephone: 1 800-465-1991

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Note of appreciation

Canada owes the success of its statistical system to a long standing partnership between Statistics Canada, the citizens of Canada, its businesses, governments and other institutions. Accurate and timely statistical information could not be produced without their continued cooperation and goodwill.

Abstract

Enhancing the competitiveness of a nation's industries is often a preoccupation of governments. This paper presents research carried out to determine the competitiveness of Canada's poultry processing industry and investigates the competitiveness of Canada's poultry processing industry from the perspective of output price, market structure, and productivity performance. The main objective of the research is to estimate the degree of competitiveness of Canada's poultry processing sector related to its U.S. counterpart during the ten-year period from 1991 to 2001.

Introduction

Global efforts to lower trade barriers among nations, and liberalize trade between nations, have long-term implications for the Canadian poultry industry which may face a potential import threat from poultry exporters such as the United States and Brazil. The Canadian supply managed system has however successfully functioned for more than 30 years and it has established enough credibility to maintain the status quo. Despite that, there is increasing pressure from other nations and from free trade agreements like NAFTA (Northern American Free Trade Agreement) and the WTO (World Trade Organization) to encourage governments' and policy-makers to re-think the current system.

The Canadian poultry production and processing sector is regulated by administrative rules. The poultry supply side is managed by the National Farm Products Council, which organizes the country's production and allocates production quota to each province, and the marketing board in each province allocates production quota to individual producers. Live birds are slaughtered and processed within the same province. Although some market signals from retailers and consumers exist, poultry production is prearranged by the marketing board. This causes some concerns of flexibility, production location, quality, price and coordination issues for poultry processors.

Compared to Canada's processors, U.S. processors control the supply system, a synchronized food supply chain that starts with the breeding birds. Large U.S. poultry processors have their own research labs to develop specialized breeds. The farmer only provides the production facility, buildings and labour, whereas chicks, feed, and veterinarian services are supplied by the processors. Although production contracts or vertical integration leave the U.S. farmer with very limited profit margins, much of the risk, product flows, flexibility and quality are borne by processors (Martinez 2002). In recent years, some large Canadian processors have become involved in live bird production. This trend reflects interest by processors to address perceived opportunities to take advantage of potential efficiencies in the supply chain.

Concept of Competitiveness

For most economists, productivity is an indicator of competitiveness. Productivity improvement can be achieved through economies of scale, quality of input factors, capacity utilization, production technology and internal and external linkages (Morrison 2000). In terms of management, competitiveness means lower cost and differentiated products and services (Porter 1985).

Flexibility, on-time delivery and premium price from product differentiation, are all sources of competitiveness (Chacko et al, 1997). From the resource-based theory, competitiveness can be interpreted as acquiring and accumulating super-productive resources. Such super-productive resources might be linked to knowledge, organization, creativity and innovation and other competitive advantages which are hard for competitors to imitate. McGrath et al (1996) state that a premium above the normal rate of return will enable a firm to compete against its rivals and accumulate resources. Under relentless competition, firms lacking the ability to earn extra premiums are doomed to operate at either their breakeven point or at a loss.

Value Added Comparison

Beyond the development of the competitiveness theory, a practical definition of competitiveness has been given by Martin and Stiefelmeyer (2001) as focusing on profitability, market share, and growth. Since profitability information is affected by different accounting methods and taxation systems, the value added ratio can be used to represent profitability. The data in Table 1 present the value added comparison information for Canada and the United States. The value added percentage, value added per wage dollar and value added per worker were all higher for the U.S. manufacturers than those in Canada in most years from 1990 to 1999. The growth rate was also higher for the U.S. manufacturers.

The compound growth rate of value added per worker (considered as labour productivity) in the United States was 6% per year compared to 3.8 % in Canada. From the value added percentage and value added per wage dollar measurement, the profitability of Canada's processors are seen to be less than the United States over that period.

Although the value added method provides a convenient way to compare industries in different countries, the different domestic pricing systems in Canada and the United States need to be taken into consideration when using value added ratios. In order to protect the Canadian quota system, functioning without import product interference, poultry imports have been limited to 7.5% of domestic production. This protection has enabled Canada's processors to sell poultry products at higher prices.

Table 2 illustrates the price gap between Canada and the United States with Canadian prices being higher than those in the United States. Table 3 provides a comparison between the two countries under the following assumptions: (1) for processors in Canada, the main input price, live birds, remains unchanged, and (2) the Canadian price - spreads (difference between farm gate price and wholesale price) adapt to the level of the United States.

Table 1. Profit measurement in Canada and in the United States in both Canadian and U.S. dollars

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Value added per sale	Canada*	29%	29%	28%	32%	32%	28%	31%	29%	30%	34%
	United States **	31%	30%	28%	30%	30%	36%	31%	38%	43%	44%
Value added per wage dollar	Canada*	1.85	1.80	1.68	2.01	2.08	1.71	1.97	1.86	1.99	2.16
	IPPI (Canada) (1997=100*)			92.7	94.7	89.8	89.4	99.1	100	98	94
	Canada deflated value*			1.81	2.12	2.32	1.91	1.99	1.86	2.03	2.30
	United States **	2.48	2.30	2.15	2.32	2.31	2.83	2.47	2.98	3.29	3.14
	PPI (U.S.) (1982=100**)	113.6	109.9	109.1	111.7	114.8	114.3	119.8	117.4	120.7	114.0
	US deflated value**	2.18	2.09	1.97	2.08	2.01	2.48	2.06	2.54	2.73	2.75
Value added per worker	Canada*	47.93	49.46	46.16	54.98	58.07	49.44	57.90	55.73	58.32	65.42
	IPPI (Canada) (1997=100*)			92.7	94.7	89.8	89.4	99.1	100	98	94
	Canada deflated value*			49.80	58.06	64.67	55.30	58.43	55.73	59.51	69.60
	United States **	36.49	34.14	34.35	37.35	38.54	48.19	43.13	53.88	61.78	62.14
	PPI (U.S.) (1982=100**)	113.6	109.9	109.1	111.7	114.8	114.3	119.8	117.4	120.7	114.0
	U.S. deflated value**	32.12	31.06	31.48	33.44	33.57	42.16	36.00	45.89	51.18	54.51

Source: Statistics Canada. Annual survey of Manufacturers and CANSIM Table 329-0038; U.S. Department of Commerce, Bureau of Labour Statistics, U.S. Department of Labour.

* calculated in Canadian dollars.
** calculated in U.S. dollars.

Table 2. Wholesale prices (cents/kilogram in Canadian dollars) in Quebec and 12 northeastern U.S. cities

	Chicken live weight price		Chicken eviscerated weight price		Chicken leg quarter price		Chicken wing price		Chicken bone in breast price		Turkey live weight price		Turkey eviscerated weight price	
	CAN	U.S.	CAN	U.S.	CAN	U.S.	CAN	U.S.	CAN	U.S.	CAN	U.S.	CAN	U.S.
	----- Canadian dollars, cents per kilogram -----													
1990	121	83		141		81		165		246	180	99	275	161
1991	117	78		131		74		148		227	170	95	276	156
1992	115	85	241	140	151	65	252	126		269	162	100	246	166
1993	116	98	251	157	150	72	256	132		285	164	111	257	175
1994	110	105	219	168	117	99	247	186		261	166	123	277	191
1995	110	105	225	171	120	110	262	224	361	258	167	124	267	184
1996	126	116	263	184	148	122	300	181	445	265	183	131	267	219
1997	126	113	258	180	141	96	274	203	426	262	182	122	277	210
1998	122	130	255	206	122	91	296	269	424	302	179	124	291	203
1999	115	120	236	190	107	61	258	216	365	266	172	133	315	187

Source: Agriculture and Agri-Food Canada, Poultry Industry-Statistics and ERS-USDA Poultry Yearbook 2001.

Table 3. Chicken price spread comparisons for whole birds

	Farm price (CAN$)	Canada actual price spread (CAN$)	Canada current wholesale price (CAN$)	U.S. price spread (US$)	U.S. price spread (CAN$)	Simulated price of Canada (CAN$)	Simulated to actual price as a percent (CAN$)	Price spread of U.S. to Canada as a percent (CAN$)
	(1)	(2)	(3) = (1) + (2)	(4)	(4)’	(5) = (1) +(4)’	(5) / (3)	(4)’ / (2)
1990	121.0			49.3	57.6	178.6		
1991	116.6			46.6	53.4	170.0		
1992	114.9	126.1	241.0	45.7	55.2	170.1	71%	44%
1993	116.4	134.6	251.0	45.8	59.0	175.4	70%	44%
1994	110.1	108.9	219.0	45.8	62.5	172.6	79%	57%
1995	109.6	115.7	225.3	47.8	65.7	175.3	78%	57%
1996	125.9	136.9	262.8	50.2	68.5	194.4	74%	50%
1997	126.3	131.2	257.5	48.3	66.8	193.1	75%	51%
1998	122.3	132.6	254.9	51.1	75.9	198.2	78%	57%
1999	114.7	121.5	236.2	47.0	69.9	184.6	78%	57%

Note: The price spread is calculated between live weight price and eviscerated price.
The price spread is calculated from price information in Quebec and 12 North-eastern U.S. cities.

Source: Agriculture and Agri-Food Canada. Poultry Industry-Statistics, ERS-USDA Poultry Yearbook 2001

The simulated price in Canada was created as the benchmark for comparison. The results show that the simulated price was much lower than the actual price. Therefore, the value added per worker and value added per wage dollar would be adjusted even lower than the current figures shown in Table 3. Above all, the adjusted value added comparison indicates that the Canadian processors had been outperformed by their U.S. counterparts.

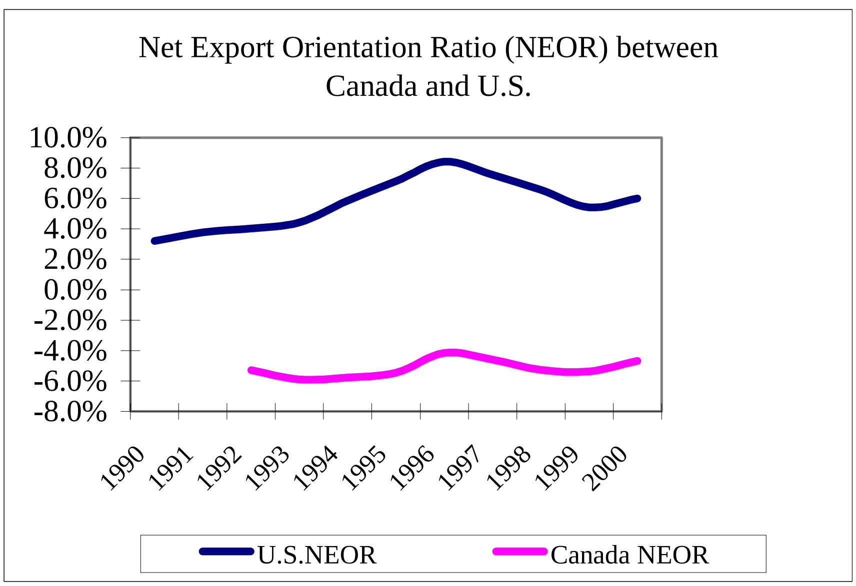
Because of import control policies, the use of market share as the competitiveness index will not reflect the real competitiveness for Canada's poultry processing industry. Figure 1 presents the Net Export Orientation Ratio (NEOR), which can be calculated from the following formula. Supply management and import controls result in this measure being negative in Canada.

Net Export Orientation Ratio (NEOR)

= (exports – imports) / total domestic

production

Figure 1. Net Export Orientation Ratio (NEOR) for Canada and the U.S.



Source: Statistics Canada and the U.S. Department of Commerce

Productivity Growth

One dimension of competitiveness is an industry's ability to remain competitive or to improve its competitiveness. A productivity growth rate comparison shows the competitive position for both the United States and Canada over time. There are many ways to measure productivity. Labour productivity, a primary indicator of productivity, is measured by units of output per worker or units of output per wage dollar. As labour productivity is often associated with capital stock, the skill level of workers and capital stock have a synergistic effect on labour productivity. The Total Factor Productivity (TFP) index includes all input factors (labour, capital, and materials) and represents overall productivity.

Traditionally, the productivity growth model was based on an assumption of perfect competition, constant returns to scale (CRS) and instantaneous adjustment to inputs. According to Morrison (2000), Adelaja (1992), the production function and cost function are specified as follows:

$$Yt = FT\ (Xt,Tt)\ ,\ \ TC = TC(p,t,Y) \qquad (1)$$

Yt output at time t. TC is total cost for production level Y
Xt input at time t, usually containing three categories: labour inputs(XL), capital inputs (XK), material inputs (XM).
P is the price vector.
Tt is the value of the trend variable (technology proxy) for time period t

For Yt = FT (Xt,Tt) Differentiate t with respect to Y,

$$(\partial Y/ \partial t)*dt = FTt *dt + \sum(\partial Y/\partial Xi)*(\partial Xi/ \partial t)*dt \qquad (2)$$

Under profit maximization and perfect competition assumptions, the marginal benefit of input i will equal the marginal cost (market price), PY (∂Y/ ∂Xi)= Pi

$$(\partial Y/ \partial t)*dt = FTt *dt + \sum(Pi/Py)*(\partial Xi/ \partial t)*dt \qquad (3)$$

or

$$(\partial lnY/ \partial t)*dt = (FTt /Y)*dt + \sum(Si)*(\partial lnXi/ \partial t)*dt \qquad (4)$$

So the primary productivity growth index is:

$$eYt = (FTt /Y)*dt = dlnY/dt- \sum Si* (dlnXi /dt) \qquad (5)$$

Si is the share of input j in terms of the value of total output (Pj*Xj/ PY* Y)

Similarly, The dual productivity growth index:

$$eCt = \partial lnTC / \partial t = dlnTC/dt - dlnY/dt - \sum Mj\ (dlnPj/dt) \quad (6)$$

Where c is unit cost derived by (total cost/ output) under CRS, TC = PY*Y
M is share of input j in total cost (Pj*Xj/ TC).

Under an assumption of constant returns to scale (CRS), no market power (perfect competition), and the marginal benefit from output equal to the marginal input cost (instantaneous adjustment),

$$eYt = - ect \quad (7)$$

There are some other productivity measurements which incorporate effects from research and development, economies of scale, imperfect competition, and demand conditions. These models bring together methods from the New Empirical Industrial Organization (NEIO) approach and conventional Total Factor Productivity Growth (TFPG) and use firm level data. Considering factors of economies of scale, imperfect competition and demand conditions can not be neglected in explaining productivity growth. A more comprehensive model is needed to provide a better explanation of competitiveness. Research by Azzam et al (2002) on the U.S. food industry offers some improvement on earlier models. Azzam suggests the following enhancements to better explain competitiveness.

$$P = Ø\ MC = Ø\ \varepsilon AC \quad (8)$$

Where P is the output price, MC is the marginal cost, AC is the average cost. Ø is the markup index and is equal to 1+ (P-MC) / P.
ε = dlnC / dlnQ = MC/AC and refers to the inverse of economies of size.

From equation (8), the output price is determined by multiple explainable variables: markup over marginal cost, where marginal cost is determined by economies of scale and average cost.

$$\Delta P = \Delta\ Ø + \Delta\varepsilon + \Delta C - \Delta Q \quad (9)$$

Where ΔC is the change in input cost, ΔQ is the change in output quantity.

The growth of output price is dependent on the alteration of markup, economies of scale, production cost and quantities supplied.

From the dual cost function, the rate of change in cost is:

$$\Delta C = \varepsilon\Delta Q + \sum Ki\ \Delta Wi + \Delta T \quad (10)$$

Where Ki is the share of the ith input, and ΔWi is the input price

Substituting (10) into (9), the growth of output price is:

$$\Delta P = \Delta Ø + \Delta\varepsilon + (\varepsilon\text{-}1)\Delta Q + \sum Ki\, \Delta Wi + \Delta T \qquad (11)$$

From the perspective of market supply and demand, the output demand growth rate ΔQ is:

$$\Delta Q = \lambda + \eta\, (\Delta P - \Delta D) + \gamma\Delta Y \qquad (12)$$

Where λ is the demand time trend, η is the price elasticity of demand, γ is the income elasticity and D is a deflator.

The Total Factor Productivity Growth (TFPG) can be calculated by:

$$TFPG = A\, \Delta Q - (1/\theta)\, \Delta T \qquad (13)$$

Where A = (θ –ε)/ θ = (P – MC)/P (Lerner index of oligopoly power),
θ = P/AC.

The first right hand side item in equation (13) is the scale mark-up effect and the second is the technology change effect. If the industry is perfectly competitive and returns to scale exist, MC = AC = P. Thus, A becomes zero, and TFPG is therefore just equal to ΔT.

Substituting equation (12) into (11) solving for ΔQ and substituting the result into equation (13), yields:

$$TFPG = B\eta\Delta Ø + B\, (\lambda + \gamma\Delta Y) + B\eta\Delta\varepsilon + B\eta\, [\, \sum(Ki\, \Delta Wi - \Delta D)] + (B\eta - 1/\theta)\, \Delta T \qquad (14)$$

Where B = A/ [1- η (ε-1)]

In equation (14), TFPG further decomposes the source of productivity growth. Where BηΔΦ refers to the markup effect, B (λ + γΔY) refers to the demand effect, BηΔε refers to economies of scale, Bη [∑(Ki ΔWi –D)] refers to effects of input factors, and (Bη – 1/θ) ΔT refers to technology change. In order to solve equation (14), the information on markup level (Ø), factors from demand structure (η, γ , λ), and the cost structure (ε , T) for each year will be determined by conducting the followed regression.

According to the modified generalized Leontief production function:

$$C\, (q, w) = qj \sum i \sum j\, \alpha\, ij\, wi\, 1/2wj\, 1/2 + q\, t \sum i\, \gamma i\, wi + q2 \sum i\, \beta i\, wi \qquad (15)$$

According to Azzam et al (2002), the aggregated Industry output price can be determined by:

$$P = - [H (1+\Phi)] / \delta + \sum i \sum j\ \alpha\ ij\ wi\ 1/2wj\ 1/2 + t \sum i\ \gamma i\ wi + 2HQ \sum i\ \beta i\ wi \quad (16)$$

H = ∑ j sj2 is the Herfindahl Index
Φ = Sj* Φj = Sj * d ∑i≠j qi /dqj is the industry (weighted) conjectural variation
δ is the semi-elasticity of demand
Wi is the input factor Xr's price (r : labour, materials, capital).

The factor demand equation:

$$Xr/Q = \sum i \sum j\ \alpha\ ij\ (wi/wj)1/2 + t\gamma i + HQ\beta i \quad (17)$$

Where Xr is the input (labour, materials, capital)
Also, the Demand equation is developed by market conditions.

$$lnQ = do + \delta P + d2Y + \lambda t \quad (18)$$

where η = δP is the elasticity of demand and γ = d2Y is the income elasticity.
Y is the income and λ is the time trend.

The mark up capability Ø is equal to:

$$Ø = P/MC = P / (D + 2HQE) \quad (19)$$

Where D = ∑i ∑j α ij wi 1/2wj 1/2 + t ∑i γi wi and E = ∑i βi wi
The ratio of output price to average cost θ is:

$$\theta = P/ AC = P / (D + HQE) \quad (20)$$

Economies of scale:

$$\varepsilon = MC / AC = (D + 2HQE) / (D + HQE) \quad (21)$$

Equations (16), (17) and (18) contain 5 main regression functions which provide coefficients α ij, γi, βi, η, λ, d. Demand (Q), Price (P) and input factor (Xr) are endogenous variables. Input factor prices (Wi) , income elasticity d2Y, time trend (T), and Herfindahl Index (H) are exogenous variables.

The data used for equations (16), (17) and (18) are based on Statistics Canada's Annual survey of Manufacturing (ASM) micro records and tax data from the Industrial Organization and Finance Division (IOFD). Data for materials inputs and labour inputs at the industry level are compiled from Statistics Canada's online CANSIM data base.

The capital input, calculated by Statistics Canada, is equal to the capital depreciation and capital opportunity cost. The aggregated capital input data only exist at the meat processing industry level (p level). The fixed asset data for the poultry processing sector is based on aggregated tax data. The relationships between depreciation costs related to fixed assets are calculated through regression techniques using individual firm data for 2001. The capital opportunity costs are defined as the rate of return of 10-year government bonds.

Some of the poultry processing firms in this study process beef or pork products in addition to poultry. In such instances, their fixed asset data are weighted by shares of the poultry products' value among the firm's total shipments value. The income data are based on data from Statistics Canada's Canadian family income index. Prices of poultry outputs are represented by the basket content index of fresh or frozen poultry meat. The period covered is 1990-2001. The value of the time trend T is assigned from 1 to 12 to represent 12 years. Deflators for material inputs, shipment value, and capital input employ the Farm Product Price Index, Industry Price Index and Consumer Price Index respectively.

Experimental results presented in Table 4 and Table 5 show that the productivity growth rates are different between the new empirical industrial organization (NEIO) and the conventional productivity models. The NEIO results show that the Canadian poultry processing sector underwent moderate total factor productivity growth; the average annual rate being 1.23%. The conventional model results show that productivity grew at a positive rate of 4.24% on average. The productivity growth from the NEIO model accounts for about one third of the conventional numbers.

Because positive mark-ups and economies of size exist, the NEIO model relaxes the assumptions of constant returns to scale and perfect competition. The Solow residue from the conventional model is not well explained as a source of productivity growth, but the NEIO model attributes the source of productivity growth to mark-up ability, economies of scale, demand, input factors, and technology change.

The most significant contributions to TFPG are demand growth and exogenous technology change, with the average annual rate being 0.49% and 0.37% respectively. Change in demand conditions exceeded other factors as a primary factor leading to TFPG. However, as a special case from other food processing industries, the Canadian poultry supply is constrained by the supply management system. Conditions of demand, such as income and price, are not the main determinants on the output that the poultry industry will supply. The weak price elasticity of demand η (-0.30) and income elasticity show that the demand conditions had limited effect on output levels.

On the other hand, the live poultry input variation shows a close relationship with rate of TFPG due to demand change (Table 6). From Table 6, the increased TFPG due to demand change was usually accompanied by change of farm production in the same year or one year before. Farm production of live poultry is determined by supply management policy. In 1994 and 1999, the Chicken Farmers of Canada (CFC) and the Chicken Farmers of Ontario (CFO) reformed their supply control policy; and allocated higher production quotas to farmers. The resulting production policy changes at the farm level had a negative effect on the TFPG of the poultry processing sector.

Table 4. Selected parameters of the Total Factor Productivity Growth model (TFPG)

Year	t	H	Φ	ε	η	Φ	λ	A=(P – MC)/P	B=A/ [1- η (ε-1)]
	Time trend	Herfindahl index	Industry conjectural variation	MC/AC	Demand elasticity	P/MC	Income elasticity	Lerner index of pligopoly power	
1991	1	0.030507	-0.01857	1.01984	-0.30329	1.033453	0.887226	0.03237	0.032177
1992	2	0.069002	-0.2383	1.04427	-0.2956	1.058942	0.8844	0.055662	0.054943
1993	3	0.066852	1.3275	1.04676	-0.30181	1.172271	0.861796	0.146955	0.14491
1994	4	0.072971	0.7534	1.04880	-0.28703	1.147366	0.877336	0.128439	0.126665
1995	5	0.09186	-0.033	1.05917	-0.28585	1.100773	0.880162	0.091547	0.090025
1996	6	0.071319	-0.1684	1.05266	-0.31688	1.062198	0.866034	0.058556	0.057594
1997	7	0.070121	-0.5072	1.05625	-0.31866	1.036652	0.887226	0.035356	0.034734
1998	8	0.060184	1.0775	1.05143	-0.31245	1.139788	0.922545	0.122644	0.120704
1999	9	0.06452	0.1242	1.05262	-0.30063	1.084115	0.933847	0.077589	0.07638
2000	10	0.130662	-0.1245	1.11310	-0.29412	1.119639	0.966341	0.106855	0.103415
2001	11	0.056	0.782	1.05342	-0.31011	1.113914	0.987533	0.102264	0.100598

Table 5. Total Factor Productivity Growth model (TFPG) – Results for the poultry processing sector

	BηΔΦ	B (λ + γΔY)	BηΔε	BηINPUT	(Bη-1/θ)*ΔT(Bη-1/θ)		
	Mark up	Demand	Scale	Input	Tech	NEIO TFPG	Conv. TFPG
1991					0.43%		
1992	-0.04%	0.23%	-0.04%	0.12%	0.37%	0.63%	1.95%
1993	-0.05%	0.31%	-0.01%	-0.36%	0.41%	0.30%	4.88%
1994	1.27%	0.75%	-0.01%	0.31%	0.34%	2.67%	-0.61%
1995	0.72%	0.42%	-0.03%	-0.04%	0.34%	1.42%	-4.02%
1996	0.36%	0.17%	0.01%	-0.11%	0.40%	0.83%	9.30%
1997	0.15%	0.23%	0.00%	0.06%	0.39%	0.82%	9.29%
1998	-0.16%	0.96%	0.02%	0.11%	0.38%	1.29%	5.67%
1999	0.63%	0.42%	0.00%	0.10%	0.35%	1.50%	-2.84%
2000	0.22%	0.79%	-0.18%	-0.07%	0.29%	1.05%	11.41%
2001	0.48%	0.66%	0.19%	0.09%	0.36%	1.77%	7.37%

Table 6. Relationship between farm production and Total Factor Productivity Growth due to demand

Year	Annual production (tonnes eviscerated)	Farm production growth	TFPG due to demand
1990	555,133		
1991	559,522	0.79%	
1992	562,684	0.57%	0.23%
1993	601,854	6.96%	0.31%
1994	685,109	13.83%	0.75%
1995	685,894	0.11%	0.42%
1996	713,515	4.03%	0.17%
1997	748,580	4.91%	0.23%
1998	787,831	5.24%	0.96%
1999	847,602	7.59%	0.42%
2000	880,738	3.91%	0.79%
2001	930,145	5.61%	0.66%

Source: Agriculture and Agri-Food Canada, Annual Production by Province.

The influence of the mark-up ability however, also made some positive contribution to TFPG on average, about 0.36%. The Lerner index of oligopoly power is approximately 0.08. Different market structures will have different Lerner indexes. The Lerner index is 0 for a competitive market and is 1 for monopoly market. The average Lerner index for the Canadian poultry processing market indicated that the market was relatively competitive. The productivity growth from mark-ups peaked in 1994. In that year and the subsequent year, the poultry sector underwent dramatic market reconstruction and consolidation. The Lerner index also reached a high point of 0.15 in 1993 (Table 4). The contribution from input factors and economies of scale had a negligible effect on TFPG. The economies of size $\varepsilon > 1$ demonstrate that the industry as a whole operated with less dependence on economies of scale (Table 4).

Since U.S. research on the NEIO / TFPG model of the poultry processing sector, conducted by Azzam et al (2002), was for the years 1973-1992, and our Canadian study analyses the years 1991 to 2001, it was not possible to conduct a benchmark comparison between the two studies. Our observation that the NEIO model reduces the conventional productivity growth estimates for the Canadian poultry sector by two thirds is however consistent with Azzam's observations with regard to the use of the model to measure U.S. productivity growth estimates. In both Canada and the United States, poultry products are demand inelastic and productivity growth shows positive development.

Financial Performance Index

Canadian tax data were used to provide additional information on industrial performance. Based on data from Statistics Canada's Industrial Organization and Finance Division (IOFD) tax record data base, the following financial ratios were analysed:

- Sales growth - the change in sales revenues from year to year.
- Operating profit margin - the net operating profit (profit excluding interest expense, non-operating gains or losses, and tax expenses) divided by the total operating revenue.
- Return on equity - a measure of the net profit per share.
- Inventory turnover - a measure of management efficiency.
- Liability to assets - a measure of solvency.

The financial performance for Canada's poultry processing industry is estimated in Table 7. Due to the inconsistency in the number of firms from one year to the next, some figures in Table 7 vary significantly between years. Furthermore, the estimates in Table 7 are for the meat processing sector in total. Meat processing includes all enterprises that process beef, pork, poultry or any combination. Poultry processors are not identified separately.

Table 7. Financial information on the meat processing industry

	Sales growth	Profit	Return on equity	Inventory turnover	Liabilities to assets
1993	N/A	0.029172	0.146547	55.66518	0.714301
1994	0.0562	0.033173	0.032792	11.83783	0.300993
1995	0.0143	0.016013	0.365174	43.54306	0.714642
1996	0.1153	0.021686	0.319997	32.8078	0.719127
1997	0.0921	0.012327	0.363216	42.54692	0.748198
1998	-0.0298	0.042093	2.446117	32.31504	0.731221
1999	0.027	0.017206	1.432281	138.7174	0.924795
2000	0.1205	0.009089	0.888489	170.033	4.428475
2001	0.1292	-0.32197	-0.9002	70.98726	1.022648

Table 7 shows that the operating profit of meat processors was less than 4% over the period. The net profit rate will be lower than these figures after deducting other expense such as interest and taxes. Sales growth was high in 1996, 1997, 2000 and 2001, but profitability declined as sales increased.

The liabilities to assets ratios show a trend of increasing debt. The efficiency index on inventory turnover improved in 1999 and 2000. The return on equity has however declined in recent years. The decline might relate to the asset expansion that firms pursued, leveraging assets to borrow for investment. The increased interest costs may be a prominent factor in the reduction in the return on equity.

Conclusions

According to the value added comparison between Canada and the United States, the Canadian poultry industry has been outperformed by that of the United States. Despite being outperformed by U.S. processors however, productivity growth in the Canadian poultry processing industry has nevertheless experienced steady increases.

The main determinant of enhanced Canadian poultry processor productivity is the demand effect, which has been determined in part by the Canadian supply management system. The financial ratios show profitability, solvency, and efficiency. The Canadian poultry processing industry has clearly improved its performance over time, but its competitiveness has lagged behind that of processors in the United States.

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