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# Impacts of Trade and Agricultural Policies on the World Malt and Malting Barley Market*

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***Abstract:*** Major changes are occurring in agricultural and trade policies that affect trade and competition in malt and malting barley. A math programing model was constructed to analyze effects of these changes. Simulations were conducted to analyze changes in EU supply and restitutions, the EEP subsidy regime, and equalizing import tariffs on malt and malting barley. Results suggest that these pressures will give rise to changes in trade flows and competitiveness between producing and exporting regions.

## Impacts of Trade and Agricultural Policies on the World Malt and Malting Barley Market

Changes are occurring in major policies that have had important effects on the evolution of trade and competition in malt and malting barley. The world supply of malting barley has been declining due in part to major agricultural policy changes in the EU and the US. Pressure also exists for changes in trade policies. The EU has traditionally used export restitutions to dispose surplus barley, and this mechanism has contributed to their dominance in the world malt trade. The US initiated the Export Enhancement Program (EEP) in 1985. Extensive use has been made of EEP subsidies, particularly on malt, though recent initiatives have targeted malting barley. One of the major issues confronting the US administration of EEP is whether to subsidize malt or malting barley exports. Both the EU and the US are under pressure to reduce explicit export subsidies. Other trade policies relevant to this sector are import tariffs. Some importing countries have configured their tariffs to favor local processing, despite that in general it is cheaper to ship malt than malting barley. Under the GATT importers are expected to reduce these tariffs.

An important aspect of trade in this industry that affects a country's competitiveness is quality differentials both in the supply of malting barley and demand for malt. The supply side is affected by the planted variety distribution and proportion of crop suitable for malting. Both vary substantially across major malting barley production regions. Brewers also have rigid quality preferences making demand very inelastic and mitigating the potential effectiveness of export subsidies. These are affected by the types of beer produced, technology used, and tradition. In practice, many brewers have adopted processes and products that favor use of two row (2R) malt, the type most countries produce (excepting the US). Bojduniak and Sturgess, Carter, Johnson and Wilson (1994b) discuss policy issues affecting malting barley production in the EU, Canada and North America respectively.

This paper analyzes effects of these changes on the spatial distribution of malt and malting barley in the world. A mathematical programming model of this sector was developed and used to analyze impacts of changes in supply and trade policies on the spatial distribution of malt and malting barley.

## ANALYTICAL MODEL

**Model Specification** The objective is to minimize the cost of satisfying world demand for malt subject to supply constraints, given transportation costs and limitations, trade policies, and quality availabilities and requirements. The model is an extension of Johnson and Wilson (1994). The component of the model pertaining to offshore flows are described briefly. Complete model details are contained in (Names withheld). The model is static and barley supplies are exogenous. Malt demand is fixed by region based on estimated beer production. Supply and demand parameters for the base case are broadly representative of conditions in the early 1990s and are varied parametrically in model simulations.

Cost elements included in the model are: the value of feed barley (opportunity cost of malting barley); barley shipment costs to malt plants and importing countries; malt shipment costs from malt plants to brewery locations; import tariffs and export subsidies on malting barley and malt. The model is more detailed for North America (NA), in that, shipment alternatives from specific production regions to malt and brewery plants are included.

The objective function is :

$$\text{MIN } W = \sum_{p}\sum_{m}\sum_{t} Y0_{pmt}[FP_p + TY0_{pm}] + \sum_{p_u}\sum_{i_u}\sum_{t} Y1_{p_u i_u t}[FP_{p_u} + TY1_{p_u i_u}] +$$

$$\sum_{p_c}\sum_{i_c}\sum_{t} Y1_{p_c i_c t}[FP_{p_c} + TY1_{p_c i_c}] + \sum_{m}\sum_{b}\sum_{t} Z0_{mbt}[MPC_m + TZ0_{mb}] +$$

$$\sum_{m_o}\sum_{j_o}\sum_{t} Z1_{m_o j_o t}[TZ1_{m_o j_o}] + \sum_{m_c}\sum_{j_c}\sum_{t} Z1_{m_o j_c t}[TZ1_{m_o j_c}] +$$

$$\sum_{i}\sum_{k}\sum_{t} Y2R_{ikt} * [\tau_k *(FP_i + TY2_{ik}) + MPC_k] +$$

$$\sum_{i_s}\sum_{k}\sum_{t} Y2S_{i_s kt} * [\tau_k *(FP_{i_s} + TY2_{i_s k} - SUBB_k) + MPC_k] +$$

$$\sum_{j}\sum_{k}\sum_{t} Z2R_{jkt} * [\delta_k * (TZ2B_{jk})] + \sum_{j_s}\sum_{k}\sum_{t} Z2S_{j_s kt} * [\delta_k * (TZ2B_{j_s k} - SUBM_k)] +$$

$$\sum_{j}\sum_{k}\sum_{t} Z3R_{jkt} * [\delta_k *(MPC_j + TZ3C_{jk})] +$$

$$\sum_{j_s}\sum_{k}\sum_{t} Z3S_{j_s kt} * [\delta_k *(MPC_{j_s} + TZ3C_{j_s}k - SUBM_k)]$$

where, W is objective function value, Y0 and Z0 are malting barley and malt flows from NA production regions to NA malt plants and malt plants to breweries, Y1 and Z1 are malting barley and malt flows form NA production regions to NA offshore ports, Y2R and Y2S are non-subsidized and subsizied malting barley shipments from ports to import demand regions, Z2R and Z2S are non-subsidized and subsidized bulk malt shipments from export locations to import demand regions, Z3R and Z3S are non-subsidized and subsidized container malt shipments from export locations to import demand regions; $\tau$ and $\delta$ are tariff on malting barley and malt charged by the importing regions, SUBB and SUBM are subsidies on malting barley and malt by exporting countries; p, m, and b are the sets of NA malting barley producing, malting, and brewing regions; t is malting barley and malt types, i and j are the sets of malting barley and malt export locations, k is the set of malting barley and malt import locations. Subscripts u, and c on p, m, i, and j refer to subsets of locations in the US, Canada, and subscript s on i, and j refer to export locations that allow subsidized malting barley and malt shipments.

FP is the feed price in $/mt in the exporting region, MPC is the malt production cost in the subscripted region, TY0 and TZ0 refer to the malting barley and malt shipping cost from production region to malt plant locations and malt plants to breweries in NA, TY1 and TZ1 are the shipping costs of malting barley and malt from production regions and plant locations to exporting locations in NA, TY2 is the malting barley shipping cost from export to importing locations, TZ2B and TZ3C are bulk and container malt shipping cost from export to import locations.

**Base Case Assumptions** The base case represents market conditions in the early 1990s, supplies of malting barley and malt and feed barley prices in exporting regions are based on 1990-92 averages. Subsidies on malting barley and malt exports are averages during the comparable period. Tariffs, obtained from an importer survey, are weighted average of countries in each region in 1993. Malting barley supplies are divided into three types: 2R; 6RW (white aleurone); and 6RB (blue aleurone). Restrictions were placed on individual countries on the portion of malt that could be comprised of 6R using actual data on malt imports during the period 1988 and 1990. There are 989 individual constraints in the model grouped into 55 blocks. Generally these entail restrictions on movements, demand-supply balance equations, quality restrictions and restrictions on vertical integration in the US beer/malting sector.

There are 23 barley production regions in the US and 7 in Canada. Barley from these regions move either to malt plants (20 in NA) or to five NA export locations. There are four malt export locations in NA and five malting barley and six malt supply ports outside of NA. The latter include Australia, the EU, Eastern Europe, and South America. Availability of malting barley and malt for export is set at recent levels for regions outside NA. For NA these are solved endogenously based on transportation costs and other factors affecting spatial equilibrium.

There are 20 malt import demand regions; some countries are treated individually and others are grouped into regions based on beer production level, malt required to produce a barrel of beer, possibility for capacity of malting, tariff levels, and preference for bulk and/or container shipments. Some regions have indigenous malt plants (e.g., China, Japan, Brazil) and can import both barley and malt; others import malt exclusively (e.g., North and West Africa, Caribbean, and Central America).

Ocean shipping costs were calculated for malt (both bulk and container) and malting barley using the Army Corp of Engineers model. Offshore shipments of malting barley are all handled in bulk but malt was allowed to be shipped in bulk or by container. Some regions can only import in containers and constraints were imposed to assure such flows.

## EMPIRICAL RESULTS

Trade flows in the base case correspond closely to those observed during early 1990s. Malting barley exports, aggregated by type, amount to 30 percent of the malt requirement of all importing regions (Table 1). Malting barley (2R) and malt exports (2R) dominate the world market and are dominated by Canada (49%) and Australia (39%). The EU has more than one half of total 2R malt exports. Shares of Australia, Canada, Eastern Europe, and South American malt exports range from 8 to 11 percent of 2R malt exports. Exports of 6R malting barley and malt comprise a small portion of overall trade and the US accounts for almost all of it. The US exports 66,000 mt of 2R malt representing 3 percent of the market.

**CAP Reform: Reducing EU Malt Export Licences** The optimal EU malt exports in the base case was limited to historical licences (1.447 mmt). Reductions in malting barley supplies would likely reduce the volume of licences granted for malt exports. Given the dominance of EU in the world malt market, these changes would have considerable effects on malt distribution in the world. Simulations were conducted to identify impacts of reduced malt availability in the EU (1 mmt) on trade flows. Results of this and other simulations are shown in Table 2.

Most changes occur in malt flows, though some malting barley flows are affected. Malting barley exports from Australia and Canada increase by almost 200,000 mt and 150,000 mt respectively. EU malt flows to Central America are replaced partly by eastern Europe. Also, EU would lose Caribbean, west and east Africa, and eastern and northern South American markets. The East African market was gained by Australia while shipments to west Africa were replaced by South American countries. The US shipments to northern South America increase by 38% while malting barley shipments from Canada and malting barley and malt shipments from South American countries replace EU shipments to eastern South America. Reductions in EU malt licences would increase shares of Canada in all of South America and Japan. The US gains shares in Caribbean, northern and eastern south America, while Australia's would increase in South Africa.

**EU Malt Export Restitution** Simulations were conducted to quantify potential impacts of reduced restitutions on flows. Imports are unchanged for reductions up to 30% in malt export refunds. Changes would occur only in the case of northern and eastern South America, and Russia. Eastern South America would import more malting barley and less of malt while Russia would import more malt and less malting barley. Changes in malting barley flows would be negligible. EU would lose northern South American malt exports to Canada and the US.

**EEP** Simulations were conducted by reducing EEP bonuses in increments of 10%. Results are summarized in Figure 1. The base case assumed a weighted average EEP bonus of $93/mt and exports were nearly 110,000 mt. Reductions in EEP bonus would reduce malt exports and exports are particularly sensitive in the 30-40% range of reductions.

Changes in flows for a 60% reduction in the bonus from the base case are shown in Table 2. Malting barley flows would remain unchanged. A reduction in EEP would reduce US 2R malt shipments by more than one half of base case levels and flows to targeted regions are affected most. Malt exports from Canada would capture US losses even though part of the motivation for EEP is directed at the EU. The EU would capture North Africa from the US. South America and EU together would replace US shipments to West Africa while Canadian malt exports to Philippines would increase.

An important policy issue in EEP administration is the extent of use to promote exports of malting barley (commodity) or malt (value added). The majority of EEP in the barley sector has been for malt with only negligible sales of malting barley. The model was used to evaluate alternative US EEP strategies. An EEP budget of $10 million (historical maximum on malt) was assumed for either malting barley or malt. For malting barley, the bonus level was iterated from $10 to 50/mt with corresponding quantity limits. Both the bonus level (in the objective function) and the quantity limit (as a constraint) were used as parameters letting the model choose the optimal destinations and size of shipments.

Net revenue was computed as the difference between the sum of product of quantity sold and the corresponding marginal value of supplies at each US port and the sum of product of quantity sold and the bonus level. Results are shown in Figure 2a. Maximum net returns of $69 million from EEP sales were at $14/mt bonus on malting barley. Comparable simulations were conducted using EEP on malt after adjusting for bonus level (1.3 times the malting barley bonus) and quantity limits (0.75 times quantity limit). A maximum net revenue of $118 million is obtained at $ 22/ mt (Figure 2b) bonus.

These results indicate that with an EEP budget of $10 million, the net revenue would be greater if entire budget is allocated to malt. These differences are primarily due to the composition and characteristics of malting barley and malt importers and incumbent competitors in each. For EEP on malting barley, the US would confront Canada (a lower cost supplier) in most markets. The primary incumbent in using EEP on malt is the EU, which has less of a relative advantage. The results also show that a lower bonus level covering a larger volume would generate greater net revenue than a combination of higher bonus and smaller volume.

**Importing Countries' Tariffs** Simulations were conducted to evaluate effects of tariff elimination on the magnitude and direction of trade flows. Of particular importance is the difference in tariff rates applied to malting barley and malt imports. A tariff reduction favors malt imports. Malting barley and malt trade composition changes as a result of importer tariff elimination; malting barley imports would decline by 100,000 mt. A drastic reduction in malting barley imports into northern South America is observed. Also, exporter shares in Japanese malt market are altered while flows to China remained at base case levels.

## CONCLUSIONS

Change of policies in major malting barley producing countries are resulting in reduced supplies. In addition, several trade policies (EU restitutions, US EEP, and importer tariffs in particular) are under pressure for change. Among numerous developments affecting the malting barley and malt sector, two are important. The US malt exports are sensitive to EEP changes, particularly in contrast to comparable changes in EU restitutions. Mainly the quality restrictions of major importing countries, favoring types of malt grown in non-US exporting regions, cause this. Also the import tariff regime has distorted the trade composition from what would otherwise be optimal. These will change trade flows and competitiveness among supplying regions.

The US has not been a major player in this sector in recent decades. Results from this study identify some major constraints for US exports. One of these is the relatively high opportunity cost of malting barley in the US (measured as feed barley value). These are not high compared to other competitors except Canada. Second is the export availability of 6R (2R is surplus in the US). Though at present not all markets readily accept 6R as a substitute for 2R, some do and these are important niche markets that the US would have an advantage in serving. However, 6R supplies are limited, which limits out ability to penetrate these markets. Third is related to the import tariff regime of malt and malting barley. These have two offsetting effects--discouraging malt trade and encouraging malting barley exports.

Both public policies and private strategies will affect the evolution of trade in this sector. Set-Aside policies, choice of EEP allocations to malt or malting barley exports, and identification of target markets are some of the public policy issues that can change the US position. Finally, though much of the thrust of international trade issues has focused on export subsidies, these results demonstrate that existence of tariff differentials on malt versus malting barley has an important effect on the composition of trade and location of processing. In future trade discussions these warrant further attention.

| Table 1. BASE MODEL: Barley and Malt Exports by Source | | | | | |
|---|---|---|---|---|---|
| | | Malting Barley | | Malt | |
| Exporting Country | Port | 6RW | 2RW | 6RW | 2RW |
| | | 000 mt | | | |
| USA | Portland | 65 | 0 | 4 | 50 |
| | Duluth | 226 | 0 | 0 | 0 |
| | Mobile | 0 | 0 | 39 | 16 |
| Canada | Thunder Bay | 0 | 282 | 0 | 0 |
| | Vancouver | 10 | 348 | 0 | 211 |
| Australia | Fremantle | 0 | 103 | 0 | 204 |
| | Sydney | 0 | 400 | 0 | 204 |
| European Union | Hamburg | 0 | 50 | 0 | 1447 |
| S. America | Buenos Aires | 0 | 100 | 0 | 242 |
| Eastern Europe | Hamburg | 0 | 0 | 0 | 305 |
| Total | | 301 | 1283 | 43 | 2679 |

Table 2. Changes in Malting Barley and Malt Flows from Base Case Levels for Changes in Export Trade Policies

| | | EU Malt Export Licences Reduced to 1 mmt | | | | | | 30% Reduction in EU Malt Restitution | | | | | | 60% Reduction in US EEP | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | USA | EU | Canada | Australia | Eastern Europe | South America | USA | EU | Canada | Australia | Eastern Europe | South America | USA | EU | Canada | Australia | Eastern Europe | South America |
| North Africa | Malt | | | | | | | | | | | | | -3 | 3 | | | | |
| Cen. Ameri. | Malt | | -45 | | | 45 | | | | | | | | -1 | -10 | | | 11 | |
| South Afri. | Malt | | | | 43 | 103 | -146 | | 242 | | -49 | | -193 | | | | 43 | | -43 |
| East Asia | M. Barley | | | 123 | | | | | | | | | | | | | | | |
| | Malt | | | | -92 | | | | | | | | | | | | | | |
| Caribbean | Malt | 14 | -14 | | | | | | | | | | | | | | | | |
| West Africa | Malt | | -119 | | | | 119 | | 50 | | | | -50 | -50 | 7 | | | | 43 |
| Philippines | Malt | | | | | | | | | | | | | -12 | | 12 | | | |
| East Africa | M. Barley | | -7 | | 25 | | -18 | | -6 | | 6 | | | | | | | | |
| NS. America | M. Barley | -24 | 6 | 18 | | | | -24 | | 24 | | | | | | | | | |
| | Malt | 90 | -90 | | | | | 18 | -82 | | | | | | | | | | |
| ES. America | M. Barley | -202 | | 102 | | | 100 | -7 | | 7 | | | | | | | | | |
| | Malt | 151 | -178 | | | | 27 | 5 | -262 | | | 15 | 242 | | | | | | |
| China | M. Barley | | | -111 | 111 | | | | | -44 | 44 | | | | | -29 | 29 | | |
| Oceana | Malt | | | | | | | | | | | | | | | | | | |
| Japan | M. Barley | | | -16 | 16 | | | | | | | | | | | | | | |
| | Malt | | | 100 | 49 | -149 | | | | -34 | 49 | -15 | | | | 54 | -43 | | -11 |
| WS America | M. Barley | | | 82 | | | -82 | | | | | | | | | | | | |
| Russia | M. Barley | | | -44 | 44 | | | | -44 | | | | | | | | | | |
| | Malt | | | | | | | | 33 | | | | | | | | | | |

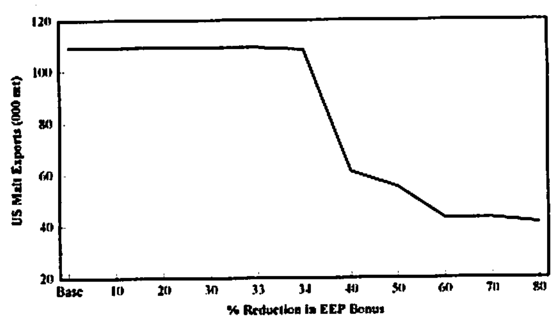


Figure 1. Reductions in US EEP Bonus and Malt Exports

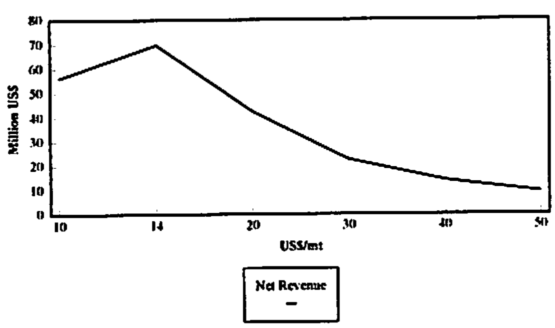


Figure 2a. Bonus Levels and Net Revenue from Malting Barley Sales Under EEP

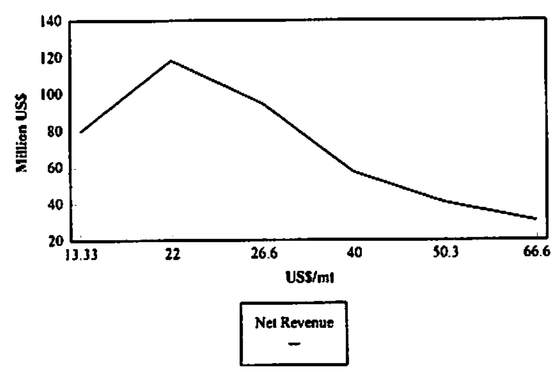


Figure 2b. Bonus Levels and Net Revenue from Malt Sales Under EEP

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