Trade Liberalization and International Merger in Cournot Industries: The Case of Barley Malting in North America

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Abstract

The argument that we put forward and examine in this paper is that when a free trade policy merges formally distinct markets characterized by stable Cournot oligopolies and having similar cost structures, additional incentives are created for mergers within the newly combined industry that affect the gains from free trade. We use a Cournot-Nash oligopoly model to examine the incentives for malting company mergers following Canadian-U.S. free trade agreement. Mergers reduce the free trade gains to malt consumers and malt barley producers, while the producer surplus in the malting industry increases. Overall, mergers increase the total gains from free trade beyond those without mergers

Open borders lead to increased discipline in industry pricing in the domestic market in much the same way they discipline domestic government policy (see Sumner and Halstrom 1997). The argument examined in this paper is that when a free trade policy creates a single market from formally distinct markets, the increased number of firms in the marketplace increases competition and drives down prices, which under some conditions increases the incentive for mergers.

The analysis was motivated by observation of the malting barley industry in Canada and the United States. In 1985, prior to the Canadian-U.S. Trade Agreement (FTA), the two domestic markets for barley malt were distinctly separated by import license requirements into Canada and import tariffs in the United States. Four firms controlled 90 percent of the Canadian malting capacity, while six firms controlled over 80 percent of the U.S. malting capacity before FTA.[1]

FTA created a free trade area by removing import licensing requirements and eliminating tariffs for both malting barley and barley malt, a process begun in 1987 and largely completed by 1995. In the period from 1985 to 1995, there were a number of mergers and joint ventures resulting in firms with plants on both sides of the border. As a result of these mergers, in 1995 five firms owned 80 percent of the malting capacity in the merged Canadian-U.S. market. Interestingly enough, despite all of the merger activity among malting firms there were very few plant closures and very little new capacity was built. Even new entrants to this industry purchased the assets of existing firms, rather than building new plants.

[1]The data on plant capacities, although not publicly available, are widely known within the industry. The data that we received from three separate industry sources were consistent.

Industry Description and a Summary of Trade Agreements

There are reasons to believe that malting technology is very similar across countries. Barley malting is a very old process that has developed over centuries. Much of the specialized equipment for barley malting is sold internationally. There is also mobility of human capital moving between plants and between countries.

In 1985 the Canadian malting industry was comprised of four firms: Canada Malt, Prairie Malt, Dominion Malt, and Westcan Malting. These firms had a combined capacity of 873,000 metric tons, and are held to be operating at 80 percent of capacity (see Johnson and Wilson, 1994). Canada Malt was by far the largest of these firms with over 53 percent of total Canadian malt capacity. Malt exports from Canada in 1986 totaled more than 300,000 metric tons; 13 percent of total exports were shipped to the United States. Two Canadian brewers ─ Molson and Labatt ─ jointly held 59 percent of the ownership of Canada Malt. Prior to FTA the malting margins for the domestic sales of malt were effectively determined within the malting industry in Canada. Import licenses and tariffs largely prevented malt and beer imports into Canada. The Canadian Wheat Board (CWB) largely controlled the price for the 30 to 40 percent of Canadian barley malted and sold internationally.

In 1985 five U.S. firms other than brewers had capacity of 2,025,181 metric tons, again thought to operate at 80 percent of capacity. Malting capacity o f 647,083 metric tons was owned by U.S. brewers. Exports from the United States have historically been quite limited; most malt exports are tied to the USDA's Export Enhancement Program (see Johnson and Wilson 1994).

Malting margins in the United States were protected from import competition by a tariff on malt that was three times as large as the tariff on barley.

The complete implementation of FTA created one market for Canadian and U.S. malting industries. By 1995 the transition to a single Canadian-US. malt market was effectively complete. The effects of FTA on the malting industry structure were primarily on ownership of existing plants rather than on construction of new plants or on shut down of old facilities.[2] There were six important changes in malting firm ownership, all of which resulted in increased concentration in the Canadian-US malting industry.

The first malting industry change was the purchase of Great Western Malting by Canada Malt in 1988, making Canada Malt the largest firm in the new merged North American industry. The second change was a purchase by Schrier of 51 percent of Prairie Malt in 1989 (the remaining ownership was held by the Saskatchewan Wheat Pool, a producers' group). The third change was Archer Daniel Midland's purchase of 65 percent of Dominion Malting. The fourth change was a joint venture between Cargill and Ladish in 1991, marking Cargill's entry into the Canadian-U.S. Malting industry. The fifth change was a new plant (85,000 metric ton capacity, 3 percent of total industry capacity) constructed by Rahr in Alberta. Finally, ConAgra entered the North American malting market by purchasing 70 percent of Canada Malt, an effort finalized in 1996.

[2]One plant was closed in Thunder Bay and one was built in Alberta during the period of interest. Both these plants were owned by Canada Malt and the result was a small change in total capacity (approximately 50,000 metric tons). One plant was closed in Thunder Bay and one was built in Alberta during the period of interest. Both these plants were owned by Canada Malt and the result was a small change in total capacity (approximately 50,000 metric tons).

Modeling the Canadian-U.S. Barley Industry

Firm Behavior

There are numerous models of the economic behavior of oligopolies that range from perfectly competitive to collusive monopolistic and monopsonistic behavior (Carlton and Perloff, 1994). The range of behavior attributed to oligopolies ranges from, at one extreme a price-setting model by Bertrand where the outcome is perfectly competitive behavior and, at the other extreme, the cartel theory where the oligopoly colludes to maximize joint profits as a cartel.[3] Neither of these two extremes are empirically appealing for barley malting. The model of Cournot-Nash behavior, where each firm considers the output of all other plants as given when output is chosen, provides a tractable and consistent intermediate case. See Fjell and Pal (1996) and Liu (1996) for examples of Cournot-Nash models.

The economics of mergers have been examined using the Cournot-Nash framework. Salant, Switzer, and Reynolds (1983) assume that *n* identical Cournot firms, all with constant marginal costs, operate within a market and achieve a Cournot-Nash equilibrium. They show that mergers have the potential to *decrease* profits of the merging entities for mergers that do not include all of the firms within a market and where no cost savings are possible from the mergers within this identical constant cost industry.[4]

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[3]Note however that the Bertrand model can give rise to the Cournot outcome if the assumption of unlimited capacity is relaxed (see Carlton and Perloff 1994 for a discussion).

[4] Aumann 1973 finds a somewhat similar result using the notion of the core and heterogeneous utility functions among traders, where a monopolist may do better to split into a number of competitive firms; this possibility, however, is not present when all firms strive to maximize profits.

Farrell and Shapiro (1990) consider many components important for understanding the results of horizontal mergers between Cournot firms. They use homogenous goods and an exogenously determined number of firms to assess the welfare implications for mergers for a number of demand and cost specifications.

There are two primary differences between our application and previous literature. First, we evaluate the welfare implications of multiple mergers within an industry, not only one merger between two firms. Second, although savings in fixed costs play an important role for the welfare analysis in both Head and Ries, and in Levin, they do not in our application. As we discussed earlier, these mergers were not accompanied by plant closures. Furthermore, the large distances between merged firms' plant locations, and the significant differences in the barley grown within these plant locations preclude substantial firm research and development cost savings.

Azzam and Schroeter (1995) apply a Cournot oligopoly model to the U.S. beef packing industry. They rely, as we do in our analysis, on previous estimates of key parameters to carry out their estimation. Most importantly, they model mergers as providing cost reductions, requiring tradeoffs between the social gains from cost reductions with the social losses from decreased competition. The primary difference between Azzam and Schroeter's application and ours is that we have an important external shock (FTA) that prompted the initiation of mergers.

Our simulation model views the Canadian-U.S. barley market at two time periods, pre- and post-trade liberalization. We assume that both the Canadian and the U.S. malting industries were operating as separate and stable Cournot oligopolies before trade liberalization.

Demand and Cost Functions.

Linear demand for homogeneous malt in each country is given by $p(X) = \alpha Z \beta X$, where X is the total output produced by n firms and $\alpha, \beta > 0$. These firms face an upward sloping supply curve for malting barley. The supply curve for malting barley is $s(X) = \gamma + \delta X$, where X is the malt equivalent of barley for the industry and $\delta > 0$. The linear derived demand for malting services is given by subtracting barley supply from malt demand, giving $p_{ms}(X) = a - bX$, again a linear function. The marginal revenue for a single malting firm in this Cournot malting industry is: $MR_i = a - bX_{-i} - 2bX_i$, where X_{-i} is the production of all firms except i and X_i is the output of firm i.

Since malting firms vary greatly in output, we allow their cost functions to vary. We know only that these firms have survived and that their outputs are considerably different; we do not know their profits. The linear marginal cost curve for firm i , derived from a quadratic cost function is given by: $MC_i = e + c_i X_i$, where $c_i > 0$ and e represents a common intercept across firms.[5] The output from firm i, given the demand and marginal cost curves, can be found by setting the marginal revenue equal to the marginal costs, giving:

(1)
$$X_i = \frac{a - bX_{-i}}{2b + c_i}$$

Linear demand and marginal cost curves satisfy the conditions for equilibrium in Farrell and Shapiro (and most theory for Cournot equilibria) — the reaction curves slope downward, and cost

[5]Note that achievable economies of scale in this industry are unlikely to be present at current production levels for two reasons. First, there were a number of firms producing under each country's stable Cournot equilibrium before the free trade agreement. Second, when mergers or joint ventures occurred after the free trade agreement, they have not been accompanied by plant closures or new construction.

intersects demand from below. Our linear marginal cost structure (e, c_i) was constrained to parsimoniously match observable behavior in which firms vary widely in output and small firms remain in production with trade liberalization.

The Impacts of the Free Trade Agreement on the Canadian-U.S. Malting Industry

Three static regimes for the malting industry are examined: pre-FTA, post-FTA allowing no mergers, and post-FTA after mergers. The following constructed curves were common to all three regimes: a demand curve within each country, each firm's premerger marginal cost function, and the supply curve for barley in each country. The marginal cost curve went through the origin for each firm (i.e. $e = 0$). The malting plants that were owned by the brewing industry were excluded throughout the analysis since their malt output was traded internally. A Cournot-Nash outcome was estimated for each of the three regimes.

Before FTA the four firms in Canada were assumed to face a linear demand curve for malt that was separate from the linear demand curve faced by the seven U.S. malting firms. The Canadian malt demand curve was made somewhat more elastic (-2.0 versus -1.0) to account for a larger proportion of exports. After FTA these separate linear demand curves were horizontally summed to create a single Canadian-U.S. demand.

As a starting point for comparison, we assumed that each plant was producing at 80 percent of capacity, the price of barley was $133 per metric ton, and barley costs made up 60 percent of the $222 per metric ton price of malt (all prices in U.S. dollars).[6] The marginal cost for each firm was calculated to be consistent with the observed prices and outputs, assuming Cournot

[6]Industry sources take barley to be 60 percent of the price of malt. The barley price of $133 per metric ton is an approximate current price.

conjectures for each firm. The prices, costs, and quantities were then used to calculate firm profits, malt consumer surplus, and malting barley producer surplus.

To examine the effects of free trade and the subsequent mergers, the pre-FTA outcomes from the separate and stable Cournot oligopolies were compared to the two post-FTA situations (no merger and mergers). In all cases the firms' marginal cost curves are those estimated for the pre-FTA case, with output for each enterprise constrained by capacity.

Results

The Effects of Free Trade on Firm Output

The first column of Table 1 lists the firms present in 1985 and also reflects the mergers after 1985. For example, Prairie Malt merged with Schrier in 1989. The second column in Table 1 lists the slopes for the marginal cost curves for each firm estimated from the pre-FTA equilibria.

Columns three and four give the firm output levels and marginal costs estimated from the pre-FTA regime. The fifth and sixth columns give the outputs and marginal costs after FTA but hold firm structure constant (allow no mergers). Total industry output increases by over 6 percent relative to that before FTA due to increased competition among the eleven firms.

The seventh and eighth columns give the post-FTA outputs and marginal costs after accounting for the observed merger activity (from eleven to five firms). The marginal costs are now equal across previously separate enterprises (subject to capacity constraints), reflecting optimal allocation of production.

Prices, Profits, and Welfare

Table 2 presents the prices, quantities, and welfare measures for malt producers, malt consumers, and barley producers in the three regimes. The percentage changes in these economic

variables as a result of FTA but without mergers are listed in the third column of Table 2. The malt price, the price for malting services, and producer surplus for malting firms decrease as firms within the industry face increased competition. Malt consumer surplus, malt barley producer surplus, and malt barley price increase because of the increased industry output. Total welfare increases by 2 percent, as losses by the malting industry are more than offset by surplus gains upstream and downstream from the firms.

The percentage changes from the net effects of FTA, including industry mergers, are given in the fifth column of Table 2. The percentage differences in the post-FTA situation created by mergers are reported in the fourth column. Mergers reduce the free trade gains to malt consumers, malt barley producers, while the producer surplus in the malting industry increases.

Merging firms decreased their output by about 21 percent relative to output before FTA, while nonmerging firms increased their output by about 19 percent, reflecting the new Cournot solution. Merging firms increased producer surplus about 34 percent from the pre-FTA levels, while nonmerging firms saw an approximate 7 percent increase in producer surplus relative to that before FTA. Relative to the pre-FTA period, malt production in Canada increased by over 12 percent, whereas in the U.S. malt production dropped slightly.

Perhaps most notable is the increase in total (social) surplus when mergers occur. The economic gain created by the reduced costs of merging firms more that offsets the augmentation of market power. Mergers created gains over and above those from free commodity trade.

We carried out a series of sensitivity analyses over our results but do not address them at length due to space considerations. These analyses examined assumptions about cost synergies, elasticities, and cost structure. The important results for the sensitivity analyses are that (1) the

quantitative results change in the expected direction, (2) the qualitative (sign) effects on economic measures are unchanged across the quantitative changes, and (3) the magnitudes of the effects of FTA are relatively robust to these sensitivity analyses.

Summary and Conclusions

Theories of comparative advantage can explain the expansion in trade after restrictions are reduced or removed. The substitution of capital and mobile factors of production for low-cost, less mobile factors, such as labor, has also been studied extensively. In this paper we examine the incentive for horizontal mergers across international borders when trade is liberalized. For the malting industry, we show that the observed mergers are consistent with an economic response to the creation of the freer trade. Using a simple Cournot oligopoly model, we show that although these mergers reduce competition, they can have a welfare enhancing effect in our analysis.

In this paper we rely on the single example of Canadian and U.S. malting industry for our empirical content. The question remains as to how general the effect of free trade on horizontal mergers actually is. If this process is a general phenomena we should see mergers occurring with greater frequency in commodities that tend to be produced in oligopolistic industries, in commodities where reduced trade costs have merged formally distinct markets, in countries that have entered free trade agreements, and where interregional barriers are being removed.

There is a need to examine in greater detail the potential effects of mergers stemming from free trade, particularly when this freer trade is the result of bilateral or regional trade agreements. In our example, the mergers reduced non-industry welfare while enhancing firm welfare and total welfare. The potential does exist, however, that such mergers may more than offset the cost savings stemming from free trade. Under what conditions should mergers be facilitated? Are

there conditions under which the mergers should be blocked? To what extent should competition policy be amended to take these effects into account? These are important policy questions that need to be addressed.

Table 1: Simulated firm-level effects of FTA and mergers (base case)

Firm	Slope of Enterprise Marginal Cost	Pre-FTA		FTA, No Merger		FTA with Merger	
		Quantity	Enterprise Marginal Cost	Quantity	Enterprise Marginal Cost	Quantity	Enterprise Marginal Cost
Canada Malt[Can]	0.050	225.5	11.2	281.8	14.0	281.8[1]	20.8
Great Western[US]	0.155	272.0	42.0	271.1	41.9	134.3	20.8
ConAgra	0.155					416.1	20.8
Schreir[US]	0.717	100.0	71.7	87.8	62.9	72.5	52.0
Prairie Malt[Can]	0.273	144.0	39.3	180.0	49.1	190.6	52.0
Prairie Malt/Schreier	0.198					263.1	52.0
Dominion Malt[Can]	0.863	73.6	63.5	74.7	64.5	53.9	46.6
ADM[US]	0.182	251.2	45.6	246.4	44.7	256.4	46.6
Dominion Malt/ADM	0.150					310.3	46.6
West Can[Can]	0.876	72.8	63.8	73.7	64.6	52.5	46.0
Rahr[US]	0.175	256.0	44.8	252.0	44.1	262.9	46.0
West Can/Rahl	0.146					315.3	46.0
Cargill/Ladish[US]	0.024	452.0	11.0	524.6	12.8	565.0	13.8
Froedtert[US]	0.141	284.0	40.0	285.8	40.2	321.6	45.3
Minnesota[US]	1.271	61.6	78.3	52.7	67.0	59.3	75.4
Total		2192.7		2330.7		2250.9	

[1] Operating at the capacity constraint, marginal cost equal to the Great Western plants.
[Can] Indicates plant location in Canada.
[US] Indicates plant location in the United States.

Table 2: Simulated effects of free trade and mergers on the malting industry

Economic Variable	Pre-FTA (base case)	Without Merger Change	Merger change	Combined FTA & Merger Change
Prices[1]				
Malting services	89	-17.8%	12.5%	-7.5%
Malt	222	-5.1%	3.1%	-2.1%
Barley	133	3.1%	-1.8%	1.3%
Quantity malted				
Canadian locations	516	18.3%	-5.1%	12.2%
U.S. locations	1,677	2.6%	-2.8%	-0.3%
Merging firms	1,646	-10.9%	-11.1%	-20.7%
Nonmerging firms	798	8.2%	9.6%	18.6%
Total quantity malted	2,193	6.3%	-3.4%	2.7%
Malting industry producer surplus				
Merging firms	94,497	-19.0%	66.0%	34.4%
Nonmerging firms	60,323	-13.5%	23.4%	6.7%
Total	154,820	-16.9%	48.7%	23.6%
Overall welfare effects				
Malt consumer surplus	214,970	11.9%	-6.2%	4.9%
Barley producer surplus	73,089	13.0%	-6.7%	5.4%
Malting firm producer surplus	154,820	-16.9%	48.7%	23.6%
Total welfare	442,878	2.0%	9.3%	11.5%

[1] Prices and quantities given on a dollar per metric ton basis.

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