Imperfect Substitutes, Deferred Producer Payment System, and State Trading Enterprises: An Empirical Test of Leadership in the Global Malting Barley Markets

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Introduction

The role and behavior of state trading enterprises (STEs) became a sensitive and central political issue following the Uruguay Round of GATT and the subsequent development of an international hard law framework for managing trade disputes. The major issue of concern has been the single desk export marketing function of several large STEs such as the Canadian Wheat Board, Australian Wheat Board, and the Australian Barley Board. The fundamental question was whether or not STEs could maintain and/or advance a distortionary market presence while the rest of the world made significant commitments to free, undistorted trade via tariffication of quotas, scheduled tariff reductions and a real or at least perceived loss of national autonomy through the WTO trade dispute process.

Previous empirical research suggested that STEs have exerted a long-term leadership role in grain export markets (see, e.g., Paarlberg and Abbott; Schmitz and Furtan), while other studies have shown considerable skepticism about such claims (Carter; and Carter, Lyons and Berwald). Carter et. al's scathing assessment of the CWB's cost management practices seems to suggest that even if any rents are captured from the export market, they do not pass to farmers in Canada. Furthermore, until recently, all of the past empirical literature lacks a consistent argument to explain the mechanism through which an STE could maintain such a leadership position. Consequently, the empirical evidence supporting claims of market leadership was either indirect or anecdotal.

Hamilton and Stiegert indicate that the deferred producer payment system used by most STE's could provide the very mechanism to generate a leadership outcome. The STEs typically pay upstream producers a below-market price, and then later provide lump-sum reimbursement after proceeds are generated in a downstream international market. The delayed payment approach is capable of creating a credible marginal cost advantage for STEs in the international market. In this way, the prepayment system becomes the critical precommitment mechanism necessary for market leadership (Brander and Spencer, 1984, 1985).

Hamilton and Stiegert (2002) found that the observed levels of deferred payments used by the Canadian Wheat Board in international durum markets were statistically not different from the Stackelberg leader markdown in 17 of 23 study years. Further, the Wilcoxen nonparametric test failed to reject the null hypothesis that the deferred producer payment system generated the Stackelberg leadership. While the durum market is not large relative to other feed and food grains, this initial study pointed to a very plausible explanation for why the CWB could attain its perceived price leadership status in hard wheat markets.

In this paper, we wish to extend from Hamilton and Stiegert to develop the theoretical framework to consider multiple STEs competing for exports with differentiated products. Specifically we build a framework that is parameter driven and links easily to a test of market leadership for the Canadian Wheat Board (CWB) and Australian Barley Board (ABB) in the world malting barley market.

Background

The CWB and ABB: The major exporters of bulk malting barley are Australia, Canada, and the European Union. They account for about 90% of the world malting barley

exports in the year 1996-97, with market shares of about 52%, 32% and 6%, respectively (Center for international Economics (CIE)). The Canadian Wheat board (CWB) and the Australian Barley Board (ABB) are the two STEs operating in the international market for malting barley. The CWB is a single-desk state trading agency responsible for the marketing of all wheat and barley sold for human domestic consumption and for export with the jurisdiction over Alberta, Saskatchewan, Manitoba, and a small section of British Columbia. Those areas typically produce 95 percent of the Canadian barley crop. The ABB oversees only barley marketing; Australian wheat is marketed through a separate STE (Australian Wheat Board).

One of the major responsibilities of the CWB is to market wheat and barley in order to maximize returns to prairie producers. At the beginning of each crop year, the government establishes initial producer payments for grain sold to the CWB. The initial payment is usually well below the final pooled price, normally set at 70 to 85 percent of the total estimated pool return. The farmers get an initial payment upon delivery, which is guaranteed by the government. Once the CWB has marketed all the grain in a particular pool, the revenue is pooled, and freight and handling charges are deducted. If returns to pool exceed the sum of initial payment, then a final payment is distributed to each individual producer based on the relative producer share of grain in that particular pool. Should returns fall short, the federal government will make up the difference.

Australia produces barley in 5 states: South Australia, Victoria, Western Australia, New South Wales, and Queensland. The Australian Barley Board (ABB) has the sole right to export barley grown in South Australia and Victoria. The ABB accounted for about 56% of barley exports from Australia in 1995-96 (57% for feed barley and 54% for malting

barley)(CIE). The domestic market for malting barley is effectively controlled through the single desk power of the ABB. One of the objectives of the ABB is to maximize the net returns to Victorian and South Australian growers who deliver barley or other grain to a pool of the Board by securing, developing and maintaining markets for grain, and minimizing costs as far as practicable (Victorian and South Australian Barley Marketing Act 1993). The ABB's prepayment system is similar to that of CWB. In 1999, the ABB was privatized and changed to ABB Grain Ltd. It's single desk export rights for barley from South Australia and Victoria was exempted in July, 2001.

Supply and Demand of Malting Barley: Demand for malting barley is derived from the demand for malt, which in turn is driven by the demand for beer. For marketing purposes, barley is classed into feed and malting varieties. Malting barley is simply high-quality barley that has the appropriate characteristics to produce good malt. The supply of malting-quality barley has an important spatial dimension. Breeding programs, agronomic practices, soil characteristics, climatic conditions, and expected price differentials determine variety types grown in different regions. Although malting varieties comprise about one half or more of total barley production in many countries, only about 10% of world barley production is actually malted. The other 90%, whether malting or feed varieties, is used as feed (Bi-weekly Bulletin). The malting barley is further divided into two-row (2R) and six-row white (6RW) aleurone barley and six-row blue aleurone (6RB) varieties, for which brewer demands differ.

Farmers in Canada grow both 2-row and 6-row varieties of barley. Since 1991, plantings of 6-row white varieties have increased much due to the contracts for the U.S. market. Australian barley producers almost exclusively plant 2-row varieties. Variety type

has an important impact on extraction rates and taste (Schmitz, Gray, and Ulrich). Brewers, the end-users of malting barley, have specific quality requirements in terms of acceptable varieties, protein, moisture, plumpness, germination and tolerances for damaged kernels. In general, in the world market, malt demand consists almost entirely of two-row varieties, except U.S. and some North American brewers make extensive use of malt produced with six-row white aleurone barley. China is now the world's largest malting barley importer, accounting for about 38% of world import (Center for International Economics). Australia has a competitive advantage for exports into Asia, particularly into China, because Australian barley varieties germinate in one day, while Canadian and EU barley varieties germinate in three days (Bi-weekly bulletin). The U.S. has been Canada's largest market for six-row malting barley. Although the U.S. is a major producer of malting barley, its high beer consumption results in a net import demand for six-row malting barley.

Theoretical Structure

Initial payments for commodities brokered by the CWB and the ABB usually set substantially below-market prices: usually at 70-85% of the total payment. Consequently, the delayed payment approach is capable of providing the necessary precommitment to shift rent by creating a credible marginal cost advantage for the STEs in an international market. Moreover, in the case of STEs, the final payment in a delayed producer payment system, which is typically delivered in lump-sum fashion, provides an explicit method of transfer back to the input supplier that rationalizes the system. So the delayed producer payment structure is equivalent in this regard to a policy of direct export subsidization.

We begin with a theoretical model that proposes endogenous control of an upstream supply in that STEs choose the initial prices of their principal material, given that they

compete in a market of imperfect substitutes. Through the procedure of marketing and producer payments by STEs, we consider STEs and producers as vertically connected. The vertical structure analyzed here consists of two stages. The first stage is an output stage, in which the STEs and other exporting firms maximize profits by choosing quantities and maintain the ability to either store non-optimal supplies or downgrade the quality of non-optimal supplies sale to a residual market, feed barley market. We estimate the output stage by considering government trade policy as a shift parameter in the domestic marginal cost function. The second stage is a precommitment stage, in which both STEs simultaneously choose their initial payments for the material input. In this stage, we employ a subset of the output-stage results to characterize the value of the trade policy parameter associated with the optimal degree of rent-shifting.

As introduced in the first part, agronomic practices, soil characteristics, and climatic conditions determine varietal types grown in different regions, and the brewers have specific quality requirements in terms of acceptable varieties, protein, plumpness and germination. Therefore we consider the malting barley market as consisting of imperfect substitutes. Let x, y, and z represent total supply of the malting barley to the world market by CWB, ABB, and the other malting barley-exporting countries, respectively and denote the downstream inverse demand functions of malting barley marketed by CWB, ABB and Other Exporting Countries as P_c , P_a , and P_o, respectively. Inverse demand functions of malting barley are:

$$P_c = P_c(x,y,z;\Phi_1) \qquad (1)$$
$$P_a = P_a(x,y,z;\Phi_2) \qquad (2)$$
$$P_o = P_o(x,y,z;\Phi_3) \qquad (3)$$

$Ö_i$ are exogeneous variables. If barley varieties were perfect substitutes or homogeneous, all demands would have same price; if barley varieties were imperfect substitutes, each demand change would have different effect on each price.

In the output stage, the marketing costs are assumed to be linear in output and are subsumed into the market price. The STEs and the other exporting countries choose their outputs to maximize profits.

$$Max p_c(x) = P_c x - w_c x \quad (4)$$
$$Max p_a(y) = P_a y - w_a y \quad (5)$$
$$Max p_o(z) = P_o z - c_o z \quad (6)$$

where w_c and w_a are initial payments set in the precommitment stage; and c_0 is the price received by farmers of other exporting countries.

Assume that the CWB (*c*), the ABB (*a*) and the Other exporting countries (*o*) are in Cournot competition. Maximization of (4), (5) and (6) with respect to x, y, and z, respectively yield the first order conditions:

$$P_c + xP_{c1} - w_c = 0 \quad (7)$$
$$P_a + yP_{a2} - w_a = 0 \quad (8)$$
$$P_o + zP_{o3} - c_o = 0 \quad (9)$$

In the precommitment stage, the STEs select transfer prices, w_c and w_a, so as to

$$Max p_{cp} = P_c(x(w_c, w_a, c_c), y(w_c, w_a, c_a), z(w_c, w_a, c_o))x(w_c, w_a, c_c) - c_c\, x(w_c, w_a, c_c) \quad (10)$$
$$Max p_{ap} = P_a(x(w_c, w_a, c_c), y(w_c, w_a, c_a), z(w_c, w_a, c_o))y(w_c, w_a, c_a) - c_a\, y(w_c, w_a, c_a) \quad (11)$$

where c_c and c_a are the unit production cost in Canada and Australia, and π_{cp} and π_{ap} are the profit of producers under CWB and ABB, respectively.

Letting w*'s denote the optimal initial payments, the upstream prices set by the STEs for the optimal rent-shifting strategies are:

$$w_c^* - c_c = x(P_{c2}\frac{\frac{\partial y}{\partial w_c}}{\frac{\partial x}{\partial w_c}} + P_{c3}\frac{\frac{\partial z}{\partial w_c}}{\frac{\partial x}{\partial w_c}}) \qquad (12)$$

$$w_a^* - c_a = y(P_{a1}\frac{\frac{\partial x}{\partial w_a}}{\frac{\partial y}{\partial w_a}} + P_{a3}\frac{\frac{\partial z}{\partial w_a}}{\frac{\partial y}{\partial w_a}}) \qquad (13)$$

where

$$\frac{\frac{\partial y}{\partial w_c}}{\frac{\partial x}{\partial w_c}} = \frac{(P_{a3} + yP_{a23})(P_{o1} + zP_{o31}) - (2P_{o3} + zP_{o33})(P_{a1} + yP_{a21})}{(2P_{a2} + yP_{a22})(2P_{o3} + zP_{o33}) - (P_{a3} + yP_{a23})(P_{o2} + zP_{o32})}$$

$$\frac{\frac{\partial z}{\partial w_c}}{\frac{\partial x}{\partial w_c}} = \frac{(P_{a1} + yP_{a21})(P_{o2} + zP_{o32}) - (2P_{a2} + yP_{a22})(P_{o1} + zP_{o31})}{(2P_{a2} + yP_{a22})(2P_{o3} + zP_{o33}) - (P_{a3} + yP_{a23})(P_{o2} + zP_{o32})}$$

$$\frac{\frac{\partial x}{\partial w_a}}{\frac{\partial y}{\partial w_a}} = \frac{(P_{c3} + xP_{c13})(P_{o2} + zP_{o32}) - (2P_{o3} + zP_{o33})(P_{c2} + xP_{c12})}{(2P_{c1} + xP_{c11})(2P_{o3} + zP_{o33}) - (P_{c3} + xP_{c13})(P_{o1} + zP_{o31})}$$

$$\frac{\frac{\partial z}{\partial w_a}}{\frac{\partial y}{\partial w_a}} = \frac{(P_{c2} + xP_{c12})(P_{o1} + zP_{o31}) - (2P_{c1} + xP_{c11})(P_{o2} + zP_{o32})}{(2P_{c1} + xP_{c11})(2P_{o3} + zP_{o33}) - (P_{c3} + xP_{c13})(P_{o1} + zP_{o31})}$$

P_{ij} is the derivative of P_i w.r.t j; P_{ijk} is the cross derivative of P_i w.r.t. j and k (i=c,a,o; j, k=1,2,3, which represents x, y, and z, respectively).

The profit-maximizing upstream transfer prices set by the STEs specify that domestic upstream producers sell the input at a price below marginal cost if $w_i<c_i$ (i=c,a), which increases market shares in the international malting barley market in an analogous fashion as a domestic output subsidy.

Empirical Methodology

Let γ_{ij} denote the conjectural variation, which indicates firm i's expectations about the reaction of firm j to a change in its quantity. Different choices of the conjectural variations in output lead directly to the relevant first-order conditions for the various models: in the Cournot model, $\gamma_{ij}=0$, each firm believes that the other firm's choice is independent from its own. Therefore, the conjectural variations model arises by assuming each firm views rivals' output as a function of it's own output. Because the reaction of foreign marketing agents to a change in the quantity of domestic exports is endogenous in the precommitment stage, this implies that the conduct parameter associated with the domestic marketing agent is predetermined. Hence, the conduct of the domestic marketing agent could be estimated as a free parameter in the output stage. Consequently, we can test the rent-shifting hypothesis after evaluating the market power.

Combining conjectural variations into the model, the equations (7), (8), and (9) are modified as:

$$P_c + x(P_{c1} + P_{c2}\frac{\partial y}{\partial x} + P_{c3}\frac{\partial z}{\partial x}) - w_c = 0 \qquad (14)$$

$$P_a + y(P_{a1}\frac{\partial x}{\partial y} + P_{a2} + P_{a3}\frac{\partial z}{\partial y}) - w_a = 0 \qquad (15)$$

$$P_o + z(P_{o1}\frac{\partial x}{\partial z} + P_{o2}\frac{\partial y}{\partial z} + P_{o3}) - c_o = 0 \qquad (16)$$

We set $My/Mx=\gamma_{12}$, $Mz/Mx=\gamma_{13}$, $Mx/My=\gamma_{21}$, $Mz/My=\gamma_{23}$, $Mx/Mz=\gamma_{31}$, and $My/Mz=\gamma_{32}$. If the CWB, the ABB and Other exporting countries are in Cournot equilibrium, then all γ_{ij}'s will be zero. We can now write (14), (15), and (16) as following:

$$P_c + x(P_{c1} + g_{12}P_{c2} + g_{13}P_{c3}) - w_c = 0 \qquad (17)$$

$$P_a + y(g_{21}P_{a1} + P_{a2} + g_{23}P_{a3}) - w_a = 0 \qquad (18)$$

$$P_o + z(g_{31}P_{o1} + g_{32}P_{o2} + P_{o3}) - c_o = 0 \qquad (19)$$

Consequently, the optimal initial payments could be expressed as:

$$w_c^* - c_c = x[P_{c2}(\frac{\frac{\partial y}{\partial w_c}}{\frac{\partial x}{\partial w_c}} - g_{12}) + P_{c3}(\frac{\frac{\partial z}{\partial w_c}}{\frac{\partial x}{\partial w_c}} - g_{13})] \qquad (20)$$

$$w_a^* - c_a = y[P_{a1}(\frac{\frac{\partial x}{\partial w_a}}{\frac{\partial y}{\partial w_a}} - g_{21}) + P_{a3}(\frac{\frac{\partial z}{\partial w_a}}{\frac{\partial y}{\partial w_a}} - g_{23})] \qquad (21)$$

where

$$\frac{\frac{\partial y}{\partial w_c}}{\frac{\partial x}{\partial w_c}} = \frac{S_6 S_7 - S_4 S_9}{S_5 S_9 - S_6 S_8}$$

$$\frac{\frac{\partial z}{\partial w_c}}{\frac{\partial x}{\partial w_c}} = \frac{S_4 S_8 - S_5 S_7}{S_5 S_9 - S_6 S_8}$$

$$\frac{\frac{\partial x}{\partial w_a}}{\frac{\partial y}{\partial w_a}} = \frac{S_3 S_8 - S_2 S_9}{S_1 S_9 - S_3 S_7}$$

$$\frac{\frac{\partial z}{\partial w_a}}{\frac{\partial y}{\partial w_a}} = \frac{S_2 S_7 - S_1 S_8}{S_1 S_9 - S_3 S_7}$$

and S_i's are the items in the matrix S.

$$S = \begin{pmatrix} S_1 & S_2 & S_3 \\ S_4 & S_5 & S_6 \\ S_7 & S_8 & S_9 \end{pmatrix}$$

$$= \begin{pmatrix} 2P_{c1} + (g_{12}P_{c2} + g_{13}P_{c3}) + x(P_{c11} + g_{12}P_{c21} + g_{13}P_{c31}) & P_{c2} + x(P_{d2} + g_{12}P_{c22} + g_{13}P_{c32}) & P_{c3} + x(P_{d3} + g_{12}P_{c23} + g_{13}P_{c33}) \\ P_{a1} + y(g_{21}P_{a11} + P_{a21} + g_{23}P_{a31}) & 2P_{a2} + (g_{21}P_{a1} + g_{23}P_{a3}) + y(g_{21}P_{a12} + P_{a22} + g_{23}P_{a32}) & P_{a3} + y(g_{21}P_{a13} + P_{a23} + g_{23}P_{a33}) \\ P_{o1} + z(g_{31}P_{o11} + g_{32}P_{o21} + P_{o31}) & P_{o2} + z(g_{31}P_{o12} + g_{32}P_{o22} + P_{o32}) & 2P_{o3} + (g_{31}P_{o1} + g_{32}P_{o2}) + z(g_{31}P_{o13} + g_{32}P_{o23} + P_{o33}) \end{pmatrix}$$

In equations (17), (18) and (19), the departure of γ's from zero value is a logically consistent test of whether the Cournot-Nash model provides an accurate description of the industry equilibrium. Under the Cournot hypothesis, the optimal initial payments of the CWB and the ABB in (20) and (21) are in accordance with (12) and (13).

To test the hypothesis that the CWB and ABB strategically utilize their pre-payment systems and product differentiation to shift rents from other foreign firms, we need to evaluate the following formulas.

$$\frac{\partial p_i}{\partial w_j} = \frac{\partial p_i}{\partial x}\frac{\partial x}{\partial w_j} + \frac{\partial p_i}{\partial y}\frac{\partial y}{w_j} + \frac{\partial p_i}{\partial z}\frac{\partial z}{\partial w_j} \qquad (22)$$

In (22), if i=c, then the first item will be cancelled out by first order condition; and if i=a, then the second term will be cancelled out. X/ w_j (X=x,y,and z) has been defined and ði/ X is as following:

$$\frac{\partial p_c}{\partial y} = g_{21}(P_c - w_c) + x(g_{21}P_{c1} + P_{c2} + g_{23}P_{c3}) \qquad (23)$$

$$\frac{\partial p_c}{\partial z} = g_{31}(P_c - w_c) + x(g_{31}P_{c1} + g_{32}P_{c2} + P_{c3}) \qquad (24)$$

$$\frac{\partial p_a}{\partial x} = g_{12}(P_a - w_a) + y(P_{a1} + g_{12}P_{a2} + g_{13}P_{a3}) \qquad (25)$$

$$\frac{\partial p_a}{\partial z} = g_{32}(P_a - w_a) + y(g_{31}P_{a1} + g_{32}P_{a2} + P_{a3}) \qquad (26)$$

If ðc/ w_c<0 and ði/ w_c>0 (i= a, or o), then CWB is strategically utilize their pre-payment system to shift rents from country i. Similar analysis could be applied to ABB.

Data and Empirical Analysis

In order to evaluate the degree of market power, and further test rent shifting, we need to identify γ's.

From (17), (18) and (19), we can write

$$P_{ct} - w_{ct} + P_{c1}x_t = l_{12}(P_{c2}x_t) + l_{13}(P_{c3}x_t) \qquad (27)$$
$$P_{at} - w_{at} + P_{a2}y_t = l_{21}(P_{a1}y_t) + l_{23}(P_{a3}y_t) \qquad (28)$$
$$P_{ot} - c_{ot} + P_{o3}z_t = l_{31}(P_{o1}z_t) + l_{32}(P_{o2}z_t) \qquad (29)$$

The market power parameters in above equations are the coefficients $ë_{ij}$'s with a negative sign, that is, $ã_{ij} = -ë_{ij}$.

Hence, we need to recover the quantity derivatives of prices. We did this by utilizing Rotterdam model with symmetry, homogeneity and curvature imposed.

The Rotterdam model is

$$m_{it} d\log q_{it} = b_i d\log \overline{Y}_t + \sum_{j=1}^{n} c_{ij} d\log p_{jt}$$

where

$$d\log q_{it} = \ln q_{it} - \ln q_{i,t-1}$$
$$d\log \overline{Y}_t = \sum_{j=1}^{n} m_{jt}(\ln q_{jt} - \ln q_{j,t-1})$$
$$d\log p_j = \ln p_{jt} - \ln p_{j,t-1}$$

q_i is the quantity of the good i (i=1,2, 3, which represents c, a, o, respectively); n=3; j=1,2,3, which represents c, a, and o, respectively; m_i is the budget share of good i; and b_i and c_{ij} are the parameters we need to estimate. With symmetry, homogeneity and negativity (or curvature) imposed, $Ó_i\ b_i=1\ c_{ij}=c_{ji}$, $Ó_i$ cij=0 and $c_{ii}<0$. The appropriate curvature can be imposed by estimating the Cholesky decomposition, which is shown by Featherstone and Moss. If C is the matrix of parameters c_{ij}, then C is a negative definite matrix to ensure downward sloping demand curves. The parameter matrix C then becomes

$$
\begin{aligned}
C &= \begin{pmatrix} c_{11} & c_{12} & c_{13} \\ c_{12} & c_{22} & c_{23} \\ c_{13} & c_{23} & c_{33} \end{pmatrix} \\
&= -\begin{pmatrix} a_{11} & 0 & 0 \\ a_{12} & a_{22} & 0 \\ a_{13} & a_{23} & a_{33} \end{pmatrix}\begin{pmatrix} a_{11} & a_{12} & a_{13} \\ 0 & a_{22} & a_{23} \\ 0 & 0 & a_{33} \end{pmatrix} \\
&= -\begin{pmatrix} a_{11}a_{11} & a_{11}a_{12} & a_{11}a_{13} \\ a_{11}a_{12} & a_{12}a_{12}+a_{22}a_{22} & a_{12}a_{13}+a_{22}a_{23} \\ a_{11}a_{13} & a_{12}a_{13}+a_{22}a_{23} & a_{13}a_{13}+a_{23}a_{23}+a_{33}a_{33} \end{pmatrix} \\
&= -A
\end{aligned}
$$

Obviously, A is positive definite and consequently, C is negative definite.

After estimating parameters, b and c, we can recover the income elasticities and compensated elasticities. And then using Slustsky equation, we can get uncompensated elasticities. Hence, the derivatives of prices with respect to quantities could be recovered.

Data Description

Annual data on quantities, prices of CWB and ABB sales, and initial payments to producers for CWB and ABB were collected for the period of 1975/76 to 1997/98 from CWB and ABB annual report. The sales of other countries were estimated by the world total disappearance of barley deducted by feed use and then by CWB and ABB sales. The annual data on world total disappearance of barley were collected for the same period from various issues of U.S. Department of Agriculture: *Feed Situation and Outlook Yearbook*. The prices of malting barley in US principal market were used as a substitute of that for other countries. The GDP deflator for each country was used to deflate the nominal variables for each country and was collected from the International Monetary Fund publication: *International Financial Statistics*. All price variables were changed into U.S dollars.

Empirical Results

With homogeneity, symmetry, and curvature imposed, we estimated the Rotterdam model with 3 goods as a demand system. The results are shown in table 1.

Table 1. Estimates of Rotterdam Modle

	Coefficient	t-ratio
b1	-0.002148	-0.58647
a11	0.17429**	4.7155
a12	-0.13547**	-2.0739
b2	0.001339	0.54941
a22	0.14723	1.1943

Note: ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level

The Value of c_{ij} by Calculation					
c_{11}	-0.0303785	c_{21}	0.0236113	c_{31}	0.0067672
c_{12}	0.0236113	c_{22}	-0.0400281	c_{32}	0.0164167
c_{13}	0.0067672	c_{23}	0.0164167	c_{33}	-0.0231839

c_{13}, c_{23}, and c_{33} was recovered by homogeneity. $c_{12}=c_{21}$, $c_{13}=c_{31}$, and $c_{23}=c_{32}$ were by symmetry.

The income elasticities and compensated price elasticities could be calculated from estimates of parameters, and uncompensated price elasticities could be recovered by Slutsky equation. Income elasticity is $e_i=b_i/m_i$, compensated price elasticity is $e_{ij}=c_{ij}/m_i$, and uncompensated price elasticity is $e_{ij}-e_i$ by Slustsky equation. From uncompensated price elasticities, we could get the first derivatives of prices with respect to each quantity.

The estimates of uncompensated price elasticities are listed in table 2

Table 2. Mean of the Uncompensated Price Elasticities

	CWB	ABB	Others
CWB	-1.1158	0.87049	0.32432
ABB	1.6931	-2.8761	1.0868
Others	1.4373	1.0998	-0.96438

The own price elasticity for CWB is –1.1158, and cross price elasticities for CWB are 0.87049 and 0.32432 with respect to ABB and Others, respectively. Therefore, the ABB price has bigger effect on CWB than Others does. Similarly, CWB has bigger price effect on ABB than others does. In addition, CWB has bigger price effect on Others than ABB does.

Since we have got the quantity derivatives of price, the market power parameters could be identified. Using SUR to solve (27), (28), and (29), we got the estimates of market power parameters, $\tilde{a}_{ij}$'s, which are listed in table 3.

Table 3. Estimates of market power parameters.

	Coefficient	t-ratio
$\ddot{e}_{12}=-\tilde{a}_{12}$	-0.73284**	-302.43
$\ddot{e}_{13}=-\tilde{a}_{13}$	-0.16230**	-9.1831
$\ddot{e}_{21}=-\tilde{a}_{21}$	-0.61563**	-66.567
$\ddot{e}_{23}=-\tilde{a}_{23}$	0.0025981	0.9615
$\ddot{e}_{31}=-\tilde{a}_{31}$	0.72682	1.0255
$\ddot{e}_{32}=-\tilde{a}_{32}$	-0.89027	-0.7981

From the above results, we can see that CWB and ABB are more collusive. Substituting the market power parameters and quantity derivatives into (17) and (18), we fail to reject that P_c-w_c is greater than P_a-w_a. Therefore, we can conclude that CWB has higher

mark up than ABB does and consequently, CWB has more market power. In addition, $\tilde{a}_{13}$ is significant and $\tilde{a}_{31}$ is not significant, we can conclude that CWB has the market leadership toward Stackerberg. But ABB doesn't have this market leadership. The ABB and the other exporting countries seem in Cournot equilibrium.

The second derivatives of prices could be derived from the Rotterdam model. Consequently, the hypothesis of rent shifting could be testable. We can do this by evaluating (23), (24), (25) and (26). And we can evaluate if the STEs set the initial payments at optimal levels by (20) and (21). Since we haven't got the data on the production costs, the test of the hypothesis and evaluation of the initial payments will be done in the future.

Conclusions

Because the reaction of foreign marketing agents to a change in the quantity of domestic exports is endogenous in the precommitment stage, this implies that the conduct parameter is pre-determined. The conduct is estimated as a free parameter in the output stage. The parameters estimated in the output stage also define the optimal level at which the government precommitment variable should be set. Consequently, if the necessary condition for rent-shifting behavior is not refutable, it is possible to calculate the optimal precommitment level and test whether the observed trade policy parameter is set in a fashion consistent with theory.

The purpose of this paper was to derive an applicable method to evaluate the market power and to test the hypothesis of rent shifting behavior in international malting barley market, in which the CWB and the ABB operate as STEs and the exported product is imperfect substitute. The empirical framework was also developed and requires parameter

estimate for demand under the assumption of product heterogeneity. Future research will consider the effect of EU export subsidy and get the data on the production costs to test the rent shifting hypothesis and evaluate the initial payments level.

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