Revisiting the Impact of Trade Liberalization and Mergers on the Malting Industry of North America

Neuere Einschätzungen zu den Auswirkungen von Handelsliberalisierung und Fusionen in der Mälzerei-Industrie Nordamerikas

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Abstract

This paper builds on the work of BUSCHENA and GRAY (1999) to look at the effects of mergers in the North American malting industry as ten firms in two separated markets merged into four firms in an integrated market. We explore the sensitivity of our results to the assumption of market power. We show that welfare gains from free trade are not generally lost but can face considerable redistribution under reasonable assumptions of market power.

Varying the rival reactions did not change the result that total economic surplus with four firms after NAFTA is greater than when there were ten firms but no trade. Mergers reduce the trade gains of malt consumers and barley producers in both countries and reduce the welfare losses of malting plants in the U.S. According to our estimates, the second wave of mergers may have led to a positive total welfare effect for malting plants in Canada if the oligopoly is exercising significant market power.

Key Words

malting; oligopoly; CUSTA; NAFTA; mergers; malting barley

Zusammenfassung

Dieses Papier befasst sich mit dem Handel und den Fusionen in der nordamerikanischen Mälzerei-Industrie, in der zehn Firmen in zwei getrennten Märkten zu vier Unternehmen in einem einzigen Markt integriert wurden. Wir zeigen, dass unter realistischen Annahmen von Marktmacht die Wohlfahrtsgewinne aus dem freien Handel zwar nicht völlig verloren gehen, aber zu einem erheblichen Teil umverteilt werden können. Fusionen reduzieren die Handelsgewinne von Malzaufkäufern und Gerste-Produzenten und reduzieren die Gesamtwohlfahrtsverluste der Mälzereien.

Schlüsselwörter

Mälzereien; Oligopol; CUSTA; NAFTA; Fusionen; Braugerste

1 Introduction

In 1998, after the signing of the Canadian-U.S. Trade Agreement (CUSTA) and the North American Free Trade Agreement (NAFTA), there were six firms controlling 80% of the U.S. malt production and another four firms controlling 90% of the Canadian production. As of the winter of 2010/11, these ten firms had merged into four, which control more than 80% of the malting business in North America.[1] Group Malteurop, Cargill Inc., Grain Corp and Rahr each has annual capacity for over 500,000 metric tonnes (t) of malt production in North America (FIRST KEY AGRIBUSINESS, 2010). The original firms from 1998 and current owners of malting plants in North America are listed in table 1 along with current production capacity. Canada Malt and Great Western did merge under ConAgra and ConAgra then sold their plants to GrainCorp Malt (GRAINCORP MALT, 2011). Prairie Malt and Schreier merged in 1998 (PRAIRIE MALT LTD, 2012). Both of these plants are now listed as Cargill Plant locations (CARGILL, 2011). Dominion

[1] Although Mexico has some malt barley imports, barley production and beer production, there are no firms with more than 125,000 t in malting capacity (FIRST KEY AGRIBUSINESS, 2010).

Table 1. Original firms and current owners of malting plants in North America

Firms 2011, 1998	Current Size in '000 t (plants)
Grain Corp	**663**
Canada Malt (Canada)	(250,125,75)
Great Western (USA)	(121,92)
Cargill Inc.	**645**
Schreier (USA)	(30)
Prairie Malt (Canada)	(215)
Cargill/Ladish (USA)	(400)
Malteurop	**597**
Dominion (Canada)	(82)
ADM (USA)	(200,115)
Froedtert (USA)	(200)
Rahr Malting	**510**
West Can (Canada)	(140)
Rahr (USA)	(370)
Total Size	**2,415**

Sources: pre-CUSTA: BUSCHENA and GRAY (1999) and current size: FIRST KEY (2010)

Malt and Froedtert were bought by ADM Malting which was later bought by Malteurop in 2008 (BUSINESS JOURNAL, 2003; MALTEUROP, 2011). Finally, Rahr bought the expanded West Can in Alix, Alberta (RAHR MALTING, 2012). There were minor improvements in many of the plants that led to small changes in capacity. Some minor plants were closed and some reduced capacity. Current plant capacities are listed in brackets next to their original owners. The total tonnage for each of the four remaining firms is listed in bold font in table 1. Total capacity of these independent firms is now 2.42 million t.

The welfare implications of a first merger wave up to 1999 were analyzed by BUSCHENA and GRAY (1999) using a Cournot-Nash oligopoly model for the North American barley malting industry, as the 10 firms had merged or were planning to merge into seven firms. Their results that barley producers and malt consumers gained from free trade were robust to changes in the shape of their cost function and possible plant synergies. Malting firms suffered from free trade because they faced new competition and flatter demand and supply functions if Canadian and U.S. markets are integrated. The malting firms' losses were mitigated by subsequent mergers and a resulting improvement in their market power within the oligopoly model. Based on their estimation of trade and merger impacts, they found that welfare would increase under most parameter values as cost and market efficiencies in the sector would more than off-set welfare losses due to cartel pricing behaviors.

This paper looks at the subsequent mergers that brought the seven firms modeled by BUSCHENA and GRAY (1999) down to four. It also explores whether relaxing the assumptions about market power and cost for the malting firms can affect welfare throughout the system. While BUSCHENA and GRAY (1999) found that free trade gains were not significantly eroded after the early mergers, this result no longer holds with only four firms. Mergers in this model can generate cost savings by reallocating production and they can generate welfare losses through market power rents extracted from barley suppliers and malt consumers. Total welfare changes and price impacts on the downstream brewing industry caused by the subsequent recent mergers were assessed as well as the effect of reduced market power on these results.

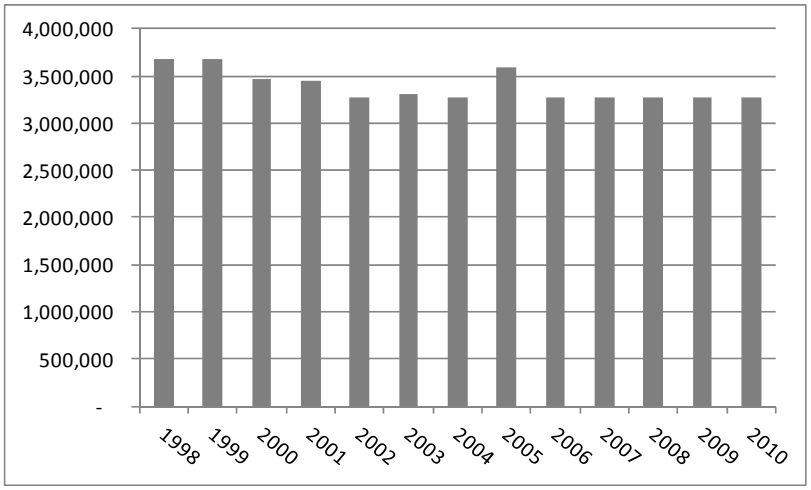
Although recent empirical work suggests the value of some mergers is negative for many shareholders (Moeller et al., 2004, 2005), there has been a significant amount of theoretical and empirical research pointing that firms benefit from mergers or acquisitions under a host of common conditions. ANDRADE et al. (2001) discussed five broad categories of theoretical reasons for mergers: (a) "efficiency-related reasons that often involve economies of scale or other 'synergies'; (b) attempts to create market power, perhaps by forming monopolies or oligopolies; (c) market discipline, as in the case of the removal of incompetent target management; (d) self-serving attempts by acquirer management to 'over-expand' and other agency costs; and (e) to take advantage of opportunities for diversification. They argue that antitrust laws have diminished mergers to acquire market power. However, NEARY (2007) presented a clear case for Cournot games of low cost firms profitably buying higher cost firms and studies by BREINLICH (2008) and BERTRAND and ZITOUNA (2006) support this with empirical evidence. Also, several researchers including NEARY (2007) and HARFORD (2005) suggest merger waves are triggered by changes in trade conditions and industrial regulations

2 The Changes in the Malting Industry in Canada and the U.S. 1998 to 2011

The markets related to malting, namely, malt, barley and beer, were distinctly separated between Canada and the U.S. prior to the Canada-U.S. Trade Agreement negotiated at the end of 1987 (BUSCHENA and GRAY, 1999). CUSTA removed most of the barriers to

trade between Canada and the U.S. In 1994, Mexico was added to this free trade region through the North American Free Trade Agreement. By 1995 virtually all tariffs on malting barley, malt and beer had been eliminated between the three partners of NAFTA. Between them, Canada and the U.S. produce around 3.2 million MT of barley malt (THOMPSON et al., 2006). In 2008, Canada exported 694,958 MT or around 68% of its capacity. Despite the falling area and production, malting plants were not decreasing their output in Canada and malting barley exports have held steady at around a million t a year for the last decade (CWB, 2011). The U.S. exported slightly less, 675,253 MT, but this represented only 30% of its capacity. Both Canada and the U.S. are net exporters of malt. Together they supply about 19% of the 7.3 million t worldwide trade in malt (FAO, 2011). Figure 1 shows the relatively stable pattern of total malting activity in Canada and the U.S. since 1998. The figure includes roughly 840,000 MT of malt produced by U.S. beer producers Coors and Anheuser-Busch (THOMPSON et al., 2006), which is not part of our analysis[2].

Figure 1. Total U.S. and Canadian malting capacity between 1998 and 2010 in metric tonnes (t)



Source: THOMPSON et al. (2006)

There has been a steady fall in the area of barley seeded in Canada (STATISTICS CANADA, 2011a). Various factors have led to this decline. First, canola in Canada has been a strong competitor for acres. Prices, improving yields and new herbicide tolerance have made canola a favourite crop for Canadian farmers.[3] Second, barley has also lost its place as a major cattle feed, in part because dry distillers grains have flooded the Canadian feed market making protein quite cheap as a feed ingredient. Barley's higher protein content meant that it was traded at a premium to corn for many years. Now it is traded at significant discount.[4] Third, increases in fusarium head blight (FHB) is another reason that farmers are moving away from barley in some areas. FHB is a fungal disease primarily found in wheat, barley and oats. FHB was originally found in the eastern prairies of Manitoba but over time it has spread to the west into Saskatchewan and Alberta and over more total area (THOMPSON et al., 2006).

The barley crop in the U.S. is forecasted to be around 4.4 million MT in 2012 (USDA, 2012) roughly 75% of the 1998 crop. Some of the same factors that have been impacting the Canadian seeded area have been leading to a reduction in U.S. seeded area. About 56% of the forecasted crop will be used for malt (AMBA, 2012). The U.S. is roughly self sufficient in barley, but it often imports Canadian malting barley and exports feed barley (USDA, 2012).

There has been steady beer demand in Canada since 1992 at just under 70 liters per capita (E-MALT, 2004). The U.S. has had a very slight upward trend in total demand, but a slight decrease in quantity per capita since 2003 (BEER INSTITUTE, 2012). This along with increasing demand in developing countries has led to strong beer demand worldwide. China, Russia, and Brazil now account for 45 billion litres of beer consumption – more than the EU or the U.S. (KIRIN, 2011). Canada and the U.S. are importing larger

[2] Note there were some offsetting capacity shifts in the late 1990s and early part of the new millennium between Canada and the US. A few US plants were closed or downsized between 1998 and 2002. Canadian capacity increased in 2001 and 2002 but it did not change the overall structure significantly. In 2005, the only major new North American plant in the last two decades, Malteurop's Great Falls plant, opened with capacity of 185,000 t. In 2006, Cargill closed its older Jefferson Junction plant which had been as large as 280,000 t, but by 2006 was only operating at 180,000 t.

[3] The big change in the Canadian barley market has been the drastic drop in feed use. 10.5 million MT was fed in 1997/98. In 2010/11 only 6.4 million MT were fed (STATISTICS CANADA, 2011b).

[4] The ICE Feed Barley Price in 2006 was $120/tn while CBOT corn was $83(Canadian Dollars)/tn. In the summer of 2011 Barley was at $210, Corn was $289(Canadian Dollars)/tn (ICE, 2011, and CME, 2011).

amounts of beer, but Canada is still a net exporter. The balance in the U.S. has shifted as new European imports have increased in the last decade. The U.S. is now a significant net importer of beer.

3 The Economic Model

Following BUSCHENA and GRAY (1999) directly but with support from NEARY (2007), BREINLICH (2008) and BERTRAND and ZITOUNA (2006) we begin with isolated markets in Canada and the U.S. prior to free trade operating in an oligopolistic market. Free trade initially increases the number of competing firms but subsequent mergers lead to the four dominant firms listed in table 1. For the purposes of this study and in order to provide empirical results directly comparable with those of BUSCHENA and GRAY (1999) for the first merger wave we employ their modeling approach which is based on a Cournot-Nash equilibrium setup.[5] It is assumed that firms with some market power choose their output that maximizes profit by taking as given the quantity produced by rival firms. Malting firms should have some degree of market power generated by local monopsonistic procurement options, but we are unsure of the degree of market power. In addition, we assume fixed costs were not a major factor in this industry[6]. Even if fixed costs were quite high, the marginal cost assumptions used below would only be affected if the optimized plants failed to be profitable even at optimized output. Despite significant shifts in barley supply and beer demand there were very few plant closures, with the only major plant closure being replaced with a newer plant of similar capacity. This allows us to model merger benefits through reductions in marginal cost and changing Cournot oligopoly solutions, as suggested by FARREL and SHAPIRO (1990) and AZZAM and SCHROETER (1995).

As in BUSCHENA and GRAY (1999), a linear inverse demand for homogeneous malt is defined for each country as: $p_m(X) = z - kX$, where X is the total output of malt by the n firms in the market and z and k are positive parameters. The firms also face an upward sloping inverse supply curve for malting barley: $p_{sb}(X) = v + wX$, where X is now a malt equivalent of barley and w is a positive parameter. These two functions, malt demand and barley supply are both solved in terms of a malt equivalent of barley. They can be combined into a linear derived inverse demand for malting services given as: $p_{ms}(X) = a - bX$ incorporating both malt demand and barley supply. Thus the p_{ms} inverse demand includes oligopoly effects in the demand for malt and oligopsony effects in the supply of barley. We clarify malting service costs below, but barley costs are already included in the p_{ms} function[7]. Total revenue for the ith firm is: $TR_i = p_{ms}(X)\ X_i = [a - b(X_i + X_{-i})]\ X_i$ with X_{-i} being the production of all other firms except the ith one. The marginal revenue for the ith firm can be given as: $MR_i = a - b(X_{-i}) - 2b\ X_i$. The linear marginal cost curve for firm i is allowed to vary with current production levels. Marginal Cost is assumed to be: $MC_i = e + c_iX_i$, where c_i is positive and firm-specific parameter and e is a common intercept across firms. We justify the common intercept on the basis of the relative stability of total capacity across our time frame.

Optimal output can be derived under these assumptions by setting marginal revenue equal to marginal cost for each firm:

$$(1)\quad X_i = \frac{a - b(X_{-i}) - e}{(2+\theta)b + c_i},$$

where θ is equal to $d\ X_{-i}/d\ X_i$ or total rival reactions and can be considered as a measure of the degree of market power exercised by firms in this market. θ=0 would indicate a Cournot solution and θ=-1 would indicate a Bertrand or competitive solution. θ>0 would indicate the move towards collusion or a monopolistic solution. (1) implies that as X_{-i} increases, X_i decreases regardless of θ and in the case where all n firms are identical $X_{-i} = (n\text{-}1)(X_i)$. This last equation shows that as n increases (decreases) a single firm's output becomes very small (large) and prices approach those of perfect competition (monopoly). As n decreases, the case of low market power becomes less

[5] We argue that a cartel is not likely given the returns to violating the cartel. On the other hand, a Bertrand competitive equilibrium is inconsistent with the mergers without plant closures.

[6] The most recent new plant in Great Falls cost $60 million in 2004 to build THE BILLINGS GAZETTE (2004). This is not insignificant but amortized over the life of the plant is low compared to annual barley costs of around $54 million and accompanying malting costs estimated by our model to be between $5 and $36 million per year. Also the impact of moderate fixed costs does not impact the optimal output levels as long as initial plants are profitable.

[7] Total revenue for marketing services is really net revenue of malt sales less barley costs all in a malt equivalent of barley. Profit = $p_mX - p_{sb}\ X$ – Malting Service Costs and $p_{ms}\ X = p_mX - p_{sb}\ X$ (or $p_{ms} = p_m - p_{sb}$).

realistic. Note that variations in the firms necessarily impact the effects of increasing firm numbers. It is possible that a very efficient firm entering the market could be welfare improving, even if it exercises considerable market power as long as prices to final users fall.

The firm-specific marginal cost slope c_i is important in modeling terms.[8] In the case that it decreases, optimal firm output will increase. Costs savings are built into the model as merging firms equalize marginal cost across plants. We do not model the costs synergies included in BUSCHENA and GRAY (1999).

4 Simulated Merger Effects

For our initial "Base case", U.S. and Canadian firms participate in separated markets with no free trade. Capacities were used to assign plants unique marginal cost curves passing through the origin using the assumed malt demand, barley supply and equation (1). Entry was not explicitly modeled. The second scenario looks at the sector after free trade. Canadian and U.S. market demands and input supplies were summed to create a single North American inverse demand for malting services. A new game was assumed and new marginal costs derived. Subsequent cases allowed the mergers from 1998 to 2011, with merged firms equalizing marginal costs across each plant starting from the original firms. Free trade may have induced mergers leading to the current structure. Malting firms likely suffered welfare losses from free trade. By merging and reducing the numbers of firms in an oligopoly market they may have gained back some of that welfare. The merger activity advanced more than originally assumed by BUSCHENA and GRAY (1999).

Both separate and grouped demand reflect observed export demand. Like BUSCHENA and GRAY (1999) we assume a malt demand elasticity of -2.0 and -1.0 for Canada and the U.S., respectively, because a larger portion of Canadian malt production is exported. Barley supply elasticity was assumed to be 2.0 for both markets. This was based on FAPRI's elasticity for Canadian barley of .37 (FAPRI, 2011) divided by .18 which is the 10 year share of malt sales of the total barley supply (CWB, 2011). We are assuming an ARMINGTON (1969) breakdown of feed and malt barley demand encompassed in the FAPRI estimate. The prices for barley, malt and malt services were set at \$300, \$500 and \$200, all in tonnes of malt equivalents. Table 1 shows the 1985 plant quantities and total production in brackets below the new owners.

For these starting values, a and b in equation (1) can be obtained using the elasticity and price values noted above. Notice that e was set to zero by the assumption of marginal cost curve passing through the origin. Once θ is set, equation (1) can be used to solve for all c_i for a given level of competition.

For our starting values, a Cournot solution was not realistic. On the first run of the base case with $\theta = 0$, and other elasticites and quantities as listed, a large firm in Canada had negative marginal costs and attempted to process unrealistically huge quantities of malt. For this reason we use $\theta = -0.1$ for the highest degree of market power. The results for that level of θ are shown in table 2. The first column lists the calculated c_i for each firm prior to the FTA. Note the different marginal costs for each starting firm in the Pre-FTA column. The next column, "FTA no Merger", shows the optimal level of production for each firm with the combined U.S. and Canadian malt demand and barley supply. The third scenario shows the results for firms merged as they were at the time of BUSCHENA and GRAY (1999) study and the last column shows the results for the firms as they are today. In these scenarios, firms are merging and adjusting plant output to equalize marginal costs. Note that less efficient, high cost, plants produce less after the merger and lower cost plants produce more. This behavior is leading to some cost reduction even with firms exercising market power.

The industry effect of the FTA and the subsequent mergers are presented in table 3, which shows the price, quantities and welfare effects at the sector level starting with the Pre-FTA base case; then the market after free trade and then the effects of the two merger waves. In the "FTA No Mergers" case the FTA combines the demand and supply of Canada and the U.S. and the number of firms in the Cournot game increase. The demand for malt and the supply of barley are less elastic, malting service prices fall and welfare falls for the malting firms but welfare increases for both barley producers and malt consu-

[8] Each of the plants listed in brackets on the far left of table 1 actually has a unique c_i, but merged behavior was assumed in initial conditions for a firm with several plants on the same side of the Canada/US border. This means that, in initial conditions for Canada Malt in Canada and Great Western and ADM in the U.S., different plant quantities are all set at the same marginal cost based on our assumed behavior of merged plants. Only one marginal cost is estimated for each firm even if they have several plants.

Table 2. Simulated firm level effects of free trade and mergers assuming high market power or θ = -0.1

	Slope of	Pre-FTA		FTA no Merger		FTA with Mergers		With 2011 Mergers	
Firm	Marginal Cost	Quantity	Marginal Cost	Quantity	Marginal Cost	Quantity	Marginal Cost	Quantity	Marginal Cost
Canada MaltCan	0.039	450.0	17.4	638.3	24.6	671.3	25.9	746.3	28.8
Great WesternUS	0.556	213.0	118.5	196.9	109.5	46.6	25.9	51.8	28.8
Grain Corp	0.036					717.9	25.9	798.0	28.8
Schreier	6.284	30.0	188.5	22.7	142.9	18.7	117.3	9.5	60.0
PrairieMalt Can	0.524	215.0	112.7	205.6	107.8	223.7	117.3	114.4	60.0
Prairie Malt/Scheier	0.484					242.3	117.3	-	-
LadishUS	0.117	400.0	46.9	476.2	55.8	529.7	62.1	511.9	60.0
Cargill	0.094							635.8	60.0
Dominion MaltCan	2.033	82.0	166.7	66.2	134.6	43.4	88.2	41.3	84.0
ADMUS	0.252	315.0	79.4	331.6	83.6	350.1	88.2	333.3	84.0
Dominion Malt/ADM	0.224					393.5	88.2	-	-
FroedtertUS	0.617	200.0	123.4	182.0	112.3	202.5	125.0	136.1	84.0
Malteurop	0.164							510.7	84.0
West CanCan	1.023	140.0	143.2	121.2	124.0	66.6	68.1	74.0	75.7
RahrUS	0.158	370.0	58.3	421.0	66.4	431.8	68.1	480.0	75.7
West Can/Rahl	0.137					498.4	68.1	554.0	75.7

Sources: initial quantities based on BUSCHENA and GRAY (1999) and FIRST KEY (2010), slopes of marginal cost estimated by authors using elasticities from BUSCHENA and GRAY (1999) and FAPRI (2011). All post FTA numbers estimated by authors.

mers.[9] In accordance with BUSCHENA and GRAY (1999) findings, the FTA without mergers had the largest impact, as the price of malting serivces decreased by 26%, and the total quatity malted fell by 10%. Free trade also reduced malting firm producer surplus by 23%. The malting industry reduced malt prices by 7.5% and increased the price of barley by 7.5%, increasing consumer surplus by 19.2% and barley producer surplus by 21.5%. These more competitive outcomes are somewhat reduced with the FTA and the mergers as reported by BUSCHENA and GRAY (1999). When the mergers up to 2011 are simulated along with the FTA, a positive pro-competitive effect on welfare survives. The price of malting services decreases by 8.9% relative to the pre-FTA baseline. The total quantity malted increases by a modest 3.5% with the growth occuring in Canada. The malt consumer surplus increases by 6.3% and barley producer surplus increases by 8.4%. The malting industry producer surplus only decreases by 1.9% relative to pre-FTA.

Table 3. Welfare effects of free trade and mergers. Percentage changes from market conditions before Free Trade Agreements (FTA) Assuming Market Power (θ = -0.1)

	Pre-FTA	FTA no Mergers	FTA with Mergers	2011 Mergers
Prices				
malting services	200	-26.35%	-18.07%	-8.92%
malt	500	-7.47%	-5.13%	-2.53%
barley	300	5.11%	3.50%	1.73%
Quantity malted '000				
Canadian locations	887	16.27%	13.30%	10.03%
US locations	1,528	6.70%	3.36%	-0.35%
Total quantity malted	2,415	10.22%	7.01%	3.46%
Welfare effects $'000				
malt consumer surplus (US)	382,000	15.51%	10.51%	5.12%
barley producer surplus (US)	114,600	21.48%	14.51%	7.04%
malting firm producer surplus (US)	245,143	-28.03%	-19.29%	-8.99%
malt consumer surplus (CND)	110,875	32.13%	21.55%	10.38%
barley producer surplus (CND)	66,525	21.48%	14.51%	7.04%
malting firm producer surplus (CND)	144,516	-16.27%	-4.04%	10.07%
Total welfare	**1,063,659**	**3.91%**	**3.50%**	**3.42%**

Source: initial quantities based on BUSCHENA and GRAY (1999) and FIRST KEY (2010); prices based on export values of malt and barley from FAO (2011). All welfare and post FTA numbers estimated by authors.

[9] These welfare measures are calculated using the ending total quantity of malt from the firm level analysis and solved prices for malt demand (p_m), barley supply(p_{sb}) and malting services (p_{ms}) discussed above.

The numbers of firms decrease and plant level marginal costs are set equal among firms as they merge in the last two columns of table 3. This leads to fewer firms in equilibrium and an erosion of welfare for barley producers and malt buyers. However, even at our highest reasonable level of market power (θ = -0.1) barley producers and malt customers are still better off than before the FTA. As of the 2011 mergers, Canadian malting firms are back to above their original welfare by 10%, and U.S. malting firms are only 8.9% less than their original levels. Barley producers and malting customers have suffered large decreases in welfare after their initial gains from free trade. They are still better off compared to the pre-FTA situation, but they are facing much worse prices than prior to the mergers. After the FTA, barley prices were estimated to increase from $300/t to $315/t for farmers and malt customers saw a price drop from $500/t to $463/t. After the 2011 mergers are incorporated into the model, barely prices fell to $305 and malt price increased to $487. This amounts to a $10/t claw back of the gains to barley producers and a $24/t reversal of the gains to malt consumers.

Perhaps the most intersting result is the relatively modest and constant total welfare gain across each senario. The FTA without mergers genrated a 3.9% increase in overall welfare. This gain is eroded slightly, to 3.5%, with the 1999 mergers and then to 3.4% with the 2011 mergers. Although considerable welfare was lost by barley producers and final malt consumers, it was nearly all gained back by the merged malting firms.

Sensitivity Analysis

The model was run at varying levels of θ and welfare measures were taken for each level of supply chain. In each case, the results were consistent with those based on the baseline parameters but were more muted, reducing the impact of the FTA and the subsequent mergers. In the extreme case, when θ was set equal to -1, there are no changes in prices, marginal costs or welfare and thus there is no real motive for merging. Table 4 shows firm level results of the simulation for the conjectural variation parameter θ = -.9 or nearly a fully competitive outcome and table 5 shows the resulting industry level impacts on prices, quantities and welfare.

We also examined the sensitivity of our assumption regarding demand and supply elasticities. At more inelastic supply and demand (-1, -0.5 and 1 for Canadian malt demand, U.S. malt demand and barley supply elasticities, respectively) a θ of 0 or higher was still unrealistic, in fact we needed to restrict θ to-0.4 or less to get reasonable results and these look very similar to table 3 for barley producers, malt consumers and total welfare. Malting firms in this case suffer bigger losses from free trade and Canadian firms do not reach the same gains from the second wave of mergers as they did in the base case although they are close to starting welfare levels by 2011.

Table 4. Simulated firm level effects assuming low market power (θ = -0.9)

	Slope of	Pre-FTA		FTA no Merger		FTA with Mergers		With 2011 Mergers	
Firm	Marginal Cost	Quantity	Marginal Cost	Quantity	Marginal Cost	Quantity	Marginal Cost	Quantity	Marginal Cost
Canada MaltCan	0.399	450.0	179.7	463.3	185.0	458.4	183.1	463.6	185.2
Great WesternUS	0.896	213.0	190.9	212.4	190.4	204.2	183.1	206.5	185.2
Grain Corp	0.276					662.6	183.1	670.2	185.2
Schreier	6.624	30.0	198.7	29.3	194.3	29.0	192.0	28.0	185.7
PrairieMalt Can	0.885	215.0	190.3	215.0	190.3	216.9	192.0	209.8	185.7
Prairie Malt/Scheier	0.781					245.8	192.0	-	-
LadishUS	0.457	400.0	183.0	407.1	186.2	411.9	188.4	406.0	185.7
Cargill	0.288							643.8	185.7
Dominion MaltCan	2.394	82.0	196.3	80.7	193.2	78.8	188.7	78.1	186.9
ADMUS	0.592	315.0	186.6	317.6	188.1	318.6	188.7	315.5	186.9
Dominion Malt/ADM	0.475					397.4	188.7	-	-
FroedtertUS	0.957	200.0	191.5	199.1	190.7	201.5	192.9	195.2	186.9
Malteurop	0.317							588.8	186.9
West CanCan	1.383	140.0	193.7	138.8	192.0	134.7	186.3	136.2	188.5
RahrUS	0.498	370.0	184.3	375.3	186.9	374.2	186.3	378.5	188.5
West Can/Rahl	0.366					508.9	186.3	514.7	188.5

Source: initial quantities based on BUSCHENA and GRAY (1999) and FIRST KEY (2010); slopes of marginal cost estimated by authors using elasticities from BUSCHENA and GRAY (1999) and FAPRI (2011). All post FTA numbers estimated by authors.

Assumptions regarding the cost curve were also checked. We introduced a more inelastic marginal cost curve by setting the shared intercept of the cost curves to -1. Again a θ of 0 or higher was unrealistic. The first value of θ for which we could obtain a reasonable equilibrium was -0.1 as in the base case. Total welfare impacts were within one percentage point to all of the values in all cells of table 3.

The most drastic impact on our results was the assumption for the value of θ. The most extreme cases are listed in tables 3 and 5. Table 6 shows the price, quantity and welfare impacts for different values of θ and table 7 shows the corresponding welfare changes. Basically all of the signs stay the same but the corresponding magnitudes are reduced towards zero as the level of market power approaches pure competition (θ =-1). The only sign change is for the Canadian malting plants which realize a net gain above pre free trade welfare levels of over 10% by 2011 when their market power is quite high (θ =-0.1). As market power falls this gain is eroded and then becomes a net loss before moving back to zero. Interestingly, the total welfare

Table 5. Market level effects assuming low market power (θ = -0.9)

	Pre-FTA	FTA no Mergers	FTA with Mergers	2011 Mergers
Prices				
malting services	200	-2.54%	-1.40%	-0.27%
malt	500	-0.72%	-0.40%	-0.08%
barley	300	0.49%	0.27%	0.05%
Quantity malted '000				
Canadian locations	887	1.22%	0.20%	0.09%
US locations	1,528	0.85%	0.74%	0.11%
Total quantity malted	2,415	0.98%	0.54%	0.10%
Welfare effects $'000				
malt consumer surplus (US)	382,000	1.44%	0.79%	0.15%
barley producer surplus (US)	114,600	1.98%	1.09%	0.21%
malting firm producer surplus (US)	163,060	-4.67%	-2.53%	-0.46%
malt consumer surplus (CND)	110,875	2.90%	1.59%	0.30%
barley producer surplus (CND)	66,525	1.98%	1.09%	0.21%
malting firm producer surplus (CND)	94,902	-4.57%	-2.51%	-0.38%
Total welfare	**931,962**	**0.04%**	**0.03%**	**0.02%**

Source: initial quantities based on BUSCHENA and GRAY (1999) and FIRST KEY (2010); prices based on export values of malt and barley from FAO (2011). All welfare and post FTA numbers estimed by authors.

Table 6. The sensitivity of free trade impacts to levels of θ or decreasing market power

	Decreasing Values of θ					
	-0.1	-0.3	-0.5	-0.7	-0.9	-1
Change in Prices						
malting services	-26.35%	-19.66%	-13.53%	-7.85%	-2.54%	0.00%
malt	-7.47%	-5.58%	-3.84%	-2.23%	-0.72%	0.00%
barley	5.11%	3.81%	2.62%	1.52%	0.49%	0.00%
Change in Quantity Total Malted	10.22%	7.62%	5.25%	3.04%	0.98%	0.00%
Change in Welfare						
malt consumer surplus (US)	15.51%	11.46%	7.82%	4.50%	1.44%	0.00%
barley producer surplus (US)	21.48%	15.83%	10.77%	6.18%	1.98%	0.00%
malting firm producer surplus (US)	-28.03%	-23.56%	-18.49%	-12.37%	-4.67%	0.00%
malt consumer surplus (CND)	32.13%	23.55%	15.94%	9.10%	2.90%	0.00%
barley producer surplus (CND)	21.48%	15.83%	10.77%	6.18%	1.98%	0.00%
malting firm producer surplus (CND)	-16.27%	-17.48%	-15.71%	-11.44%	-4.57%	0.00%
Total welfare	**3.91%**	**2.19%**	**1.05%**	**0.36%**	**0.04%**	**0.00%**

Source: estimated by authors

Table 7. The sensitivity of 2011 merger impacts to levels of θ or decreasing market power

	Decreasing Values of θ					
	-0.1	-0.3	-0.5	-0.7	-0.9	-1
Change in Prices						
malting services	-8.92%	-4.87%	-2.53%	-1.11%	-0.27%	0.00%
malt	-2.53%	-1.38%	-0.72%	-0.32%	-0.08%	0.00%
barley	1.73%	0.94%	0.49%	0.22%	0.05%	0.00%
Change in Quantity Total Malted	3.46%	1.89%	0.98%	0.43%	0.10%	0.00%
Change in Welfare						
malt consumer surplus (US)	5.12%	2.78%	1.44%	0.63%	0.15%	0.00%
barley producer surplus (US)	7.04%	3.81%	1.97%	0.86%	0.21%	0.00%
malting firm producer surplus (US)	-8.99%	-4.72%	-2.73%	-1.46%	-0.46%	0.00%
malt consumer surplus (CND)	10.38%	5.60%	2.89%	1.27%	0.30%	0.00%
barley producer surplus (CND)	7.04%	3.81%	1.97%	0.86%	0.21%	0.00%
malting firm producer surplus (CND)	10.07%	2.36%	-0.12%	-0.70%	-0.38%	0.00%
Total welfare	**3.42%**	**1.58%**	**0.66%**	**0.20%**	**0.02%**	**0.00%**
% of Free Trade Welfare Retained	87.47%	72.18%	62.61%	55.63%	50.03%	0.00%

Source: estimated by authors

gains are more immune to merger activity at higher market power levels as shown on the bottom line of table 7. The second merger wave retained 87.4% of total welfare gains from free trade at high levels of market power. At lower levels of market power only 50% is retained although the gains from free trade were very low to start with.

5 Conclusions and Discussion

Four malting firms control over 80% of the malting in Canada and the U.S. as of the summer of 2011. Like BUSCHENA and GRAY in 1999, we find that free trade in the malting sector led to welfare gains for barley producers and malt consumers that still hold even at these most recent levels of concentration. We explore the effects of lower levels of market power on these findings and show they are robust in direction, but total impacts are very low at low levels of market power.

Using the optimal output for firms with different marginal cost curves and a high level of market power, we find that free trade led to a 3.9% increase in total welfare assuming a 1998 firm structure. This was due to better prices for barley producers and more malt barley sales and lower prices for malt consumers. There were ten firms in this sector as of 1985. As these ten combined into four, the impacts of market power compound, but even at the highest levels of market power and concentration, welfare was increased for everyone except the U.S. malting firms. Recent mergers have significantly redistributed the gains from freer trade from barley producers and malt consumers to malting firms, but total welfare gains are still 3.4% over the pre free trade levels. As we relaxed the assumed level of market power and decreased the malting firms' ability to affect prices, the overall welfare impacts fall from 3.4% to less than 0.1%.

At the highest reasonable level of market power, free trade leads to a price rise of $15/t for barley producers and they see a welfare increase of over 20%. Malt consumers see a price fall of over $50/t and welfare gains of 15% in the U.S. (30% in Canada) due to free trade. Malting firms see big welfare losses as they face more competition and flatter demand and supply curves. After the mergers of recent years, our model suggests barley prices dropped nearly $10/t from the post free trade levels and malt prices increase $45/t. By 2011, Canadian malting plants are absolutely better off than they were before NAFTA and U.S. malting plants have regained much of their welfare lost due to free trade. These reversals are at the direct expense of reducing the gains made by barley producers and malt consumers from free trade. Although total welfare is still higher than before free trade, considerable redistribution has occurred in favor of the malting plants with each merger.

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