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CONCENTRATION AND MARKET POWER IN CANADIAN AGRIBUSINESS

James Rude and Murray Fulton

INTRODUCTION

A long-held belief in industrial economics is that extending the size of the market reduces concentration and diminishes the ability of firms to exercise market power. At its simplest, this proposition stems from the idea that larger markets will be able to support a greater numbers of firms, and that the presence of more firms leads to more competitive pricing. This belief has had particular application in the area of trade. Trade economists have a long history of assuming that open borders help discipline monopolistic type behavior in domestic markets (Bhagwati, 1965). For instance, in a country with import restrictions, a non-competitive industry will be able raise prices without fear of foreign competition. In small countries the problem may be made worse by the fact that the size of the domestic market is such that only a small number of firms operate, often at less than minimum efficient scale. Open borders, however, provide disciplines on the domestic firms' pricing behavior and increase the size of the market, both of which should serve to reduce concentration and decrease firms' abilities to exercise market power¹.

¹ Market power is the ability to establish a price that exceeds marginal cost. In general, we define competitive behavior as the absence of market power. See Sutton (1991) for examples of the literature on the connection between the extent of the market and market concentration.

Canada has a small, relatively open economy and for the most part its agricultural producers, processors, and input providers face world prices and do not exercise market power on world markets. In this context, trade liberalization was seen as a force in promoting competitive behavior. Indeed, the Canada/U.S. Trade Agreement (CUSTA) of 1989, and later adding Mexico in the North American Free Trade Agreement (NAFTA), was viewed as a way of expanding the market, achieving economies of scale and reducing concentration (Harris and Cox, 1983). The story outlined above is consistent with older theories of industrial organization that are structured around the Structure-Conduct-Performance paradigm (for example, Bain 1968). More recent theories of industrial organization, however, have stressed that increased market size is no longer seen as always guaranteeing less concentrated markets (Sutton 1991). As well, the positive relationship that has been assumed to exist between concentration and the exercise of market power has been increasingly questioned in the industrial economics literature.

The purpose of this study is to examine the issues of whether larger markets result in greater concentration and whether greater concentration results in a greater exercise of market power. The focus of the study is the Canadian agribusiness sector over the period 1983-96. Particular attention is paid to the signing of CUSTA, since for some agricultural industries this agreement signaled a significant expansion of the market.

The paper is structured as follows. The next section addresses the issue of market concentration in the Canadian agribusiness sector. The section begins with an examination of the link between market size and market concentration. This section then presents empirical data on concentration ratios in a number of agricultural sectors. The third section of the paper examines the link between market structure and market power, first from a conceptual perspective and then from an empirical perspective. The fourth and final section of the paper discusses the implications of these results and options for research with regard to the competitiveness in Canadian agriculture.

IS AGRIBUSINESS BECOMING MORE CONCENTRATED IN CANADA?

The first step in determining the concentration of an industry is to define the relevant market. As Stigler (1982) laments, economists have neglected market definition both in theory and empirical application. The usual approach is to define the limit of a market as a break in the chain of substitutes by considering cross elasticities of demand and supply. Legal definitions of relevant markets have emerged in the U.S. Department of Justice *Merger Guidelines*, and in a similar set of Canadian *Merger Guidelines*. These definitions attempt to measure the influence of potential substitutes on profitability to help delineate markets.

Most empirical studies of market concentration use data collected by national statistical agencies. In both Canada and the United States the basic system of categorizing the output of business establishments by industry or product line is the Standard Industrial Classifications (SIC)². SIC definitions become progressively narrower with successive additions of numerical digits. For example, the Canadian food sector is defined by SIC 10, while meat and meat products (excluding poultry) is defined by SIC 1011. Publicly available data on industry concentration is typically limited to the four-digit level of aggregation.

Relevant markets do not necessarily follow a national four-digit SIC delineation and questions of relevant geographic markets and the appropriate degree of aggregation raise problems with national-based measures of concentration. For instance, when trade is important, the question arises of whether national definitions of concentration are relevant. Furthermore, four-digit SIC data do not distinguish between vertical components of an industry. For example, the primary processing of a product may become more concentrated at the same time that further processing is becoming more fragmented with niche markets.

² For data prior to 1997 Industry Canada does attempt detailed concordance between U. S. and Canadian industrial classification systems. A new industrial classification system for North America, North American Industrial Classifications System (NAICS) was introduced in 2000 but to date very little historic data is supplied.

These data issues are important for the empirical examination of concentration and market power in the Canadian agri-food industry. The lack of data on relevant markets and on concentration measures that span international boundaries makes the drawing of conclusions about changing concentration and market power difficult (Palsson and Monteiro 2001).

Leaving the problem of defining the relevant market aside, what is the impact of increasing the size of the market on concentration? This question is particularly relevant when considering the impact of trade liberalization, since one of the major impacts of economic integration through trade liberalization is a larger market. At first blush, a larger market should result in less concentration, since the market should now be able to support more firms. Sutton (1991), however, cautions that increased market size may not always result in less concentrated markets. The reason lies in sunk costs, costs that cannot be recouped once they are incurred, even if production is halted. The presence of sunk costs means that for firms to be profitable, price needs to be raised above marginal cost, typically by reducing the amount of competition (i.e., the number of firms). Sutton shows that while an inverse relationship exists between market size and market concentration when sunk costs are exogenous to the firm, this relationship does not hold when sunk costs are endogenous. Sutton identifies two forms of endogenous sunk costs, advertising and research and development (R&D), that are likely to place a lower bound on the level of concentration as market size increases. Concentration has a lower bound because companies typically find it desirable to expand their advertising and R&D expenditures as market size increases. The result is higher sunk costs, which in turn means less competition in order to ensure that firms are profitable.

The evidence suggests that much of the Canadian agribusiness sector is in the exogenous sunk cost category, although there are exceptions, particularly for farm inputs. The food processing industry, at least in Canada, does not involve a significant degree of research and development. For example, between 1988 and 1993 R&D intensity (R&D expenditures/shipments) declined from 0.16 per cent to 0.12 per cent (Industry Canada, 1997). Although the food and beverage sector has low R&D intensity, advertising expenditures can be significant, especially in the beverage sector. R&D spending, however, is much more important in the farm-input sector. Research expenditures in the

agri-chemical and seed sectors represent a very significant sunk cost. For example McEwan and Deen (1997) state that it costs the pesticide industry from \$US70 to \$US100 million for the R&D necessary to bring a new compound to the global market. Research intensity is also significant for farm machinery development. For example, John Deere spends over \$US1.5 million each working day on R&D (John Deere, 2001).

By expanding the market, trade liberalization can play a significant role in industry rationalization for other reasons. Prior to CUSTA, much of Canadian manufacturing was criticized as being protected, small in size and inefficient (Eastman and Stykolt, 1967 and Wonnacott, 1975). Closed borders and an inward-looking industry resulted in a preponderance of firms with less than minimum efficient scale and which offered too many product lines, often with short production runs. For example, fruit and vegetable canning, and pork and beef packing were identified as industries operating at less than minimum efficient scale (Harris and Cox, 1983). Trade liberalization should force some inward looking firms to look to export markets, to rationalize their production runs, and to achieve minimum efficient scale.

The other effect of trade liberalization is an increase in intra-industry trade. These intra-industry effects tend to dominate between countries with similar factor endowments (such as Canada and the United States) where the comparative advantage effects of trade liberalization are of less importance. Associated with the increase in intra-industry trade is an increase in specialization of plant production. Thus, expanding the size of the market through trade liberalization has the possibility of increasing both product specialization and scale economies of production. In turn, these impacts may have the effect of increasing concentration measures based on national boundaries. At the same time, the increased scale and increased specialization may result in lower costs, thus implying an inverse relationship between concentration and price mark-ups.

Industry rationalization typically occurs through mergers and acquisitions. Mergers occur for a variety of reasons. They may be a way for low cost firms to take over the production of high cost firms, thereby increasing profitability and increasing efficiency. Mergers may occur as firms attempt to acquire new intellectual property. Mergers may also be the result of different

valuations of companies that are held by different industry players and the result of a drive by company leaders to increase their personal influence (Shy, 1996). Farrell and Shapiro (1990) evaluated the conditions that are required for a merger to produce cost savings that can increase output and reduce price after the merger. Cost savings can occur when: (1) the merged firm reallocates production between plants; (2) the merged firm shifts capital across plants; and (3) the firms in the merger entity learn from each other in terms of sharing techniques, patents or management skills.

There have been a significant number of mergers in the agrifood sector over the past ten years. Between 1987/88 and 1999/2000 the Canadian Competition Bureau examined 265 mergers in the agrifood sector; this number represents nine per cent of the total mergers during that time period (Palsson and Monteiro, 2001).

Despite their prevalence, the literature on mergers and acquisitions in the agrifood industry is very small. One of the few studies is Buschena and Gray (1999), who examined the incentives for horizontal mergers in the North American barley malting industry when trade was liberalized through CUSTA. They observed no movement of physical capital or closures of plants when the industry consolidated from four major firms in Canada and six major firms in the United States to five major North American firms. Trade induced mergers have off-setting effects: cost efficiencies increase welfare and a reduced number of firms can reduce total output. Buschena and Gray showed that the mergers were both profit-enhancing and welfare-enhancing. Looking at mergers more generally, McDougall (1995) found that Canadian corporations that have been taken over by foreign interests increase their investment and R&D spending, while firms taken over by Canadian interests had no change in investment in physical capital or R&D investment.

EMPIRICAL EVIDENCE ON CONCENTRATION

The period since the signing of the Canada-United States Free Trade Agreement at the beginning of 1989 has been a time of rapid adjustment for the Canadian food and beverage processing sector. Since 1988, the sector has recorded modest overall real growth in shipments of seven per cent and has under

Table 1: Food and Beverage Concentration (pre and post CUSTA).

<i>Sector</i>	<i>pre CUSTA Avg. Herf</i>	<i>post CUSTA avg. Herf</i>	<i>Change in Concentration</i>	<i>Annual Import Growth</i>	<i>Annual Export Growth</i>
				<i>(percent)</i>	
Poultry products	0.0505	0.0670	↑	11*	21**
Other dairy	0.0846	0.1161	↑	8*	8**
Prepared flour mixes and cereals	0.1757	0.1036	↑	19*	19**
Potato Chips	0.2650	0.3416	↑	16*	21**
Soft Drinks	0.1214	0.1951	↑	1*	29**
Brewery Products	0.3047	0.4230	↑	11*	4**
Vegetable oil	0.1586	0.3215	↑	5	16
Canned and preserved fruit and vegetables	0.0598	0.0613	n/c	11	17**
Frozen fruit and vegetables	0.1931	0.1654	n/c	1	16
Fluid milk	0.0772	0.0889	n/c	12*	12**
Flour	0.1842	0.1770	n/c	15*	4
Biscuits	0.2431	0.2358	n/c	10	25
Bread and other bakery	0.0654	0.0790	n/c	15*	14
Confections	0.1381	0.1319	n/c	11	18
Dry Pasta	0.2467	0.2460	n/c	13	18**
Malt	0.0409	0.0396	n/c	-4*	11
Distillery Products	0.2366	0.2506	n/c	6*	5
Winery	0.1350	0.1654	n/c	9	24**
Meat and meat products	0.0593	0.0380	↓	6	10
Feed	0.0242	0.0205	↓	11	13**

Source: Authors' calculations with data taken from Statistics Canada (2000)

*value of imports less than 10% of value of shipments

**value of exports less than 10% of value of shipments

↑ statistically significant increase after 1989 (Wilcoxon-Mann-Witney test)

↓ statistically significant decrease after 1989

n/c - no statistical change in mean of Hefindahl index

performed relative to the U.S. food and beverage processing sector in terms of growth, productivity and return on investment. Between 1988 and 1991, performance of the sector deteriorated. This deterioration reflected a period of

performed relative to the U.S. food and beverage processing sector in terms of growth, productivity and return on investment. Between 1988 and 1991, performance of the sector deteriorated. This deterioration reflected a period of major restructuring and adaptation in response to trade liberalization, the high Canada/U.S. exchange rate, and the effects of the recession in the early 1990s (AAFC, 1998).

Table 1 examines the relationship between trade liberalization and market concentration in Canadian food and beverage processing. Concentration is measured by a Herfindahl index, which is equal to the sum of the squared market shares for all firms in the industry³. The second and third columns of Table 1 show the average Herfindahl index for the periods prior to CUSTA (1983-88) and following CUSTA (1989-96). Data for Herfindahl indexes are not available after 1996. However, over 70 agrifood mergers have occurred in the period from 1997 to 2000 (Palsson and Monteiro, 2001) so the results in Table 1 may significantly understate the degree of concentration that has occurred in the post-CUSTA period.

The fourth column of Table 1 presents the results of a statistical test of whether the average Herfindahl indexes for the two periods are statistically different.⁴ To test the difference in averages before and after 1989, a non-parametric Wilcoxon-Mann-Whitney test was employed. This approach, rather than a t-test of equal means, was used because of suspected non-normality of the distribution of Herfindahl indexes⁵. The fifth and sixth columns show the average annual growth rates in the value of imports and exports between 1988 and 1999 for each sector. Care must be taken to recognize that trade is not

³ The Herfindahl index takes account of both the number of firms and their relative sizes. The reason why the Herfindahl index is used, rather than a CR4 index is because all of the industry's activities are accounted for rather than just for the four largest firms. As well, data on Herfindahl indexes are frequently available when CR-4 ratios are withheld for reasons of confidentiality.

⁴ Since the definition of the concentration measures used in Table 1 does not change between periods, this test can not account for relevant geographic markets as discussed by *McGeorge* (2001).

⁵ The W-M-W test is a less powerful test than the t-test. When a t-test is used to compare the means, a few cases emerged in which the t-test indicated a statistically significant change while the W-M-W indicated a non-significant change.

important for some of the industries listed in Table 1. For instance, the average import intensity (imports divided by shipments) of fluid milk is 0.1 per cent and the average export intensity is 0.5 per cent. Industries with low trade intensities (less than 10 per cent) are highlighted with an asterisk.

A number of conclusions can be drawn about concentration in the food and beverage industry from the data in Table 1. First, over half of the sectors display no significant change, suggesting that trade liberalization has had little effect on industry structure, at least as measured by the Herfindahl index. Second, a number of the sectors which showed a statistically significant increase in concentration involved goods with little trade, either because the border is closed due to supply management (e.g., poultry products and other dairy) or because the products are not extensively traded because of high product transportation costs (e.g., soft drinks), or because of product characteristics (e.g., taste) specific to Canada (e.g., potato chips and brewery products). Third, concentration fell in only two sectors, meat and meat products, and feed.

The results presented in Table 1 provide only very limited support to the belief that market concentration falls with an increase in the size of the market (in this case, trade liberalization through CUSTA). This limited support follows both from the observation that concentration only fell in two cases (meat and meat products and feed), and from the fact that concentration appears to rise for goods that are not traded.

However, even this limited support must be questioned. The falling concentration in meat and meat products and in feed are probably not a result of trade liberalization, but likely derive from other industry factors. Likewise, the cases of significant increases in concentration largely reflect industry trends and structural change that are independent of trade liberalization. For instance, casual observation of the poultry and dairy sectors in the United States suggests that concentration has risen there as well. Thus, rising concentration should not be attributed- - at least solely- - to supply management. Similarly, concentration appears to be rising in brewery products in the United States, again suggesting that other factors are at work in determining concentration. The following paragraphs examine some of these industry specific trends and changes.

First, meat and meat products. Concentration in this sector has to be examined at a more disaggregated level than is possible using the statistics used in Table 1. While the overall statistics show a decline in concentration, this decline is likely the result of a fall in concentration in further-processing. Further-processing makes up a significant portion of the meat and meat products industry. For example, in pork, 65 per cent of the slaughtered product goes to other Canadian meat processors, while in beef, 25 per cent of slaughter goes to other Canadian processors (AAFC, 2000b).

The beef slaughter industry in Canada, like its counterpart in the United States, has become significantly more concentrated over the last decade. Between 1992 and 1999 the four-firm concentration ratio for federally inspected Canadian beef slaughter steadily increased from 53 percent to 78 percent (AAFC, 1999a). By comparison between 1990 and 1998 four-firm concentration in U.S. steer and heifer packing increased from 73 percent to 80 percent (MacDonald, 2001). The increase in Canadian beef packing concentration has been driven by U.S. investment in the Alberta sector, which has resulted in two firms, Iowa Beef Packers (IBP) and Cargill, dominating Canadian cattle slaughter. Additional investments by these companies have increased this concentration over time.

The parallel change in concentration on both sides of the border is unlikely due to trade liberalization. The North American beef trade was largely integrated prior to CUSTA/NAFTA. The major impact of CUSTA on beef trade was that Canada and the United States exempted each other from their meat import laws. Tariffs prior to 1988 were low and represented only a minor barrier, while measures such as border inspection and equivalent grading still have not been resolved (Hayes and Kerr, 1997). Factors such as wages (MacDonald, 2001), exchange rates, environmental policies and domestic regulations have likely had a larger impact on trade flows than a change in border measures.

CUSTA, of course, has had some impact. For instance, CUSTA, and later NAFTA, provided Cargill and IBP with an increased sense of security to invest in Canadian slaughter. Nevertheless, there is no reason to expect that further trade liberalization will have any further significant impact on concen-

tration. However, the composition of ownership may change as a result of potential acquisitions such as Tyson buying IBP.

For pork, trade was also relatively barrier free prior to CUSTA, with neither Canada nor the United States assessing tariffs on fresh or frozen pork. Until 1998 Canada prohibited the importation of live hogs from the United States for health reasons (pseudo-rabies). Since 1998 hogs can be imported from designated disease free areas. Increased concentration in Canadian hog slaughter has been more gradual than that in beef, with the four-firm concentration ratio increasing from 51 per cent to 56 per cent between 1992 and 1999 (AAFC, 1999b). In the United States the four-firm concentration rate increased from 40 per cent in 1990 to 54 per cent in 1998 (MacDonald, 2001).

For the feed industry, other factors besides trade liberalization, e.g., technology, are likely behind the decline in concentration. Automation and computerized least cost formulation, the availability of pre-mixes, and the establishment of integrated feed and livestock operations have all had a huge impact on the feed industry. These developments have led to an increase in on-farm mixing and a decline in the importance of large-scale commercial feed mills. As noted above, sectors such as poultry products, other dairy products, and soft drinks are not open to the direct forces of trade liberalization and experienced a significant increase in concentration. Dairy and poultry are supply managed sectors and were not subject to additional market access through CUSTA. The soft drink sector involves a non-traded product and the largest soft drink companies tend not to ship finished product across the Canada-U.S. border because of differences in ingredient and labeling regulations (AAFC, 2000a). The brewery sector also experienced a significant increase in concentration, but the trend in increased brewery concentration predated CUSTA. CUSTA did advance the elimination of intra-provincial trade barriers in beer, which resulted in a significant consolidation and rationalization in the Canadian industry.

Vegetable oil has been the fastest growing food processing sector over the last decade. Between 1987 and 1997 capacity has increased by almost 150 per cent. Two companies, CanAmara and Archer Daniels Midland (ADM), dominate the industry with 78 per cent of the crush (AAFC, 1997). It is difficult to determine if trade liberalization increased concentration in this sector as

the period just prior to CUSTA caused severe financial difficulties for the sector, and the period subsequent to the agreement coincided with a rapid expansion of Canadian oilseed production. Oilseed crush capacity has increased from 6,850 tonnes per day in 1987 to 16,865 tonnes per day in 1997 (AAFC, 1997). This increase in capacity in a capital-intensive industry has come through expansions and modernization, which has resulted in increased concentration.

Increased concentration for the snack food and prepared flour mix and cereals sectors may well be associated with industry rationalization. The snack food sector has large sunk costs due to intensive advertising and therefore is susceptible to increased concentration. Furthermore, the sector is capital intensive, and over the last decade has faced a rapidly growing market. Other food and beverage sectors showed no statistically significant change in concentration at the four-digit level. The fruit and vegetable sector faced significant restructuring and consolidation of product lines but at the same time national brands were facing increased competition from private labels. There are, however, pockets of extreme concentration such as H.J. Heinz, the sole supplier of jarred baby food in Canada⁶. For the bakery sector, economies of scale are hard to achieve given the perishable nature of the product. The confectionery sector has faced significant rationalization, and has become more open to trade; some of the larger plants have been able to establish global product mandates because of cost advantages for sugar. Nonetheless there are still regional differences in tastes for confections and niche markets play a significant role. Although change in concentration for flour processing is not significant up to 1996, concentration increased substantially in 1997 when ADM purchased Maple Leaf Mills. This acquisition is not accounted for in Table 1.

Publicly available information on concentration in the farm input sector is difficult to acquire and is not reflected in Table 1. In many cases Canada is a price taker on global markets for farm inputs and domestic measures of concentration are meaningless. Furthermore, for the most part this sector did not face significant trade barriers prior to CUSTA and changes in market structure and conduct in this sector cannot be traced back to trade liberalization.

⁶ An anti-dumping suit against Gerber Baby food has left Heinz as the only source of jarred baby food in Canada.

However, some spatial elements of the market may allow for limited exercise of market power in select geographic locations.

Recent linkages between the agri-chemical and seed markets, on a global basis, have occurred at rapid pace through numerous mergers and acquisitions as chemical companies vertically integrate into the seed and biotechnology industries in order to capture profits from biotechnology innovations which are complementary to their chemical technology⁷. Since 1996 Monsanto has spent over \$US 8 billion acquiring seed and agriculture biotechnology companies (RAFI, 1999). The top ten agri-chemical companies account for approximately 85 per cent of the global agri-chemical market (\$US 31 billion). Likewise the top 10 seed companies control over 30 per cent of the world seed market, with even higher concentrations for specific products (four companies control 69 per cent of the North American seed corn market and four companies control 47 per cent of North American soybean market) (RAFI, 1999). Five companies, dominated by Aventis, formulate farm chemicals in Canada, with the basic ingredients all imported.

Sales of bulk fertilizer in Canada is dominated by Agrium with almost 50 per cent of the market (authors' estimates based on firm employment). In terms of the production of nitrogen fertilizer, the four-firm concentration ratio is the range of 80-85 per cent (authors' estimates based on capacity). Canadian-based operations produce a quarter of North America's nitrogen fertilizer and Canada is the world leader in potash production. The farm machinery sector in Canada is dominated by three mainline brands (John Deere, Case-New Holland and Agco) and most of the equipment is imported at world prices. There is also a competitive fringe of innovative "shortline" manufactures.

DOES INCREASED CONCENTRATION LEAD TO MORE MARKET CONCENTRATION?

A concept central to the industrial organization literature is that increased concentration leads to increased market power, while less concentra-

⁷ See Hayenga (1998) for a description of acquisitions in the seed industry by chemical companies. RAFI (1999) provides some up dated details.

tion increases the disciplines on industry pricing. This concept forms the basis of the classical Structure-Conduct-Performance (S-C-P) approach to industrial organization⁸. Under the logic of the S-C-P approach, there is a straight line relationship from structure (e.g., size of market, number of firms) to the conduct of the firms (e.g., level of price mark-ups, advertising) to performance (e.g., profitability and economic efficiency). The determination of structure is explained by barriers-to-entry that are exogenously determined. The implication of this theory is that the more concentrated an industry, the larger is the deviation from competitive pricing and the more market power that firms exercise.

The one-way causality aspect of the S-C-P model is its most controversial aspect. In response, economists have developed models in which there is substantial feedback between structure, conduct and performance⁹. For instance, under the new theory, determinants of market structure are not exogenous, performance affects structure and profitability affects entry. The newer literature stresses how firms can strategically manipulate their environment rather than simply adapting to existing environmental conditions. In this more dynamic world, more efficient firms should grow faster than less efficient firms resulting in a more concentrated industry structure. Viewed in this light, increased concentration, when combined with cost efficiencies, does not necessarily lead to higher prices and may in fact result in lower prices. In general, the belief is that there is a trade-off between increased efficiencies and increased market power. Azzam (1997) makes an explicit attempt to measure this trade-off between market power effects and cost efficiency effects.

The view that there is a trade-off between market power effects and cost efficiency is not shared by all economists. Baumol, Panzar and Willig (1992) recognize that while certain cost structures, for example increasing returns to scale, may lead to markets of one or few firms, they stress that firms may not be able to exercise market power because the markets are contestable. The equi-

⁸ This approach to empirical industrial organization was introduced in Mason and largely developed by Joe Bain. See Carlton and Perloff (1999), p.p. 238-267, for more details.

⁹ See Jacquemin (1991) for an excellent survey of modern industrial organization, including the adaptation of the S-C-P approach, and new strategic approaches to industrial organization.

librium in a contestable market has all the desirable properties of perfect competition, i.e., prices as low as possible while still covering costs, and there is cost minimization and zero economic profits. Moreover, this result is obtainable with only a few firms so that very concentrated markets can end up with the same characteristics as competitive markets.

The key requirements for market contestability are: (1) potential entrants must not be at a cost disadvantage to existing firms; and (2) entry and exit must be costless. For entry and exit to be costless, there must be no sunk costs. If there are no sunk costs, potential entrants can use a "hit and run" strategy in which they enter an industry, undercut the price of incumbents, reap the profits and exit before the incumbents have time to retaliate. In anticipation of entrants acting in this manner, the incumbents forestall entry by keeping price at average cost. The consequence is that, even in an industry that is highly concentrated, prices can be kept at or near competitive levels. However, if sunk costs are present, firms entering an industry are unable to exit again without losing a portion of their investment. As a result, "hit and run" strategies are much less profitable and incumbents are able to keep price above average cost. Thus, with sunk costs, markets are not contestable and market power is once again an issue.

Sunk costs can have additional effects on the market structure and conduct. Sutton (1991) reformulates the basic theoretical model in industrial organization with a two-stage game formulation to explain the two-way link between structure and conduct. The focus of Sutton's theory is sunk costs. In the first stage of Sutton's model, the firm makes investments in advertising and research and development in order to enhance the consumers' willingness to pay. In the second stage firms engage in some form of competition (price, quantity, or joint profit maximization)¹⁰. Sutton identifies two types of sunk costs, exogenous and endogenous. Exogenous sunk costs depend solely on entry costs such as the construction cost of a minimum efficient scale plant. If only exogenous sunk costs are present, Sutton predicts that an increase in the size of the market will lead to less concentration. Sutton also shows that with exogenous

¹⁰ Rather than identifying unique equilibrium outcomes Sutton (1991) uses a bounds approach to narrow down a set of feasible outcomes which can be supported as equilibrium.

sunk costs, increased “toughness” of price competition leads to a more concentrated industry. This latter prediction opens the possibility of direct contradictions to the predictions of the S-C-P approach.

Endogenous sunk costs are firm-level strategic variables such as advertising or research and development. Firms choose their expenditures on these costs depending on the demand characteristics in the market (e.g., size of market). There are three predictions for endogenous sunk cost markets. First, as market size increases, concentration will not decrease and has an effective lower bound. Second, there is no monotonic relationship between market size and minimum concentration levels. Third, increased setup costs increase minimum concentration levels.

EMPIRICAL EVIDENCE ON MARKET POWER

Empirical evidence on the exercise of market power in the Canadian agrifood sector is limited, with research focused largely on the food processing sector. This narrow focus is largely due to the lack of sufficient empirical data to examine other agrifood sectors. Lopez (1984) measured market power in the Canadian food processing sector at the two-digit level. Lopez’s approach employed explicit price theory and optimizing behavior by firms¹¹. Lopez estimates market power with a Lerner index that is the difference between price and marginal costs as a fraction of price, and measures a mark-up of prices over marginal cost. Lopez could not reject the hypothesis of the exercise of market power in the Canadian food processing sector and found an average Lerner index of 0.504, which implies that on average prices were 50.4 per cent above marginal costs. Lopez’s results have been criticized for being too aggregated.

Cranfield et. al. (1995) attempted to remedy this shortcoming by examining the food processing sector at a more disaggregated level: dairy processing, fruit and vegetable processing, poultry processing, and the processing of meat and meat products. The authors again rejected competitive behaviour

¹¹ This approach, which is commonly referred to as an Appelbaum model, differs from empirical applications of the S-C-P approach, because it accounts for explicit optimization by firms. The approach estimates market demand equations, a complete cost system (input demands and marginal cost equations), and an explicit measure of a Lerner index $[(P-MC)/P]$.

across the more disaggregated group of food sub-sectors. Market power increased over time (1966 to 1990) for dairy, poultry and red meats, and declined for fruit and vegetable processing. The average Lerner indexes were 0.390 (dairy), 0.407 (fruit and vegetables), 0.024 (poultry) and 0.374 (red meats).

In a subsequent study of beef processing alone, Cranfield (1999) found much lower levels of market power. He found that price was 12.5 per cent above marginal costs over the study period (1973-1991). In another industry-specific study, Fulton and Tang (1999) tested for competitive behaviour in the Canadian chicken industry. Their study, which examined both the processing and the retail sectors, found departures from competitive pricing in the sector. However, the source of this market power- the processing and/or the retail sector- could not be identified.

While the prior empirical research on market power in Canadian food processing indicates a departure from competitive behavior, the studies do not provide much information about the impact of trade liberalization on the exercise of market power. We attempt to provide more information about the relationship between concentration and market power by reverting to a S-C-P approach of estimating the relationship between a price-cost margin and various proxies for industry structure¹². Rather than following the standard S-C-P approach of cross sectional estimation, price-average variable cost margins for selected food sub-sectors are regressed on structural variables over time.

Given data limitations, the estimation period is restricted to the period 1983-96. The price-average variable cost margins are calculated by taking the value of shipments less materials costs less wages and salaries and dividing this term by the value of shipments¹³. This margin is a proxy for a Lerner index with average variable costs. The explanatory variables, which are intended as

¹² Many economists examine the relationship between average variable cost margins, based on Census of Manufacturing data, and various proxies for industry structure such as concentration ratios, capital to output ratio and other variables deemed important. For an example of this approach see Domowitz, Hubbard and Petersen (1986).

¹³ The price-average variable cost margin is typically calculated as sales revenues minus payroll minus material costs, all divided by sales (Carlton and Perloff, 1999). As an alternative to the margin discussed in the text, we also calculated the margins as the difference between industrial product price indexes and materials cost indexes. For the most part this alternative definition of the mark-up did not produce significantly different results.

Table 2: Estimation Results.

	<i>Elasticity of concentration</i>	<i>CUSTA Dummy</i>	<i>Change in Concentration</i>	<i>average margin</i>	<i>average annual margin growth (percent)</i>
Poultry	1.20**	nss	↑	11	8
Fluid milk	0.40**	nss	n/c	17	2
Other dairy	1.30*	nss	↑	20	2
Bakery	0.70*	nss	n/c	26	1
Vegetable oil	0.60*	nss	↑	13	10
Snacks	0.66*	nss	↑	43	2
Fruit and vegetables	nss	nss	n/c	32	1
Flour	nss	4%*	n/c	13	3
Feed	nss	2%**	↓	15	2
Pre mixes and cereals	nss	nss	↑	44	1
Sugar confections	nss	nss	n/c	33	0
Pasta	nss	12%**	n/c	27	5
Meat	-0.39*	nss	↓	11	3

Source: Estimated by authors.

nss = not statistically significant from zero

*significant at 95% confidence level

** significant at 90% confidence level

proxies for industry structure, are the Herfindahl index and the ratio of the capital stock to the value of shipments. A dummy variable is included to account for the post-CUSTA period¹⁴.

Table 2 presents a summary of the estimation results for a selection of food sub-sectors. The first column of Table 2 gives the elasticity of the price mark-up with respect to changes in concentration (changes in the Herfindahl

¹⁴ It would be desirable to include measures of trade intensity in the estimation, but due to introduction of H-S system these data are only available on four-digit SIC basis subsequent to 1988.

index). The second column shows the change in mark-up associated with a change in trade policy regimes (i.e., the introduction of CUSTA). These numbers in column one are reported in percentage terms since the mark-up is a percent of average variable cost. The final two columns are descriptive statistics showing the average mark-up and average annual growth rate in the mark-up for the sample period 1983-96. Details of the empirical estimates are provided in Appendix 1.

The results in Table 2 are similar to many previous S-C-P type studies that "have difficulty detecting economically and statistically significant effects of concentration on performance" (Carlton and Perloff, 1999). This difficulty in finding a relationship between concentration and market power may be a result of data limitations (see discussion earlier in the paper), specification error, or problems with the level of aggregation.

Two general observations can be made from Table 2. First, those sectors which show a statistically significant positive relationship between concentration and market power are generally those sectors which have seen a significant increase in concentration over time. As a result, there appears to be some support for the standard S-C-P proposition that rising concentration does affect price margins. Second, the dummy variable for CUSTA is only statistically significant in three sectors. The lack of a connection between the trade liberalization and mark-ups across a large number of sectors of Canadian agribusiness suggests that other factors besides trade are at work in explaining the industrial conduct of these industries. The rest of this section looks at these sector-specific factors.

A significant positive relationship between concentration and market power is found in the supply-managed sectors of other dairy products, poultry products, and fluid milk, as well as in the bakery, vegetable oil and snacks sectors. The concentration elasticities for poultry and other dairy products exceed unity while elasticities for the non-supply managed sectors are inelastic. The connection between concentration and market power for the supply-managed sectors is consistent with earlier studies (Cranfield et. al. 1995, Fulton and Tang 1999). A note of caution is again in order, however, dairy and

poultry processing in the United States have also become increasingly concentrated and concerns about potential abuse of market power exist there as well.

The significant negative relationship between the Herfindahl index and the mark-up for meat and meat products is a matter of interest, and is further explored below¹⁵. For the U.S. beef packing sector MacDonald (2001) found that although concentration was increasing dramatically, the farm-wholesale price spread had decreased over time. While the results of this paper find a similar negative relationship between concentration and mark-ups, the measured change in concentration in the Canadian case is exactly the opposite to what MacDonald (2001) found, i.e., in Canada, the numbers show an increasing margin with less concentration.

How can the differences between Canada and the United States be reconciled? Much of the difference stems from the aggregation of the data used in this analysis. As pointed out earlier in the paper, the data used in Table 2 contain both the slaughter sector and the further processing sector. As in the United States, concentration in Canada has been rising at the slaughter level. Concentration at the further processing level in Canada, however, appears to be falling.

To make a meaningful comparison with U.S. data, the five-digit Annual Survey of Manufactures data should be used to focus specifically on the slaughter industry. However, this information is not publicly available for Canada so an approximation must be made. MacDonald calculated a deflated price spread between what packers pay for animals and what they receive for beef, with adjustments for transportation and slaughter costs and profits. Given data limitations, an approximate Canada wholesale-farm price margin for beef was calculated as the difference between the industrial product price index for fresh and frozen beef (Statistics Canada, 2001b) and the material products price index for slaughter cattle and calves (Statistics Canada, 2001b). This margin was then divided by the industrial product price index to get an approximation of a mark-up. Figure 1 shows the wholesale-farm price mark-up for beef. Although this approximated mark-up is not directly comparable to MacDonald's spreads, it indicates that cattle prices were not outpaced by beef prices and that the

¹⁵ Cranfield et.al. (1995) also obtained a significant negative coefficient on the Herfindahl index in their red meats mark-up equation.

Figure 1: Beef Wholesale-Farm Price Mark-ups, 1981-2000.

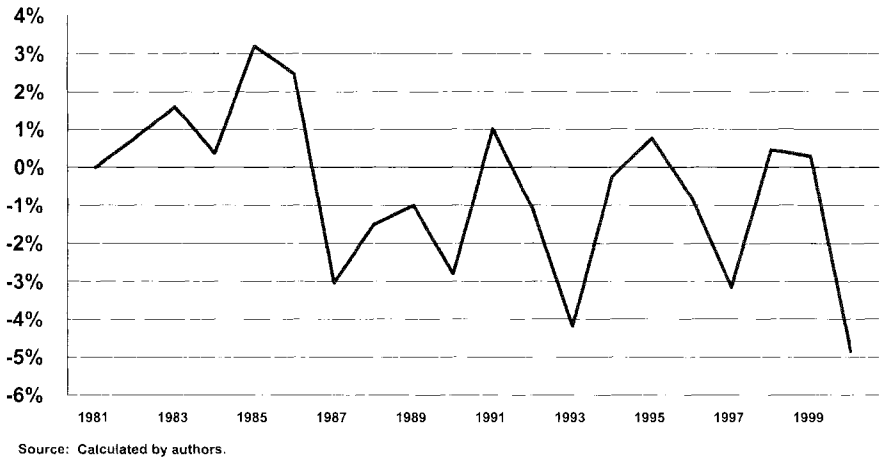
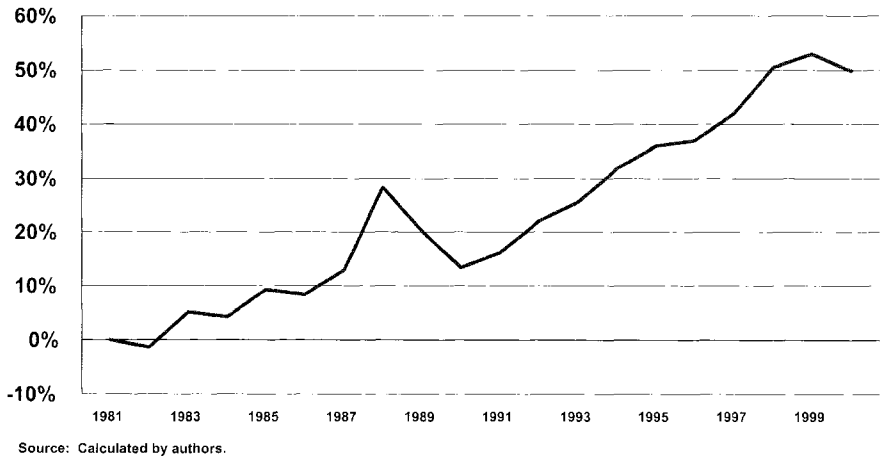


Figure 2: Pork Wholesale-Farm Price Mark-Ups, 1981-2000.



margin has in general trended downward as the four-firm concentration rate increased from the mid-30s to almost 80 per cent. Thus, MacDonald’s conclusion of “hard competition with high concentration” also appears to apply for Canadian beef packing.

A comparison of hog and pork prices is made using the industrial product price index for fresh and frozen pork and the raw materials price index for hogs for slaughter. Figure 2 shows the proportional mark-up is increasing over time; federally inspected hog slaughter is also slowly becoming more concentrated over time. On the surface, this positive relation between mark-up and concentration implies the existence of market power. However, it is also possible that the rising mark-up is due to increasing processing costs as the amount of value added pork products increases. It is not possible to answer this question at this point without further information that is not available.

The significant relationship between concentration and price-average variable cost mark-ups for vegetable oils and bakery products also raises questions. Oilseed crush margins are notoriously variable, yet the price-average variable cost margin increases over the sample period. A comparison of industrial and raw product price indices for the sample period indicates significant fluctuations in the price spread. The production of bakery products has tended to shift from independent establishments to in-store supermarket bakeries. While this may put upward pressure on bakery concentration, it is questionable whether prices will rise given the practice of using bread as a "loss leader". The results for both of these sectors raise questions about the reliability of the data and the need for further disaggregated analysis.

The nitrogen fertilizer sector has also been subject to suspicions of abuse of market power and in 1998 the Competition Bureau initiated an inquiry into the practices of one manufacturer/vertically integrated distributor. However, there was insufficient evidence to support the allegations and the inquiry was closed (Chandler and Jackson, 2000). Payne (1998) examined pricing practices for nitrogen fertilizer in a spatial context. He found no relationship between price and distance in western Canada. In fact none of competitive-behavior, base-point pricing, or collusion was supported by the price/distance data. Payne concluded that the U.S. market is the focus for Canadian nitrogen fertilizer producers and that Canada was a secondary market. Uniform pricing throughout western Canada might be a strategy to avoid charges of dumping into the U.S. market. The ability to pursue this strategy indicates some degree of market power.

McEwan and Deen (1997) examined pesticide pricing in Canada. They found that over time there was strong price competition in the pesticide market. However, their focus was mostly with the distribution and retail levels of the market and they did not examine the North American pesticide supply chain for evidence of market power. They did conclude that the pricing of product is only marginally influenced by the cost of production.

The Competition Bureau initiated an inquiry of Monsanto's canola marketing practices under the tied selling, exclusive dealing and abuse of dominant provisions of the Competition Act. With a tie-in sale a customer can buy one product only if another product is purchased. The Competition Bureau concluded that under Monsanto's new marketing program, there is no restriction on the ability of farmers to use any brand of glyphosate herbicide registered for use with its herbicide tolerant seed. As a result the inquiry was discontinued. (Chandler and Jackson, 2000).

As scientific innovations increase the interdependence between agricultural inputs, issues surrounding vertical market restrictions and vertical market conduct will increasingly surface. Researchers in agricultural economics are beginning to pay attention to the strategies that are used by firms to exploit these vertical relationships. For instance, Hennessy and Hayes (2000) examined product tying in agri-chemical and seed markets by looking at the motivation and behavior of some of the participants in the glyphosate and 'Round-up' ready soybeans markets. A great deal more attention will be paid to abuse of market power between vertical markets in future research.

CONCLUDING REMARKS

The purpose of this paper was to examine the issues of whether more, larger markets result in greater concentration and whether greater concentration results in a greater exercise of market power. The focus of the study is the Canadian agribusiness sector over the period 1983-96. Examining the first question, the results of this paper suggest that there is little connection between larger markets and market concentration. The paper could identify only a few instances where increased market size (as measured by trade liberalization in the form of CUSTA) lead to changes in concentration. While concentration is

rising in some parts of the Canadian agribusiness sector, the increase appears to be associated with industry-specific factors and not trade liberalization. Likewise falling concentration ratios, although confined to only a very few sectors, appears not be linked to trade liberalization.

On the second question, the results of this paper show that in a number of agribusiness sectors there is a positive relationship between greater concentration and the exercise of market power. Sectors in which the exercise of market power appear to be a concern are poultry products, fluid and other dairy products, vegetable oil, snack foods, and bakery products. Flour¹⁶, feed, and prepared flour mixes and cereals, fruit and vegetable processing, and sugar and chocolate confections did not appear to represent a problem with market power. However, as is discussed below, these results should be treated with some hesitation, since further research is required.

An important corollary to both of these results is that detailed sector information is required to identify the source of market concentration and to understand the relationship between market concentration and the exercise of market power (Palsson and Monteiro, 2001). One of the findings of this paper is that both data and research on market concentration in Canadian agriculture is generally lacking. Undertaking the research that is necessary to fully understand the many issues involved in industrial structure will require efforts in a number of areas.

Determining concentration requires a definition of the relevant market. This relevant market will have different geographic bounds depending on what product is being studied. For example, the relevant market for feed mills that serve a local market will be different than a biotechnology based seed/herbicide market that may be global or North American at its smallest delineation. Relatively little information on measures of concentration is available on a regional basis¹⁷. Concentration measures do not cross international borders

¹⁶ Late in 1997 ADM acquired the milling assets of Maple Leaf Mills Inc. The Competition Tribunal reviewed this acquisition and issued a consent order requiring ADM to divest some of its assets.

¹⁷ In Canada, although regional information on concentration is publicly available for hog and cattle slaughter it is not readily available for other markets.

and other relevant industrial data has only just become available with cross-border concordances in the new North American Industrial Classifications System. Relevant markets do not always respect vertical boundaries as in the case of vertical restraints in seed and pesticide products where dominant players are vertically integrated between these markets. There is virtually no information on concentration between vertical markets.

While this study was able to identify evidence of increased concentration, it was not able to identify trade liberalization as a major cause. In fact, the authors speculate that concentration was driven by other factors including supply management, cost structures, and the local nature of some markets. But conjecture must be backed up by evidence and to date this evidence does not exist. Empirical evidence on the cost structure of meat processing industries, which is available for the United States, is not available for Canada¹⁸. To obtain this information detailed plant specific data sets are required which are not available outside of Statistics Canada.

Two of the problem areas identified involve supply managed products which have not been exposed to trade liberalization. Will complete trade liberalization lead to less concentration in these sub-sectors and therefore reduce the amount of market power exercised? It is not clear that an expanded market will lead to less concentration. Although neither dairy nor poultry processing involves large research expenditure, advertising expenditures on dairy products can be important (Goddard and Tielu, 1995). As Sutton predicts, increased market size may not reduce concentration because of the endogenous sunk costs in advertising. Problems with vertical integration in the U. S. poultry industry might be imported to Canada in an open market. As such there is always a danger of swapping one form of distortion for another.

Although this study was unable to find a strong link between industry concentration and trade liberalization, concentration remains a problem in number of Canadian agrifood sectors. The problems associated with increased con-

¹⁸ See for instance Ollinger, MacDonald, and Madison (2000) cost function estimates of structural change in the United States poultry sectors and MacDonald, Ollinger, Nelson and Handy (2000) cost function estimates of the meat packing sector and the associated implications for consolidation.

centration are further exacerbated by structural changes in agriculture. Domestic competition policy remains a viable means of dealing with increased concentration due to mergers and non-competitive pricing behavior. Domestic competition laws can be viewed as complementing trade liberalization agreements by ensuring that the benefits of such agreements are realized and not negated by private restraints to trade. Firms are unlikely to have market power where entry into a particular industry is relatively easy and trade liberalization should improve the conditions for easy entry.

However, trade liberalization creates problems for competition policy and its enforcement. National competition laws face jurisdictional limitations as multinational companies expand their enterprise, possibly with anti-competitive activity. Further, except for mergers, competition laws are not equipped to handle structural problems. Two alternative methods of strengthening competition policy are by international cooperation¹⁹ or by harmonization of national competition policies including the strengthening of structural remedies. A description and analysis of these alternative approaches is a subject for further research.

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¹⁹ International cooperation in competition policy involves voluntary codes of conduct through the OECD and UNCTAD and through bilateral agreements for information exchange among competition authorities in a number of countries.

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APPENDIX 1**Table A1: Estimation Results**

	<i>constant</i>	<i>Herf</i>	<i>K/shipment</i>	<i>dummy</i>	<i>r-squared</i>	<i>D-W</i>
meat	0.07 (1.24)	-0.93 (-2.11)	0.74 (1.71)	-0.01 (-0.99)	0.66	1.79
poultry	- 0.01 (-0.09)	2.30 (1.55)	-0.24 (-0.77)	0.02 (0.69)	0.76	1.79
fruit and vegetables	0.34 (2.50)	1.10 (1.28)	-0.42 (-1.34)	0.01 (1.22)	0.37	1.53
dairy	-0.08 (-0.94)	2.49 (2.10)	0.28 (1.36)	-0.04 (-1.09)	0.65	1.27
flour	0.04 (0.56)	0.02 (0.05)	0.45 (3.77)	0.04 (6.11)	0.87	2.16
feed	0.15 (2.98)	-1.96 (-0.86)	0.17 (1.38)	0.02 (1.71)	0.38	1.38
pre mix cereal	0.50 (5.23)	0.01 (0.02)	-0.11 (-2.00)	0.02 (1.04)	0.67	2.76
vegetable oil	-0.04 (-1.79)	0.30 (3.97)	0.56 (4.81)	0.01 (0.78)	0.90	2.22
snacks	0.28 (1.60)	0.92 (1.79)	-0.48 (-1.52)	-0.01 (-0.30)	0.69	1.12
pasta	0.29 (0.60)	-0.66 (-0.35)	0.15 (0.83)	0.12 (1.51)	0.58	1.90
bakery	0.12 (1.10)	1.59 (5.78)	-0.21 (-0.54)	0.03 (1.27)	0.80	1.88
fluid milk	0.19 (1.94)	0.85 (1.55)	-8.13 (-1.16)	-0.02 (-1.24)	0.37	1.60
sug conf	0.36 (6.25)	0.08 (0.12)	-0.08 (-0.43)	0.01 (0.76)	0.13	1.32

Note: t-statistics in brackets

Source: Base data Statistics Canada, (2000c)