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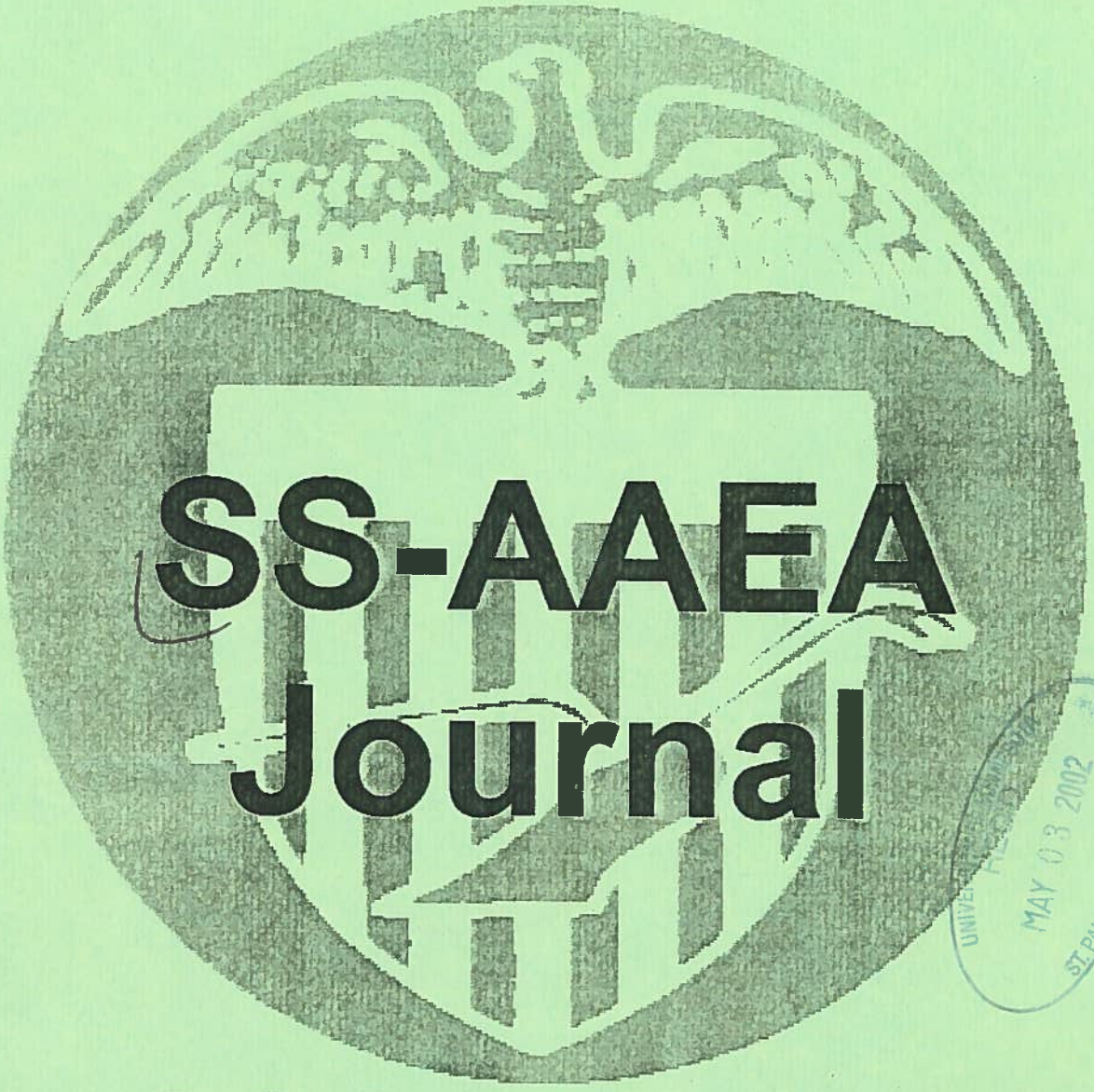

SS-AAEA Journal

2000-2001

1st Place

Price Discrimination and Pricing to Market Behavior of Canadian Canola Exporters

Jennifer Brown

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Abstract

The role of exchange rate fluctuation on the pricing behavior of Canadian canola exporters to Japan, Mexico and the U.S. is examined using a model through which non-competitive and exchange-rate related pricing behavior can be identified, including price discrimination and pricing to market (PTM). Price discrimination was identified for Canadian canola exports to Mexico, Japan and the U.S. over the period of 1993 to 1999. Results also suggest that PTM strategies were employed for Japanese imports. Canadian canola exporters used local currency price stabilization to dampen the effects of relative price changes in the Japanese currency. This non-competitive pricing behaviour may be linked to the large size of Japanese imports relative to Mexico and the U.S.

Introduction

The Canadian agrifood industry, with its long tradition of international trade, has faced substantial changes in exchange rate variability in recent years. While the overall trade effect of exchange rate changes can be complicated by the depreciating Canadian dollar's impact on macroeconomic performance (Coleman and Meilke), the declining U.S./Canada exchange rate generally encourages U.S. imports of Canadian goods. Without adjusting for the change, depreciation of the Canadian dollar relative to the U.S. currency makes the purchase of Canadian commodities more attractive to U.S. buyers. Because many foreign agricultural commodity transactions are denominated in a common currency (Pick and Carter), and because the U.S. dollar dominates numerous world markets, Canadian currency depreciation relative to the U.S. dollar may further strengthen Canada's export position worldwide. Canadian exporters, however, may react to exchange rate fluctuation, making their pricing decision based on such factors as the importing country, whether the variation is considered permanent or temporary, the nature of the industry and market structure.

In his influential article, Krugman examines both the influence of market structure and the impact of exchange rate fluctuations on trade. Much of the previous research pertaining to Canadian trade examined exporting activities under the assumption of perfectly competitive conditions, overlooking the possibility of market power and an exporter's ability to price discriminate. This depiction of world agricultural markets is, however, questionable. Informal evidence, such as the dominance of a few large firms and the presence of government agencies or marketing boards that regulate trade, suggests that imperfectly competitive behavior may in fact be characteristic of some agricultural markets (Park and Pick).

Krugman introduced the concept of Pricing to Market (PTM) to relate exchange rate changes to importing pricing decisions. PTM suggests that exporters with market power may

maintain or upwardly (or downwardly) adjust importer-specific export prices when the importer experiences a currency appreciation (or depreciation). Empirical studies support the idea that market segmentation, price discrimination and exchange rate influenced pricing strategies better reflect the behavior of many agricultural exporters.

The objective of this paper is to examine the role of exchange rate fluctuation in the pricing decisions of Canadian canola exporters to Japan, Mexico and the U.S. Coefficients, estimated through Knetter's PTM (1989) framework, are used to test whether Canadian export-pricing strategies differ across destinations. Canola, as Canada's top oilseed crop in terms of production, was grown on 485,500 hectares in 2000, yielding 7 million tonnes of seed (Canola Council of Canada). Approximately $2 billion of Canadian canola seed is exported annually. Interest in Japan, Mexico and the U.S. is motivated by the fact that they are historically large importers of Canadian canola, and imports to these countries are not regulated by state trading institutions (Ackerman and Dixit). Furthermore, no previous studies have examined Canada's canola export market for PTM behavior.

The following section reviews previous PTM in agriculture. Details of the empirical model follow the literature review. Results and qualitative conclusions drawn from the model are summarized before a final discussion of the presence of price discrimination and PTM in Canada's canola export market.

Literature Review

While the overall PTM literature is limited, recent research has focused on U.S. and Canadian agricultural export markets. Pick and Park's examination of five U.S. commodities between 1978 and 1988 found evidence of PTM in soybean exports to the Netherlands, soybean meal exports to Canada and Germany and wheat exports to Egypt, Korea, Venezuela and the Philippines. Pick and Carter confirmed the U.S. wheat results, reporting PTM to

Venezuela and the Philippines, as well as China and the U.S.S.R. Park and Pick again examined U.S. wheat export markets and, considering the impact of the Export Enhancement Program (EEP), expanded this PTM list to include Egypt, Japan, Korea, the Philippines, Taiwan and Venezuela. Empirical results confirmed the significant effects of EEP on destination specific wheat prices. Patterson, Reca, and Abbott reported evidence of PTM for U.S. chicken exports to Canada and the Netherlands, while the price of U.S. beef exports to Hong Kong, Japan and Sweden reflected a magnified impact of exchange rate changes.

Carew concluded that Canadian exporters of wheat, pulse crops and tobacco were able to price discriminate to Italy, the U.K., Japan and Bangladesh, as exporters employed opportunistic pricing strategies and amplified the effects of exchange rate changes. Evidence confirmed the existence of market segmentation in foreign markets for Canadian wheat; Italian and Japanese importers, the largest and second largest importers of wheat worldwide, respectively, were able to secure lower prices for wheat than importers in the U.S., U.K. and Algeria.

Carew's results for U.S. wheat strongly suggested imperfectly competitive and price stabilization behavior by exporters, finding evidence of price discrimination with South Korea, Egypt, Venezuela and the Philippines. In the Canadian pulse market, there was only evidence of PTM in the Japanese market, while exports to Belgium, the Netherlands and Spain were priced to magnify the effects of exchange rate fluctuation. In contrast, data suggested that U.S. pulse exporters did, in fact, use PTM strategies, perhaps related to the U.S.'s relatively small share of the world pulse export market. Market segmentation and price discrimination were not observed in most tobacco markets. Carew suggests that Canadian tobacco exporters willingly reduced their profit to absorb exchange rate changes, aiming to capture greater market share from non-traditional suppliers. Results for U.S. tobacco exports reveals that non-competitive, stabilizing pricing strategies are not prevalent

in most markets, as PTM was found only in exports to Thailand. Exporting to Canada and Egypt, however, U.S. suppliers amplified the effects of exchange rates on importers' prices.

Empirical Framework

Adopting the framework developed by Knetter (1989), the pricing behavior of Canadian canola exporters will be tested for perfectly and imperfectly competitive behavior. The model distinguishes between marginal cost changes and exchange-rate-related markup adjustments by an exporter (Knetter, 1989). Destination markets are assumed to have the following demand:

$$(1) \qquad q_{it} = f_i(e_{it} p_{it}) v_{it} \qquad \forall \ \ i = 1,...,N \qquad \text{and} \qquad t = 1,...,T,$$

where q_{it} is the quantity demanded by country i in period t, p_{it} is the export price in Canadian currency in period t, e_{it} is the exchange rate calculated as the destination market currency per unit of Canadian currency, and v_{it} is a random demand shifter.

Canadian exporters' cost function is denoted as:

$$(2) \qquad C_t = C(\sum_i q_{it}) \delta_t,$$

where C_t is the cost of producing $\sum_i q_{it}$ units of output in Canadian currency and δ_t is a random variable that may shift the cost function. Substituting (1) into (2), the profit maximization problem can be written as:

$$(3) \qquad \max_{p_i} \ \ \pi(p_1,...,p_n) = \sum_{i=1}^{N} p_i q_i(e_i p_i) - C\left\{\sum_{i=1}^{N} q_i(e_i p_i), \delta\right\} \quad \forall t = 1,...,T,$$

The first-order condition for profit maximization states that price in Canadian currency is a markup over marginal cost:

$$(4) \qquad p_{it} = MC_t \left\{\frac{\eta_i}{\eta_{it} - 1}\right\}, \qquad \forall \ i = 1,...,N, \ \text{and} \ t = 1,...,T,$$

where MC_t is the marginal cost of production in period t, and η_i is the price elasticity of demand in importing market i. The markup for exports to the ith market depends on the elasticity of demand in the specific market, as perceived by the exporter, who allocates output across destinations to equate marginal revenue in the each market with the common marginal cost. Importing countries with less elastic demand schedules may be vulnerable to exporters' exploitive price discrimination strategies, as the markup is dependent upon the importer's price elasticity of demand.

To identify and understand the pricing strategies used in international commodity trading, tests for discriminatory pricing and PTM behavior are required. Following Knetter (1989), a fixed effects model is used to test for PTM behavior in Canada's canola exports:

$$(6) \qquad \ln(p_{it}) = \theta_t + \lambda_i + \beta_i \ln(e_{it}) + u_{it}, \qquad \forall\, i = 1,...,N, \text{ and } t = 1,...,T,$$

where $\ln(p_{it})$ is the natural log of the Canadian price in market i in period t, θ_t represents a dummy variable for time effects, λ_i is a dummy variable for importing country effects, β_i denotes the exchange rate parameter, $\ln(e_{it})$ is the natural log of the real exchange rate variable and u_{it} is the disturbance term.

The null hypothesis of a perfectly competitive market requires that price and marginal cost are equal and that export prices are identical across importers. There is, therefore, no country effect (λ_i=0 for all i) and no relationship between exchange rate changes and price changes (β_i=0 for all i). Moreover, when λ_i=0 for all i and β_i=0 for all i, the time parameter is an exact measure of marginal cost (Goldberg and Knetter, 1997).

When price discrimination occurs in a market, a fixed markup over marginal cost produces the price charged to importers. In this instance, there is a country effect ($\lambda_i \neq 0$ for all i), but no exchange rate effect (β_i=0 for all i). The time effect then acts as an index of marginal cost, while the country effect reflects differences in the markup between destination

countries. The country effect, therefore, reflects the existence of price discrimination across destinations.

When β_i has a statistically significant non-zero value, a market is segmented and the constant elasticity of demand hypothesis can be rejected, as the price elasticity of demand may fluctuate with the exchange rate. In a segmented export market, importers with differing price elasticities of demand can be identified and are effectively separated to prevent the movement of the commodity among the markets. In this case, when an importer's currency depreciates with respect to the exporter's currency, the importer's domestic price increases.[1] If the demand elasticity changes, then the markup changes, suggesting that the export price is dependent upon the exchange rate. This is referred to as Pricing to Market (PTM), as the optimal markup of a price-discriminating monopolist varies with movements in bilateral exchange rates and across destinations.

In the PTM scenario where demand is less convex than a constant-elasticity demand schedule, β_i is expected to be negative (Patterson, Reca, and Abbott). Krugman suggests that a negative coefficient is more consistent with PTM strategies, as a positive β_i suggests that exporters amplify the effects of an importer's currency depreciation by raising the export price. This amplification may be the result of opportunistic pricing strategies or attempts to expand market share.

Data

To test for non-competitive behavior by Canadian canola exporters, equation (6) was estimated for three major canola-importing countries: Japan, Mexico and the United States. These countries were selected because they represent the top three importers of Canadian canola, accounting for almost 86 percent of total canola exports from Canada between 1990 and 1997. The commodity investigated is "Rape or Colza seed for oil extraction whether or

not broken".[2] Prices (p_{it}) are unit values, taken as the quotient of the value of exports and the quantity exported to market *i* in period *t*. Quarterly data, spanning the period 1993 to 1999, are summarized in Table 1.[3] The monthly data are available online from the University of Toronto's Trade Analyzer website and are aggregated to a quarterly basis.[4]

Monthly exchange rates, expressed as units of importer's currency per unit of Canadian currency, are available online from the Bank of Canada and are used to generate the average exchange rate for the quarter.[5] Since optimal export price is unaffected by inflationary exchange rate changes in importing nations, exchange rate adjustment is necessary in the model (Knetter, 1993). Therefore, real exchange rates are calculated by deflating with the Consumer Price Index for each destination country.[6]

Results

The model is estimated using a generalized least squares procedure for a panel (cross-sectional, time-series) data set.[7] The first quarter's time dummy variable is dropped to avoid singularity. The time effects, therefore, must be interpreted as differentials from the time period implicit in the constant. Following Patterson, Reca, and Abbott, the country dummy variables are constrained to sum to zero. While one country dummy is typically dropped to avoid singularity (Knetter, 1989; Pick and Park; Goldberg and Knetter, 1997; Carew), imposing the restriction that all country dummy coefficients sum to a constant simplifies the interpretation of the results (Suits). Instead of representing the difference between each country effect and the excluded country effect, the coefficients in the restricted model measure the difference between the respective country and the "national average" export price (Patterson, Reca, and Abbott). The country effect coefficients identify the countries in which discriminatory pricing strategies were observed.

Because the Canadian dollar suddenly slipped relative to the U.S. currency in 1995, the dataset was divided and separate regression coefficients were estimated for two shorter time periods, 1993:1 to 1996:2 and 1996:3 to 1999:4, and the entire sample, 1993:1 to 1999:4. By comparing conclusions across three periods, inferences can be made about the behavior of Canadian exporters before and after the large exchange rate change.

The results of the PTM model for Canadian canola exports to Japan, Mexico and the U.S. are presented in Table 2. The null hypothesis that price effects of all destinations are equal ($\lambda_1=\lambda_2=\lambda_3$) is rejected at a five percent significance level for all time periods. If country effects were equal across importers, there would have been no evidence to support price discrimination by destination. In this case, however, there is support for the inclusion of a country effect variable. When examining homogeneous products, statistically significant F-tests for equality of country effects is strong evidence against the competitive market model in which arbitrage leads to the law of one price (Knetter, 1993).

There is evidence to suggest that market segmentation and discriminatory pricing on the basis of destination applies to Japan, Mexico and the U.S., as the country effect coefficients are significantly different from zero in all but the case of Mexico in the second period. That is, the canola export market is segmented and Canadian canola exporters were able to price discriminate with these international buyers.

The null hypothesis that all exchange rate effect coefficients are equal to zero ($\beta_1=\beta_2=\beta_3=0$) is rejected at the five percent level for all time periods, confirming the need to include the exchange rate effect parameter in the model for Canadian canola exports. Japan's exchange rate coefficient is significantly negative ($\beta_1<0$) for all three periods. The negative coefficient suggests that Canadian exporters adjusted the export price of canola destined for Japan in order to dampen the effects of relative price changes in the Japanese currency, thus supporting the PTM hypothesis for that market. Knetter (1989) labeled this form of price

discrimination "local currency price stabilization" (LCPS) and later noted that large buyers tend to experience more LCPS then small importers (Knetter, 1993). The canola PTM model results for Japan are consistent with this generalization, as Japan's imports were more than six and nine times those of Mexico and the U.S., respectively, between 1990 and 1997. Had the exchange rate coefficient been significantly greater than zero ($\beta_1>0$), there would have been no evidence to suggest LCPS. Instead, it would support the claim that Canada was either amplifying the exchange rate change to apply opportunistic pricing practices (increasing relative prices) or to capture market share (decreasing relative prices). Neither of these scenarios, however, is supported by Canada's PTM model for 1993 to 1999. If Japan's Food Agency were acting as a single-desk buyer for the oilseed, as it does for wheat, barley and rice, PTM results could have indicated the influence of the state trading enterprise in protecting the nation from Canadian exporters' price discrimination. Instead, the presence of PTM is likely due to the relative size of Japan's canola purchases on the world market.

Exchange rate coefficients are also significantly different from zero for Mexico and the U.S. from 1996:3 to 1999:4. These negative coefficients suggest that Canadian exporters stabilized the import price of canola during these time periods to offset dramatic exchange rate change and employed a PTM strategy.

Summary

Price discrimination and deviations from the law of one price may indeed be reality for international export markets. Considering the possibility of non-competitive behavior, Knetter's (1989) Pricing to Market model is used to test for the discriminatory pricing of Canadian canola exports to Japan, the U.S. and Mexico.

PTM has been previously observed in Canadian export pricing of wheat, pulse and tobacco. While results suggest price discrimination in Canadian canola exports to Japan,

Mexico and the U.S., there is little evidence that Canadian exporters magnify the effects of exchange rate changes. Rather, PTM behavior is observed for Canadian exports to the Japanese market, suggesting that Canadian exporters adjust the price to stabilize exchange rate fluctuation in the destination currency. This non-competitive behavior may be linked to the large quantity of Japanese imports relative to U.S. and Mexico, or Canadian exporters' efforts to maintain market share through steady importer prices. The stabilizing PTM behavior observed in these foreign markets beginning in mid-1996 may be linked to the dramatic Canadian exchange rate fluctuation of the mid-1990's.

TABLE 1. Summary of Prices and Real Exchange Rates for Japan, Mexico and the U.S.

Country	1993:1 to 1996:2		1996:3 to 1999:4		1993:1 to 1999:4	
	mean prices ($/KGM)	*mean real exchange rate**	*mean prices* ($/KGM)	*mean real exchange rate**	*mean prices* ($/KGM)	*mean real exchange rate**
Japan	0.392	76.982	0.413	84.011	0.403	80.497
	(0.055)	(8.588)	(0.038)	(7.087)	(0.048)	(8.515)
Mexico	0.378	3.966	0.411	6.844	0.395	5.405
	(0.042)	(1.784)	(0.047)	(0.529)	(0.047)	(1.953)
United States	0.379	0.756	0.414	0.707	0.397	0.731
	(0.062)	(0.025)	(0.041)	(0.033)	(0.055)	(0.038)

Note: The values in parentheses are standard deviations.
*for Japan: *Yen/CDN;* Mexico: *Mexican New Peso/CDN;* U.S.: *U.S. dollar/CDN*

TABLE 2. Regression Results for Knetter's Pricing to Market Model for Canadian Canola Exports to Japan, Mexico and the U.S.

Country	1993:1 to 1996:2		1996:3 to 1999:4		1993:1 to 1999:4	
	country (λ)	exchange rate (β)	country (λ)	exchange rate (β)	country (λ)	exchange rate (β)
Japan	2.038*	-0.759*	0.613**	-0.325*	2.317*	-0.795*
	(0.247)	(0.252)	(0.255)	(0.058)	(0.104)	(0.021)
Mexico	-1.279*	0.064	0.338	-0.611*	-1.186*	-0.0002
	(0.045)	(0.038)	(0.238)	(0.128)	(0.040)	(0.029)
United States	-0.759**	1.568	-0.951*	-0.362*	-1.131*	0.164
	(0.252)	(0.972)	(0.046)	(0.137)	(0.099)	(0.353)
F-tests						
H_o: $\lambda_1=\lambda_2=\lambda_3$	449.951*		236.392*		535.828*	
	(2,39)		(2,39)		(2, 81)	
H_o: $\beta_1=\beta_2=\beta_3=0$		34017.31*		40458.52*		11926.62*
		(3,38)		(3,38)		(3, 80)

Note: The values in parentheses are standard deviations and degrees of freedom for coefficient estimates and F-tests, respectively.
*, ** and *** denote significance at one, five and ten percent levels, respectively.

Footnotes

[1] For example, if the U.S./Canadian exchange rate changes from $0.50US/CDN to $0.60US/CDN, then the U.S. price to import CDN$30 of goods increases from US$15 to US$18.

[2] Harmonized Commodity Description and Coding System: 12050020

[3] Quarterly data has been typically used in previous studies involving Knetter's 1989 model (Patterson, Reca, and Abbott). Moreover, higher frequency datasets tend to experience greater noise because of erratic shipping schedules (Knetter, 1993), making quarterly data preferred over data aggregated annually. The New Peso was adopted by Mexico prior to 1993, making any conversions between old and new Mexican currency unnecessary.

[4] http://www.datacenter.chass.utoronto.ca/trade

[5] http://www.bankofcanada.ca/en/exchange-avg.htm

[6] Consumer price indices were gathered from the International Monetary Fund's International Financial Statistics Yearbook.

[7] The regression model uses the Parks (1967) method, as described in Kmenta, which assumes heteroskedasticity and autoregression, and can be extended to include the assumption of cross-sectional correlation. An F-test rejected the null hypothesis of cross-sectional independence at a one percent significance level, supporting the use of the extended method.

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